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Shaw's TEXTBOOK OF OPERATIVE GYNAECOLOGY

7th Edition

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Marcus E. Setchell | John H. Shepherd
Consulting Editor:
Christopher N. Hudson
Sub-Editor:
Tom E. Setchell

Shaw's Textbook of Operative Gynaecology

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Seventh Edition

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Shaw's Textbook of Operative Gynaecology, 7/e
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Mosby, Saunders, Churchill Livingstone, Butterworth-Heinemann and Hanley & Belfus are the Health Science imprints of Elsevier.

First Edition 1954
Second Edition 1960
Third Edition 1968
Fourth Edition 1977
Fifth Edition 1983
Sixth Edition 2001
Seventh Edition 2013

ISBN: 978-81-312-1160-1

Published by Elsevier, a division of Reed Elsevier India Private Limited.
Registered Office: 305, Rohit House, 3 Tolstoy Marg, New Delhi-110 001.
Corporate Office: 14th Floor, Building No. 10B, DLF Cyber City, Phase II, Gurgaon–122 002, Haryana, India.

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Typeset by Chitra Computers, Delhi

Printed and bound at EIH Unit Ltd. Press, Manesar.

Preface

The preface to the sixth edition of *Shaw's Textbook of Operative Gynaecology* opened by raising questions about the long-term viability of operative surgery books in a world where advances in information technology were dramatically changing the way in which information is disseminated, with profound effects on methods of learning and teaching. Despite the continuing pace of progress in the development and application of digital technology, the demand still remains for a state-of-the-art book, which can live on a bookshelf or in the operating theatre. It is therefore, no surprise, that the publishers have sought a new edition, when the book is fast approaching the age of expected retirement, it being almost 60 years since the first edition* was published.

The globalisation of publishing had seen the rights of the work transferred to B. I. Churchill Livingstone in New Delhi in 1993. That company has now been absorbed into the very large international publishing company, Elsevier. It is entirely appropriate for the publication of this book to continue to be in Delhi, as the technology and skills of publication and printing have risen to such high standards in India. Demography, economics and historical medical associations make it sensible to produce a hard copy book close to where the market is greatest. Nevertheless, it is predicted that the book will continue to be in demand by postgraduate trainees and consultants in the UK, Europe, Africa and the Middle Eastern countries, as well as Australia and New Zealand and many other parts of the world. We are fortunate that Elsevier's worldwide organisation means that the book can be distributed literally all over the world.

The last edition's Preface also acknowledged the increasing sub-specialisation within medicine generally, and notably in gynaecological surgery. The benefits to the patient of being cared for by sub-specialists and their teams have become increasingly apparent, and most sizeable departments throughout the world have now embraced this principle. The sub-specialties of Gynaecological Oncology, Fertility and Reproductive Medicine, Gynaecological Urology and Pelvic Floor are now well developed, whilst minimal access surgery, endometriosis and fibroid treatment, fistula surgery and many other specialist areas of gynaecology are becoming recognised as disciplines where patient care improves if there is a concentration of the workload to a smaller number of individual surgeons. This has led to a major change in the authorship structure of the book. We have commissioned a large number of experts in the sub-specialties to review and rewrite much of the material. In previous editions, the majority of the contributors were members of the staff of St. Bartholomew's Hospital, but writers have now been recruited from many other centres of excellence. We welcome them warmly and thank them for their contribution of time, skill and energy.

Inevitably this has led to some loss of consistency in style, but the Editors feel that any disadvantage of this is far outweighed by the intense experience that the sub-specialist authors bring to their subjects. No longer can a surgeon simply quote their preferences for a particular technique based on individual experience, but must write from a position of knowledge of objective evidence-based outcome measures. All authors have been encouraged to give attention to the prevention and management of complications within their specialist area. These new chapters are complemented by many new colour digital photographs, which with modern technology can be inserted at any chosen point in the text.

There are also major changes in the editorship of this seventh edition. Professor Christopher N. Hudson who has been an Editor of the last three editions becomes Consulting Editor. His contribution to this book has been considerable. He trained under, and worked with, Mr. John Howkins (qv below) and was appointed Co-editor in 1977. His long association and working experience with departments in Africa and other tropical countries have brought special expertise to the surgical management of fistulae and obstetric trauma. As one of the first gynaecological cancer specialists, he has also brought particular expertise to this area. We are grateful for his continuing guidance and for retaining authorship of the chapter on Surgical Anatomy.

The senior Editor (MES) trained at a time when gynaecological trainees at the end of their apprenticeship were expected to be able to carry out the whole panoply of gynaecological operations, including surgery for cancer, pelvic floor repairs, infertility, as well as benign hysterectomy, myomectomy and endometriosis, and the new procedures of diagnostic laparoscopy and laparoscopic sterilisation. In addition, holding the Fellowship of one or more of the surgical colleges, and/or the acquisition of a postgraduate MD or PhD by thesis, were almost mandatory before becoming a Consultant. Although consultants were expected to be generalists by and large, many took on a "special interest" according to the needs of their department. In this writer's first Consultant post, the inheritance of an established tertiary practice for adolescent and paediatric gynaecology on joining the staff of St. Bartholomew's Hospital called for some rapid learning, and subsequent needs of the Department led to the unlikely combination of heading up the pregnancy termination service and Assisted Conception Unit simultaneously.

Not surprisingly, the need for sub-specialist appointments was soon recognised and St. Bartholomew's Hospital was fortunate in being able to appoint a sub-specialist in gynaecological oncology who had undergone a full sub-specialist training programme in the USA in the shape of Mr. (now Professor) John Shepherd. His appointment to co-editorship is therefore most welcome, and his revision and updating of the gynaecological cancer chapters has been particularly valued.

A matter for discussion between the publishers and editors in future editions will be the extent to which the book should become an online publication, perhaps with associated digital recordings of operative procedures.

We hope the book will continue to be a training manual for generalist trainees and serve as a learning aid during their operative training experience, as well providing in-depth knowledge of some operations that they may never expect to perform unless they proceed to sub-specialist training. For those who do, knowledge and know-how of the more specialised operations described will be invaluable. In addition, those generalists who may take a special interest in aspects of benign gynaecology will find detailed descriptions of laparoscopic surgery helpful.

Acknowledgments

Most of the new artwork has been provided by Mrs. Joanna Cameron, to whom we are most grateful. We also thank our non-gynaecological colleagues who have provided chapters on anaesthesia, oncology, imaging and radiotherapy, as well as medico-legal aspects.

Much of the typing and incorporation of editorial amendments has been carried out by Katherine Fletcher, Medical Secretary. The editors also acknowledge the help of their personal secretaries, and wives and families whose computer skills have supplemented their basic skills. The authors and editors also acknowledge that many hours of “family time” have been sacrificed to make completion of this task possible. We are especially grateful to Mr. Tom Setchell who has been co-opted as Sub-Editor. Finally, we are grateful to the whole team of our publishers, Elsevier, Delhi for their tolerant patience, help and encouragement to see this project to conclusion.

2012 **MES**
JHS

*Historical Note

Wilfred Shaw MD FRCS FRCOG, the first author and Editor of this textbook was born in 1897. He was educated at Cambridge University and St. Bartholomew’s Hospital, where his academic brilliance was recognised by the award of many prizes. His medical training was interrupted by the First World War where he served in a destroyer as ‘Surgeon Probationer’, delaying his qualification as a doctor until 1921. His MD thesis from Cambridge on the oestrogen-producing cells of the ovary resulted in the Prize for the best thesis, and he went on to gain many other prestigious awards. Unusually for the times, he undertook postgraduate training in Vienna, Berlin, Gratz and Dublin. He was a foundation member of the Royal College of Obstetricians and Gynaecologists, and was appointed to the staff of St. Bartholomew’s Hospital in 1930. He was a brilliant and innovative surgeon, devising many new operations as well as writing papers on ovarian physiology and histology. His hobbies included Astrophysics, English history and poetry, and horticulture, becoming an expert in fruit tree grafting. He developed a serious illness in 1951, which he knew would be fatal. In forced retirement, he proceeded to write his *Textbook of Operative Gynaecology*, which was published shortly after his death in 1953 at the age of 55.

Of great significance is the death of former Editor, **Mr. John Howkins** in 2003. Born in 1907, he qualified from the Middlesex Hospital in 1932. His training was interrupted by the Second World War where he served in the Royal Air Force. After the war, he was appointed Consultant Gynaecologist to St. Bartholomew’s Hospital, joining Mr. Wilfred Shaw. On retirement in 1970, he became a sheep farmer in Wales, a second career that he enjoyed for 30 years. His contribution and interest in this book had continued for almost 50 years, and this long experience will be greatly missed. Some blocks of his text remain intact as their clarity and eloquence cannot be surpassed. We have also retained a substantial number of the illustrations from previous editions because of the clarity of many of these beautifully executed drawings that provide examples of the historical development of medical art and surgical teaching.

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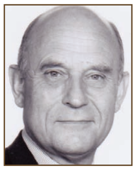

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SECTION A

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SECTION OUTLINE

Women's Health Needs in a Globally Changing Society

1

Marcus E. Setchell

Introduction

The scope and role, as well as the techniques, of gynaecological surgery have changed radically since the previous edition of this book in 2001, and much of it beyond recognition since the first edition in 1954. More importantly, the increased educational opportunities for women all over the world have widened their options to become included in all aspects of professional and working life, in addition to, or in place of, their more traditional roles as wives, mothers, child raisers and home providers.

Women's healthcare formerly consisted largely of pregnancy and labour care, and treatment for major health and life-threatening gynaecological disorders. It now extends to all stages of life from pre-conception to old age. No longer is gynaecology predominantly a surgical speciality; it involves many disciplines including doctors from allied specialities, nurses, midwives and physiotherapists, all contributing their important, differing skills to provide complete healthcare for women at different stages of their lives. Prevention and screening, counselling, diagnostic tests, medical treatments and minimally invasive surgical and radiological procedures are all crucial components, in addition to both new and established gynaecological surgical procedures. Priorities and the patterns of care required in different parts of the world vary widely. Cultural and religious differences may greatly influence the kind of healthcare that is appropriate in some communities and not in others.

Along with their midwifery colleagues and general practitioners, obstetricians have a major part to play in women's healthcare from pre-conception through early embryonic and fetal life, up to and beyond the birth of a baby. Gynaecologists' services may be required in childhood and adolescence, through to the reproductive years, where there may be considerable health needs in relation to contraception, infertility and early pregnancy failure. Young and middle-aged women may develop menstrual problems and disorders, as well as cancers and pelvic floor problems. Many of these gynaecological problems are particularly prevalent in the peri-menopausal years, and many women will need care and advice in a normal physiological menopause. The post-menopausal years see a different spectrum of disorders requiring specialist gynaecological care. Some of these problems may occur into advanced old age, completing the lifespan provision of care that is required.

Healthcare Requirements and the Life Cycle

PRE-CONCEPTION AND PRE-NATAL

It is a sad fact that in many parts of the world the female embryo/fetus is at greater risk in utero than the male, as a result of pregnancy termination on grounds of gender. Whilst this is illegal in many countries, in others there is a brisk trade in early detection of gender by ultrasound or chromosomal testing, followed by termination if early pregnancy diagnosis has revealed that an unfavoured gender is present.

Advances in in vitro fertilisation (IVF) and pre-implantation genetic diagnosis now allow gender determination at a four-cell embryo stage; the desired gender embryo can be selected and implanted, and the remaining ones disposed of. Whilst this may be repugnant to some, in those societies where a woman will be pressurised into very high parity in order to achieve the desired sex, there may be a place for this to protect the health of the woman and prevent a potentially very large family, which the parents neither want nor can afford.

Fetal medicine specialists may diagnose clinical conditions in utero, with particular implications for women, such as Turner's syndrome (45 XO) and triple X condition (47 XXX) chromosomal disorders, as well as structural abnormalities. Some developmental and anatomical abnormalities diagnosed in utero will require specialised interventional procedures prior to birth, or consideration of the need for pregnancy termination.

INFANCY AND CHILDHOOD

Apart from the obvious responsibilities of the obstetrician at instrumental deliveries and Caesarean section, and to deal with emergency complications at delivery and in the early neonatal period, not uncommonly an additional gynaecological surgeon is required to assist in the control of serious post-partum haemorrhage, and/or uterine rupture and other genital tract trauma. Exceptionally, a paediatric gynaecologist may be needed in the early neonatal period in cases of indeterminate gender or other lower genital tract anomalies. In childhood, the gynaecologist may be required to deal with minor vaginal infections, and help with the diagnosis and removal of foreign bodies placed in the vagina. Sadly, there has been an increasing need for gynaecologists with paediatric experience to examine and counsel girls who may have been victims of sexual abuse. Less often, they may need to deal with the physical trauma that has been inflicted, as well as the psychological aftermath.

PUBERTY AND ADOLESCENCE

Puberty occurs earlier in girls than in boys. Geographical variations in the age of onset may be more related to environmental conditions and diet than ethnic characteristics. The puberty growth spurt occurs at a younger age in females than in males, and growth continues throughout adolescence to womanhood. Age of onset of menstruation is quite variable, but anywhere between the ages of 10 and 16 years is normal. In the absence of other clinical symptoms or signs, it is not usually appropriate to investigate primary amenorrhoea before the age of 16, unless there is absent development of secondary sexual characteristics. Precocious menarche does require investigation by a paediatric endocrinologist and/or gynaecologist, and any vaginal bleeding in infancy must be taken seriously to determine whether there has been any local trauma or possibly one of the rare varieties of genital malignancy. Throughout the world there are wide variations in what is considered to be the appropriate age for a young woman to commence intercourse, and differences exist in the legal age for marriage.

In many western countries, there has been a notable decrease in the age of first intercourse, and with it an increase in the incidence of both teenage pregnancy and sexually transmitted diseases in teenagers. Consequently, much attention has been given to sex education in adolescence and childhood, requiring judicious and sensitive advice on contraception and the prevention of transmission of sexually transmitted diseases. More recently, the advent of human papilloma virus (HPV) vaccines has opened up a whole new vaccination programme for young girls to reduce the incidence of HPV infection and the potential risk of development of pre-malignant and malignant change in the vulnerable transformation zone of the cervix.

The high incidence of termination of pregnancy in teenage girls remains a cause for concern. Conversely the availability of termination provides a preferable alternative for some to the educational and social problems that so often ensue when very young girls become mothers.

Dysmenorrhoea and menorrhagia occurring in adolescence are other problems requiring expert care from either general practitioner or gynaecologist. Weight-related amenorrhoea appears to be an increasing problem, requiring multidisciplinary care over a long period. Obesity in the young is recognised to have many adverse health effects, and may be a factor in the frequent occurrence of polycystic ovary syndrome.

In some communities, ritual mutilation of the female genitalia (female circumcision) is still practised and this is now a matter of serious worldwide concern. In many countries, performance of these procedures is illegal, whilst in others the strength of ancient custom rules, and the practice continues whether or not it is legal. The procedure varies from minimal labial trimming to full Pharaonic circumcision and infibulation. It is widely agreed that it is unethical for a medical practitioner to be involved in such a procedure, even though its performance under clinical conditions and anaesthesia can be considered 'more humane'. Rather more controversial is the ethical position of a gynaecologist asked to recreate a woman's anatomy to its circumcised state after childbirth or a gynaecological procedure. Fortunately, education and the spread of women's groups that oppose the practice and support women in refusing to comply are slowly reducing this inhumane assault.

ADULTHOOD

The twentieth century saw women in the western world fight and win many battles for equality, education and democratic rights, such that we now take for granted that women's opportunities, expectations and achievements are equal to or exceed those of men. However, many modern women find themselves caught in the dilemma between the drive and desire to procreate within a relatively short biological time frame, and the expectation of themselves and from others to maintain their position in the workplace and society. Although in some countries, women's place in society has advanced very little over centuries, in others there is a rapid catch up.

A growing number of women quite reasonably choose to delay pregnancy until well into the third decade, with considerable consequences. Apart from needing prolonged contraception, fertility will be gradually declining, and there is the opportunity for gynaecological problems (such as endometriosis and fibroids) to develop. Pregnancy risk factors (such as miscarriage, chromosomal defects and pre-eclampsia) increase, and general health risks (such as obesity, hypertension, smoking, etc.) have longer to develop.

Gynaecologists and healthcare planners must take into account the effect this has on healthcare needs of women and adapt services accordingly.

Fortunately, many developments in Gynaecology that have taken place in recent years, such as diagnostic tools that provide more accurate and earlier diagnosis, minimally invasive treatments, greater understanding of infertility, and assisted conception help to counteract some of the potential problems created by modern life.

Changing Attitudes to Gynaecological Surgery

Gynaecologists must expect and welcome that adult women attending a Gynaecology clinic today are more aware of their aspirations and expectations in relation to treatment and outcome, and expect to be fully informed about choices available to them. Conditions for which they attend may include quality of life disorders such as menorrhagia and dysmenorrhoea, or pre-menstrual symptoms. At the other end of the spectrum, some of them will have malignant or pre-malignant conditions. Whatever the nature of their gynaecological problem, in this age group, they are likely to be concerned about any likely consequences on their reproductive potential.

Women have always regarded femininity as a visual image. Thus, the impact of disfiguring procedures or events has always been severe; extreme in the case of the face or breasts, but, to a lesser extent has also involved the vulva. Now, however, to a much greater extent, women focus upon the integrity of their internal organs. In some cultures, continued menstruation is an important outward sign of femininity so that even abnormal menstruation may be preferred to hysterectomy. In others, menstruation holds no such social significance and its cessation may actually be welcomed. To some, the 'womb' may become the object of blame for a perception that life is less than perfect, or even a result of a psychosexual aberration. The sympathetic gynaecologist needs to be alert to the full potential range of attitudes which can colour an individual's approach to serious, trivial or even imagined problems of the upper genital tract.

A very significant attitudinal change has been towards the gonads. Males have always been fiercely protective of their gonads as a visible part of the image of masculinity. In women, however, gonadal ablation has in the past been treated in a very cavalier fashion. Even the terms 'uterine appendages' or 'adnexa' tend to trivialise structures which may be removed during the operation of hysterectomy at the whim of the surgeon, particularly if it is known that future reproduction is not desired. Many women now are as protective of their internal gonads as are males of theirs.

The preservation of all aspects of 'femininity', which is sexual function, menstruation, fertility and hormonal function, are of fundamental importance whether medical or surgical gynaecological care is being given. The issue becomes more complex in the presence of benign ovarian pathology, such as ovarian endometriosis, which may not have been suspected prior to surgery. The clinical circumstances surrounding advice for ovarian removal or conservation are discussed in Chapter 10. Whereas unilateral or partial oophorectomy may be a reasonable *ad hoc* response to an unexpected finding of ovarian pathology; it must be apparent that total removal of all functional ovarian tissue cannot, under any circumstances, be regarded as a mere encore to some other pelvic procedure. It is a serious step which should be the subject of explanation, discussion and documented consent.

Many women will have just as strong feelings about the integrity of the uterus, even if they have no further desire for pregnancy. Hysterectomy is rightly perceived as the last resort, when more conservative treatments have been tried and failed. If there is any possibility that a planned conservative operation (e.g. myomectomy or widespread endometriosis) could necessitate hysterectomy, prior explanation and consent are essential. Giving information about a remote risk of damage to the uterus in such operations as pregnancy termination or uterine ablation should be given in a different and less alarming form.

By the same token, a woman's perception of her external genitalia and the role of the clitoris should be acknowledged; clitoral sparing procedures may sometimes be included in partial vulval resections for conditions short of invasive malignancy.

Infertility and Assisted Conception

If pregnancy has been delayed, whether because of career, late partnership or economic reasons, once a couple want to start a family, it becomes a matter of urgency. The old management of waiting for two years before initiating investigation is inappropriate in a woman in her late thirties.

Developments in assisted conception have rendered tubal surgery almost obsolete. Whilst these advances benefit many, they come with considerable cost. Governments and those commissioning healthcare have to make difficult decisions in deciding priorities for healthcare spending, and inevitably such decisions vary in different parts of the world. Pressure groups perceive access to expensive infertility treatments as a right, and when there are regional differences in provision and free access within the same country, this is seen as an unacceptable inequity.

As the techniques of assisted reproduction have widened beyond the bounds of basic treatment for the infertile, difficult ethical issues have arisen which need to be thoroughly explored. The use of ovum donation in post-menopausal women well into their fifties and above is just one of the controversial aspects which arouse heated debate. Cryopreservation of oocytes (egg freezing) which was originally seen as a treatment to help a small group of young women whose ovarian function was going to be destroyed by cancer treatment is now seen as something that many young women will consider in their twenties and early thirties, if they have yet to find their ideal partner. It is necessary to have a legal framework, within which there is sufficient flexibility to allow reasonable future developments and yet ensure that morally and ethically unacceptable procedures are prevented.

Parity

Changing social custom in relation to partnerships and marriage as well as career aspirations of women have led to delay in elective childbearing, which tends to be clustered in the late twenties and early thirties over a relatively short time span. This means that there is a 'time window' during which gynaecological pathology may arise before ambitions of childbearing have been realised. The problems of teenage and unwanted pregnancy, however, remain and are reflected in an increased demand for pregnancy termination (see Chapter 9) including the more difficult terminations in the mid trimester.

Most European countries have seen a striking reduction in family size, and many are no longer maintaining their population numbers. There are a number of contributory factors, including later age of first pregnancy, increased use of contraception and sterilisation, and an increase in the incidence of sub-fertility. In today's over-populated world, good provision of contraception globally is of profound importance to prevent poverty and improve the health of women and children.

In many westernised communities, grand multiparity is rare. Grand multiparity brings with it its own risks in pregnancy, as well as a tendency to certain gynaecological conditions. The urogenital hiatus is divaricated with concomitant pelvic floor relaxation, which often leads to uterine descent, which in turn may progress to vaginal extroversion with uterine procidentia (see Chapter 14). Moreover, peri-menopausal menorrhagia is common in women of higher parity due to myohyperplasia of the uterine muscle (at one time referred to as chronic sub-involution). The combined effect of multiple childbearing and excessive menstruation makes anaemia highly prevalent in this group. In many communities, grand multiparity is a reflection of poor socio-economic status with a high infant mortality and a perceived need to produce a large family. In such cases, the woman approaching the menopause will show signs of physical and psychological 'wear and tear' out of proportion to her age. Where grand multiparity is of cultural origin in a relatively affluent society, this effect may not be seen, although the anaemia from menstrual dysfunction may well still be a problem.

MENOPAUSE

The menopause is a critical landmark in a woman's life and the average age is now around 50. Those with an early menarche tend to have a delayed menopause and this may possibly be a risk factor for endometrial and ovarian cancer. Women with fibroids also tend to have a delayed menopause.

The menopause is a subject of a great deal of myth and misunderstanding. Women themselves, and all healthcare professionals who deal with them, should have a clear appreciation of what may be classed as a normal menopause, namely either abrupt cessation of menstruation or progressively diminishing flow, or a progressively lengthening interval between otherwise normal menstrual episodes. The practice of labelling aberrations of menstruation during the climacteric as 'merely the change' is dangerous misinformation. Although the majority of such aberrations may have a non-sinister cause, failure to make a timely diagnosis of malignancy may ultimately prove fatal.

The menopause is but one incident within the climacteric—the correct term for the time of life when ovarian function effectively ceases. The climacteric extends over a number of years and may be characterised by episodes of vasomotor instability, but there are hormone-related changes in a number of other body systems. Together with emotional changes, engendered by the clear demonstration of the end of the reproductive era, there are also likely to be social as well as somatic effects. The changes in the breasts and external genitalia are obvious but there is a tendency to ascribe all the contemporaneous changes of ageing to the climacteric (including the skin changes found equally in the ageing male!).

To many, the menopause is an unwelcome reminder of the passage of time and the entry into a new phase of life. It is particularly resented if it is accompanied by severe menopausal symptoms of night sweats and hot flushes, along with fatigue and a reduction in energy. These symptoms may interfere with work and pleasure, added to which there may be a reduction in libido. Little wonder that depression is a common occurrence at this stage of life, and that many women seek relief from these symptoms, either with naturopathic treatments or hormone replacement. Whilst some women will gain some relief from herbal and dietary remedies, oestrogen replacement is the only treatment which has been shown to relieve symptoms in controlled trials. However the waive of publications in the late 1990s and early part of the twenty-first century pointing out significant (if small) risks to health with prolonged usage of hormone replacement therapy (HRT), discouraged many women from using this effective treatment. More recent evidence has shifted opinion towards accepting that used for periods of 2–5 years, HRT is a beneficial and safe way to ameliorate the appreciable distress of the menopause.

POST-MENOPAUSAL YEARS AND THE EFFECTS OF AGEING

The climacteric and hormonal changes of course contribute to the process of ageing, although the latter continues well after the hormonal changes have settled to a steady state.

Urinary Function

In the female, the lower urinary tract is supplied with oestrogen receptors and in common with other areas, shows climacteric as well as ageing effects. Over time, there is a reduction in turgidity and elasticity of the proximal urethra and bladder neck, leading to a measure of urethral sphincter incompetence (see Chapter 13) for which, under appropriate circumstances, HRT may offer some benefit, and pelvic floor physiotherapy often results in dramatic improvement. Bladder detrusor overactivity, however, increases with age in both sexes. The impact on continence in the female is correspondingly greater, and the inconvenience and embarrassment of frequency and urgency is not likely to be tolerated in today's society which has an expectation of health and activity into the seventh and eighth decade. These problems may be compounded naturally by the effects of pelvic relaxation.

Pelvic Floor Relaxation

The aetiology of uterovaginal prolapse and pelvic floor laxity is multi-factorial. Nulliparous uterine prolapse does occur, usually in older women during the climacteric, but primacy in aetiology must go to childbirth injury (see Chapter 14). The effects of childbirth damage may not be felt for some decades and the precipitating factor may be a structural change in collagen, associated with ageing and with the hormonal changes of the climacteric.

The role of constipation and chronic straining at stool as a causation factor is under-appreciated. So many women relate the onset of constipation to pregnancy that this factor tends to be ignored. Insufficient emphasis has been placed upon the importance of re-establishing a normal bowel habit after childbirth.[1] The penalty for this neglect may be felt many years later. Chronic straining not only imposes recurring mechanical damage to the pelvic support, but also may induce a traction neuropathy and in extreme cases both rectal prolapse and incontinence. This distressing symptom may not be primarily a gynaecological problem, but the gynaecological component is regrettably all too frequently 'conveniently overlooked'.

Coitus: Dyspareunia/Apareunia

No assumptions about age and continuation of sexual activity are justified. Women today feel much more able to discuss this openly and so should gynaecologists and general practitioners, but with tact and sensitivity. No surgical intervention likely to impair this should be undertaken without appropriate and sympathetic prior discussion (see Chapter 14).

Ageing and the climacteric, however, may induce changes which provoke dyspareunia or even apareunia. Shrinkage may affect not only the vestibule but the vagina. Atrophy of the epithelium leads to thinning, fragility and soreness, producing painful fissuring of the fourchette and navicular fossa which splits each time that intercourse is attempted, aggravated by the deficiency in lubrication. These changes can be readily reversed by the use of local vaginal oestrogen for a 2 week course, and healthy vaginal skin maintained with use once or twice weekly. It should be remembered that dyspareunia is not invariably age related and it can occur in women of all ages. Lichen sclerosus et atrophicus may cause severe dyspareunia, culminating in the classical appearance of 'keel shaped' vulva with absence of the labia minora. Conversely, severe vulval pain and tenderness (vulvodynia) may be associated with minimal atrophic changes (vulvar vestibulitis) (see Chapter 7).

Osteoporosis

Perhaps the most important metabolic change associated with the climacteric is osteoporosis. Although osteoporosis does occur in males, the sex ratio is heavily biased against women. Bone density studies show that in susceptible individuals, bone loss can begin before any other symptoms of the climacteric are present, and family history in this context is important.[2] Both public and professional awareness of the condition is relatively recent including appreciation of the risk to life and health, not just from a propensity to limb fractures, but from collapse of the spine with serious compromise of function of intrathoracic and intra-abdominal organs. As screening for osteoporosis becomes more readily available, it is often appropriate for the gynaecologist to initiate this, especially in the context of a Menopause Clinic. Although treatment is predominantly with calcium, vitamin D and bisphosphonates, oestrogen therapy does still have a place and gynaecologists should have sufficient knowledge to discuss these matters.

Locomotor and Skeletal Changes

In older women, the effects of osteoporosis detailed above may be added to the effects of age-related joint changes. Restricted mobility of the hips may severely limit surgical access, but the importance of lack of mobility goes well beyond this, aggravating especially the effects of impairment of physiological functions and continence.

Other Endocrinopathy

Thyrotoxicosis without other signs is an occasional source of confusion for cardiac problems. Of direct relevance to gynaecological practice, however, is the insidious onset of hypothyroidism, which may present with dysfunctional uterine bleeding. Not only would other attempts at hormonal manipulation with gestational steroids be inappropriate, but so also would surgery, which, together with anaesthesia, in the presence of uncorrected hypothyroidism is potentially dangerous.

Type 2 diabetes needs to be borne in mind. On occasion, diabetes presents to the gynaecologist with a florid but typical vulvitis. The association of glucose intolerance with obesity is relevant. The concomitant enhancement of peripheral aromatisation of oestrogen precursors steroids is a risk factor for endometrial carcinoma.

Gynaecological Cancers

The post-menopausal years include the age group with the highest incidence of carcinomas of the endometrium, ovary and vulva. Most non-gynaecological cancers are also age related, so it behoves the gynaecologist to have a high index of suspicion when dealing with patients at this stage of life, and to enquire about weight loss, abdominal symptoms and bowel function.

Assessment of the patient's physical and mental state of health will be of great importance in selecting treatment appropriate for her. Many older patients are remarkably robust today and their views must be taken into consideration just as for younger women. For example, an 85-year-old patient asked to delay her operation for carcinoma of the endometrium until the tennis season was over as she had some important matches to play; she went on to have four more good seasons postoperatively.

Changing Role of Gynaecologists

Historically, the first successful abdominal operation was 'ovariotomy' or removal of an ovarian cyst[3] and gynaecological surgery historically developed a long tradition of genital tract ablation. Surgery is only one element of the therapeutics of women's health problems and non-surgical treatments of many conditions, such as endometriosis, fibroids, infertility and dysfunctional uterine bleeding play an increasingly important part. These non-surgical treatments include drugs, physiotherapy, radiological interventions, and involve many other specialists, including radiotherapists, oncologists and endocrinologists (Table 1.1).

Table 1.1: Non-surgical options

Dysfunctional uterine bleeding Gestogens Haemostatic therapy (tranexamic acid) GnRH agonists Mirena IUS	**Endometriosis** GnRH agonists Progestogens Danazol
Stress urinary incontinence Physiotherapy Pessaries (rings, cubes and shelf) Biofeedback	**Genital prolapse** Pelvic floor physiotherapy Per-urethral injections Electronic pessaries
Fibroids Uterine artery embolisation Magnetic resonance-guided focussed ultrasound	**Pelvic cysts/abscesses** Ultrasound-guided aspiration

Diagnostic Developments

The precision of modern surgery has been greatly enhanced by the accuracy of pre-operative diagnosis, provided by both imaging and endoscopic techniques. Ian Donald,[4] in the face of professional scepticism, pioneered the introduction of diagnostic ultrasonography, now an everyday tool of both radiologists and gynaecologists. CT scanning, magnetic resonance imaging and Positron emission tomography scans have further improved the accuracy of diagnosis. More recently, interventional procedures have been devised for use under the control of such techniques. The scope of interventional radiology now is outlined in Chapter 4.

Modern Developments

One of the most significant developments over the last 10–20 years has been the increasing sub-specialisation within Gynaecology. Most hospitals are now staffed with one or more specialists in gynaecological cancer, urogynaecology and the pelvic floor, reproductive medicine (infertility), minimal access surgery and colposcopy. Some will have separate medical gynaecologists, paediatric and adolescent gynaecology specialists, and community gynaecologists (termination of pregnancy and contraception). A few have a sub-specialist for fibroids or endometriosis. The patient has the benefit of truly expert care, but there is a danger that she is not treated as a whole person, but rather as a condition going through a process of treatment.

Another major change has been the switch from open laparotomy for gynaecological operations to laparoscopic procedures and more recently the introduction of robotic surgery (see Chapter 17). Although investigational and operative endoscopy has long been utilised in the bladder, the thorax and the alimentary canal, the potential for ‘peritoneoscopy’ was not picked up by general surgeons.[5] In the gynaecological fraternity, Palmer,[6] Steptoe[7] and others, revisited and popularised the abdominal route for peritoneal endoscopy in the 1960s in preference to access via the pouch of Douglas (culdoscopy) for which the knee chest position was normally required.

The diagnostic and operative potential of intraperitoneal endoscopy was enhanced by the utilisation of a second portal for manipulation and diathermy. Second generation interventional endoscopy began with the perfection of camera and video technology with the surgeon now operating with a two dimensional screen using a range of instruments through two or more ports (see Chapters 3, 9, 10 and 11). Current technology provides visualisation enhanced by magnification of startling clarity and definition. As in macrosurgery, obesity, adhesions and haemorrhage can create difficulties which extend operating time considerably beyond that of conventional surgery.

Hysteroscopic surgery has also prevented the need for more major procedures, and the various forms of endometrial ablation have diminished the need for hysterectomy. One of the consequences of the growth of sub-specialisation and the reduction in the number of open operations in benign gynaecology has been the loss of learning opportunities for trainees.

Advances in anaesthesia (both regional and general), blood transfusion and antibiotics are all key innovations which have contributed spectacularly to the safety of surgery, thus permitting not only the development of major pelvic procedures but also to the restoration of function by time-consuming and complex reconstructive operations. These advances have occurred as a result of cross-disciplinary collaboration between modern surgical teams; the technical skills of urologists, colorectal surgeons and plastic surgeons may all be required together with the intensive care physician for postoperative management and the care of the critically ill patient.

Clinical Considerations

Many of the conventional procedures described in this book are now capable of being performed using minimally invasive techniques. These are presented together, but the selection of the actual procedure to be used must be individual both to the patient and her surgeon. For the former, the attractions of smaller incisions, less postoperative pain and quicker recuperation are obvious: an audit of both outcome and safety is less easily achieved. What is quite clear is that different manipulative skills are required for endoscopic surgery which must be taught and accredited (see Chapter 5) and that the skills and facilities for conventional open surgery must always also be available. The difficulties encountered are occasionally insuperable, requiring immediate reversion to open manual surgery.

Finally, ambulatory care must not be equated with diminished surveillance in the postoperative period. Failure to recognise a complication at the time that such an event has occurred followed by premature discharge from hospital care, may mean that a complication which would be apparent in the early postoperative period, has been overlooked, with serious consequences.

Measures of Outcome

PATIENT SATISFACTION

There is an increasing emphasis on the need for 'an evidence base' for any therapy or intervention, but the collection and appraisal of such evidence is not always easy. Randomised controlled trials provide the soundest basis but too frequently they are not available and indeed may not be appropriate, so that other 'softer' criteria have to be adopted. Because a procedure is time honoured this does not necessarily make it sound. For generations women have accepted the risks, disappointments and sequels of childbirth without complaint. Today, their expectations have markedly changed in relation both to reproductive and coital ability. Any surgical operation may be followed by a depressive illness. Surgical procedures which impact upon sexual and reproductive function have a particular propensity to generate reactive depression. Audit of results and patient experience surveys remain important measures of the success of a Department's work.

PAIN RELIEF

Just as anaesthesia revolutionised the scope and applicability of surgery, so has analgesia moderated the course of postoperative recovery. Pain appreciation is complex and the role of natural control mechanisms including endorphins is ill understood. Nevertheless, anaesthesia during operation clearly plays an important part in reduction of postoperative pain. A good anaesthetic reduces the trauma of access through the abdominal wall as well as influencing tissue oozing which can be responsible for bruising and haematoma formation, a very important cause for postoperative morbidity and pain. The length and depth of anaesthesia have obvious impact in their own right on the process of postoperative recovery. Some of the principles evolved in palliative care and the management of chronic pain have been adapted for short-term use in the control of postoperative pain. One of the principles seems to be that it is better to prevent pain than to treat established pain after a significant threshold has been reached. The use of 'patient-controlled anaesthesia' (PCA) using a manually operated pump has proved a popular advance (see Chapters 6 and 20).

POSTOPERATIVE CARE

Given the obvious advantages of shortened convalescence, it is not surprising that there has been a marked change in the way care is provided postoperatively. For the great majority of elective surgical procedures early mobilisation is practised with early discharge, graduated convalescence and early return to full normal activity and work.

Day case and early discharge mean that the patient must absorb a great deal of information in a short time about their operation and recovery plans, perhaps while still under the effects of anaesthesia and analgesia. Leaflets may be needed to reinforce the advice given, which should include instructions for medication, activity to be encouraged or avoided, expectations of pain and bleeding, return of normal bladder and bowel function, any special dietary requirements, as well as expected return to work, exercise and resumption of intercourse

The intrusion of health economics into clinical care, long appreciated in the under-privileged Third World, has proceeded at pace in developed countries in the 1990s. In the last decade of the millennium, fuelled by the economic recession, elective surgery has been compartmentalised by 'diagnosis-related groups'. This concept may make fiscal sense but is a move away from the individualisation of treatment which is the cornerstone of modern surgical management. It may also be specifically counter-productive in the care of malignant disease where there will be a hidden premium on under treatment if the provider of healthcare is liable to be penalised for increased length of stay. Similar economic considerations drive the demands of purchasers of healthcare for more and more minimally invasive surgery carried out on an office or ambulatory basis.

Conclusion

All these changes coincide with, but are not driven by, improvement worldwide in the status of women. They also have happened at a time when rising costs of healthcare both in public and private healthcare have brought scrutiny and analysis of costs and benefits. Rationing of healthcare is an emotive subject but in one form or another is inevitable. If, however, the system stifles innovation and penalises excellence in subspecialisation and tertiary referral, the standards expected by the public of their medical and nursing care will not be maintained.

The 'changing ages of women' and the multitude of technical advances present the gynaecological surgeon with ever-changing challenges. The theme which emerges is that each woman is 'her own person' with individual hopes, fears, ambitions and views, all of which are deserving of respect and attention. This is what helps to make gynaecology such a fascinating speciality in which to work. It is the duty of the profession to audit performance and outcome measures against the background of quality assurance and the duty of the individual surgeon to ensure that his or her performance matches the standards set by the profession and society.

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Surgical Anatomy

2

Christopher N. Hudson

Most pathology can be considered as a distortion of normal anatomy and physiology. Consequently, those aspects of these subjects which are particularly relevant to the practice to gynaecological surgery may be considered as 'applied anatomy and physiology'. Because the alimentary and urinary tracts leave the pelvis closely applied to the female genital tract, disorders of function with features common to all these are frequent. They are often associated with displacement or damage (from childbirth) to supporting structures.

Such close anatomical relations also mean that intrinsic pathology in one organ may impinge on another in close proximity, presenting a challenge not only over diagnosis but for accurate and effective surgery. In this chapter, certain features of applied anatomy (including embryology) of the pelvis are highlighted by system and function.

Embryology is relevant because it provides a comprehensible basis for several rather complex anatomical relationships (e.g. the rotation of the mid gut, and the formation of the inferior vena cava and iliac venous system) and also for a range of congenital abnormalities. Moreover, certain types of neoplastic alteration may, at least in theory, have an embryological basis.

Gonads

During the course of evolution, nature has tended to make use of structures which are currently effete having been evolved for more primitive use. For instance, the allantoic arteries, supplying the extra-embryonic 'bladder' or allantois, have become the umbilical arteries in placental mammals. Likewise, the left vitelline vein draining the extra-embryonic 'intestine' or yolk sac has become the umbilical vein. To the surgeon, the obliterated umbilical arteries (or lateral umbilical ligaments) are thus a useful guide to the superior vesical and uterine arteries. The duct system of the primitive kidney (mesonephric or Wolffian duct) becomes adapted to be the male gonadal duct system (vas deferens). The importance of the Wolffian duct in the female lies in its occasional persistence (as Gartner's duct) which may course through the leaves of the broad ligament beside the cervix to an anterolateral position adjacent to the vagina. Mesonephric tubules, which in the male become epididymis and paradidymis, in the female may give rise to cystic structures adjacent to the ovary within the broad ligament (epoophoron and paroophoron) (Fig. 2.1). Very rarely, malignancy may arise in such structures and, not surprisingly, may show Mullerian type differentiation. More commonly, benign cyst formation may enter the differential diagnosis of para-vaginal and para-ovarian cysts. Pathologists have to beware lest the finding of unusual glandular inclusions of mesonephric type be wrongly ascribed to metastatic adenocarcinoma.

The gonads in both sexes arise in the embryo in the paired gonadal or germinal ridges. These lie in close proximity to the nephrogenic ridge, which is represented by the transient pronephros and then the mesonephros.

Germ cells, contrary to early teaching, do not arise in the gonadal ridge but appear very early in embryonic life at the root of yolk sac, from where they migrate laterally to the gonadal ridge. The root of the yolk sac is continuous with the dorsal mesentery, or coelomic fold, which envelopes the alimentary canal. Cranial to the umbilicus, there is a ventral mesentery as well, within which the liver develops.

In both sexes, most tumours of germ cell origin arise within the gonads, with a similar range of pathological variants, although there are marked variations in both prevalence and biological behaviour. In the male, a teratoma is uncommon, usually solid and malignant, whereas in the female, benign cystic teratoma or dermoid cyst is one of the commonest neoplastic alterations found in the 20–40 years age group (Fig. 2.2).

In both sexes, rare extra-gonadal germ cell tumours are found with a similar range of pathological variants. They arise in mid-line structures, from the pineal gland to the mediastinum, the liver and also the presacral region, where they may be overlooked on digital pelvic examination.

In gynaecological practice, extra-gonadal malignant tumours of germ cell origin, particularly yolk sac tumours, may also arise within the Mullerian system (e.g. vagina, cervix and Fallopian tube).

OVARIAN SURFACE EPITHELIAL DIFFERENTIATION

Coelomic mesothelium which covers the gonadal ridge is immediately adjacent to that part of the coelom which has been invaginated to form the paramesonephric (Mullerian) ducts, which become the female genital tract. The paramesonephric ducts eventually differentiate into three classic types of epithelium, namely endocervical (mucinous), endometrioid (cubical glandular) and endosalpingeal (ciliated, serous

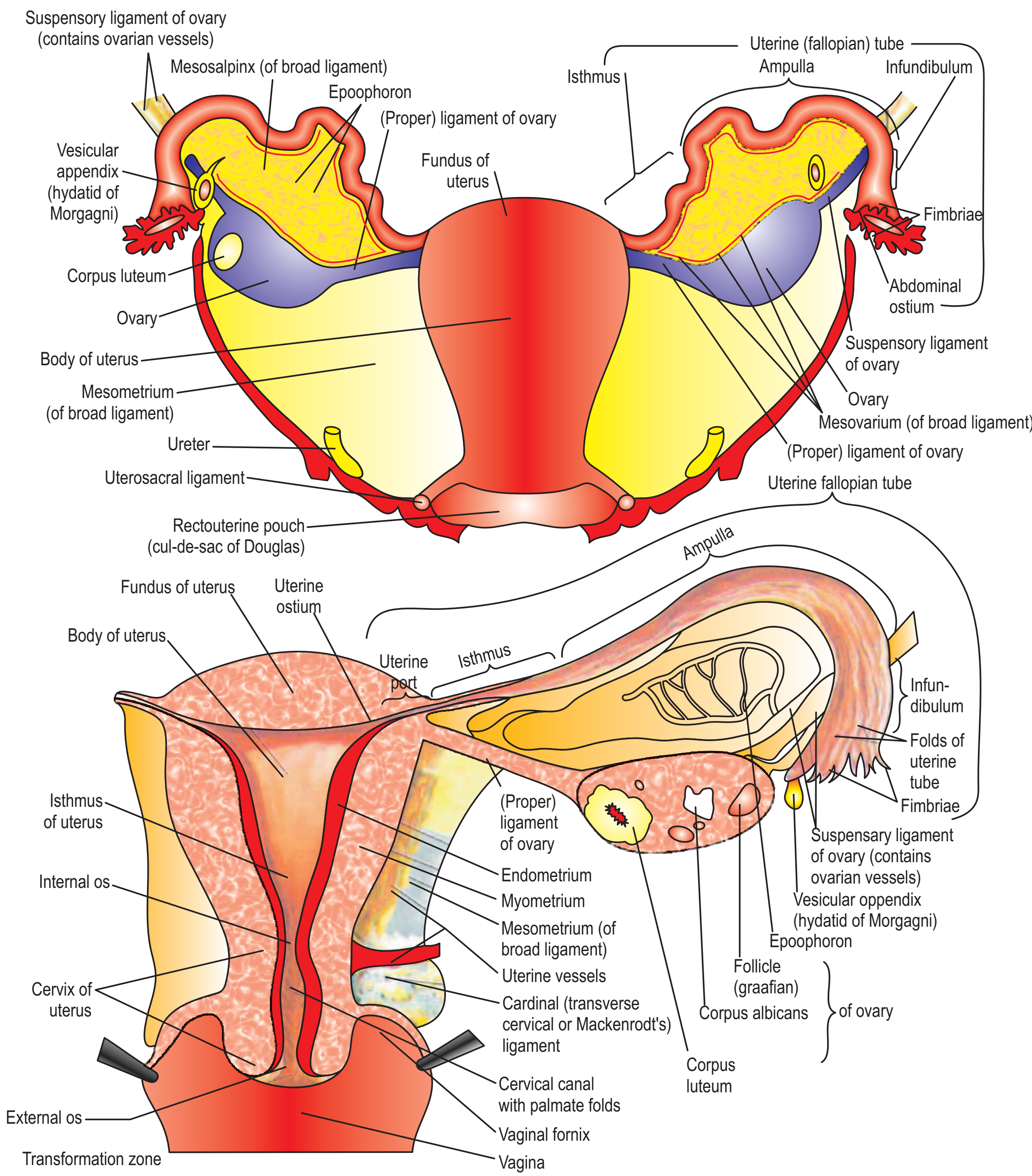

Fig. 2.1: Uterus and appendages.

and papillary). It happens that neoplasms arising from the surface epithelium of the ovary also differentiate along Mullerian lines to produce the common epithelial ovarian neoplasms. It is also considered that this surface epithelium may occasionally differentiate along Wolffian or mesonephric lines into transitional (urinary) epithelium, the resulting neoplasm being a Brenner tumour. However, similar islands of transitional type epithelium are commonly found on the broad ligament as Walthard's rests.

GONADAL MIGRATION

The gonads develop in the loins. Gonadal migration in the male occurs along the course of the gubernaculum. This is interrupted in the female by the presence of the Mullerian system, so that the gubernaculum becomes the round ligament and the ovarian ligament. The anatomical relations of the round ligament to the inguinal canal are of surgical relevance.

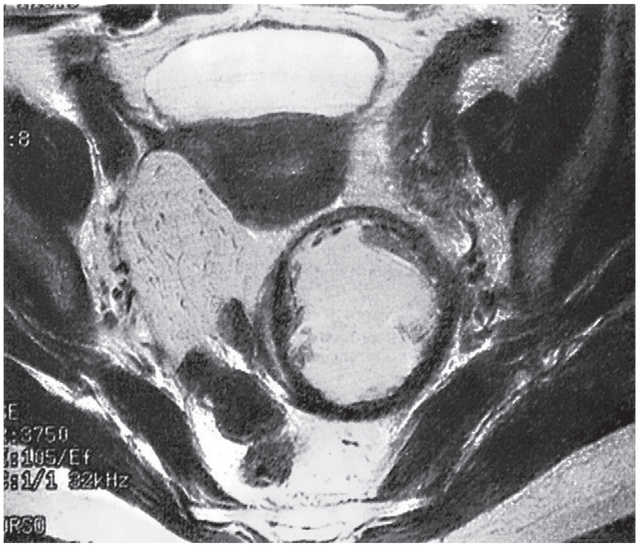

Fig. 2.2: T_2-weighted magnetic resonance scan showing uterus, bladder and benign cystic teratoma (dermoid cyst).

'TESTICULAR' PATHOLOGY

It is of direct gynaecological relevance in cases of hermaphroditism, gonadal dysgenesis and androgen insensitivity (testicular feminisation). The presence of a Y chromosome in dysgenetic gonads predisposes to neoplastic transformation either as a gonadoblastoma or frank invasive dysgerminoma.

Mullerian System

The development of the oviducts and uterus and the formation of the vagina are clinically relevant to the understanding of congenital abnormalities and to the pattern of cancer. The paired paramesonephronic ducts fuse from below upwards to form the vagina, cervix and uterine body. The vagina then solidifies and is replaced by an upgrowth from the urogenital sinus, the 5mb-vaginal bulb. The vagina eventually recanalises and is thus lined with stratified squamous epithelium which is not of Mullerian origin. This squamous epithelium will normally cover the ecto-cervix, as well as the vagina and its fornices. The junctional area between these two embryologically distinct varieties of epithelium is known as the transformation zone (see Fig. 2.1).

TRANSFORMATION ZONE

The actual situation of the transformation zone is variable, both between individuals and at different epochs in reproductive life. Exposed glandular epithelium of Mullerian origin is susceptible both to infection and to damage by semen. Squamous metaplasia will occur, with new squamous epithelium growing in and displacing the original glandular epithelium. This is naturally an unstable area and it is not surprising that it is the seat of quite frequent neoplastic transformation.

Vagina

The normal adult vagina is devoid of glandular tissue other than the Bartholin's and minor vestibular glands. Very rarely, however, islands of Mullerian glandular tissue can rarely remain as rests within the vagina covered with squamous epithelium except for gland mouths. This is vaginal adenosis, a condition which occasionally occurs spontaneously, but has received attention as a sequel to maternal ingestion of a non-steroidal oestrogen (diethylstilboestrol) towards the end of the first trimester and early second trimester.[1] There is an associated risk of development of mesonephroid (clear cell) adenocarcinoma of the vagina in adolescence and early adult life.

The long axis of the vagina is slightly bowed posteriorly so that in the standing position, it is almost horizontal and apposed to the levator plate, an anatomical consideration which assumes importance in the management of vaginal extroversion and enterocoele.[2] The uterine axis commonly approximates to a right angle from the vagina (anteversion). If the two have a common axis, the stage is set for prolapse.

The vagina is normally flattened, the apex being ballooned by the vaginal portion of the cervix and in the lower part it is H-shaped due to the protrusion of the urethra (see Fig. 2.3). If, at childbirth, the introitus is stretched and part of the perineal body torn, gaping of the lowest part of the vagina occurs which may contribute, by removal of indirect support, to the progression of a genital prolapse, initiated by endopelvic fascial tears.

Fig. 2.3: Horizontal section through mid-vagina, rectum and urethra. V, vagina; R, rectum; A, urethral rhabdosphincter; B, levator ani muscle; C, lateral ligament (pillar) of rectum; D, endopelvic (pre-rectal) fascia.

2

If the cervix is pulled down with vulsellum forceps and the anterior vaginal wall put on the stretch, transverse grooves can be seen in the anterior vaginal wall.[3] One indicates the upper limit of the bladder, while about 4 cm above the level of the external urethral meatus is a second groove and a third transverse groove lies just below the meatus. It has been suggested that the terms 'bladder sulcus', 'transverse sulcus of the anterior vaginal wall' and 'submeatal sulcus' should be used to describe these grooves. A small depression lies on either side of the meatus and a second depression lies on each side of the urethra. Between the submeatal sulcus and the transverse sulcus the vaginal wall is thrown into folds, which vary a great deal in development. If two fingers are passed along the posterior vaginal wall above the level of the levator ani muscles, a transverse fold, which is not particularly prominent, can usually be felt. The rectovaginal space lies immediately posterior to this fold.

Congenital Abnormalities

Any degree of failure of Mullerian fusion is of clinical significance both obstetrically and for early reproductive performance (see Chapter 8). The extent may vary from complete reduplication (uterus didelphys) to a septate cavity (Fig. 2.4). Failures of vaginal recanalisation are complex and can be of considerable surgical importance. They need to be distinguished from a simple impervious membrane (imperforate hymen) (see Chapter 8). Failures of recanalisation are usually distal suggesting that the process does not necessarily take place from below upwards. In other words, if the lower vagina is absent there is almost always a small upper compartment into which the cervix projects.

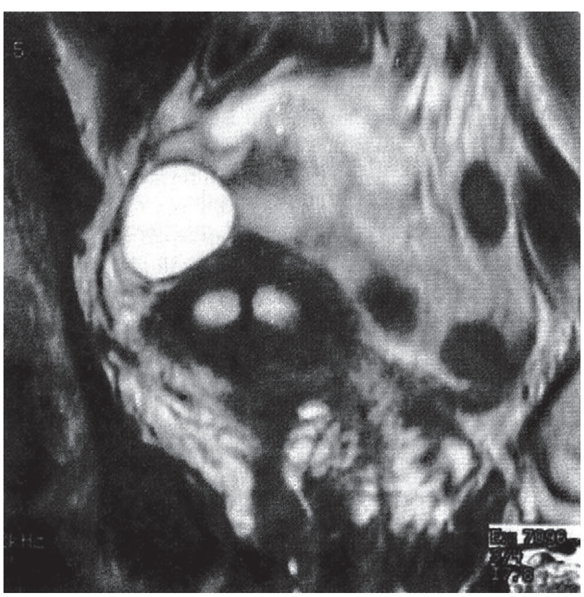

Fig. 2.4: T_2-weighted MR scan showing failure of Mullerian fusion. A single uterine body with twin cavities.

More difficult to explain is the rare occurrence of cervical agenesis in which there is a functional uterine corpus attached to a blind upper vagina by only a fold of peritoneum.[4] It must be assumed that the resorption process which is normal for the vagina has, on this occasion, involved the cervix as well. Vaginal recanalisation from the sinovaginal bulb has occurred as normal, but then failed to meet up with the lower margin of the uterus and thus create a transformation zone. Very rarely indeed the vaginal recanalisation process fails completely, resulting in a situation in which there is a small functional uterus without cervix or vagina.

Combinations of these developmental anomalies are particularly testing. Rudimentary uterine horns may not be connected with the main cavity; nor is the anatomical situation easily elucidated with standard imaging techniques. These horns, however, are not exempt from embryo implantation and the natural history of the resultant ectopic pregnancy may be quite atypical.

If the lower genital tract is reduplicated there is a number of clinically perplexing variants.[5] The vertical septum may be so deviated to one side that the presence of the second vagina is completely overlooked. If, however, one vagina is distally occluded, unilateral haematocolpos will develop without the typical history of primary amenorrhoea (cryptomenorrhoea). Furthermore, if the distal half of one vagina is not patent, the resultant upper haematocolpos is easily mistaken for an intraperitoneal cyst impacted in the pouch of Douglas.

Upper Renal Tract

MESONEPHROS AND METANEPHROS

The relative importance of the primitive kidney system, associated collecting tubules and ducts has been referred to above. The definitive kidney or metanephros, develops as a paired organ and migrates to the loin, acquiring a relevant blood supply in which process numerous vascular anomalies may arise, some of which can interfere with ureteric function.

URETER

The definitive ureter arises as a bud from the distal mesonephric (Wolffian) duct. This bud, the metanephric duct, grows in a cephalad direction to meet up with the relevant kidney (the metanephros) and join with the calyceal system. An error in this process will result in polycystic kidneys. The distal mesonephric duct itself becomes incorporated into the bladder base as the trigone; hence the separation of the terminal ureters and the ejaculatory ducts in the male.

ECTOPIC URETER

There are various forms of ectopic ureter which are clinically important in the female with openings into the distal urethra, vagina, Gartner's duct or even uterus.

CONGENITAL ANOMALIES

These are of considerable relevance to the gynaecological surgeon not least because there is a well-recognised association between urinary tract anomalies and congenital anomalies of the Mullerian system. Rock and Jones[6] described twelve cases of unilateral renal agenesis associated with reduplication of the Mullerian system with incomplete canalisation on one side resulting in unilateral haematocolpos. There are, however, other important variants of which the gynaecological surgeon should be aware as they frequently involve aberrant anatomy of the pelvic ureter, as well as giving rise to diagnostic confusion. Removal of a solitary pelvic kidney by an unwary gynaecologist is a recognised nightmare scenario and this differential diagnosis should always be borne in mind with any smooth retroperitoneal tumour. Conversely, the ureter may be duplicated in all or part of its course. The distal orifice of a duplex ureter may be ectopic.

A 'horseshoe' kidney has many variants, the lower poles of the two kidneys often having a bar of tissue joining them at the level of the renal arteries. They may, however, lie at a much lower level within the pelvis and impinge on the area of gynaecological diagnosis. As stated, the course of the ureters will be deviant. The most aberrant course of a ureter will be found in the case of 'crossed renal ectopia' when both kidneys are to be found in one loin and usually joined together. The contralateral ureter has to cross the midline and the major vessels (Figs. 2.5 and 2.6). Another rare cause of aberrant ureteric course is the retro-caval ureter in which the right ureter is hooked around the inferior vena cava.

RENAL TRANSPLANT

Finally, the gynaecological surgeon should be aware that in patients who have undergone renal transplantation, the transplanted organ is to be found in one or other iliac fossae and should not be mistakenly diagnosed as a 'gynaecological tumour'.

Urethra, Bladder Neck and External Genitalia

In both sexes, the cloaca is divided in the coronal plane by the urorectal septum. In the female, interposition of the Mullerian system and sinovaginal bulb means that abnormal communication between the alimentary canal and the urinary bladder is exceptionally rare.

Congenital anomalies of the bladder are relatively few, the most important being associated with a deficient anterior abdominal wall and incomplete pelvic girdle (ectopia vesicae). In such cases, the clitoris and vulva may be bifid. The condition is of importance to gynaecologists for the associated uterovaginal prolapse.

The allantois is the primordial 'extra-embryonic bladder'. Its remnant is the urachus which becomes the median umbilical ligament (see Fig. 2.12). Rarely, the urachus may be patent at birth and leak urine into the stump of the umbilical cord and, also rarely, malignant transformation of a persistent urachus can occur producing an adenocarcinoma at the umbilicus for which no other primary is found.

Distally, the septum may be deficient so that the urethra appears to discharge into the lower vagina rather than on to the vestibule (hypospadias). Epispadias also occurs. The functional length of the urethra has relevance to continence and congenitally short urethra, therefore, may require surgical correction.

BLADDER AND URETHRA

Supports and Attachments

Only the superior surface of the bladder is covered in peritoneum. The vault below this level is surrounded by loose areolar tissue to allow the bladder to fill and empty. The principal fixation of the bladder is around the pedicle of the inferior vesical vessels and the bladder base sits on the endopelvic fascia. The pubocervical ligaments are condensations of this fascia; laterally, the loose tissue may be developed during surgery as the paravesical space (see the text below).

The bladder detrusor muscle is not arranged in circular and longitudinal layers, but in an irregular spiral. There is no

Fig. 2.5: Vaginal ectopic ureter associated with crossed renal ectopia. Ascending ureterogram achieved by catheterisation of an abnormal ureteric orifice in the vagina. The ectopic ureter crosses the midline to a rudimentary lower pole of the left kidney which represents an ectopic right kidney.

recognisable circular sphincter at the internal meatus but there is extra elastic tissue. Some of the detrusor fibres passing down the urethra will, when they contract, have a tendency to open the bladder neck (Fig. 2.7).

Continence depends on maintenance of a pressure differential between the proximal urethra and the bladder.

The urethral pressure is contributed by the urethral smooth muscle and by the rhabdosphincter. The rhabdosphincter is an intrinsic muscle which extends from the bladder neck. The sphincter is not symmetrical being considerably thicker anteriorly than on the vaginal aspect. The nerve supply is through the pelvic nerves rather than the pudendal.

The urethra is suspended beneath the pubic arch by the paired pubo-urethral ligaments, sometimes termed the triangular ligament. In the female, this is separated by the vaginal sulcus from the rest of the bifid perineal membrane, which supports the distal quarter of the vagina (see Fig. 2.8). Just above the level of the triangular ligament, the urethra passes between the limbs of the levator ani (puborectalis) muscle. There are slips from the levator ani to the urethra

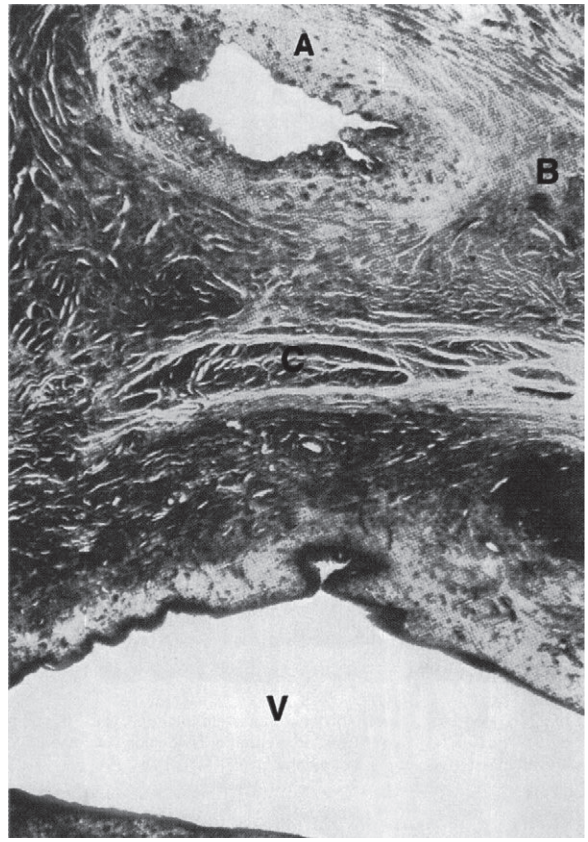

Fig. 2.7: Section of bladder neck and vagina. A, urethra; B, bladder (detrusor); C, post-urethral ligament, upper attachment of rhabdosphincter; V, vagina.

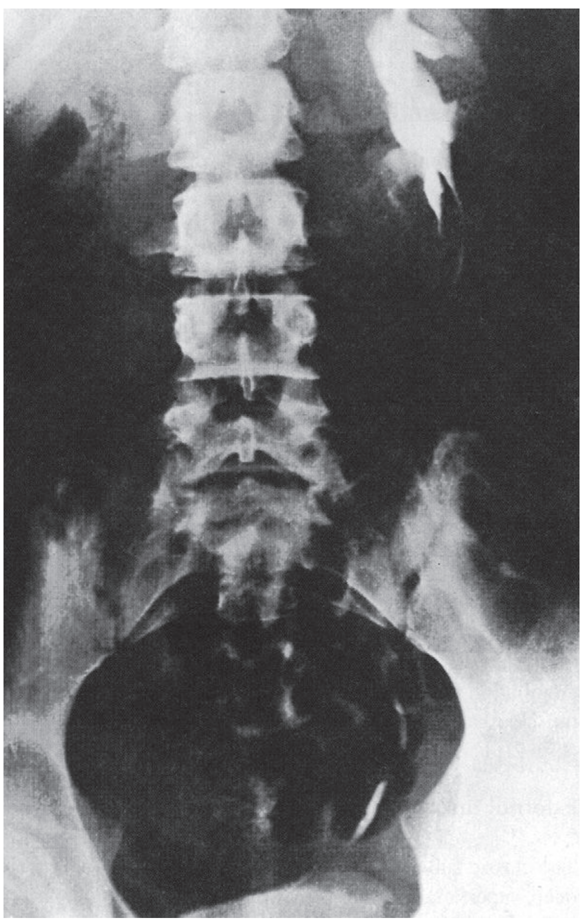

Fig. 2.6: Vaginal ectopic ureter associated with crossed renal ectopia. The excretion urogram shows an apparently solitary kidney with a normally positioned single ureter. The degree of malrotation should give rise to suspicion of an anomaly, such as a non-functioning pole in a 'horseshoe' kidney.

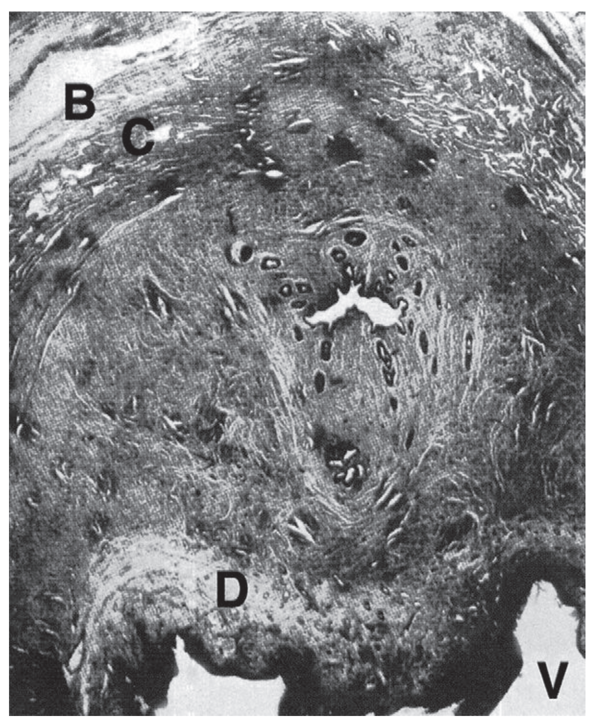

Fig. 2.8: Horizontal section of the distal urethra and vagina. B, pubourethral ligament; C, cavernous tissue; V, vagina; D, vaginal wall tethered to perineal membrane (urogenital diaphragm).

(extrinsic rhabdosphincter or compressor urethrae). This extrinsic rhabdosphincter contracts with the levator ani and mostly consists of 'fast twitch' fibres in contrast to the intrinsic muscle which is essentially 'slow twitch'.[7] The upward extensions of the pubo-urethral ligaments are the counterpart of the male puboprostatic ligaments. Laxity of the pubo-urethral supports can result in urethral hypermobility, an important factor in stress urinary incontinence (Fig. 2.8).

Ureter

Proficiency in identification and display of the ureter marks the skilled pelvic surgeon. Aside from the congenital abnormalities (see Figs. 2.5 and 2.6), the ureter has some fairly constant anatomical points. Between these its course may be distorted and deviated by pelvic pathology. At the pelvic brim the ureter crosses the iliac vessels close to their bifurcation and postero-medial to the ovarian vessels which have crossed above the brim. Below the pelvic brim the ureter is always closely related to the parietal peritoneum even when the para-rectal space is developed. For this reason, it is prone to adhere to cysts and abscesses which have become fixed to the side wall of the pelvis.

The ureter converges towards, but does not reach, the uterosacral ligaments. It is therefore at risk from plicating sutures (culdoplasty).

Where the pelvic peritoneum sweeps off the side wall to become the posterior leaf of the broad ligament, the ureter passes forward to lie over the cardinal ligament beneath the uterine artery. This is the commencement of the ureteric tunnel, which surrounds the ureter until it becomes intramural in the bladder wall. This tunnel requires release in all forms of radical hysterectomy. It will be found in the bladder pillar delineated once the vesico-cervical and para-vesical space have been developed (Fig. 2.9).

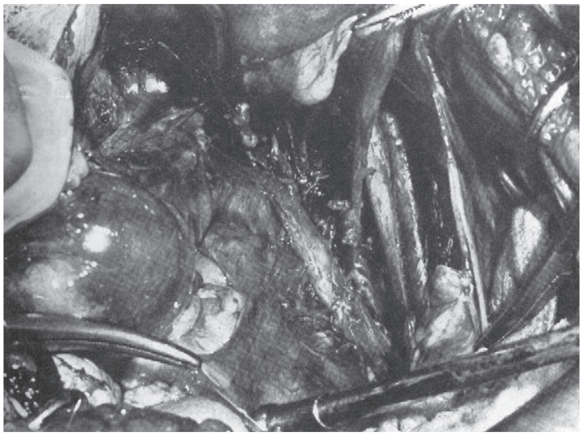

Fig. 2.9: The pelvic ureter. The ureter has been displayed during a radical hysterectomy operation. The broad ligament has been opened. The ureter, with its mesentery intact, lies on the medial leaf of the peritoneum. The obliterated hypogastric (umbilical) artery has been elevated and the uterine artery has been divided at its origin from the anterior division of the internal iliac artery.

Rectum

The rectum commences at the second piece of the sacrum. Peritoneum covers the anterior three quarters at the rectosigmoid junction but covers the front only at the level of the pouch of Douglas. The distal third has no peritoneal coat and this extra-peritoneal rectum is several centimetres long extending to the anorectal ring. Complete removal of the pelvic peritoneum at the time of radical oophorectomy involving rectosigmoid resection will therefore still leave sufficient bowel for a relatively straightforward anastomosis (see Chapter 17).

The rectum is supported by lateral ligaments which contain the middle rectal artery. They can be divided when mobilising a short distal stump. They become attenuated in rectal prolapse which, in effect, begins as intussusception at the fundus of the peritoneal cul-de-sac.

Anal Canal

Angulation of the anorectal junction by the puborectalis muscle marks the upper limit of the 'cylindrical' anal canal (Fig. 2.10).

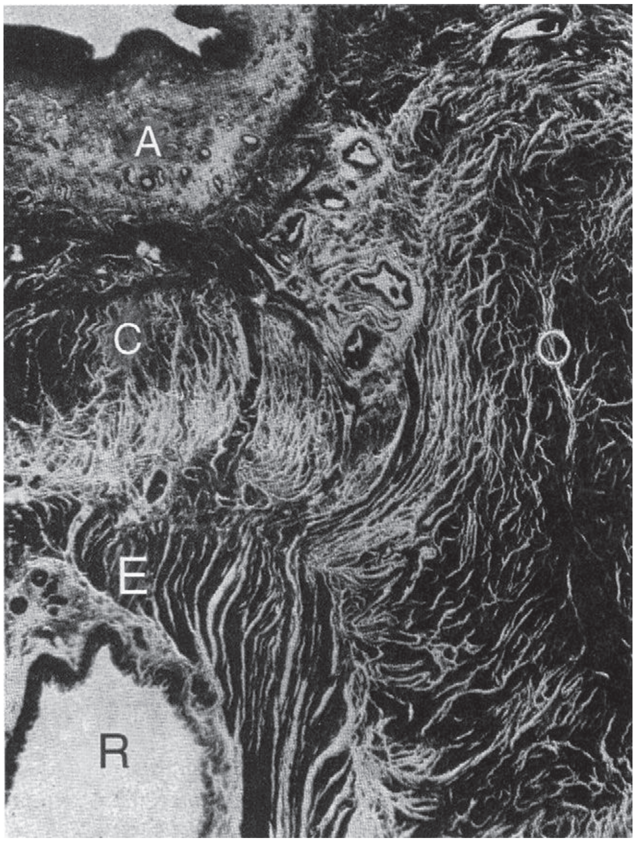

Fig. 2.10: Horizontal section between the vagina and the rectum just above the anorectal junction. V, vagina; R, rectum; A, apex of perineal body; C, outer longitudinal muscle of the rectum; E, inner circular muscle; O, levator ani (puborectalis).

EXTERNAL ANAL SPHINCTER

The classic subdivisions of the voluntary anal sphincter are deep, superficial and subcutaneous; the latter being puckered by the terminal strands of the longitudinal plain muscle. It is important to appreciate that in the female the anterior wall of the anal canal is significantly shorter than the posterior wall (the cylinder has been cut obliquely). There are no subdivisions of the anterior arc of the external anal sphincter in females (Fig. 2.11). The outline of an intact anal sphincter can usually be seen on perineal inspection. Appreciation of the asymmetric nature of the female anal canal is essential for the correct interpretation of physical signs and of transvaginal or per-anal ultrasound for the demonstration of the anal sphincters.[8]

The modern view regards the external anal sphincter as one muscle innervated by the pudendal nerve. The deepest part of this sphincter mechanism is continuous with the puborectalis sling of the levator ani muscle, and it is this muscle which provides the main element of control of defaecation; it is innervated directly from the sacral plexus. Fistula and sphincter injuries below this level produce impairment of continence of fluid faeces and flatus only, solid motions being controllable by the puborectalis alone. The key to this control is probably the angulation present at the anorectal ring. Sometimes the angle may be more acute on straining. When this occurs, evacuation of the bowel at defaecation may be incomplete, producing a vicious cycle of straining and pelvic floor inhibition, which leads to rectal prolapse as well as vaginal prolapse.

INTERNAL ANAL SPHINCTER

In common with the rest of the alimentary canal, the plain muscle of the rectal wall consists of an inner circular layer and an outer longitudinal layer (see Fig. 2.11). There is also thin muscularis mucosae in the subepithelial space above the dentate line. A condensation of the lowest portion of the inner circular layer forms the internal anal sphincter. It is the position of this muscle which has caused some confusion, not only because it extends proximally above the anterior arc of the external sphincter, but also because its lower free margin is a little way up the anal canal in the unanaesthetised patient (see Fig. 2.11). Under anaesthetic, however, the resting tone of the external sphincter is relaxed and the internal sphincter then apparently reaches to the anal verge. The intersphincteric ridge may be palpated quite easily. The outer longitudinal muscle distally receives a contribution from the levator ani (puboanalis) and obviously needs a point of attachment and in fact divides into several tails, which insert over a wide area mostly into the perianal skin. A lateral strand also separates the perianal space from the ischiorectal fossa[9] with a forward extension tethering the internal anal sphincter through attachment of the longitudinal muscle to the perineal membrane at the apex of the perineal body. This tethering extends parasagittally and may be responsible for childbirth tears of the internal anal sphincter without necessarily the external sphincter being completely divided.

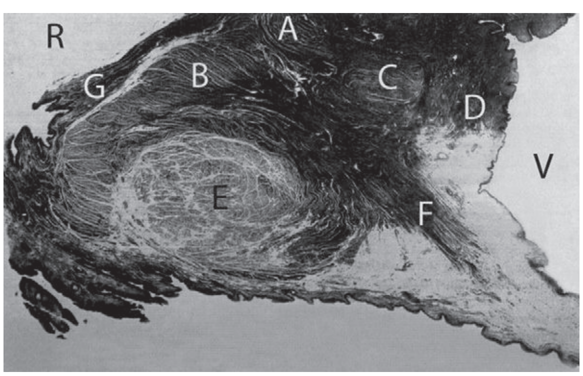

Fig. 2.11: Sagittal section through the perineal body. V, vagina; R, rectum; E, external (striated) anal sphincter muscle; G, muscularis mucosae; B, internal (unstriated) anal sphincter; A, outer longitudinal rectal muscle, dividing into 'tails', passing to the vagina at (F) and the perineal membrane at (C), to which the vaginal wall is also tethered (D).

Pelvic Fascia and Endopelvic Fascia

The pelvic fascia is defined as the fascial tissue which covers the upper and lower surfaces of the levator ani muscles, together with the medial surfaces of the two obturator internus muscles. Between the pelvic fascia and the peritoneum above, all the loose tissues are best referred to as the endopelvic fascia. This fascia is condensed posterolaterally to form the uterosacral ligaments and laterally the transverse cervical (cardinal or Mackenrodt's) ligaments. In addition, the vagina and cervix have their own fascial layer and the same remarks apply to the rectum, the bladder and the urethra. Furthermore, each of these is attached to adjacent organs and the pelvic side walls by pelvic fascia which can be recognised at operation. In the anterior compartment, this fascia is attached to a tendinous arc just medial to the attachment of the levator ani muscle to its own tendinous arc (white line) which is on the covering of the obturator internus muscle (Fig. 2.12). Tears of the endo-pelvic fascia are the initiating event for various types of vaginal prolapse.[10]

VESICOVAGINAL SPACE

Between the vesical fascia and the vaginal fascia, a plane of cleavage can be distinguished, known as the vesicovaginal space. This ill-defined space, bridged by delicate bands of connective tissue, can be demonstrated by dissection; it is relatively bloodless, and it is possible to separate the vaginal fascia from the vesical fascia by stripping, if the correct plane of cleavage is found. At the level of the transverse vaginal sulcus the vaginal fascia and vesical fascia fuse together so that there is no plane of cleavage below this level.[3] The attachment is here to the triangular ligament or perineal membrane. The rugose projections on the anterior vaginal wall lie below this level, and intervening between the vaginal

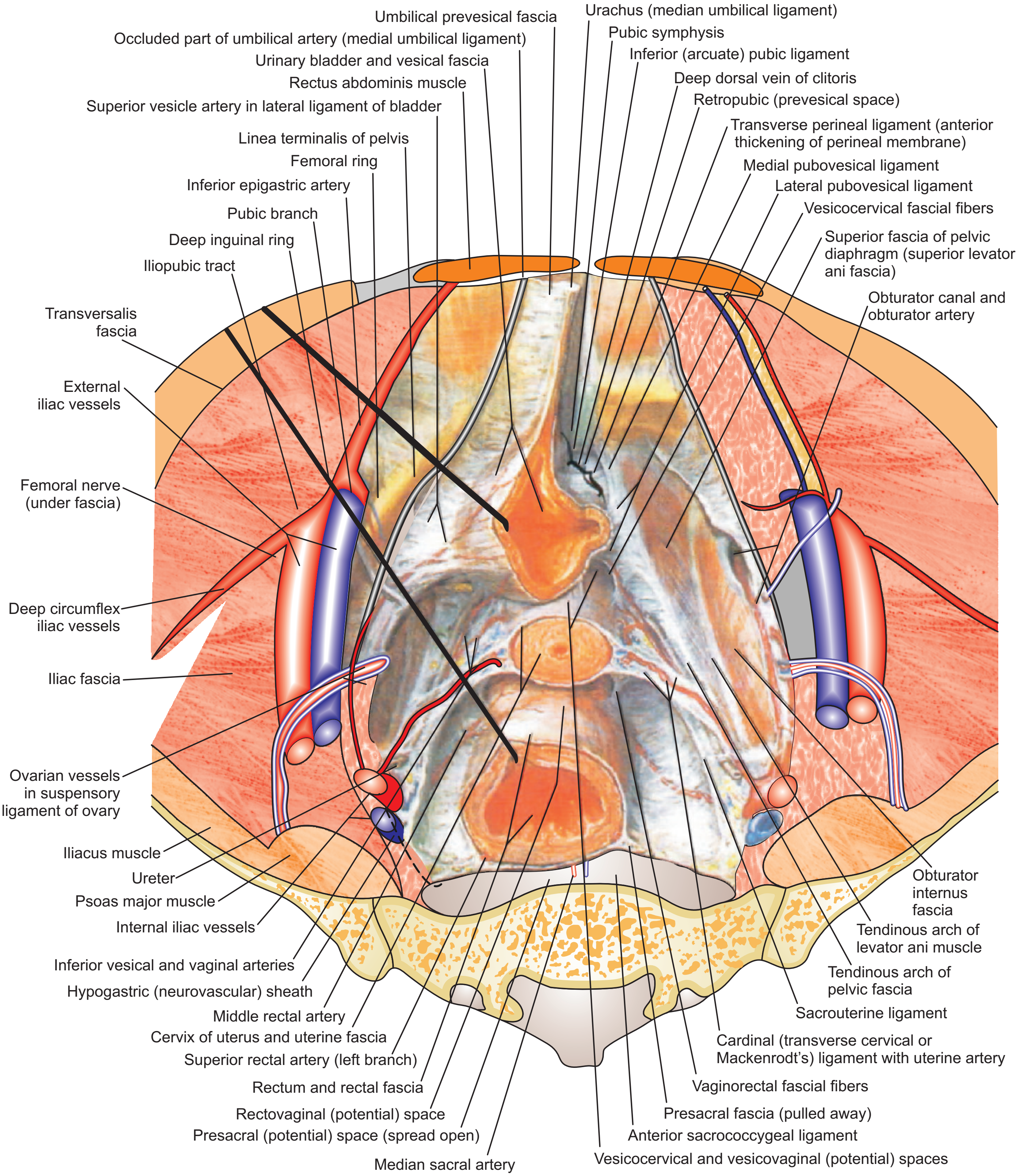

Fig. 2.12: Endopelvic fascia and spaces.

wall and the fascia covering the urethra is cavernous tissue, which must be cut through with a scalpel when the vaginal wall is dissected from the fused vaginal and urethral fascia. The fused vaginal and urethral fascia forms a condensation of tissue which is attached laterally to each pubic ramus and extends from the bladder wall or urethrovesical junction to the urethral meatus.

The ligamentous supports of the urethra, where it passes beneath the pubic arch, have been termed the anterior and posterior pubo-urethral ligaments.[11] The latter are paired, the space between them transmitting the dorsal vein of the clitoris. Between these supports, and arising by the origin of the levator ani muscles on the body of the pubis, may be found the extrinsic rhabdosphincter or compressor urethrae.

VESICOCERVICAL LIGAMENT

At abdominal operations, if the uterus is pulled upwards a small V-shaped fossa can be seen on the anterior surface in the midline. Above this level, the peritoneum is firmly attached to the uterine muscle. Below the V, the peritoneum becomes detached from the front of the uterus. In most cases the upper curvature of the bladder can be seen through the peritoneum, and there is a space of at least 2 cm between the apex of the V and the limit of the bladder. Immediately beneath the peritoneum, passing from the bladder to the uterus is a thin layer of tissue, the vesicocervical ligament. It represents the upper limit of the vesicocervical space. The V-shaped fossa lies approximately at the level of the internal os.

If during a vaginal operation the cervix is pulled down and the limit of the bladder exposed the same bands of tissue can be seen to pass from the bladder to the cervix. Three main condensations can be recognised; one is situated in the midline, while two lie laterally. The latter condensations are referred to as the pillars of the bladder. The midline condensation forms the vesicocervical ligament.

The lateral condensations beneath the bladder pillars are the pubocervical ligaments which are the anterior limb of the transverse cervical or cardinal ligaments.

The pubocervical ligaments are responsible for retaining the cervix and upper vagina within the anterior compartment of the pelvis. If attenuated or destroyed, they allow backward rotation of the whole vagina into the hollow of the sacrum (retrocession), a displacement which has to be distinguished from anterior vaginal wall prolapse (cystocoele), with which however it may be associated.

Transverse cervical ligaments (cardinal ligaments). These ‘butterfly’-shaped ligaments lie in the base of the broad ligament. They are the principal support for both the uterus and the vagina. In the standing position, they lie almost vertically.[12] The vaginal component (para-colpos) is variable and if it is deficient after hysterectomy, the stage is set for later vaginal extroversion.

The posterior arcs of the cardinal ligaments are the uterosacral ligaments which embrace the rectum and the pouch of Douglas. Their close relationship to the ureter should be noted.

POSTERIOR COMPARTMENT

Above the apex of the perineal body, the rectovaginal space intervenes between the vaginal fascia of the posterior vaginal wall and the thin fascia covering the anterior surface of the rectum. When the pre-rectal fascia has been torn in cases of rectocoele, the anterior wall of the rectum presents as a layer of muscle slightly corrugated longitudinally with prominent vessels. At the apex of the space is the fascial layer (fascia of Denonvilliers’) which supports the peritoneum of the pouch of Douglas. It is, of course, deficient in cases of enterocoele.

RECTAL PILLARS

Laterally, the rectal pillars merge with the lateral ligaments of the rectum which contain the middle rectal arteries (which are not always present). This fascial layer has to be penetrated to gain access to the sacrospinous ligament for sacrospinous colpopexy operations.

ROUND LIGAMENT AND ITS CONNECTIVE TISSUE MESENTERY

The round ligament consists of unstriated muscle fibres arranged in a central thick core of longitudinal fibres separated by a connective tissue of collagen fibres with very little elastic tissue from an outer thin layer of muscle fibres running obliquely or longitudinally.

If the round ligaments and the infundibulopelvic fold are divided, the uterus drawn over to the opposite side and the broad ligament opened up by blunt dissection, it is possible to identify a connective tissue mesentery passing from the round ligament downwards and inwards to become attached to the lateral side of the uterus anterior to the uterine vessels where it becomes continuous with the upward prolongation of the bladder pillar. The round ligament mesentery has no obvious function, but it is most helpful at hysterectomy for defining the situation of the uterine vessels. Moreover, when traced downwards and inwards it leads to the bladder pillar which can then be identified.

PARAVESICAL AND PARARECTAL SPACES

At Wertheim’s operation a deep dissection is required. It will be found that the ureter passes through a canal in the cardinal ligament. The roof of the canal is formed by connective tissue which surrounds the uterine artery, while below the ureteric canal lies the main portion of the cardinal ligament. The paravesical space lies in front of each cardinal ligament and the pararectal space behind. These spaces can be recognised at operation and are easily opened up as they contain only very tenuous cellular tissue condensations.

PRESACRAL SPACE

Within the posterior part of the pelvic cavity is a dense layer of fascia covering the anterior surface of the sacral plexus and the large vessels of the gluteal region.

This fascia (Waldeyer’s fascia) must be divided in a posterior exenteration operation. To dissect in a plane posterior to this fascia is to invite major haemorrhage. There is a useful plane of loose areolar tissue immediately behind the rectum but in front of this fascia.

Muscular Pelvic Diaphragm

The levator ani muscle, which is of great social and sexual significance, operates under two distinct disadvantages in the human, namely, walking upright (instead of 'on all fours') and the evolution of the human brain which requires delivery of a fetus with a large and disproportionately developed cranium.

The urogenital hiatus is inevitably stretched or torn in childbirth and may never return to its pristine state. Much of the pelvic support provided to the pelvic contents in this large birth canal is dynamic. Pelvic muscular relaxation thus leads to undue stress and stretch on the fixed ligamentous and fascial supports of the uterus and vagina, which, in turn gives rise to prolapse (Fig. 2.12).

LEVATOR ANI MUSCLE

Some authors maintain that the two levator ani muscles decussate and sometimes fuse together between the vagina and the rectum. Discrepancies may also be found in the descriptions in anatomical textbooks of the structure of the perineal body and of the sphincter muscles of the anus.

Dissecting room subjects are of limited value for anatomical researches, as fixation, and even anaesthesia, can alter the relationship between muscular components, such as the external and internal anal sphincters. Modem imaging (endosonography and magnetic resonance) has helped to elucidate the area, but images have had to be validated by serial dissection and histological confirmation before interpretation can be secure (Fig. 2.13).[13,14]

The origin of the levator ani muscle is from a linear area on the posterior aspect of the body of the pubis close to but not reaching

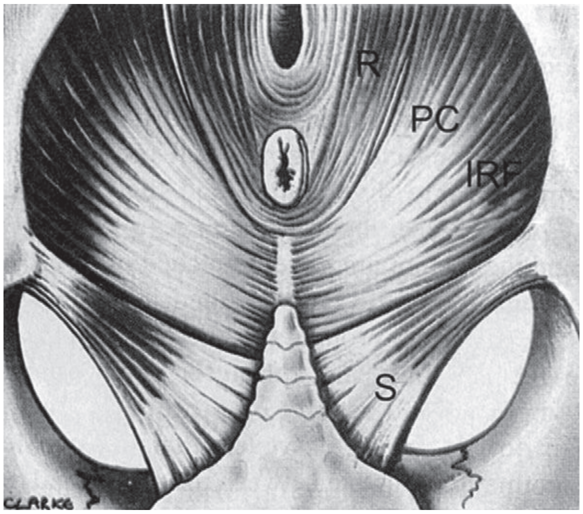

Fig. 2.13: Muscular pelvic diaphragm as viewed from below after removal of the urogenital diaphragm. R, puborectalis; PC, pubococcygens; S, sacrospinous ligament; IRF, ischiorectal fossa.

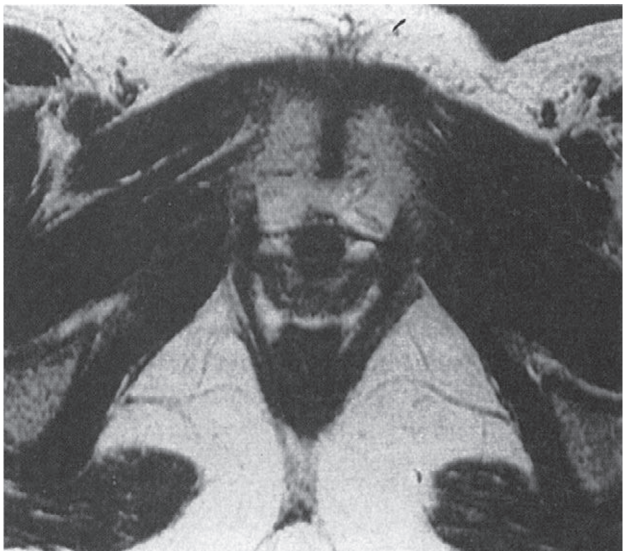

Fig. 2.14: T_2-weighted MR scan of the pelvic floor showing the pubococcygeus and puborectalis muscles.

the midline, thus forming the base of the retropubic space. Posterolaterally, the origin is from the tendinous arc (white line) over the obturator internus muscle as far as the ischial spine (see Fig. 2.12). The pubococcygeus muscles are inserted into the coccyx and into the anococcygeal raphe. The puborectalis muscle, which is functionally very important, actually forms a sling around the anorectal junction from the body of one pubic bone to the other. Because of its firm attachment to the lateral vaginal wall, it acts functionally as a vaginal sphincter without actually encircling that organ (Figs. 2.13 and 2.14).

In spite of this anatomical fact, if the patient is suffering from posterior vaginal wall prolapse and her levator muscles are divaricated, and the tissues which normally bind together the two levator muscles between the vagina and the rectum are either stretched or torn through, not only can a rectocoele be controlled if the two levator muscles are artificially brought together between the vagina and the rectum, but also anal sphincter function may be improved. The good results of a properly performed operation do not prove, however, that the two levator muscles normally decussate between the vagina and rectum, and over-zealous approximation of the pubococcygeus muscles can produce an 'hour-glass' stricture of the mid-vagina with resultant sexual dysfunction.

The nerve supply to the levator ani muscle reaches the muscle on its visceral (pelvic) aspect. In cases of major pelvic floor descent, due to chronic straining, it is subject to traction neuropathy.[15]

Urogenital Diaphragm and Ischiorectal Fossa

In the female, the perineal membrane which covers the space beneath the inferior pubic rami is effectively divided into three parts by the vagina. The related superficial and deep perineal pouches may be found lateral to the lowest part of

2

the vagina, where the two halves of the perineal membrane itself provide lateral support. This area is exposed in radical vulvectomy.

ISCHIORECTAL FOSSA

This important space is ineptly named. It is situated besides the anus, rather than the rectum, but separated distally by the perianal space. It is, however, separated from the ischium by the obturator internus muscle and the pudendal canal, and from the rectum by the levator ani muscle. Inferiorly, its medial wall is the anal canal and there is a communication between the two sides posterior to the anus, an anatomical arrangement which is important when abscess formation occurs. Communication anterior to the anal canal is, of course, blocked by the perineal body, of which the fossa is a lateral relation. Figure 2.15 illustrates the point that on each side the ischiorectal fossa has an anterior extension over the free posterior margin of the perineal membrane beneath the muscle of levator ani. Owing to the adhesion of levator ani to the lateral wall of the vagina, the ischiorectal fossa is close to the vagina at this level and collections of blood or pus may encroach upon the lumen and be palpated digitally. Such collections need to be distinguished from those in the para-vaginal space, which is cranial to the levator muscle.

PERINEAL BODY

The perineal body is a wedge-shaped body with its apex at the level of the perineal membrane where the two halves are attached to each other at the central point of the perineum immediately posterior to the lower end of the vagina. The apex fills the gap between the two halves of the puborectalis muscle between their encirclement of the anorectal junction and where they are adherent to the lateral wall of the vagina. The base is formed by the skin of the perineum extending from the posterior margin of the vestibule (navicular fossa) to the anterior anal verge.

Various important structures impinge upon or participate in the perineal body. Functionally, the most important are the anal sphincter muscles.

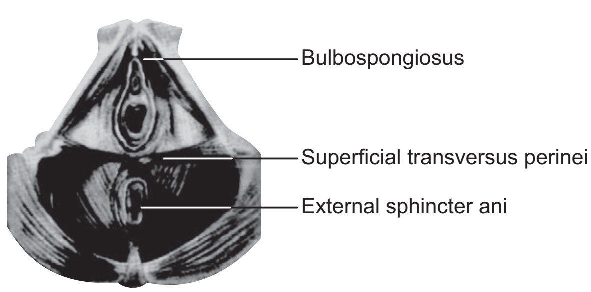

Fig. 2.15: Superficial perineal pouch and muscles, seen from below. Fat has been removed from the ischiorectal fossa to show the paravaginal extension. T_2-weighted MR scan of the pelvic floor showing the pubococcygeus and puborectalis muscles.

The superficial transverse perineal muscle overlies the free posterior border of the perineal membrane and decussates with the superficial external anal sphincter (Fig. 2.16). The deep transverse perineal muscles occupy a pouch adjacent to the perineal membrane on either side of the vagina. Their medial margin is close to the attachment of the puborectalis to the lateral wall of the vagina. Its posterior arc may have been regarded as a 'pubovaginalis'. It is not part of the urethral sphincter mechanism.

Anteriorly, within the subcutaneous tissue of the vestibule may be found fibres of the bulbospongiosus muscle which is often deficient in the midline and therefore not identified in a median episiotomy. It is a weak introital sphincter but the fibres may sometimes be found in the pedicle of fat developed for the Martius operation (see Chapter 21).

Veins and Lymphatics

The posterior part of the pelvis and the area above the pelvic rim and sacral promontory are of supreme surgical importance for here is the divergence of the main arterial supply to lower part of the body and the confluence of its venous drainage. Some understanding of vascular embryology is helpful in appreciating the asymmetry of paired vessels and possible variants.

The dorsal aorta is developmentally a paired vessel but only the left arch persists. The definitive abdominal aorta tends to occupy a rather more central position than does the inferior vena cava.

The common iliac arteries are paired segmental arteries, the terminal dorsal aorta being represented by the small median sacral artery, a small vessel which is nevertheless capable of giving rise to haemorrhage in retroperitoneal surgery for carcinoma of the ovary or for presacral neurectomy.

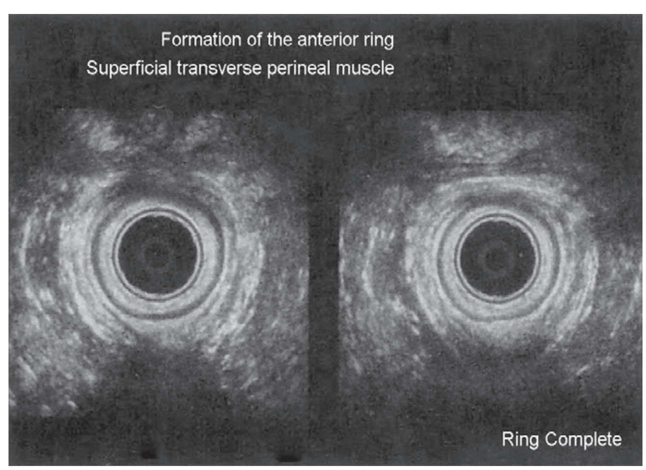

Fig. 2.16: Endo-anal ultrasound showing decussation of the superficial transverse perineal muscle with the external anal sphincter and the deeper part a complete ring (by courtesy of Prof. Clive Bartram).

VESSELS OF THE LOWER LIMB ARTERIES

The primitive arterial supply to the lower limb (ischiadic artery) followed the sciatic nerve out of the pelvis through the greater sciatic notch. This artery arose from the posterior division of the internal iliac artery and is represented in human anatomy by the gluteal vessels which still participate in the cruciate anastomosis with the deep femoral artery in the thigh.

The arrangement of perforating arteries from the deep femoral artery to the gracilis muscle remains of importance in reconstructive gynaecological surgery allowing mobility to musculocutaneous grafts from the inner aspect of the thigh (see Chapter 21). Injury to the gluteal artery can occur during transvaginal sacrospinous fixation (see Chapter 14).

ILIAC ARTERY

The development of the anterior compartment of the thigh resulted in the predominance of the external iliac artery and femoral artery as the main supply to the lower limb. There are no parietal branches of the external iliac artery until it reaches the inguinal ligament. Just occasionally, an anomalous origin of the obturator artery may course over the pubic ramus to the obturator foramen and be at risk in femoral hernia repair and pelvic lymphadenectomy.

Internal Iliac Artery

The internal iliac artery has two divisions (Fig. 2.17). The posterior division has an association with the roots of the sciatic nerve as they traverse the greater sciatic notch. Because of the cruciate anastomosis (see Fig. 2.17) retrograde flow from this division to the anterior division is possible after ligation of the stem internal iliac artery close to the bifurcation of the common iliac artery. Embryologically, the anterior division of the internal iliac (umbilical) artery is the artery to the extra-embryonic bladder (allantois). In the adult, therefore, the last patent branch of the anterior division of the internal iliac artery is a main artery to the bladder, namely the superior vesical. During radical hysterectomy the obliterated hypogastric arteries (lateral umbilical ligaments) may be identified in the para-vesical space and, if put on the stretch, provide a convenient anatomical guide to the surgeon to the anterior division of the internal iliac artery and hence to the origin of the uterine artery. There is some variation in the origin of these arteries, varying from close to the superior vesical with a short transverse course to the lateral fornix, to a high 'take off' from the formation of the anterior division with an oblique course across the cardinal ligaments to the same site. There is similar variability in the site of origin of the other branches of the internal iliac artery, although the course and distribution tend to be constant.

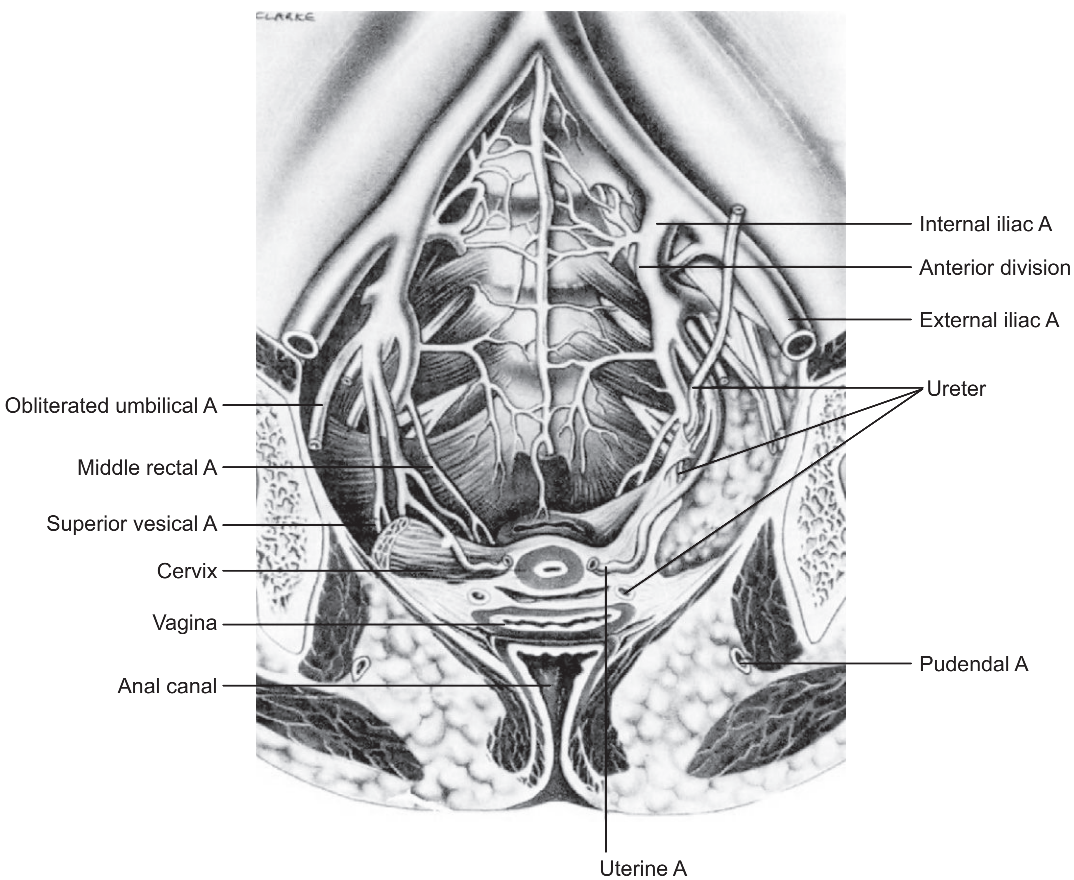

Fig. 2.17: Internal iliac artery and its relations. Diagonal section of the female pelvis passing from the hip joint to the anal canal. On the left the fat of the para-vesical space and part of the transverse cervical (cardinal) ligament have been removed. Unlabelled are the gluteal, and lateral and median sacral arteries.

The pudendal vessels accompany the pudendal nerve where they enter the pudendal sheath on the medial aspect of the ischial tuberosity (Alcocks canal). The relationship to the ischial spine is relatively constant. Not only is this important for the insertion of pudendal block for minor surgical and obstetric procedures, but also during the insertion of suspensory sutures in the operation of sacrospinous vaginal fixation placement of a suture close to the tip of the spine runs the risk of vascular and nerve damage (see Chapter 14).

VEINS

The veins of the pelvis constitute a veritable 'mine field' for the surgeon. Their embryology is obscure and their anatomy characterised by inconstancy even between two sides of the body. The vessels are thin walled and generally without valves, so that haemorrhage from trauma to a major vein will 'well up' from two or even three directions.

Inferior Vena Cava

Formed from the confluence of the two common iliac veins, the inferior vena cava is essentially a right-sided structure of complex embryology. During embryonic life, there are three pairs of longitudinal veins, the counterparts of the dorsal aorta. These are the cardinal, supracardinal and subcardinal veins. The definitive vena cava is made up of segments of all these vessels with anastomotic channels. It is atypical persistence of a sub-cardinal section which gives rise to the rare retrocaval ureter. The azygos and lumbar veins are important tributaries which need to be respected during lumbar (para-aortic) lymphadenectomy.

ILIAC VEINS

Common Iliac Veins

There is marked asymmetry in the course of these vessels, the proximal part of the left common iliac vein being represented embryologically by an inter-cardinal anastomosis. The left common iliac vein is thus substantially longer than its right counterpart and does not have the same proximity to the left common iliac artery. This vein is the lowest major vascular structure in the midline above the sacral promontory. It is, therefore, peculiarly vulnerable to injury during blind insertion of instruments for laparoscopy, either the Veress needle or the trocar.

External Iliac Veins

The external iliac veins commence at the inguinal ligament and become the common iliac veins after junction with up to three internal iliac veins. Although it is possible to dislocate medially the external iliac vein from the side wall of the pelvis in order to gain access to the lymph nodes lateral and posterior to the vein, the posterior inferior aspect needs to be treated with great circumspection as large thin-walled vessels may drain directly into the external iliac vein, particularly if the lymph nodes are pathologically enlarged. There is an especially dangerous triangle at the confluence of the main internal iliac vein with the external iliac to form the common iliac. There is a flange of vein wall between the two afferent vessels which is easily torn during pelvic lymphadenectomy. It is most important that fat-containing lymph nodes be drawn downwards and forwards parallel to the external iliac vein rather than lifted upwards. Haemorrhage in this area can only be stemmed by pressure over all three major veins forming the junction.

The femoral vein is an important structure within the field of inguinal lymphadenectomy. Within the femoral sheath, the femoral artery is 'sandwiched' between the femoral vein and the femoral nerve. Pulsation of the arteries, therefore, is a guide to the position of the vein when venous access for blood sampling is required.

The long saphenous vein enters the femoral vein through the saphenous opening and cribriform fascia. There are three or more small veins entering at this site corresponding to the small named arteries which have arisen from the adjacent femoral artery. The long saphenous vein itself lies deep to the membranous layer of the superficial fascia. If traction is applied to the sapheno-femoral junction during mobilisation, tenting of the femoral vein can occur, resulting in its partial obstruction by the ligature.

Internal Iliac Veins

The internal iliac veins are deserving of the greatest surgical respect. Haemorrhage from them can be life threatening and testing; the pelvis fills rapidly with dark blood which can usually be staunched by pressure but with rapid resumption of the bleeding when pressure is released. These veins are connected without valves to those from the gluteal region which pass between the roots of the sacral plexus, between which they are prone to retract. Attempts at haemostatic suture in this area carry a significant risk of major nerve root damage. The uterine veins are varied and run a quite different course to the uterine artery. Whereas the latter runs a more or less oblique course from the side wall of the pelvis (anterior division of internal iliac artery) over the ureter to the lateral fornix and supravaginal cervix, the former commonly run inferior to the ureter (although one branch may pass above with the artery). When the ureter is drawn upwards during the operation of hysterectomy the venous drainage is then almost vertically downwards in to the iliac veins.

The pre-sacral area, bounded by the left common iliac vein above and the two internal iliac arteries on either side, contains the venous drainage from the buttocks through the gluteal veins. The venous drainage of the sacrum and sacral canal is largely posterior to the pre-sacral fascia (Waldeyer's fascia). These veins, when torn, can retract into small bony apertures and continue to produce life-threatening haemorrhage. Special haemostatic techniques such as 'thumb tacks' or wax may be required.

OVARIAN VEINS

Unlike the ovarian arteries, which arise symmetrically from the aorta just below the origin of the renal arteries, ovarian venous drainage is asymmetrical. The tortuous ovarian veins, often with anastomotic channels across the broad ligament to the internal iliac system, wend their way in the infundibulopelvic fold across the iliac vessels to the level of the renal vessels. Once again, embryology is pertinent to the difference in anatomy at this level. Like the left common iliac vein, the left renal vein consists in its medial portion of an inter-subcardinal anastomosis, which therefore passes anterior to the aorta. The left ovarian vein joins this vessel, the left cardinal system having disappeared. Renal carcinoma invading the renal vein on the left side can sometimes give rise to retrograde venous spread to the female genital tract where secondary tumour in the ovary may histologically resemble primary 'clear cell' carcinoma.

Because of the broad ligament anastomosis metastatic deposits may find their way through the uterine and vaginal venous system to the 'water shed' at the lower quarter of the vagina where external venous drainage to the pudendal system commences. Presumably there is an element of stasis in this region as it is a site of predilection for secondary deposits from the uterus (including choriocarcinoma), particularly in the sub-urethral region.

VASCULAR SUPPLY OF THE BOWEL

Knowledge of the blood supply to the alimentary canal is directly relevant to certain areas of specialist gynaecology. The distribution of vessels and, equally important, the disposition of bloodless planes has an embryological basis. With the disappearance of the yolk sac and closure of the extra-embryonic coelom the intestine undergoes an anti-clockwise rotation about the origin of the superior mesenteric artery. The duodenum becomes plastered against the posterior abdominal wall and at the duodeno-jejunal flexure the small bowel and its mesentery appear from the hub of this rotation. The root of the mesentery which passes down to the right iliac fossa contains the ileo-colic and right colic vessels supplying the terminal ileum, caecum and right colon. This means that lateral and posterior to the caecum and right colon is a bloodless plane where the primitive colonic mesentery adhered (by zygosis) to the posterior abdominal wall. This plane is utilised when the right colon is mobilised and swung medially to expose the vena cava and aorta for the purposes of lumbar (para-aortic) lymphadenectomy (see Chapter 16). The distribution of the blood supply is also relevant to utilisation of the caecum and right colon as an artificial vagina.

Marginal Artery (of Drummond)

There is an anastomotic branch between the fields supplied by the right colic, middle colic and left colic arteries. Anastomosis is not as free as between the arcades of the ileum and identification and preservation of this artery is of importance when mobilising the left colon up to the region of the splenic flexure for low anastomosis. At a high level the inferior mesenteric vein and artery are quite separate, the vein occupying one of the para-duodenal folds on its way to form the hepatic portal vein.

The superior haemorrhoidal vessels cross the pelvic brim to the left of the midline. When there is haemorrhage in the area, they can be mistaken for the trunk of the internal iliac artery. Within the pelvis the superior haemorrhoidal vessels are the main supply of the upper rectum. Beneath the peritoneal reflection may be found on either side the middle rectal arteries within the lateral ligaments of the rectum. These do not seem crucial to the viability of the distal stump; with low anterior rectal resection, both lateral ligaments may be divided during mobilisation to the anorectal ring. Distally, there will be an anastomosis with the inferior haemorrhoidal vessels which arch across the ischiorectal fossa from the pudendal vessels to supply the anal canal. On the venous side this is also recognised as an area of portal systemic anastomosis. Above the rectosigmoid junction the blood supply of distal sigmoid colon is from above; viability may be impaired if this is compromised.

BLOOD SUPPLY OF THE URINARY BLADDER, URETER, VULVA AND INGUINAL REGION

Bladder

Although the superior vesical artery remains as the last patent branch of the allantoic (umbilical artery) it is not in fact the main blood supply to the adult bladder, which also arises from the internal iliac system as the inferior vesical artery, a large vessel in the male, partly replaced by the vaginal artery in the female. The bladder wall is extremely well vascularised to the extent that bleeding is often the first warning sign to the surgeon of encroachment upon this structure. The vascular pedicle is important when constructing the base of tube grafts for ureteric re-anastomosis (Boari operation, see Chapter 21). The ureter, by way of contrast, has a very tenuous blood supply, being picked up as small branches from most of the neighbouring large arteries, particularly where it crosses the common iliac artery at the pelvic brim. There are further branches from the uterine artery in the ureteric canal; these, of course, will be lost with lateral ligation of the uterine artery during radical hysterectomy. There is a fine mesentery attached to the ureter which lies against the peritoneum on the side wall of the pelvis. This 'envelope' should be disturbed as little as possible in radical pelvic surgery as excessive stripping can devitalise the ureter and lead to sloughing and fistula formation.

Vulva and Groin

The vulva and its appendages are liberally supplied with blood vessels from the internal and external pudendal systems. The terminal branches of the internal pudendal artery, after giving off the inferior haemorrhoidal artery are the perineal branch and the artery to the clitoris. There is a free anastomosis in the subcutaneous area which means that pedicle grafts of fat are viable whether hinged anteriorly or posteriorly (Martius operation, see Chapter 21).

In the inguinal region, the situation is quite different. There are three small arteries given off from the origin of the femoral artery before it gives off its deep (profunda) branch. That which supplies the skin of the groin must be an end artery as sloughing of the skin over the femoral triangle is fairly common after inguinal lymphadenectomy in which these arteries are ligated.

Lymphatic System

All lymphatic channels from the lower half of the body eventually converge on the thoracic duct after passing 26 through a number of lymph node stations en route. This is the basis for left-sided supraclavicular none involvement in some cases of ovarian malignancy (cp gastric cancer).

LYMPH DRAINAGE OF THE EXTERNAL GENITALIA

Inguinal Lymph Nodes

The lymphatic drainage of the lower limb converges on the medial aspect of the thigh. The primary lymph nodes lie distal to the inguinal ligament and, in modern terminology, are all called inguinal. There is one distal lymph node station in the popliteal fossa. The inguinal lymph nodes are situated superficial and deep to the deep fascia.

The superficial inguinal nodes are arranged in a 'tilted T' shape with medial and lateral horizontal groups and a vertical chain related to the long saphenous vein before it passes through the cribriform fascia. The medial horizontal group is most likely to be involved in vulval malignancy. The distribution of the lymphatic channels and their relationship to the labio-crural folds were described in a classic exposition by Parry-Jones.[15]

The deep inguinal nodes (at one time called femoral) are up to three in number in the deep part of the cribriforms fascia just above and below the sapheno-femoral venous junction and also in the femoral canal (Cloquet's node); the latter is inconstant. Deep nodes are not found distal to this point, but the distal limit of the cribriform fascia may be indistinct. Not all lymphatics from the thigh pass through the femoral canal, but may be seen on lymphography entering the pelvis across the length of the inguinal ligament.

Pelvic Lymph Nodes

Although the pelvic nodes are largely located near major vessels, their afferent drainage in no way corresponds those located near the external iliac vessels being first station nodes for some pelvic viscera. Pelvic nodes are parietal and visceral.[16]

Parietal Nodes

External iliac nodes. There are three channels and three node chains on each side. Inter-iliac nodes (commonly but incorrectly called 'obturator') are the posterior external iliac group. They lie anterior and superior to the obturator nerve (dissection of the fat beneath this nerve is unrewarding). The other node chains are related to the artery and to the cleft between the vein and artery.

Internal iliac nodes are situated between the corresponding artery and vein and posterior to the vein. Lymph drainage from the posterior thigh follows the gluteal vessels to these nodes.

Sacral nodes. Lateral and medial groups (the medial are related to the median sacral artery).

Common iliac nodes. These have similar distribution to the external iliac nodes.

Lumbar nodes (commonly called 'para-aortic' although the majority are 'para-caval').

There are four lymph chains, two lateral and one in front of and one behind the great vessels.

Lymph drainage from the ovary is bi-directional with a direct channel to nodes at the level of the renal vessels as well as to nodes on the side wall of pelvis.

The *uterine fundus* may drain in a similar manner, and intraperitoneal malignancy near the deep inguinal ring may involve inconstant, inferior epigastric nodes or the superficial inguinal groups.

Another inconstant parietal node is found in the obturator foramen, not to be confused with the inter-iliac group (see the text above). This drains the medial thigh.

Visceral Nodes

These relate to the viscera and are labelled parametrial, paravesical and para-rectal. One parametrial lymph node lies between the ureter and uterine artery. The pararectal nodes are the most distal station of the inferior mesenteric group.

The lymph node drainage of the cervix is illustrated in Fig. 2.18.

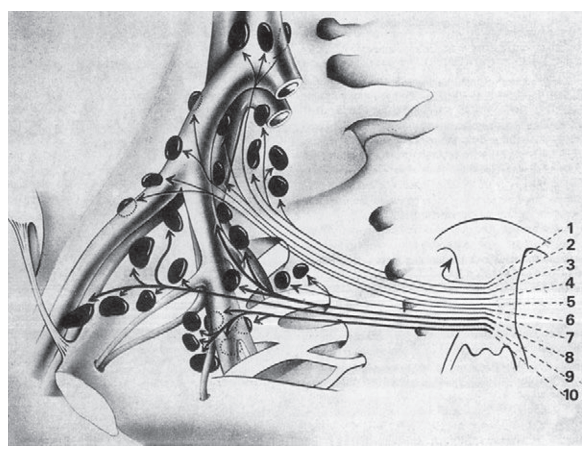

Fig. 2.18: The regional lymph node station of the uterine cervix. Channels 8, 9 and 10 (indicated by especially heavy lines) lead to those regional node stations most frequently reached by the efferent lymph vessels of the cervix. Nonetheless, it is necessary to remember that carcinoma cells can also reach the pelvic lymph nodes by way of channels, 1–7, without previous interruption. To (1) rectal, (2) subaortic (promontorial), (3) aortic, (4) medial common iliac, (5) lateral common iliac, (6) lateral external iliac, (7) sacral, (8) superior gluteal, (9) interiliac and (10) inferior gluteal lymph nodes.

Nerves

The pelvic contents are visceral and hence the nerve supply, both sensory and motor, is autonomic. Certain somatic nerves, however, pass through the field and the pelvic surgeon needs to be aware of their presence and of their significance.

FEMORAL NERVE

The lumbar plexus within the false pelvis is well protected from injury until it forms the femoral nerve in the most lateral compartment of the femoral sheath. The femoral nerve should not be exposed in the operation of inguinal lymphadenectomy. It can, however, be injured by abdominal wound retraction.

The obturator nerve appears in the pelvis from behind the bifurcation of the common iliac vessel but traverses the ovarian or obturator fossa, disappearing from view through the obturator foramen whence it is responsible for innervation of the medial compartment of the thigh.

The nerve is an important landmark during pelvic lymphadenectomy and forms the posterior margin of the dissection field. Involvement of the obturator nerve in this area can give referred pain the medial side of the knee. Likewise severance will produce some analgesia in this area and interference with adduction of the thigh. Walking can be affected.

SCIATIC NERVE

This is formed from the anterior roots of the sacral outflow and the lumbosacral trunk from L5 which crosses the pelvic brim and is susceptible to injury at this point. The nerve roots are protected by a dense fascia. Sciatic pain from malignant infiltration of the area is a sure indicator of inoperability. There is the potential for injury from a misplaced suspensory suture.

GENITO-FEMORAL NERVE

This supplies a sensory distribution to part of the vulva and adjacent high. It is demonstrable on the surface of the psoas muscle and marks the lateral limit of the dissections required for external iliac lymphadenectomy.

ILIO-INGUINAL NERVE

This nerve supplies a slightly higher area of the groin and actually traverses the inguinal canal. Its importance in gynaecology is the risk of entrapment in Pfannenstiel incisions and more particularly within the sutures used for suspensory procedures of the uterus (modified ventrisuspension) or of para-urethral tissues (slings or cystoscopically directed needle suspensions).

PUDENDAL NERVE

This accompanies the pudendal vessels in the route described above. Its main branch is the inferior haemorrhoidal, which is important as it is the nerve supply to the external anal sphincter. The nerves enter the sphincter from the posterolateral aspect, a relationship which is relevant to sphincter repair operations. The perineal nerve is an important anterior branch, and increased transmission latency may result from neuropraxia.

Autonomic Nervous System (Fig. 2.19)

SYMPATHETIC NERVES

On each sympathetic chain every spinal nerve has a ganglion related to the anterior root terminating with the ganglion impar

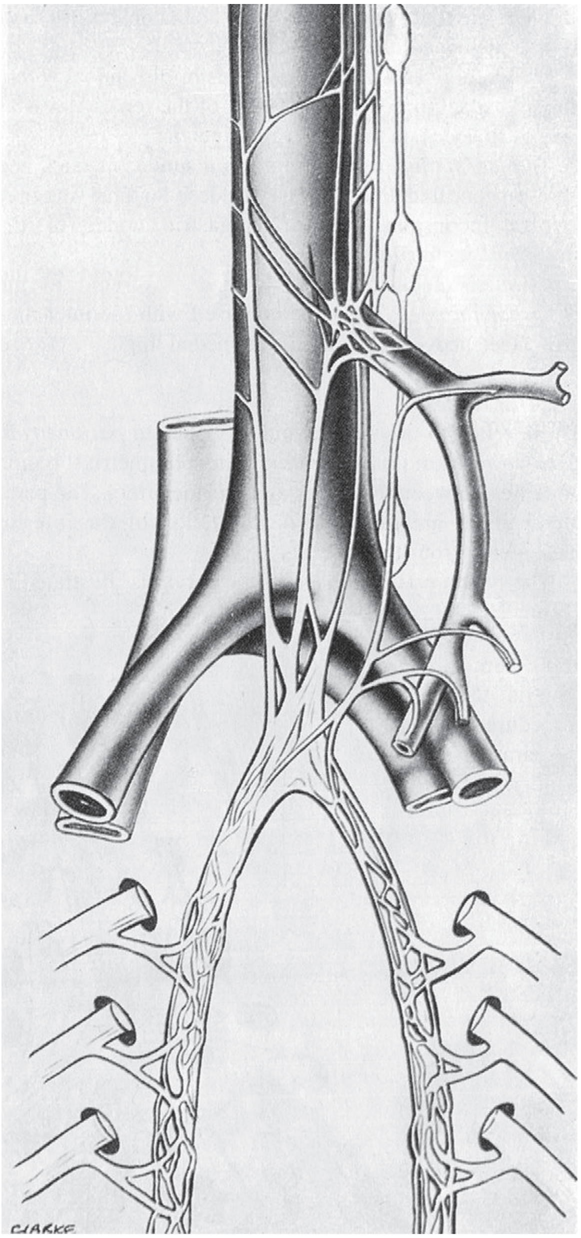

Fig. 2.19: The autonomic nerves in the pelvis. Post-ganglionic sympathetic fibres from the thoracolumbar outflow form the hypogastric plexuses. They are joined by the pre-ganglionic parasympathetic nerves from the sacral nerves 2, 3 and 4. The motor nerve supply to the detrusor muscle of the bladder traverses the root of the cardinal ligament and the parasympathetic innervation of the distal colon and rectum leaves the pelvis retrograde (nerve of Learmonth).

in front of the coccyx. The preganglionic sympathetic outflow is confined to the thoracolumbar region with grey rami communicantes conveying sympathetic motor fibres which pass up and down the sympathetic chain to relay in the ganglia. White rami leave the ganglia and come together to form the splanchnic nerves. Many sympathetic nerves are closely related to arteries entering the pelvis including the iliac and ovarian arteries.

Some of the sympathetic motor supply to pelvic organs from lower thoracic roots forms the superior hypogastric plexus in front of the sacral promontory below the left common iliac vein. This plexus also transmits visceral afferent fibres from those areas innervated by thoracic segments (e.g. cervix and uterus). The distribution of sensory fibres is variable but interruption of the hypogastric plexus (pre-sacral neurectomy) can reduce upper genital sensitivity and in particular abolish the pain of uterine contractions. In the female, there is little motor change following a pre-sacral sympathetic nerve resection, most of the efferents being associated with vascular tone. In the male, however, erectile dysfunction can result from their interruption.

PARA-SYMPATHETIC NERVES

The pelvic para-sympathetic outflow is provided by the pelvic splanchnic nerves related to sacral segments S2, 3 and 4. These form the inferior hypogastric plexuses either side of the ampulla of the rectum joining in with some of the efferents from the superior hypogastric plexus and also further post-ganglionic sympathetic fibres from the ganglia associated with the sacral nerves. This is the reason why the pre-sacral neurectomy procedure does not have demonstrable effect upon either the para-sympathetic or sympathetic innervation of the bladder. These pelvic splanchnic nerves course forwards on the side walls of the pelvis to reach the trigone and base of the bladder (nervi erigentes). Inevitably they have to pass through the lateral attachments of the transverse cervical (cardinal) ligaments. This will be in the outer third of these ligaments, but the actual situation is variable. It means that there is in some cases a substantial risk of denervation of the bladder by wide resection of the cardinal ligaments at radical hysterectomy (see Chapter 16).

Bony Pelvis

The anatomy of the female bony pelvis has long been of relevance to the obstetrician. However, with an increase in interest the application of surgery to problems in the posterior compartment of the pelvis, bony land marks in the area become important, not only for interpretation of images but also as tactile points of reference. Perhaps the most important of these are the ischial spines.

Conclusion

Anatomy is a living science and individual to each person. The principles of applied anatomy and associated physiology outlined in this chapter are essential for the understanding of much gynaecological pathology and for the demarcation of appropriate treatment.

All the various functions of the pelvis, particularly continence and coitus, need due consideration before surgical interventions are undertaken which can have far reaching effects on subsequent quality of life.

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Pre-operative Assessment and Diagnostic Procedures

3

Marcus E. Setchell

Pre-operative Assessment and Diagnosis

INTRODUCTION

The pattern of specialist care of patients requiring surgery has changed radically over the last two decades, and this has been particularly evident in gynaecology. Although all medical students have traditionally received some teaching in gynaecology, it is only more recently that general practitioners (GP) and nurses have taken on a wider role in the provision of services in areas such as contraception, cervical screening and the preliminary investigation and management of many gynaecological conditions. Often the GP works closely with hospital specialists, using jointly developed and agreed protocols of management. Where these are well developed the GP can not only book patients directly into a specialist clinic, but in some situations book them directly on to the Consultant's operative waiting list.

Rather than traditional general gynaecology clinics, many hospitals now have subspeciality clinics for disease or symptom-complex disorders. Some of these run as multidisciplinary clinics with nurse-specialists, counsellors, consultants from other specialities and ultrasound scanning or other diagnostic facilities available (see Tables 3.1 and 3.2).

SPECIALIST CLINIC

An increasingly popular concept is to provide a 'one-stop' clinic, where all diagnostic services relevant to the particular specialist clinic, whether it be ultrasound scanning, blood tests, immediate radiological referral, colposcopy and biopsy, out-patient hysteroscopy, etc. are available for the patient attending the clinic on the first appointment.

Table 3.1: Examples of specialty out-patient clinics as used in many hospitals

Childhood & adolescent	Pelvic pain
Colposcopy	Pre-admission
Early pregnancy diagnostic	Rapid access
Fertility	Reproductive medicine
Fibroids/endometriosis	Recurrent miscarriage
Gynaecological cancer	Termination of pregnancy
Menopause	Urogynaecology & pelvic floor
Menstrual disorders	Vulval disorders

Table 3.2: Examples of multidisciplinary clinics

Clinics	Additional specialists
Pelvic floor	Colorectal surgeon Radiologist Anorectal physiologist
Gynaecological cancer	Radiotherapist Medical oncologist Palliative care physician
Fertility	Andrologist Endocrinologist
Pelvic pain	Pain control specialist Psychologist
Vulval disorders	Dermatologist Psychologist

A clinical history proforma is often completed by the general practitioner prior to the first appointment, or by a clinical nurse practitioner at the clinic. Depending on the nature of the specialist clinic, preliminary pathological investigations may have been done before the first visit to the clinic. Other basic investigations, such as an ultrasound scan may be done before the patient is seen by the Consultant, who then takes a clinical history, based on the proforma if one has been completed, expanding on relevant points, before carrying out a clinical examination. This is likely to include as a minimum an abdominal and vaginal examination, and where appropriate a more general medical and/or rectal examination, with attention to any other relevant system. A preliminary diagnosis may be able to be made, decisions taken regarding the need for any other investigations, and a plan of clinical management explained to the patient and her partner or any other relative or friend if she so chooses. If more complex imaging or pathology tests are needed, a second visit will be necessary before reaching a definitive management plan.

In some hospitals, the patient can be booked for a day case or in-patient admission straightaway, and all the pre-admission arrangements, including the consent form, pre-anaesthetic and medical checks are done straightaway, whilst others prefer an additional pre-admission clinic visit a week or two prior to the day of operation. This kind of 'Clinical Care Pathway' is intended to streamline the process for the patient, and make economically efficient use of resources. The patient, however, may find this a bewildering and de-humanising experience during which she has been seen by a large number of different members of the clinical team and left with an impression of being 'processed' without a clear understanding of what is happening. It is extremely important for all members of the team to introduce themselves, explaining their role and giving the patient plenty of time to ask questions and have them answered. Whilst the use of hand-out literature may be a useful adjunct, it must never be allowed to replace doctor/nurse communication with the patient.

PRE-ADMISSION CLINIC

Most of the preparatory tasks that used to be undertaken after admission to hospital now take place in the pre-admission clinic sometime before admission, as explained above. This pre-operative check includes a review of any relevant medical, anaesthetic, drug and allergy history, and confirmation of the diagnosis and operative procedure to be carried out, leading to the production of documentation usually on a standard template proforma. If a medical condition requires review appropriate referral can be made and pre-operative blood and urine checks done, as well as an ECG, chest X-ray and any other simple investigations. Ideally, an anaesthetist should be present or available in the clinic. The exact nature of the operation will be explained to the patient, and the consent form may be completed. The pre-admission clinic will have ensured that the patient clearly understands the duration of pre-operative abstinence from food and drinks, smoking, medication withdrawal and any other instructions. She should also have been informed about expected length of stay, time off work, likely postoperative recovery and restrictions on activity. She should be advised about making arrangements for collection and transport home. This is especially important for elderly or socially isolated patients, for whom special transport or escort plans may be necessary.

HOSPITAL ADMISSION

Day case patients are usually admitted two hours prior to the starting time of the operating list, and it is now unusual for patients to be admitted for in-patient operations more than a few hours pre-operatively. Exceptions might be a patient requiring a blood transfusion, or needing local skin or sepsis care prior to surgery, e.g. fistula patients. Even bowel preparation is often given to the patient for self-administration at home prior to admission.

Shortly after admission, the patient is confronted by another overwhelming array of staff, including receptionist, nurses, junior doctors, anaesthetist and surgeon, to which may be added medical and nursing students, physiotherapist and others. All these staff will be asking questions and giving information, whilst checking documentation, ticking boxes and form-filling to ensure that nothing has been omitted. If the consent form has been completed in the pre-admission clinic it is important to discuss again with the patient in case there have been intervening changes in symptoms, and to confirm that she understands and is comfortable with what is planned. Sometimes there has been such a substantial change in the patient's condition that the planned procedure is no longer appropriate, and in such cases there should be no hesitation in cancelling or changing the procedure. Further explanation and reminders about what to expect in the early postoperative recovery phase should be given.

BLOOD TESTS

Checking the results of blood tests, and repeating them if necessary, is essential. Almost all patients having gynaecological procedures, even of the most minor nature, should have had the following tests recently, and the results be available:

(a) Haemoglobin (and FBC if anaemia is suspected because of menorrhagia or clinical appearance).
(b) Haemoglobinopathy screening where clinically indicated.
(c) Blood group, because of the rare possible risk of haemorrhage in even the most minor operations such as termination of pregnancy or laparoscopy. It is also important to know the Rhesus group when a patient is in early pregnancy, so that Anti-D prophylaxis can be given if required.
(d) Hepatitis B screening is mandatory in many hospitals for all operative patients, and HIV screening is advisable for selected high-risk groups.
(e) Beta HCG pregnancy test should be carried out in women of reproductive age who are in the second half of their menstrual cycle or the menstrual period is late. This is particularly important if the patient is having a sterilisation or intervention for infertility.
(f) Routine urine dip-stick testing for protein and glucose.

THROMBOPROPHYLAXIS

All patients should be risk assessed for thromboembolism, taking into account any previous history of thrombosis, family history, and risk factors (such as age, obesity, smoking, immobility) and the nature of the surgery.[1,2] This assessment may have been made in the pre-admission clinic. Risk is assessed as low, medium and high, using a guideline, such as those issued by the RCOG, NICE, or local modification thereof (see Table 3.3),[3] and a decision is made and documented as to whether simple measures, such as TED stockings are to be used, or low-dose heparin prophylaxis.

OTHER CONSIDERATIONS

Policies regarding skin shaving and marking vary in different hospitals. Hair clipping will often suffice to avoid hair getting into the operative field or obscuring the surgeon's view, and shaving should be kept to as small an area as necessary. Skin marking procedures designed to prevent wrong site, side or operation are increasingly used, and have been shown to reduce of rare but serious errors. Last minute changes to operating list order are another potential source of mistakes; information, both written and verbal, must be given to ward staff, anaesthetist, and theatre staff about any such changes.

Pre-med sedatives and analgesics are now rarely given, and finally the patient is ready to go to theatre. Provided she is

Table 3.3A: Assessing risks of venous thromboembolism (VTE) and bleeding

VTE risk factors	Patients who are at risk of bleeding
• Active cancer or cancer treatment • Age >60 years • Critical care admission • Dehydration • Known thrombophilias • Obesity (BMI >30 kg/m^2) • One or more significant medical comorbidities (for example, heart disease; metabolic, endocrine or respiratory pathologies; acute infectious diseases; inflammatory conditions) • Personal history or first-degree relative with a history of VTE • Use of HRT • Use of oestrogen-containing contraceptive therapy • Varicose veins with phlebitis	All patients who have any of the following: • Active bleeding • Acquired bleeding disorders (such as acute liver failure) • Concurrent use of anticoagulants known to increase the risk of bleeding (such as warfarin with INR >2) • Lumbar puncture/epidural/spinal anaesthesia within the previous 4 hours or expected within the next 12 hours • Acute stroke • Thrombocytopaenia (platelets <75 × 10^9/L) • Uncontrolled systolic hypertension (≥230/120 mmHg) • Untreated inherited bleeding disorders (such as, haemophilia or von Willebrand's disease)

Table 3.3B: Balancing the risks of VTE and bleeding before offering VTE prophylaxis

If VTE risk increased
• Offer mechanical VTE prophylaxis at admission* • Continue until mobility no longer significantly reduced
If risk of major bleeding low
• Add low molecular weight heparin (LMWH) • Continue until mobility no longer significantly reduced (generally 5–7 days)
Major cancer surgery in the abdomen or pelvis
• Continue pharmacological VTE prophylaxis for 28 days after surgery.

*Choose any one of the following:
- Anti-embolism stockings (thigh or knee length)
- Foot impulse devices
- Intermittent pneumatic compression devices (thigh or knee length)

Table 3.4: Common causes of emergency gynaecological admission

Spontaneous miscarriage (Incomplete/inevitable)
Ectopic pregnancy
Acute pelvic infection
Tubo-ovarian abscess
Ovarian cyst torsion/rupture
Severe menorrhagia
Bartholin's abscess
Urinary retention
Postoperative complications

reasonably fit and mobile, most patients now walk to the anaesthetic room, rather than be wheeled on a trolley. Once in the anaesthetic room, further checks are done to ensure that the correct patient has arrived for the expected operation.

EMERGENCY ADMISSION

Emergency Admission to hospital still accounts for an appreciable volume of the gynaecological workload of most large hospitals, but patients no longer all arrive via the Accident and Emergency Department, because of the development of Early Pregnancy Diagnostic (or assessment) Units and various forms of Emergency Gynaecology Clinics which cater for same-day referrals from general practitioners or patient self-referral. The geographical siting of these clinics will vary in different hospitals, perhaps adjacent to other Gynaecology Clinics or wards, or the A&E Department. Substantial vaginal bleeding (whether due to a miscarriage or exceptionally heavy menstrual bleeding) and acute lower abdominal pain from conditions such as ectopic pregnancy, ovarian cyst accidents and pelvic inflammatory disease are just some of the more common conditions that may still present through the A&E Department at any time (see Table 3.4). Emergency patients are often initially assessed by relatively junior staff, but 24 hour availability of ultrasound scanning machines, rapid pregnancy testing and haematological investigations allows a diagnosis to be made in A&E or the Emergency Clinic prior to admission to the emergency gynaecological ward, and in some cases the patient may return home for operation the following day, whether as a day case or in-patient. Similar documentation is prepared for emergency admission patients. Many hospitals have one or more consultants with a designated lead position as lead clinician(s) for this emerging speciality. This welcome change is to improve the care of emergency patients, who in the past were not regarded as high priority and did not always get the best and most prompt attention.

Diagnostic Procedures

HYSTEROSCOPY

Introduction

The advantage of directly inspecting the uterine cavity rather than performing blind biopsy and curettage began to appeal to gynaecologists in the early 1900s,[4] and attempts were made to examine the uterine cavity with a modified cystoscope. The technical difficulties of uterine distension and poor illumination prevented the procedure becoming useful until the arrival of fibre optical hysteroscopes in the 1970s. Initially, the use of diagnostic and operative hysteroscopy remained the preserve of a few enthusiasts, but by the 1980s the equipment had reached a point of development whereby hysteroscopy could be carried out simply and relatively cheaply in a day surgery unit. The advent of smaller guage scopes has led to a growing practice of out-patient hysteroscopy without anaesthesia, although local anaesthesia may be used if the cervical os is tight.

The operation of dilatation and curettage (D&C, see Chapter 7) was long regarded as the standard method of investigating and treating intra-uterine pathology, (even if its critics, labelling it 'an operation for the diagnostically destitute', deplored its overuse). Today it has virtually been replaced as a diagnostic procedure by hysteroscopy and directed biopsy, and as a therapeutic operation by electrosurgical resection, snaring and laser techniques for observed pathology.

A diagnostic hysteroscope consists of an outer sheath through which a distending medium is passed under pressure. Normal saline is by far the most widely used medium, but carbon dioxide is still used by some clinicians, who find it less messy. The telescope, consisting of a lens system and fibre optic illumination bundles, couples tightly to the sheath to prevent leakage of distending medium. For out-patient hysteroscopy, a 3 mm telescope with a 4 mm outer sheath is recommended, whilst for theatre usage a larger 4 mm telescope with a 5.5 mm sheath is more generally used (Fig. 3.1). Flexible hysteroscopes are much more expensive, difficult to sterilise and offer few advantages. The use of a video camera attached to the eye piece allows magnification, a more comfortable operating position, and demonstration of the intra-uterine findings to trainees and theatre staff, as well as allowing permanent photographic or video images to be made.

Indications

The indications for hysteroscopy include abnormal uterine bleeding, such as menorrhagia, intermenstrual bleeding, prolonged menstruation and post-menopausal bleeding. Regular cyclical heavy bleeding in a woman under 40, with a normal size uterus is unlikely to reveal intra-uterine pathology and should be reserved for those who have failed to respond to medical treatment. Other indications for hysteroscopy include recurrent miscarriages, infertility, suspected congenital abnormalities of the uterus, secondary amenorrhoea and misplaced or lost IUCD. Transvaginal ultrasound is usually done as a screening test and a normal scan may obviate the need for a diagnostic hysteroscopy. Saline sonography may also be helpful to demonstrate intra-uterine filling defects.

Technique

The patient is placed in the lithotomy position, the vagina and cervix are cleaned with an aqueous antiseptic solution and the position of the uterus confirmed by bimanual examination. A Sims' speculum is inserted and a tenaculum or vulsellum forceps applied to the anterior lip of the cervix. A uterine sound is passed to confirm the axis of the uterus. The hysteroscope is then connected to the distension medium and the cervix dilated by hydrodilatation pressure under direct vision. If the cervix is stenosed it may be necessary to gently dilate it to 3–4 mm, ensuring that the dilator is only passed just through the internal os.

If a low-viscosity fluid is used, normal saline or dextrose 5% are perfectly adequate for diagnostic purposes. To provide adequate uterine distension, the intra-uterine pressure needs to be 40–50 mmHg, and this may be achieved by hydrostatic pressure whereby the bag of infusion fluid is kept 1 metre above the patient, or by the use of a pressure cuff around the infusion bag. More sophisticated pressure rotatory pumps are available and are particularly useful for therapeutic procedures, such as endometrial resection or resection of fibroids, where continuous flow of fluid is necessary. If CO_2 is being used, a CO_2 insufflator which delivers gas at a maximum rate of 100 mL/min is used (Fig. 3.2). The author prefers the use of a simple pressure cuff on a bag of normal saline for diagnostic hysteroscopy, both in out-patients and the theatre, but concedes that CO_2 may be less messy.

Once the hysteroscope is passed under direct visual control through the cervix, it may take a few moments for the whole uterine cavity and fundus to become well distended. Each

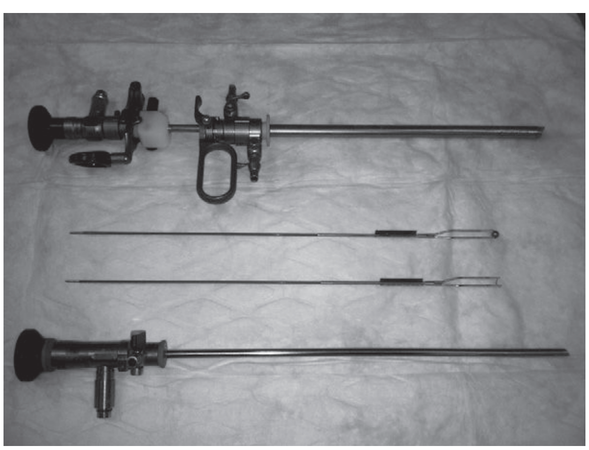

Fig. 3.1: A variety of hysteroscopes in common usage.

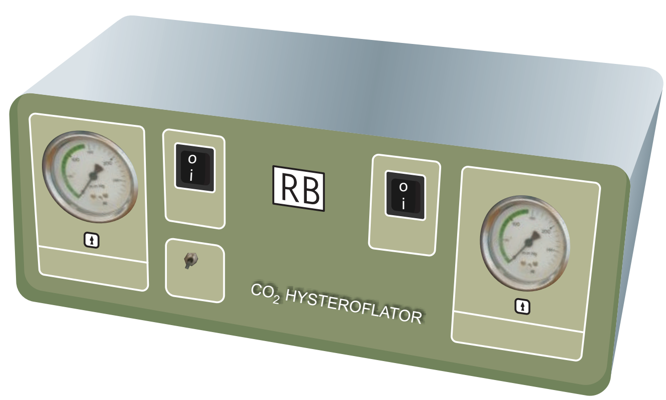

Fig. 3.2: CO_2 hysteroflator.

uterine cornu is identified, and the cavity carefully inspected for pathological lesions; it is desirable to take still photographs from the video camera system to provide permanent documentation (see Figs. 3.3–3.5).

If a directed biopsy is to be taken, the hysteroscope must be withdrawn and a wider sheath with operating channel used. In the anaesthetised patient a full D&C may be performed if there is generalised hyperplastic endometrium, or a directed biopsy or polypectomy may be performed. Major interventions such as myomectomy, endometrial resection and division of a septum or adhesions should only be carried out after full discussion with the patient (see Chapter 9).

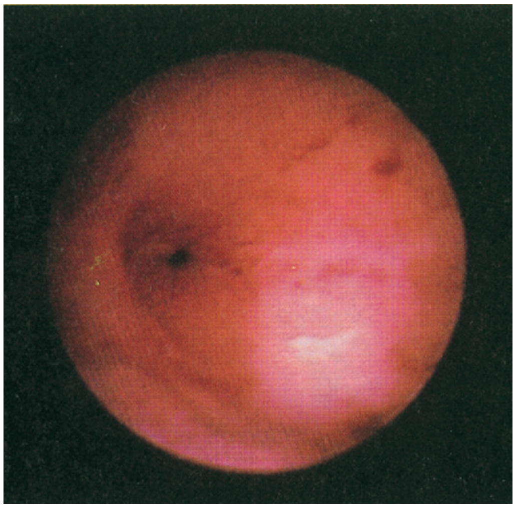

Fig. 3.3: Hysteroscopic view of normal tubal ostium.

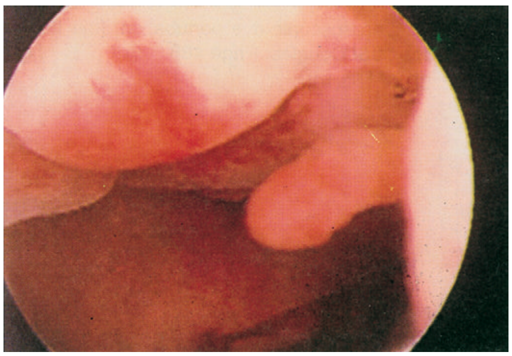

Fig. 3.4: Hysteroscopic view of polypoidal endometrium.

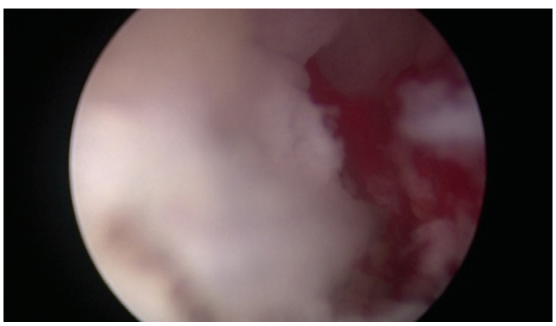

Fig. 3.5: Hysteroscopic view of endometrial carcinoma.

Out-Patient Hysteroscopy

Increasingly, straightforward hysteroscopy is being carried out as an out-patient procedure without anaesthesia, or with a paracervical block and mild sedation or analgesia.[5] It has been shown to be acceptable to many women and to have a failure rate virtually no higher than when done with anaesthesia. However studies have shown that between 3% and 10% of women report severe pain and would not recommend it to their friends.[6,7] The technique is essentially the same as any diagnostic hysteroscopy, but narrower guage instruments are used and avoidance of dilatation of the cervix is particularly important as this is likely to cause pain and/or vaso-vagal shock. It has proved less popular for therapeutic hysteroscopy, other than for the simplest of procedures (e.g. polypectomy) because of the narrow working channel and unpredictability of patient tolerance.

Complications

The important complications of hysteroscopy include perforation and fluid absorption. Whilst the latter is an important risk in ablation procedures, particularly where glycine or sorbitol are used (see Chapter 9), the use of normal saline in diagnostic hysteroscopy is unlikely to lead to any electrolyte disturbance, even if there is excessive absorption. Nevertheless, the amount of fluid input and an estimate of outflow should be recorded. Perforation will be apparent because of failure to maintain distension and poor visualisation of the cavity. The hysteroscope should be removed and if there is evidence of appreciable bleeding, laparoscopy should be performed and usually the bleeding can be controlled with diathermy or a suture. If there is insufficient evidence of bleeding to warrant immediate laparoscopy, the patient should be observed for a few hours and prophylactic antibiotics given. Infection as a complication of hysteroscopy is rare, but if during the procedure there is suspicion of cervical or pelvic infection, prophylactic antibiotics may be given.

DIAGNOSTIC LAPAROSCOPY

The establishment of laparoscopy, sometimes known as peritoneoscopy or celioscopy, has been the major advance in diagnostic gynaecology in the latter part of the twentieth century, owing much to the work and writings of Palmer,[8] and Steptoe.[9] The early techniques of laparoscopy were performed between 1910 and 1940, mainly by physicians. In the 1940s culdoscopy or transvaginal peritoneoscopy via the pouch of Douglas was developed and widely practised in the USA, but this has now been abandoned throughout the world in favour of laparoscopy. Diagnostic speculation can now be replaced by precision and certainty. Nevertheless, it cannot be too strongly emphasised that laparoscopy is a potentially hazardous technique with an appreciable morbidity and even mortality, especially where operative procedures involving the use of intraperitoneal diathermy are concerned. The wider the application and the readiness with which the procedure is undertaken makes attention to safety ever more important. Both endoscopist and anaesthetist must be aware of the particular complications and the ways of avoiding them. No gynaecologist should attempt laparoscopy unsupervised until he/she has been properly trained in safe technique, avoidance and recognition of problems, and their management should they occur.[10]

Technique

Laparoscopy is carried out in the operating theatre under full aseptic precautions. Local anaesthesia can be employed if conditions are suitable and the patient so motivated. Usually, however, general anaesthesia is preferred, both for patient comfort and predictability of successful completion of the procedure. The particular problems related to a carbon dioxide pneumoperitoneum, such as diaphragmatic splinting, inferior vena caval compression, gastric regurgitation and hypercapnia due to carbon dioxide accumulation leading to possible cardiac arrhythmias, may largely be overcome with a cuffed endotracheal tube, muscle relaxants and positive pressure ventilation.

Procedure

The patient is placed in the semi-lithotomy (Lloyd Davies) position as for abdomino-perineal operations. The abdomen, vagina and perineum are cleansed and draped (Fig. 3.6) so that laparoscopy may be abandoned in favour of laparotomy at any stage in the proceedings without re-draping or re-positioning the patient. The bladder is catheterised and bimanual examination performed. If a hysteroscopy is also being undertaken it is appropriate to do it at this stage. If it is not, the cervix may require slight dilatation in order to insert an insufflation cannula (e.g. Spackman cannula or derivative) which is then locked on to the cervix in order that the uterus may be manipulated and dye injected if indicated. This step is omitted if there is any possibility of an intra-uterine pregnancy.

The patient is supine until after the insertion of the first trocar and cannula. A small incision, usually vertical (or horizontal depending on the anatomy of the particular umbilicus and previous scars), is made through or in the inferior aspect of the umbilicus. A Veress needle is tested, and grasping it like a pencil well down the shaft, inserted through the umbilical incision at right angles to the skin, (see Fig. 3.7) until it is felt to have just penetrated the skin. There is virtually no subcutaneous fat in the umbilicus itself, even in moderately obese patients. The needle consists of a spring-loaded blunt perforated trocar within a sharp cannula. Resistance allows the sharp cannula to protrude, and loss of resistance allows the blunt trocar to spring forward again, thus diminishing the risk of perforating a viscus as the peritoneal cavity is entered. Once through the skin, the direction of the needle is continued until a second click is felt or heard as it penetrates the linea alba and peritoneum. Great care must be taken not to advance the needle further into the peritoneal cavity, as the intestine may be very close. (see Fig. 3.8). Before insufflation of carbon dioxide gas, aspiration with a syringe with 10 mL of saline attached to the needle helps to ensure that the tip is not misplaced in a viscus or blood vessel. As a further test, a small volume of saline is injected, and re-aspiration attempted. If the fluid is returned, the needle point is likely to be in a loculus rather than the general cavity. Provided it has not returned a 'drop' test may be done to see that saline enters freely under negative pressure. The needle is then connected to the insufflation apparatus [e.g. Semm's machine (WISAP)] and the gas introduced until the intraperitoneal pressure reaches 20–25 mmHg. If the pressure is unsatisfactory the needle should be re-inserted once, but if this still fails to produce a satisfactory pneumoperitoneum, it should either be re-inserted via Palmer's point (see below), or the Hassan open technique applied. Adequate distension of the abdomen is usually obtained with 3–5 litres of gas. Studies have shown that if the peritoneal pressure has been raised to 20 mmHg, the volume of gas instilled will mean that there is a distance of 5–7 cm between the skin and any abdominal viscus.

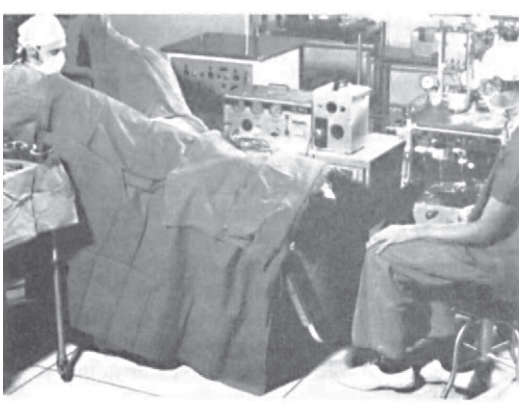

Fig. 3.6: Laparoscopy. A patient in position for laparoscopy.

Fig. 3.7: Laparoscopy. The umbilicus may be held steady with the left hand or with tissue forceps. The Veress needle is inserted at right angles to the skin of the abdominal wall, directly through the umbilicus.

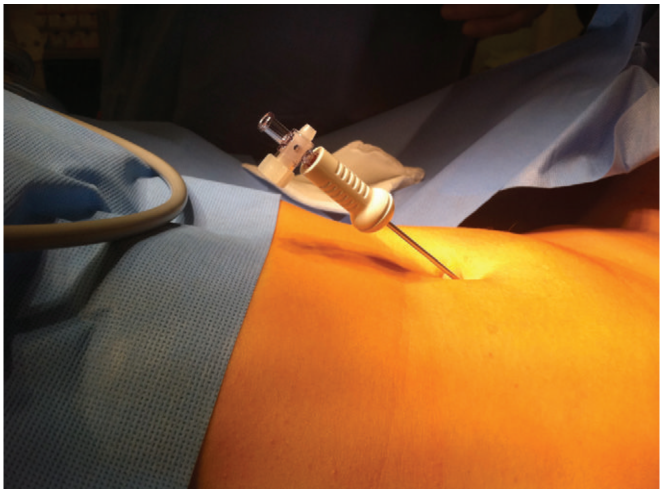

Fig. 3.8: Laparoscopy. The Veress needle is only advanced until it has *just* entered the peritoneal cavity, so as to avoid penetration of intestine or aorta.

The insufflation needle is then withdrawn and a larger 5 or 10 mm trocar and cannula (Fig. 3.9) is inserted perpendicular to the skin and then through the abdominal wall with a firm direct push. Once through the peritoneum the trocar is withdrawn and the laparoscope introduced. The pressure is now reduced to 15 mmHg and the gas volume will be satisfactory to maintain good visualisation without splinting the diaphragm and causing ventilatory difficulties once the patient is placed in the Trendelenberg position.

Once the laparoscope, with or without a video camera attachment, has been inserted, the patient is placed in a steep Trendelenburg position. In order to manipulate the pelvic contents and to visualise the full length of the Fallopian tubes and all surfaces of the pelvic viscera, it is necessary to introduce a second instrument. If the procedure is purely diagnostic, the second port may be placed centrally about 3 cm above the pubic bone rather than in the iliac fossa, after transilluminating the abdominal wall to avoid puncturing blood vessels. A blunt probe or atraumatic forceps may then be passed through the second port to clearly demonstrate all the pelvic viscera. If there is any possibility that some minor operative procedure may need to be done, it is usual to insert the second port, in one or other iliac fossa, after transillumination of the abdominal wall and having visualised the obliterated umbilical arteries. At the end of the operation as much gas as possible is expelled through the cannula by pressure on the abdomen and clips, sutures, or adhesive glue are applied to the puncture wounds.

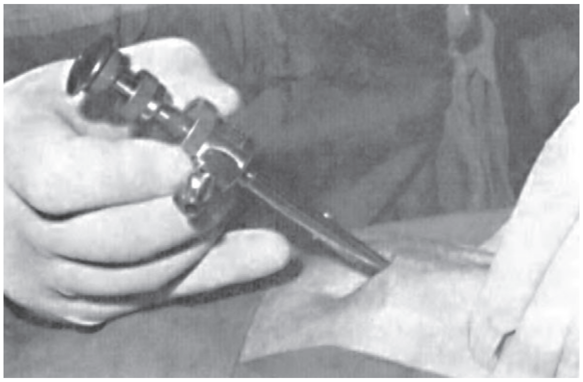

Fig. 3.9: Laparoscopy. Insertion of trocar and cannula through umbilical incision.

Indications

The indications for laparoscopy may be considered as diagnostic or therapeutic. In the former category, the laparoscope enables the clinician to make a precise diagnosis in the frequently difficult clinical situations of suspected ectopic pregnancy, pelvic inflammatory disease or endometriosis. Moreover, in most cases of indeterminate pelvic pain a gynaecological cause may be either proven or eliminated. It is important to record and document the findings carefully and most units now have access to good digital photographic or video recording equipment to create permanent images of any pathology.

In the investigation of infertility laparoscopy is invaluable. A dye, such as methylene blue, is injected through an intracervical cannula and it may be seen to traverse the tubes and spill from their fimbrial ends. If no dye enters the tube it may be because there is a cornual obstruction, but it may be artifactual either because of a loose fit of the intra-uterine cannula and leak-back of the dye or tubal spasm. If dye enters the tubes its presence may be seen through the serosa so that if the tubes are not patent, the site of the block may be determined. Blockage of the fimbrial end will lead to distension of the tube and a hydrosalpinx will become obvious. In evaluating ovarian function for infertility or menstrual disturbance, a direct inspection of the ovaries enables their size to be assessed, and the presence of follicles, corpora lutea, or polycystic ovaries cysts to be detected. If the patient's complaint has been pelvic pain or dysmenorrhoea, a careful inspection for endometriosis must be made on the surface of the ovaries and the whole of the pelvic peritoneal surface. The presence of adhesions may also be detected whether this is secondary to endometriosis or pelvic infection. Uterine fibroids and congenital anomalies may be found, and their importance assessed.

Biopsies and Aspiration

Biopsy of suspected endometriosis or peritoneal nodules may be taken with scissors or biopsy forceps. Diathermy coagulation to achieve complete haemostasis is used if necessary Aspiration of ascitic fluid or the taking of peritoneal washings may be made if appropriate. If there is pus present in the Pouch of Douglas or a tubo-ovarian abscess the fluid may be aspirated for microbiology testing, and if substantial, a drain inserted.

Ovarian cysts or para-ovarian cysts may be aspirated under direct vision and the aspirate sent for cytological examination. If the cyst fluid appears to be from an endometrial or dermoid cyst, it is particularly important to thoroughly wash out and aspirate the peritoneal cavity in order to prevent implantation of endometrioid cells in the former case, and chemical peritonitis in the case of dermoid cysts. The danger of implantation of malignant cells should not be under-estimated and aspiration of a potentially malignant ovarian cyst should only be attempted after careful consideration. Operative laparoscopy is described in appropriate chapters.

Contraindications

Any pre-existing cardiovascular or respiratory condition that precludes pneumoperitoneum or the Trendelenburg position should be regarded as a contraindication to laparoscopy. Laparoscopy should only be carried out in the presence of generalised peritonitis, intestinal ileus or obstruction by a highly experienced gynaecologist, who understands how and when to use the Hassan open technique or Palmer's point entry approach (see Fig. 3.10). The presence of adhesions does not preclude laparoscopy, but introducing instruments through, or close to, abdominal scars should be avoided. The production of the pneumoperitoneum may be difficult and the whole procedure should be abandoned if the abdominal cavity is so loculated by adhesions that the intraperitoneal pressure cannot be kept within the safety limits.[9]

Complications (Table 3.5)

Whilst some complications are less severe than others – transient shoulder pain due to any residual pneumoperitoneum is an invariable event – the more serious sequels can be life threatening. Blood vessels or an intra-abdominal viscus may be punctured by the sharp instruments. The introduction of carbon dioxide may be associated with embolism, emphysema and the consequences of hypercapnia leading to respiratory and cardiovascular problems. Infection may result from poor asepsis, exacerbation of pre-existing pelvic inflammation or breach of the gastrointestinal tract. When diathermy is used burns of the abdominal wall can occur, but more significantly intra-abdominal structures, particularly bowel, may be burned leading to necrosis and peritonitis. Often the damage is unrecognised at the time of operation. Hernia of intraperitoneal contents, especially omentum, may occur in relation to puncture sites, particularly if 10 mm or larger ports are used. Suturing of the rectus sheath with a J-needle of large port sites (other than the umbilicus) should be mandatory. Ureteric and bladder damage by diathermy coagulation or puncture have also been reported.

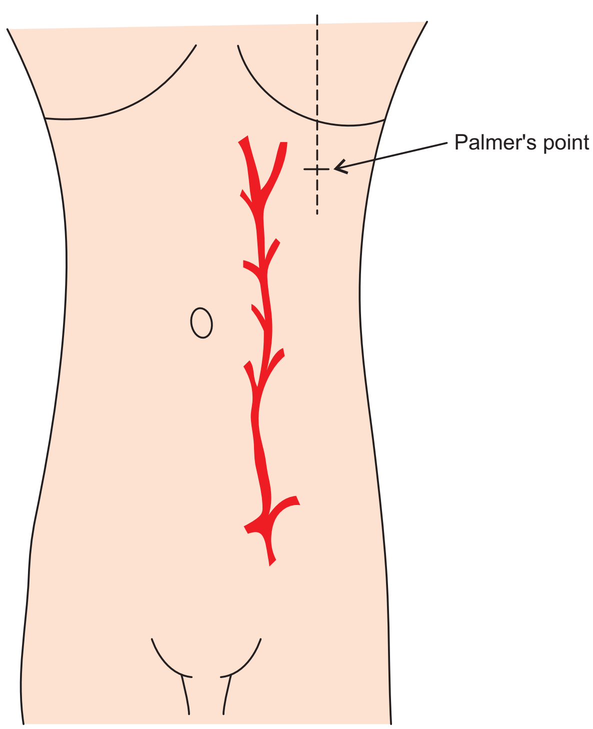

Fig. 3.10: Surface markings of Palmer's point, 2 cm below the left costal margin in the mid-clavicular line. Note the anastomosis between the inferior and superior epigastric vessels. The superior epigastric artery is medial to the incision site.

Table 3.5: Laparoscopic complications and their causes

A. Introduction of pneumoperitoneum and instruments
• Emphysema
• Gas embolism
• Haemorrhage
• Haematoma
• Intestinal perforation
• Respiratory or circulatory embarrassment
• Omental and port site hernia
• Aggravation of existing hernia
B. Operative instruments including diathermy
• Burning of skin and abdominal wall
• Burning of intestine
• Crushing/scissor injury to intestines
• Peritonitis
• Haemorrhage – primary or secondary
• Pelvic sepsis
• Bladder and ureteric injury

The Royal College of Obstetricians and Gynaecologists Confidential Enquiry into laparoscopy and its complications revealed an overall complication rate of 34/1000, of which only 2 per 1000 represented damage to bowel or urinary tract. A mortality rate 0.08/1000 was reported.

Although laparoscopy is such a valuable procedure it cannot be too strongly emphasised that the potential hazards are serious. It is mandatory therefore that steps are taken to avoid complications at all times. An adequate training for the intraperitoneal endoscopist is absolutely essential.[11]

Extragenital Endoscopy

CYSTO-URETHROSCOPY (FIG. 3.11)

Endoscopic examination of the bladder is of particular relevance to the gynaecological surgeon. Apart from the diagnosis

Fig. 3.11: Cystoscopy. Operating cystoscope with fibre optic light source.

of intrinsic vesical pathology, he or she should be able to identify the ureteric orifices and catheterise the ureters, if necessary. The relationship of the intramural ureter to a vesical fistula is often important.

Urethroscopy is a neglected procedure but is highly relevant to the study of defective control of micturition and urethral bleeding (see Chapter 21). The gynaecologist is advised that operative endoscopy should be left to the urologist, particularly the use of the transurethral resectoscope. The potential for damage in the female with this latter instrument even in relatively skilled hands is considerable.

PROCTOSIGMOIDOSCOPY AND COLONOSCOPY

Gynaecologists should be able to perform *proctoscopy*, in order to identify pathology of the anal canal, which will be particularly useful if there is doubt as to whether bleeding is vaginal or rectal in origin. It is also useful in the identification and localisation of low rectal or anal fistula. Many such cases will require co-operative management with a colo-proctological colleague. However, the gynaecologist will find it useful to gain experience in proctoscopy, both in out-patients and in theatre.

Not all gynaecologists will be skilled in the use of the sigmoidoscope, but those whose work includes gynaecological cancer or fistula work would be well advised to acquire the necessary skills. Flexible fibre optic colonoscopy is a highly skilled procedure which should only be carried out by an appropriately trained endoscopic gastroenterologist.

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Imaging in Gynaecology

4

Anju Sahdev, Rodney H. Reznek

Introduction

Imaging plays an integral and diverse role in the investigation and management of patients with gynaecological disorders. In gynaecological malignancies, it is valuable in diagnosis, staging, planning treatment, surveillance, assessing response to treatment, evaluating complications and identifying recurrent gynaecological cancer. Evaluation of patients with post-menopausal bleeding, investigating suspected adnexal masses, pre-laparoscopic evaluation of pelvic endometriosis or pelvic pain, and diagnosis of early pregnancy and post-partum problems are just some of the applications of imaging in benign gynaecological and pregnancy-related disorders. In patients with malignancy, imaging plays a vital part in monitoring treatment response often acting as a surrogate endpoint following chemotherapy and radiotherapy for drug trials.

A wide range of techniques including plain radiography, contrast studies, ultrasound (US) and cross-sectional techniques of computed tomography (CT) and magnetic resonance imaging (MRI) are widely applied in different stages of management in a patient with gynaecological cancer. Recent advances in functional and molecular imaging have widened the scope and applications of imaging by combining exquisite anatomical detail from cross-sectional imaging, particularly MRI of pelvic organs, with information of tissue and cellular activity obtained by scintigraphy and molecular imaging. In investigating benign disease, US and MRI are the recommended imaging modalities as they do not carry a radiation burden.

In this chapter, we provide a brief description of the basic principles of the different frequently used modalities and outline recent advances in imaging. We discuss the optimal use of imaging as applicable to individual gynaecological cancers with emphasis on detection, staging, planning and monitoring treatment and identifying recurrent disease. We discuss the use of imaging in the investigation and management of endometriosis and fibroid disease.

Imaging Techniques

PLAIN FILM RADIOGRAPHY AND CONTRAST STUDIES

Plain film radiography relies upon the degree of X-ray absorption (attenuation) of an X-ray beam passed through the body part to be imaged which in turn depends on the atomic density and thickness of material. Dense materials like bone and contrast agents (iodine and barium) attenuate most X-rays whilst air attenuates few within the applied beam. Once X-rays have travelled through the material they are 'collected' on to an X-ray film or onto a phosphor screen in digital systems. In conventional radiographs, less dense materials like air appear black and the converse is true for dense materials, which will appear white. Conventional radiographs are now almost universally obtained as digital images. The basic principle of digital imaging is the same as conventional radiography but utilises digital apparatus. The radiograph is produced on a phosphor screen and then read by lasers transferring the image onto laser film or displayed onto television monitors. The images can then be stored onto local digital networks or patient archive systems (PACS). The benefit of digital radiography is the varied forms of image output, long-term storage and distribution of images. As digital images can be manipulated and post processed, technically poor images do not require repeat X-rays saving patients unnecessary radiation exposure.

Conventional techniques used for patients with gynaecological cancer include plain films of the chest, abdomen and pelvis, intravenous urograms (IVUs) and barium studies. Plain films retain only a minor role in gynaecological disorders. Plain abdominal X-rays are used to assess postoperative bowel status, in particular for evaluation of bowel obstruction. Calcification in dermoid cysts, peritoneal deposits from mucinous ovarian carcinomas, incidental renal calculi and assessment of intravenous catheters and urinary stents are other common indications in gynaecological practice (Fig. 4.1). Chest X-rays are useful in the detection of pulmonary and mediastinal nodal metastases, pulmonary infective and inflammatory diseases, cardiomegaly and pleural effusions (Fig. 4.2). The main disadvantage of plain films is poor sensitivity as the inherent contrast resolution is too poor to allow separation of soft tissue structures. Lesions have to be significantly larger in size for detection on plain films compared to cross-sectional imaging.

Intravenous urography outlines the urinary tract following administration of intravenous iodinated contrast media. Intravenous urograms assist gynaecological surgery by demonstrating the number of ureters, their location and course in relation to the pelvic organs, demonstrating ureteric and renal obstruction or postoperative ureteric injury (Fig. 4.3). In many institutions, conventional IVUs have been replaced by CT

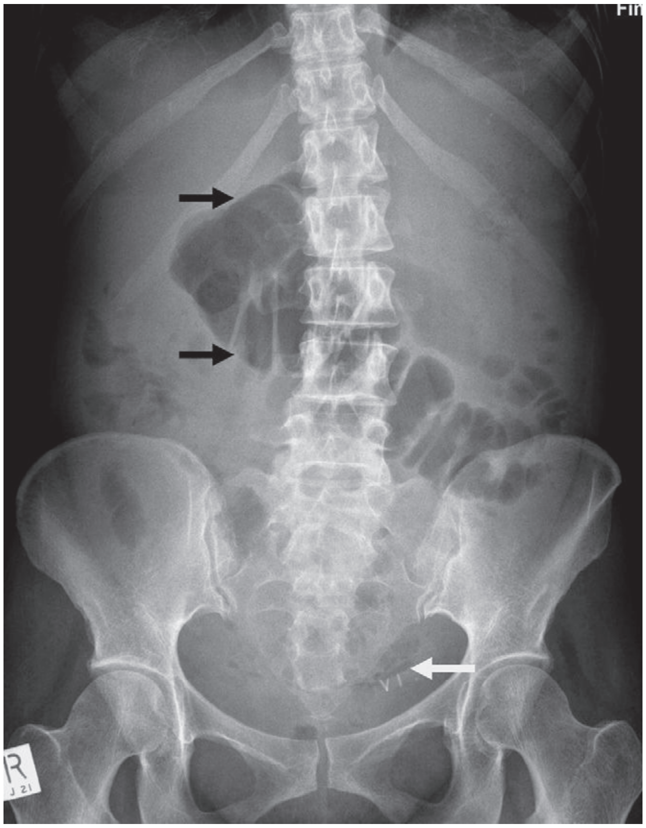

Fig. 4.1: Abdominal radiograph: 34-year-old woman following a left oophorectomy. The AXR shows surgical clips in the left adnexa with small pockets of free air around the clips (white arrow). The transverse colon is dilated and clinically the patient had no bowel sounds in keeping with a postoperative ileus.

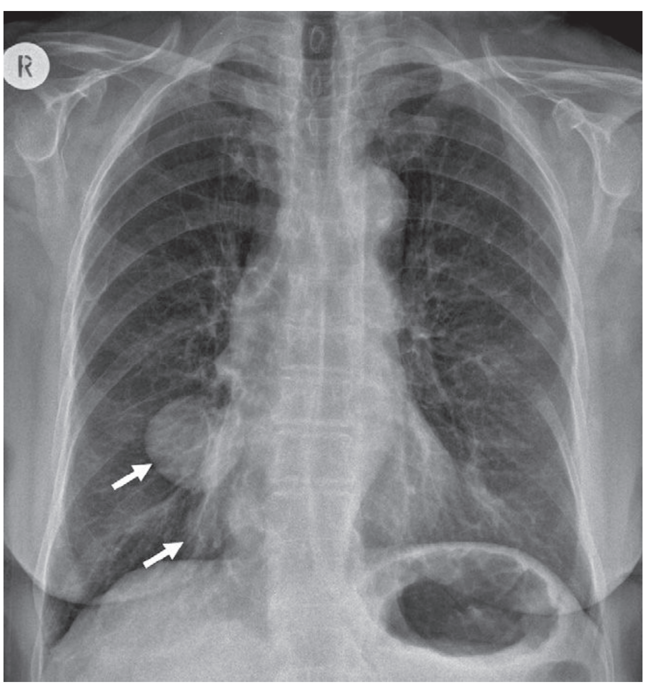

Fig. 4.2: Chest radiograph: 76-year-old woman with endometrial carcinoma. The CXR shows two large metastases in the right lower zone (arrows).

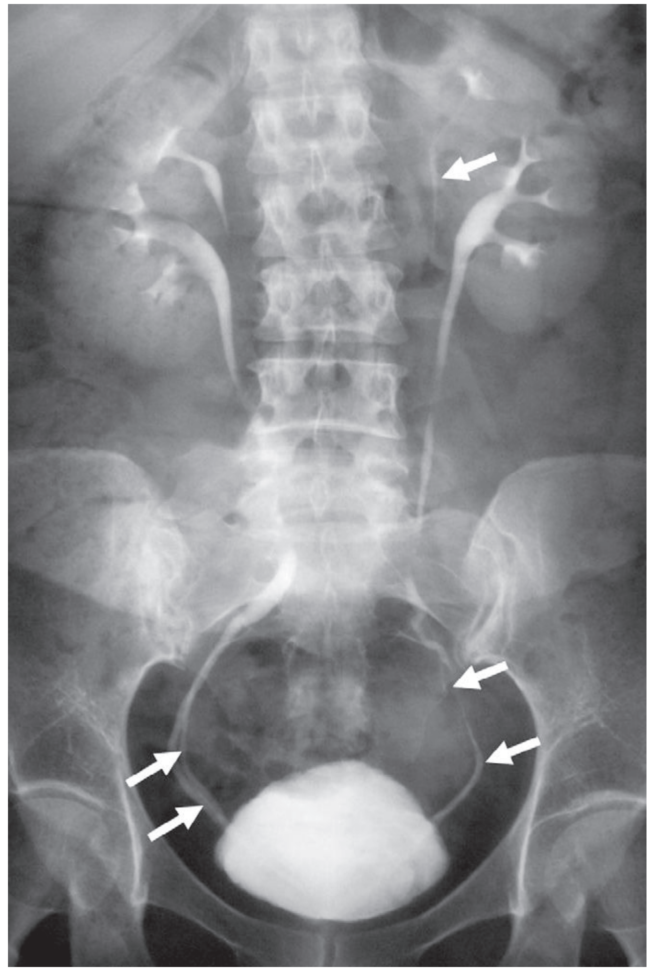

Fig. 4.3: Intravenous urography (IVU): Single full length 15 min post-contrast film from an intravenous urogram series showing bilateral unsuspected duplex collecting systems with bilateral double ureters (arrows).

IVUs. CT IVUs provide information regarding the renal parenchyma and the collecting system, increasingly replacing both renal ultrasound and IVUs in the investigation of suspected renal disease. The procedure requires the administration of intravenous contrast followed by an abdominal and pelvic CT after a delay of 15–20 minutes. This displays the renal collecting system, ureters and bladder opacified by the contrast media. CT IVUs have the added advantage of visualising and detecting abnormalities in the whole abdomen, pelvis and retroperitoneum. In gynaecological disease, obstructing abdominal or pelvic masses, retroperitoneal nodal disease and congenital variants of the kidneys can all be imaged on a single investigation (Fig. 4.4). However like IVUs, CT IVUs require administration of intravenous contrast media and therefore cannot be used in patients with iodine allergy or during pregnancy. In these patients, magnetic resonance urography provides equally good detail and avoids both radiation and contrast media (Fig. 4.5).[1]

Barium bowel studies, particularly double contrast barium studies, utilise the contrast between barium-coated mucosa

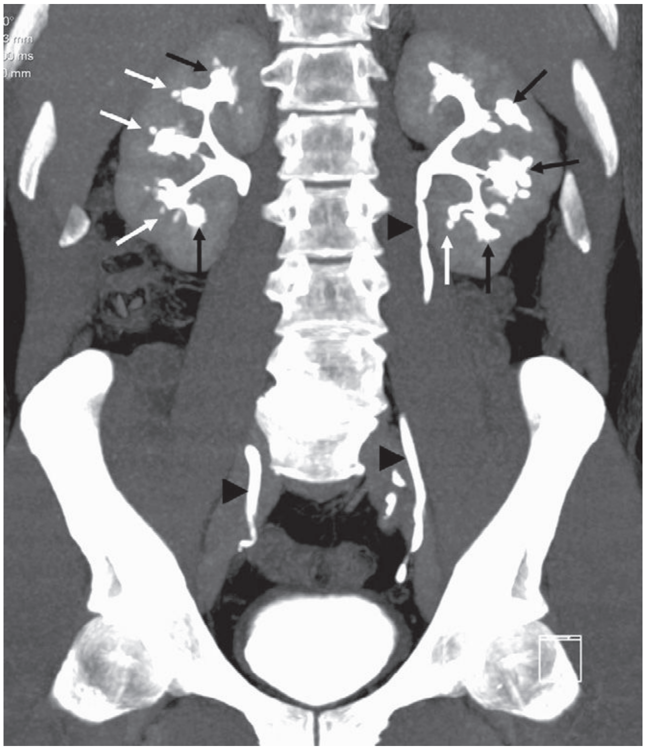

Fig. 4.4: CT IVU in a patient with frank haematuria. Full length coronal CT reconstruction from a CT IVU examination. The intra-renal collecting system, ureters and bladder are opacified by contrast. There are bilateral clubbed calyces (black arrows) and 'pencil in cup' deformities indicating papillary necrosis. CT provides information regarding the entire collecting system and examines the kidneys and the entire abdomen and pelvis in a single examination.

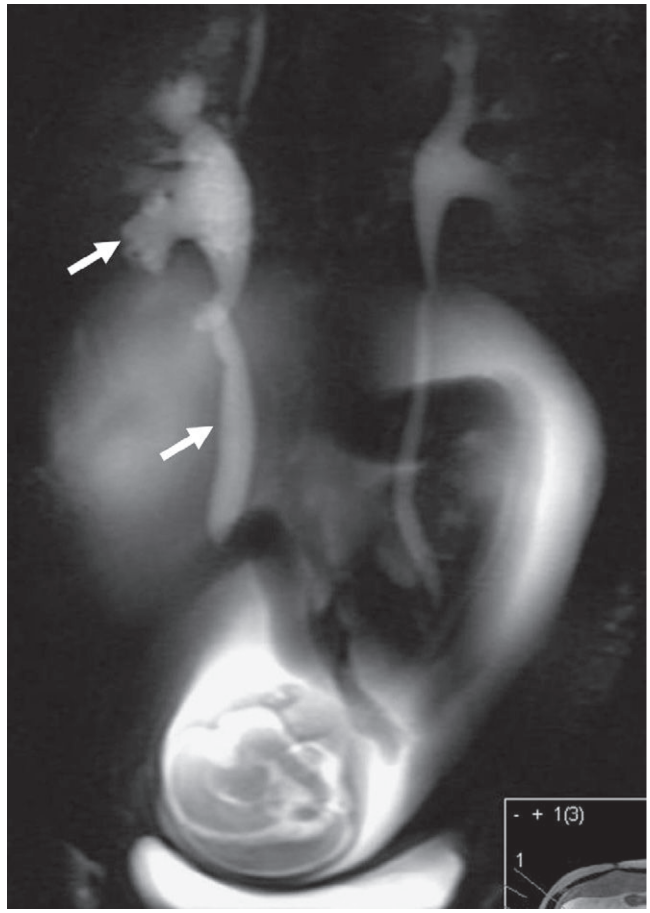

Fig. 4.5: Magnetic resonance urography (MRU): Coronal thick section heavy T_2-weighted image from a 27-year-old woman who was 32 weeks pregnant. The patient presented with right-sided loin pain. There is right-sided hydronephrosis and hydroureter (white arrows). The ureter tapers smoothly to the pelvic brim where it is compressed by the gravid uterus. No filling defects or ureteric meniscus is seen to suggest calculi. The appearances show the typical appearances of hydronephrosis of pregnancy with complete assessment of the kidneys, ureters and bladder without radiation or iodine-based contrast media.

against air within the bowel lumen for detection of mucosal lesions. Soluble contrast enema studies are utilised in the diagnosis of bowel obstruction, postoperative ileus, anastomotic leaks and fistulae (Fig. 4.6). Soluble contrast replaces barium in postoperative patients as aspiration or leakage of barium into the peritoneal cavity causes irreversible deposition of barium in the tissues. Conventional bowel contrast studies are increasing being replaced by endoscopy, CT and MRI.

ULTRASOUND

Ultrasound has many uses in gynaecology. It is often the first and only imaging modality used to demonstrate gynaecological anatomy and to evaluate physiological and pathological changes. Pelvic ultrasound may be performed by transabdominal, transvaginal, transrectal or transperineal approach. In medical imaging, ultrasound (frequencies between 2.5 and 20 Megahertz) is generated by piezoelectric crystal elements in transducers that convert an electrical signal into ultrasound and once reflected from tissues, back into electrical signal. A thin layer of acoustic jelly is placed over the area to be imaged in order to obtain effective acoustic coupling between the skin and transducer. When the transducer is in contact with skin or mucosal surface and a voltage pulse is applied across the transducer, piezoelectric crystals vibrate, generating sound waves transmitted through the body. The reflected sound waves induce a voltage across the transducer and are converted into a grey scale image. Soft tissues reflect more echoes than fluid and therefore appear brighter (or hyperechoic) while fluid appears dark (or hypoechoic). The elapsed time for the wave to return allows estimation of distance or depth providing spatial information in construction of the image. Bone and air reflect all sound and therefore structures beyond cannot be imaged. This is B-mode ultrasound.

Vascularity in soft tissues and the integrity of blood vessels may be assessed using Doppler ultrasound. The Doppler effect is shift in frequency of a wave when the source moves relative to the receiver, e.g. blood flow in vessels. When blood flows

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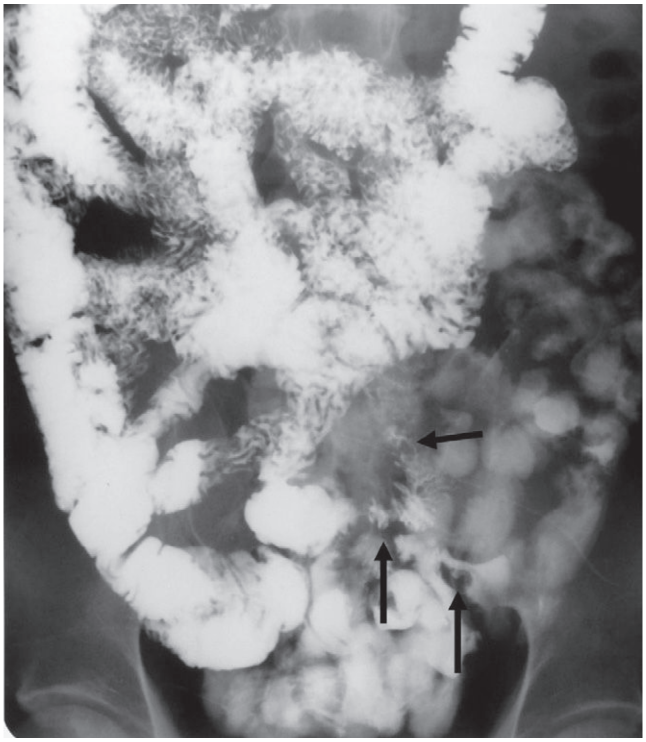


Fig. 4.6: Barium follow through with serosal disease. 56-year-old woman with ovarian cancer and known serosal disease presented with symptoms of intermittent small bowel obstruction. The barium follow through was performed to identify the site and length of small bowel involvement to plan surgery. There are distal jejunal and proximal ileal loops with bowel wall irregularity (arrows) and wide separation of the bowel loops due to the serosal disease. The patient did not have acute obstruction at the time of the study.

towards the transducer, reflected sound wave has a higher frequency than the transmitted frequency. Conversely, when blood flows away, reflected wave has a lower frequency. This frequency shift can be measured and blood flow velocity and direction can be calculated. When pulsed Doppler is applied the ultrasound transducer emits bursts of sound between which it remains quiet to receive reflected sound. This allows the combination of B-mode US imaging and a Doppler trace (duplex scan), providing depth, site and velocity information of flowing blood.[2]

Transabdominal Ultrasound (TAUS)

Transabdominal ultrasound is performed with a full bladder which provides an acoustic window to visualise pelvic organs. This utilises curvilinear and linear transducers to provide a global view of the pelvis. It is useful to interrogate the bladder for bladder dysfunction, abnormal bowel loops, pelvic side wall for enlarged nodal disease in patients with malignancy and adnexal masses. In patients unable or unwilling to undergo transvaginal US, TAUS can provide limited anatomical detail of the uterus and pre-menopausal ovaries (Fig. 4.7).

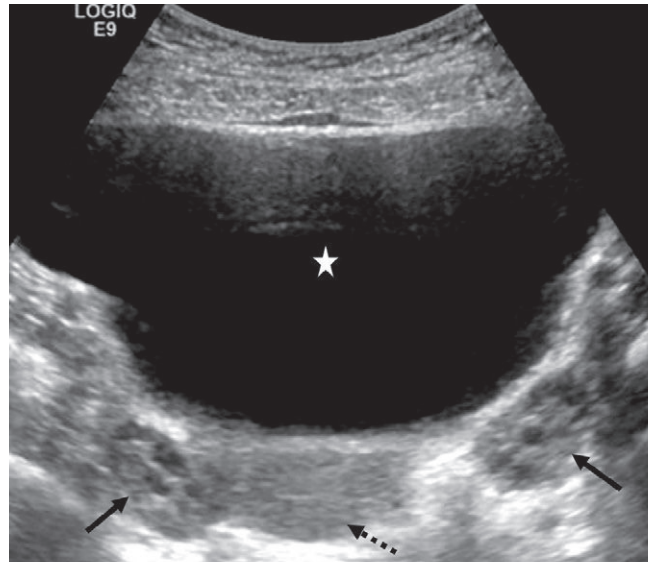


Fig. 4.7: Transabdominal ultrasound of the pelvis: The full bladder acts as an acoustic window to allow imaging of the deep pelvic structures. The fundus of the uterus (dashed arrows) and both ovaries (solid arrows) are seen on transabdominal ultrasound but detailed anatomical evaluation is limited.

Intracavity Ultrasound

Intracavity US is performed using small transducers that can be introduced into body cavities. The commonest gynaecological applications are transvaginal ultrasound (TVUS) and transrectal ultrasound (TRUS). Intracavity US utilises high-frequency (5–12MHz) ultra-small curved transducers that have a small field of view (a few centimeters only) but provide high-resolution images (Fig. 4.8). This allows accurate estimation of the endometrial thickness in patients with post-menopausal bleeding and detects endometrial polyps and masses (Fig. 4.9). Transvaginal ultrasound provides exquisite detail of ovarian follicles and their physiological development. It provides detailed assessment of small ovarian cysts and has a high sensitivity for detecting ovarian malignancy (Fig. 4.10). In the assessment of early pregnancy, TVUS is the first line investigatory modality. It is used for confirming normal uterine pregnancy, excluding or confirming ectopic pregnancy and for estimating fetal age and monitoring fetal growth.

Transrectal Ultrasound

Transrectal ultrasound is used to guide transvaginal interventional procedures, such as endometrial ablation and intracavitary placement of radioactive sources. Transanal ultrasound provides high-resolution images of the anal sphincter, providing images of the internal and external sphincter. This documents the site and extent of sphincter injury, usually an obstetric injury during child birth in women (Fig. 4.11).

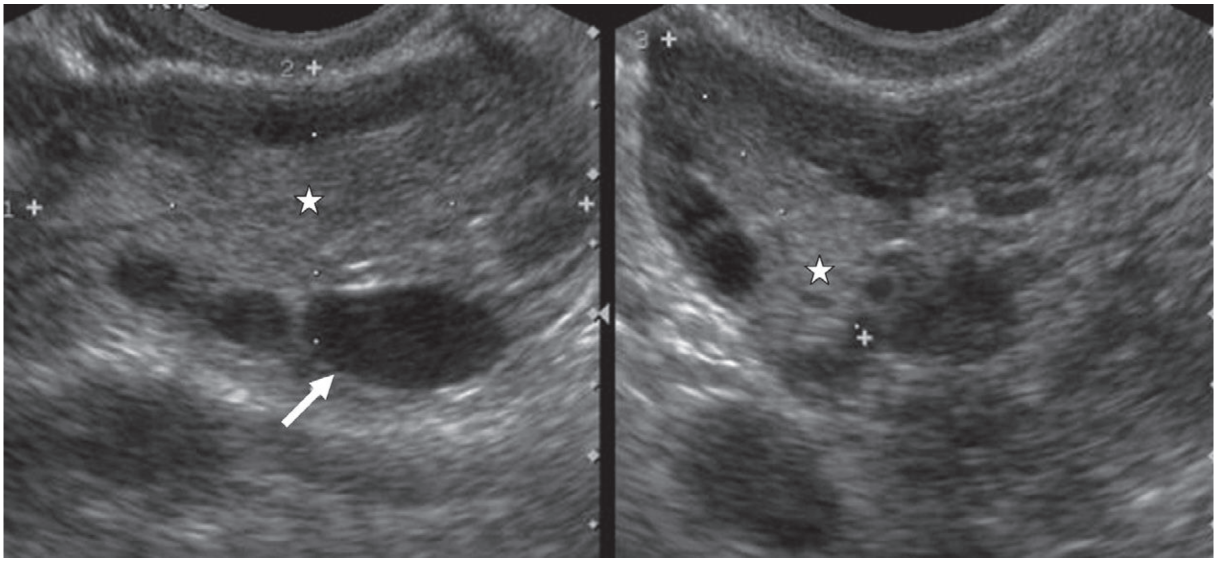


Fig. 4.8: Transvaginal ultrasound of the pelvis: Transvaginal ultrasound provides higher resolution images of the ovaries than transabdominal ultrasound. The ovarian stroma (asterix) and the fluid-filled ovarian follicles (arrows) can be evaluated in detail. The number, distribution and nature of the ovarian follicles and cysts can be evaluated in detail. The images show an increase in stromal volume and stromal echogenicity. The ovarian follicles are arranged peripherally within the ovary and the appearances of the stroma and follicles represent polycystic ovaries.

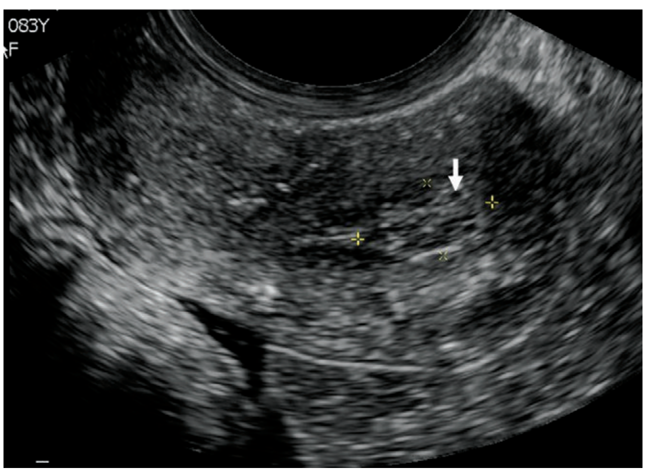


Fig. 4.9: Transvaginal ultrasound of the pelvis: Transvaginal high-resolution image of the uterus allows detailed evaluation of the myometrium and endometrium. A hyper echoic endometrial mass is demonstrated in the endometrial cavity (arrows). The smooth endometrial–myometrial interface suggests a benign endometrial polyp. This was confirmed at histology.

Ultrasound Contrast Agents (UCA)

Ultrasound contrast agents are micro gas bubbles which when exposed to an US beam, reflect sound several times more than the reflection from blood alone. Contrast agents currently in diagnostic use have a micro-bubble structure consisting of inner gas bubbles and an outer protein shell. They remain within blood vessels and display parenchymal microvasculature with real time enhancement. The contrast agents are administered to the patient via a peripheral vein and ultrasound

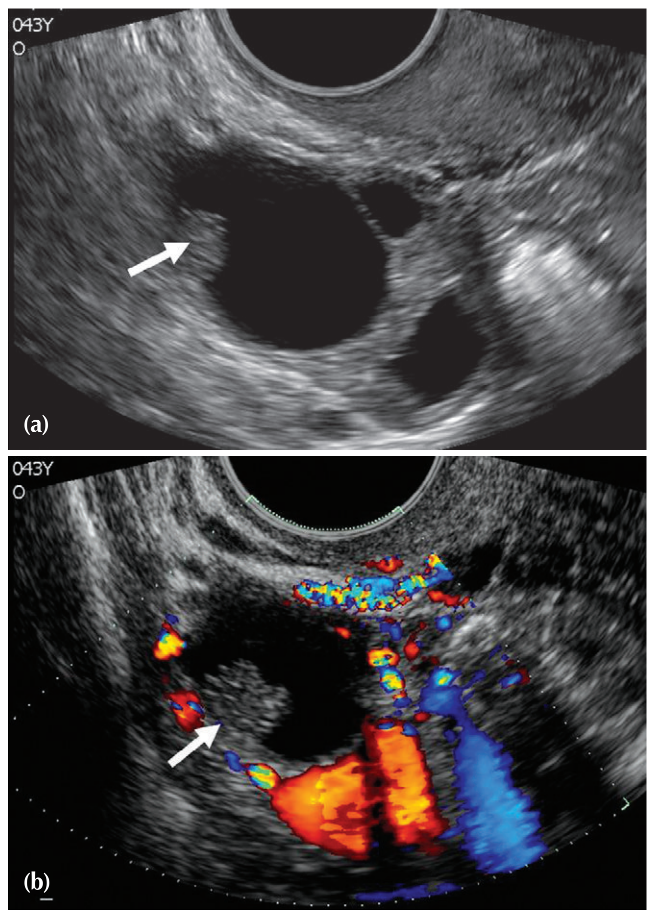


Fig. 4.10: Transvaginal ultrasound of the ovaries. **(a)** A transvaginal image showing a 3 cm ovarian cyst. The cyst has a small 6 mm solid nodule (arrow). **(b)** A Doppler image of the cyst shows increased vascular flow in the base of the nodule. Surgical removal of the cyst revealed a serous borderline adenocarcinoma of the ovary.

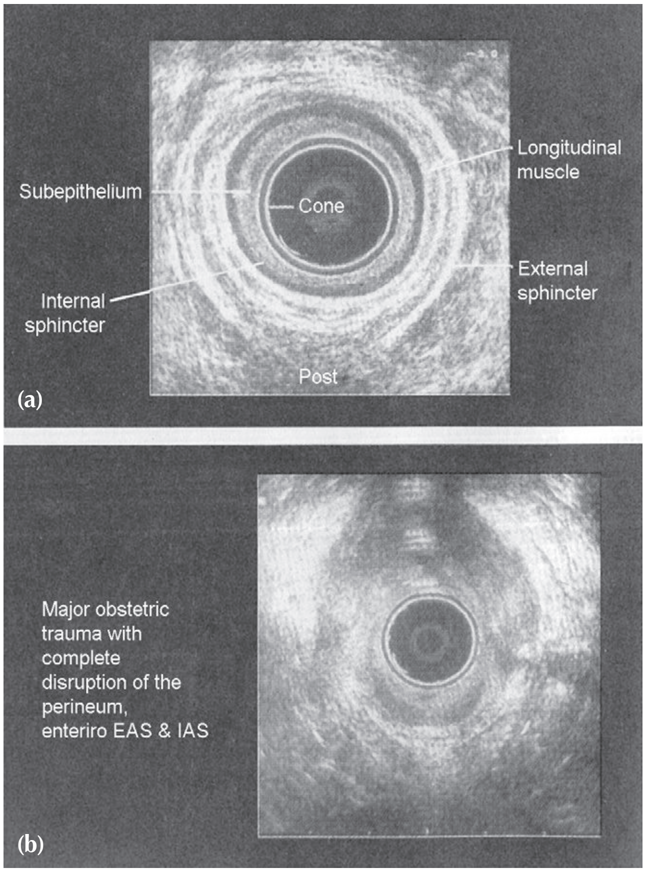


Fig. 4.11: Transrectal ultrasound showing **(a)** normal anatomy, **(b)** anal sphincter defects (by courtesy of Prof. Clive Bartram).

of target organs is performed immediately and at timed intervals. After injection, UCA traverse even the smallest capillaries and can be used to detect lesions not seen on conventional US. The assessment of micro-bubble enhancement requires contrast-specific US software which is readily available with newer US machines.

In gynaecological imaging, UCA are used to perform US hysterosalpingograms to establish tubal patency without the use of radiation-based fluoroscopic techniques.[3] Ultrasound contrast agents have also been used to improve the performance of US in the detection of hepatic metastatic disease and in the characterisation of adnexal masses.[4]

COMPUTED TOMOGRAPHY

Computed tomography (CT) is presently the most widely used imaging tool in the investigation of all patients with cancer. Images are acquired using differential X-ray absorption within the body. X-ray absorption is dependent on the tissue atomic density and thickness. The X-ray beam is narrow and passes through a thin section of the body at a time. After travelling through the patient, the beam is collected by detectors which are capable of differentiating very subtle differences in tissue density. Computed tomography therefore has much greater contrast resolution than plain radiography and is able to separate 2000 or more densities compared to about 20 on plain films. Computed tomography images are generated by computers as a grey scale representation of anatomy and the computer allocates electronic CT values to all structures within the scanned area and arranges them as a spatial image. These CT numbers called attenuation values are measured in Hounsfield units (HU) and calculated based on X-ray absorption of tissues compared to water. To generate a scale, water has an allocated Hounsfield number of 0 HU, air –1000 HU and bone +1000 HU. Fat measures between –80 and –100 HU, the normal pre-contrast liver measures between 40 and 60 HU. Although the tissue contrast of CT is good, this can be improved even further by use of oral and intravenous contrast media. Oral contrast medium outlines lumen of bowel allowing better separation of normal bowel from mesenteric, serosal or peritoneal disease, useful in the assessment of disseminated ovarian or endometrial cancer (Fig. 4.12). Intravenous contrast media is administered usually into a large peripheral vein, commonly in the antecubital fossa, at variable rates. Traditionally the term 'enhancement' refers to the appearance of tissue following intravenous injection of contrast media.

The major advantage of CT is that it provides very high-quality images of different organ systems with little or no overlap. It separates normal from abnormal tissues and can provide limited physiological information by means of quantitative measurements of enhancement and perfusion, blood volume and vessel permeability using intravenous contrast agents. It is cost effective, widely available and an easily reproducible technique. Its major disadvantages are a significant radiation burden, CT accounting for the largest proportion of medical radiation exposure in the Western world. Intravenous iodine-based contrast agents are nephrotoxic particularly in

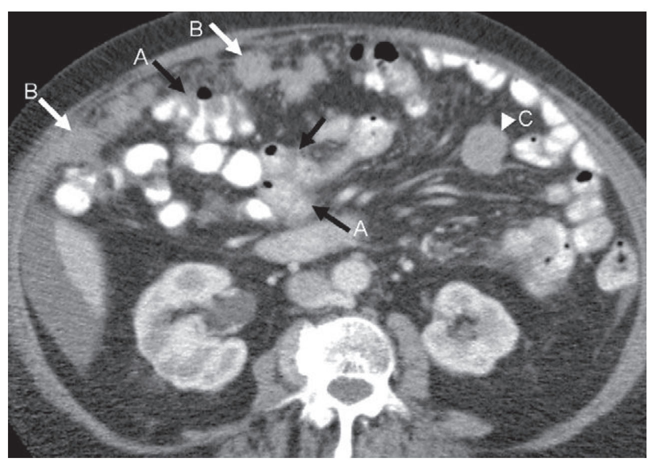


Fig. 4.12: Axial CT acquired for staging from a 63-year-old woman with mucinous adenocarcinoma of the ovary. The CT is acquired after ingestion of oral contrast media to separate the bowel lumen from bowel wall and serosa. This allows the detection of diffuse serosal disease (A arrows) particularly along small bowel serosa. The oral contrast also allows better distinction of bowel loops from omental and mesenteric deposits (B arrows and C arrow head).

patients in renal failure, where they are usually avoided except under particular circumstances. They can cause mild allergic reactions to anaphylaxis causing death.

Multidetector Computed Tomography

Recently, the ability to acquire data from more than one slice simultaneously has been developed using parallel rows of detectors. Spiral scanners are now capable of obtaining between 4 and 256 slices in a single X-ray gantry rotation. Data is therefore obtained much faster than a single slice spiral scanner. The advantages of multidetector CT include fast scanning times particularly useful in paediatric patients where sedation or general anaesthesia may be avoided or used for significantly less time. The entire chest, abdomen and pelvis can be scanned in less than 1 minute. Much thinner slices can be obtained providing a greater spatial and temporal resolution and a reduction in partial volume effects. Post processing of data allows exquisite 3D reconstruction, multiplanar image reconstruction, virtual endoscopic procedures (CT intravenous urograms, virtual CT colonography, bronchoscopy and cystoscopy) and multi-organ and limb angiography (Figs. 4.13 and 4.14).

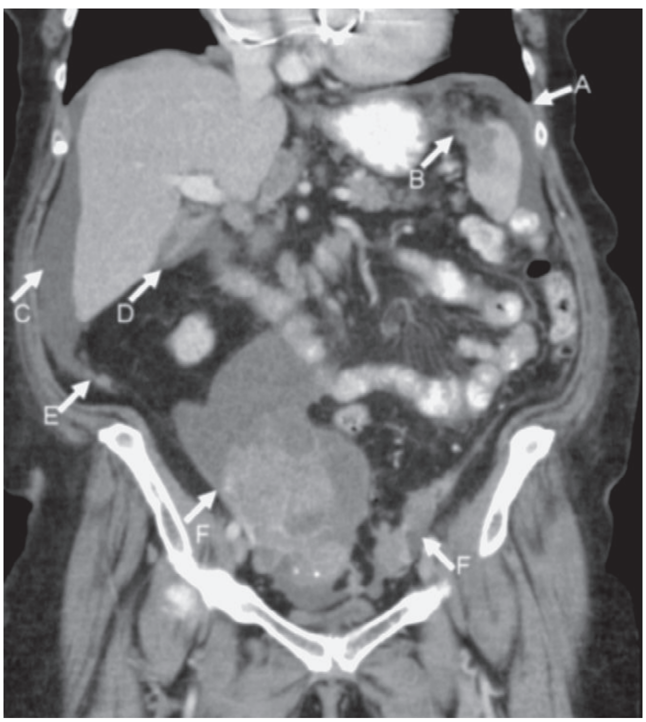


Fig. 4.13: Coronal CT reconstructed image showing extensive metastatic disease in the abdomen and pelvis in a patient with ovarian carcinoma. The coronal reconstruction utilises the ideal plane for demonstration of subdiaphragmatic, upper abdominal, para-colic and pelvic deposits. The CT shows multiple sites of disease. A: left subdiaphragmatic deposit, B: gastro-hepatic ligament infiltration, C: Peri-hepatic deposits, D: Morrison's pouch deposits, E: Right para-colic peritoneal deposits, F and G: complex solid cystic ovarian carcinomas.

Fusion/Co-Registration Techniques

Developments in CT software have allowed co-registration of other imaging modalities onto CT images. This is increasingly useful in combining functional images from nuclear medicine techniques and PET on to anatomical CT images. In gynaecology,

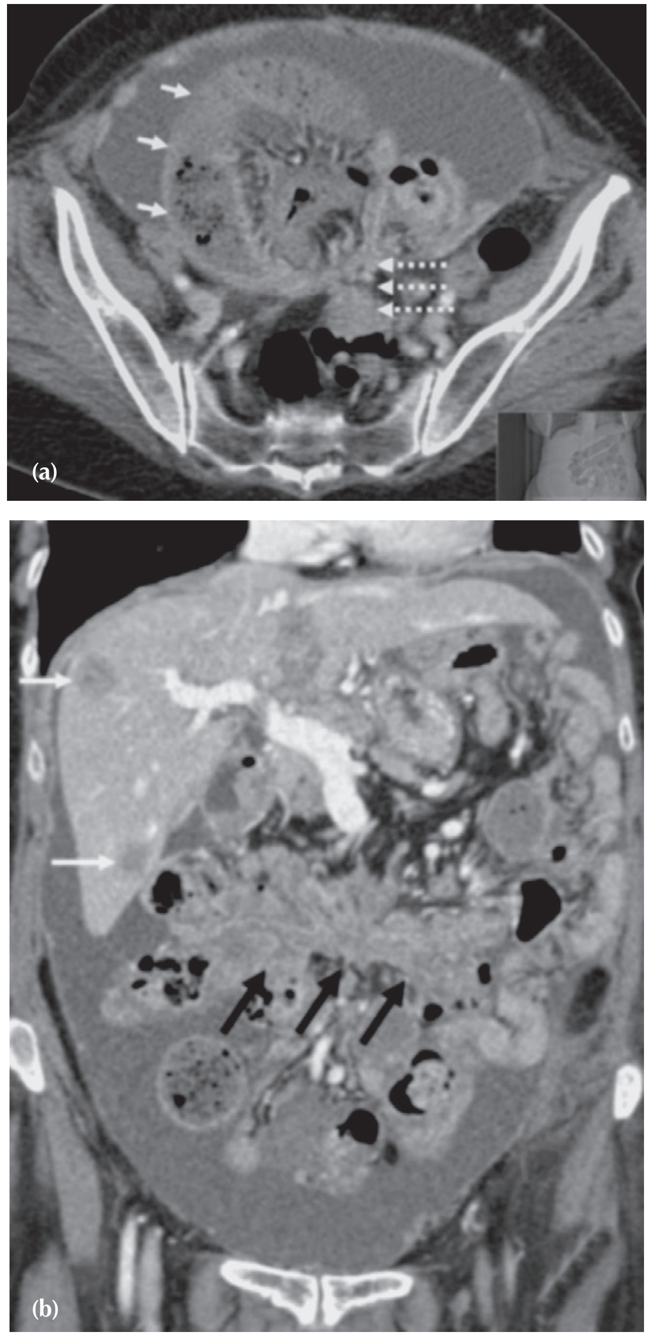


Fig. 4.14: Bowel obstruction in ovarian cancer. **(a)** Axial abdominal CT showing a dilated small bowel loop with faecalisation (block arrows). At the site of obstruction there is a narrowed segment which is tethered to a metastatic serosal deposit (dashed arrows). **(b)** Coronal reconstructed CT image of the abdomen and pelvis. This demonstrates a large infiltrative mass within the small and large bowel mesentery. This results in an atonic fixed bowel contributing the bowel obstruction.

fusion of CT and MRI imaging is particularly useful in mapping cervical cancer, which is best demonstrated on MRI but receives CT guided radiotherapy. Accurate co-registration allows targeted radiotherapy and avoids side effects of radiotherapy to bowel, bladder and other pelvic structures.

MAGNETIC RESONANCE IMAGING

4

Magnetic resonance imaging (MRI) is a non-ionising radiation-based imaging modality that utilises weak radio-wave signals emitted by body tissues when the body is placed in a strong magnetic field and radio frequency (RF) pulses are applied. These emitted signals are converted into grey scale images. The signals are predominantly associated with water protons, and to a lesser extent fat protons. Within very strong magnetic fields (like MRI magnets) spinning hydrogen protons in the body, align themselves with the external magnetic field. When a short RF pulse with the same frequency as hydrogen protons is applied, the magnetisation direction is altered and all protons align themselves in the same direction (in-phase). As soon as the RF pulse is stopped, the energy gained by the protons begins to decay. This loss of energy depends on two factors: (*a*) the protons return to their original alignment in the static magnetic field (spin-lattice relaxation) and (*b*) interactions of nearby protons disrupting local proton magnetic fields (spin-spin relaxation). The spin-lattice and spin-spin relaxation signals are mathematically converted into T1 and T2 relaxation times, respectively. T1 relaxation is short in heavy molecules such as fat and protein, while smaller molecules with more free protons have long T1 relaxation. T2 relaxation depends on dissipation of magnetic energy into the local environment. Solids, bone and large rigid molecules do not move and have very short T2 relaxation times unlike free water protons, which have a long T2 relaxation.

Image generation relies on varying the time of applied RF pulses and the time to collect returning signals. To determine the type of image (T_1 or T_2 weighted images), signals can be obtained at times when tissue T_1 or the T_2 effects predominate. Recent advances in receiver coil technology and rapid sequences have allowed faster imaging times and improved image quality.

The major advantages of MRI are its lack of radiation, lack of iodine-based contrast media and its superior tissue contrast resolution. It provides exquisite anatomical detail and on high-resolution images delineates endometrial and cervical pathologies better than TVUS (Fig. 4.15). It has a natural high contrast between tissue allowing MRI to accurately separate fat, blood and fluid. This ability makes MRI ideally suited for the characterisation of adnexal masses (Figs. 4.16 and 4.17). Its multiplanar imaging abilities were an advantage but this importance has diminished with the advent of multidetector CT. It has no known in vivo adverse effects on embryo, fetal tissues or the ovaries. The main disadvantages of MRI include longer imaging times than CT, less widespread availability and a need for specialist training. The combination of a long period in a closed space and noise generated by loud radiofrequency pulses can result in claustrophobia in adults and the studies are difficult for children to tolerate. The patients are required to lie still for the duration of the study and motion severely degrades the images usually resulting in non-diagnostic studies. The performance of MRI is also highly protocol and technique dependent. To achieve reproducibility, imaging protocols need to be standardised.

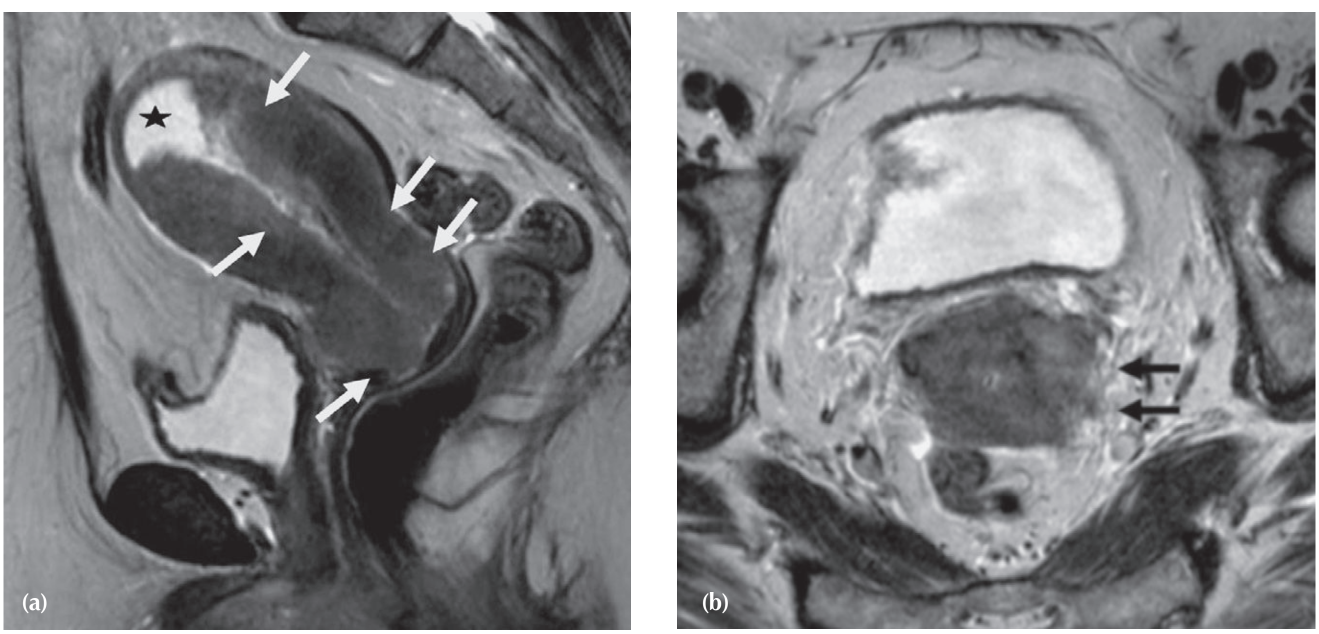


Fig. 4.15: (a) Sagittal T_2-weighted image from a 24-year-old woman with adenocarcinoma of the cervix. A large infiltrative mass is seen replacing the cervix with proximal extension and invasion of the myometrium (arrows). There is stenosis of the internal os with a resultant hydrometra (asterix). **(b)** Axial-oblique T_2-weighted image acquired to obtain a cross-sectional image of the cervix. The tumour is seen extending into the left parametrium (arrows) in keeping with a large FIGO stage IIB carcinoma.

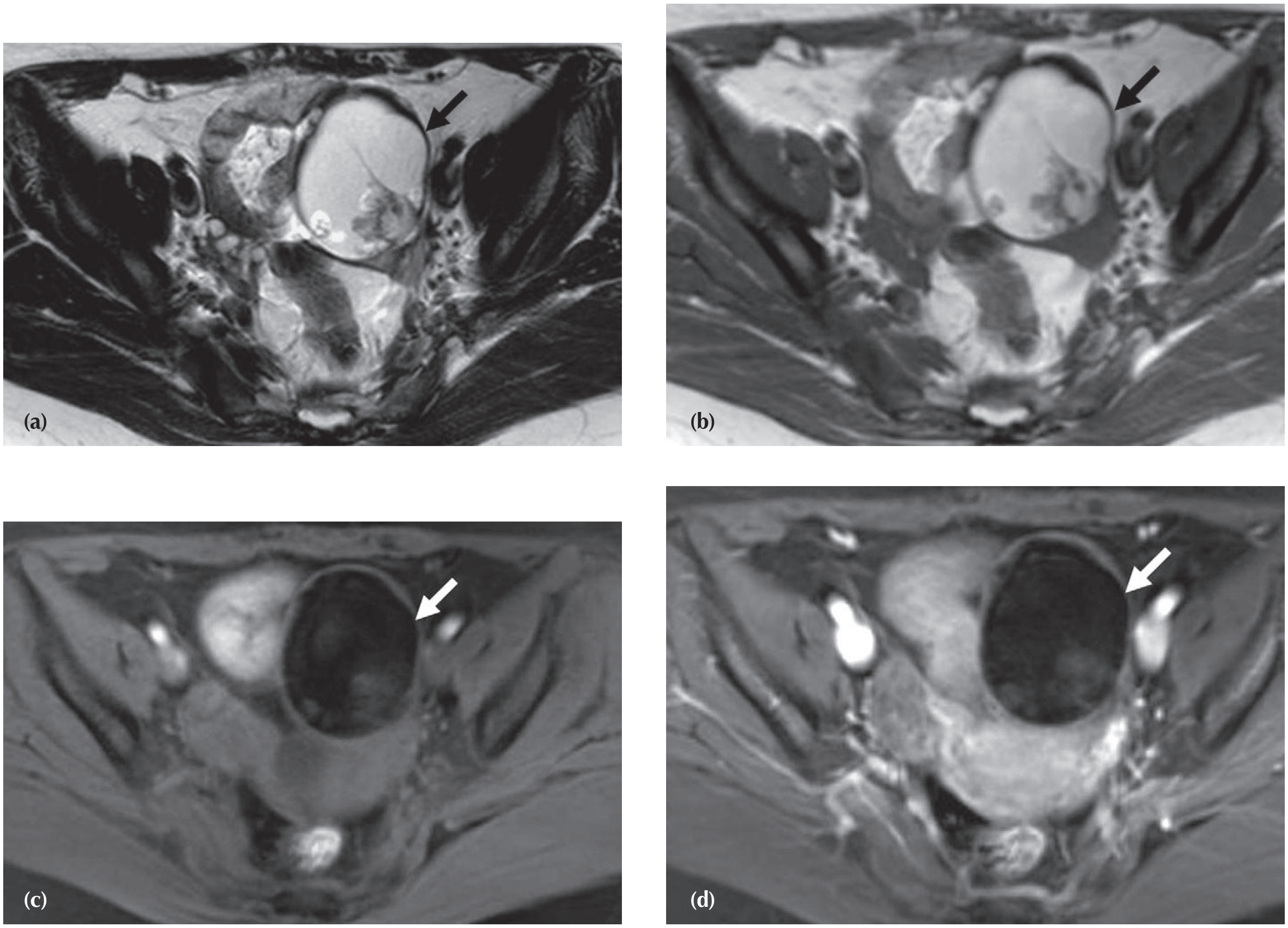


Fig. 4.16: MRI of left ovarian dermoid cyst. **(a)** Axial T_2-weighted image of the pelvis. There is a 7 cm high T_2-signal intensity cystic ovarian mass with central soft tissue. **(b)** Axial T_1-weighted image showing the cystic ovarian mass has high T_1-signal intensity material. **(c)** Axial T_1-weighted and fat-saturated image. This shows loss of the high T_1-signal intensity after application of fat saturation sequences indicating the presence of fat in the cystic ovarian mass. This detection and characterisation of fat in cystic ovarian masses is typical of ovarian dermoid cysts.

The specific contraindications to MRI are summarised in Table 4.1.

MRI contrast agents are paramagnetic molecules used to improve the natural contrast between soft tissue structures. Many different agents are used in clinical practice including gastrointestinal, intravascular (blood pool), tumour-specific, hepatobiliary and reticuloendothelial contrast agents. The most frequently used group of contrast agents are gadolinium based, intravascular blood pool agents which are administered intravenously usually in an antecubital vein and remain in the intravascular compartment. Gadolinium agents can assess tissue perfusion and provide information about capillary permeability. They show the extent of tumour neovascularity and associated permeability changes. The blood pool properties make them suitable for angiography. Angiography of pelvic vessels is useful for assessment of fibroid vascularity, investigation of chronic pelvic pain and tumour perfusion.

Gadolinium allergy and previous or present history of nephrogenic systemic fibrosis (NSF) are the absolute contraindications in clinical use. NSF results in systemic irreversible fibrosis of skin and viscera and has been linked to the use of gadolinium in people with pre-existing renal failure. The symptoms of NSF include tightening, swelling and symmetrical red patches of the skin, thickening of the skin and restriction of movement around joints, calcification, itching and sharp pains in affected areas including bone, muscle weakness and yellow plaques near the eyes. Presently, no curative treatment is available for NSF but symptom control is the mainstay of patient management. Relative contraindications for gadolinium use include pregnancy, lactation, hepatorenal syndrome, chronic hepatic disease, previous anaphylaxis to gadolinium and significant renal impairment with an eGFR below 30.

Diffusion-weighted imaging (DWI) is a relatively new inclusion in gynaecological MR imaging. This constitutes MRI

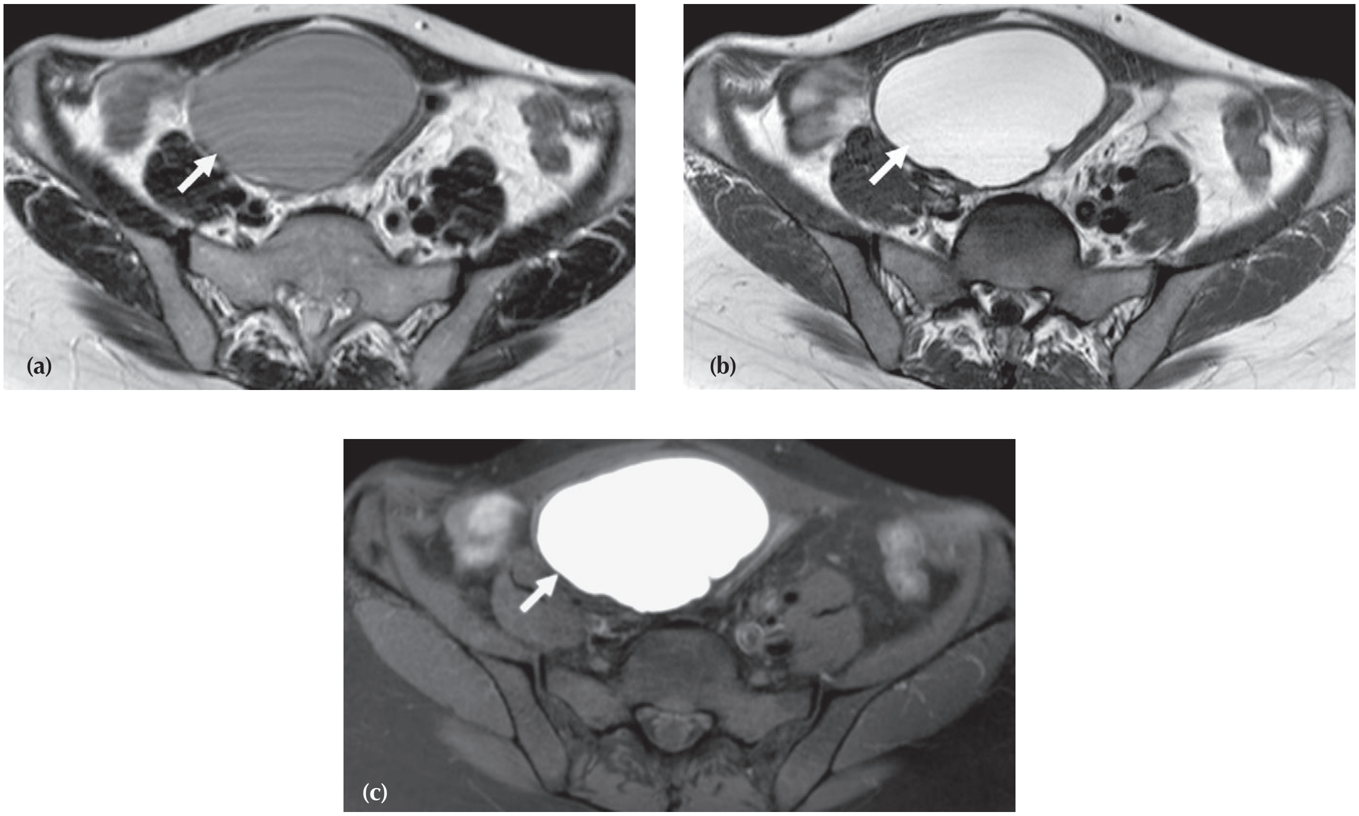


Fig. 4.17: MRI of right ovarian endometrioma. **(a)** Axial T_2-weighted image of the pelvis showing a 9 cm right ovarian cyst with intermediate signal intensity. The cyst has a smooth wall and no complex internal features. **(b)** Axial T_1-weighted image showing the cyst has high T_1-signal intensity material. **(c)** Axial T_1-weighted and fat-saturated image. The high-signal intensity retains very high signal, a characteristic property of blood. Overall the appearances are of an endometrioma.

Table 4.1: Safety of MRI

Absolute contraindication: • Metallic intra-ocular foreign bodies • Non-MRI compatible cerebral aneurysm clips • Non-MRI compatible cardiac pacemakers • Non-MRI compatible neurostimulator devices or cochlear implants • Patients with metallic surgical clips up to 6 weeks after surgery
Relative contraindication: • First trimester of pregnancy • Joint prostheses are generally acceptable but may cause susceptibility artefacts in the images and patients may experience discomfort due to heating of metallic prosthesis

sequences that use Brownian motion of proton molecules to evaluate different tissues. Brownian motion of protons is reduced with increasing cellular density/cell membranes and increasing extracellular macromolecules. This reduction of motion is seen as increasing signal intensity on diffusion-weighted images. The degree of proton motion can be quantified by the Apparent Diffusion Coefficient (ADC value). DWI is used in association with routine MRI sequences to improve the overall performance of MRI. The advantageous applications of DWI in gynaecological disease include assessment of residual or recurrent cervical cancer following chemoradiotherapy, detection of peritoneal deposits in ovarian cancer, effectiveness of uterine artery embolisation in fibroids and for the distinction between benign post-surgical changes and recurrent disease following surgery.[5–7]

The exquisite anatomical detail, the ability to detect early pathologies and the lack of radiation burden makes MRI an adjunct to US in imaging gynaecological conditions. The role of MRI in gynaecological conditions is continuously evolving. It now has an established role in gynaecological malignancies discussed later in the chapter.

NUCLEAR MEDICINE

Nuclear medicine imaging has contributed significantly in diagnosis, treatment planning and evaluation of response in patients with cancer with the development of modern scintigraphy techniques. It utilises the body's own normal and abnormal biochemical and physiological pathways making it a form of functional imaging. The patient is injected with a gamma-emitting labelled tracer and its distribution after a period of time is detected by modified gamma cameras containing scintillation crystals which are read by photomultiplier tubes. The patient lies under the gamma detector system (camera) for 20–60 minutes and the whole body distribution of the tracer is mapped into an image by applying mathematical algorithms. The image is most commonly a planar image but if tomographic techniques are applied, single-photon emission CT (SPECT) and positron emission tomography (PET) images can be obtained.

Positron Emission Tomography

PET is a nuclear medicine modality that provides quantitative tomographic images allowing non-invasive functional imaging. It has an increasingly important role in oncology for diagnosis, staging, predicting response to treatment and in the detection of recurrent disease. It utilises biochemical metabolites (commonest 2-deoxy-D-glucose), labelled with beta-emitting radiotracers (18-Fluorine) that are injected intravenously. Both glucose and deoxyglucose enter cells via cell glucose transporters and undergo phosphorylation but while glucose undergoes further enzymatic breakdown, deoxyglucose becomes trapped in intracellular compartments. Cancer cells have increased glucose cell membrane transporters and intracellular phosphorylation enzymes thereby take up and trap more glucose and deoxyglucose than normal cells. It must be remembered that FDG is not a specific marker for cancer cells and activated macrophages are also known to exhibit high tracer uptake. This has significant implications in the analysis of PET studies as active infection and cancer can behave similarly. The ^{18}Fluoro component undergoes beta decay in the body producing a high-energy positron. Once the positron slows down it produces two gamma rays which are emitted back-to-back and have energy of 511 KeV each. These decay events are detected by coincidence registration of gamma quanta. The images created represent the metabolic activity of underlying tissues.

Positron emission tomography has an advantage over conventional nuclear medicine in that it allows measurements of tracer concentrations within tissues providing the most commonly used clinical measurement index, the standard uptake value (SUV), which compares lesion activity concentration to average activity concentration of the whole body. SUV values have been utilised to differentiate between benign from malignant lesions and prognosticate survival in patients with cancers. In general, the higher the SUV the poorer the outcome, and changes in SUV before and after chemotherapy have been compared to assess the effectiveness of chemotherapy agents.

PET-CT

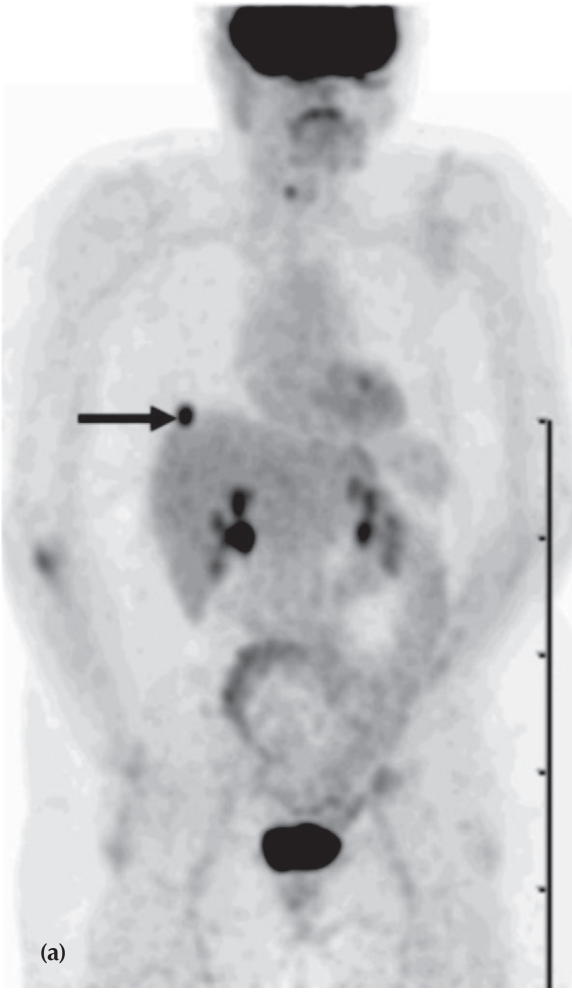
In clinical oncology, diagnosis and staging of cancer are traditionally based on CT imaging which relies on detecting anatomical alteration of normal tissues. However in cancer, functional changes precede anatomical alteration. PET has a high sensitivity for detection of this functional change but its spatial resolution for anatomical localisation is poor. Over the past decade software-based algorithms have been developed which allow fusion and combined display of CT and PET images. However these require superimposition of data acquired retrospectively and normal variations in position and activity of bowel, respiration and cardiac function contribute to correlation errors.

The alternative solution of hardware fusion has created PET-CT. This allows acquisition of CT and PET data in a single examination without altering patient position between scans. In clinical practice this involves injecting patients with 18-FDG PET tracers at least one hour prior to the start of the combined PET-CT. Contiguous spiral CT scans are acquired through the area of interest. After completion of the last spiral CT image, the patient is advanced for PET emission images acquired in a caudal-cranial direction taking up to 1 hour. Unlike conventional CT, due to the long duration of the combined acquisition, patients have their arms by their side and breathe gently during the scan. Once the CT data collection is complete, it is sent to the PET console for attenuation and scatter correction. Once corrected, PET and CT data can be viewed separately, side-by-side or as a fused image. Early results show that combined PET-CT improves diagnostic accuracy compared to CT or PET alone.[8] The main advantage of PET-CT is a whole body imaging technique allowing the early detection of distant metastases in gynaecological malignancies (Fig. 4.18). The combination with CT reduces false positive results due to physiological FDG uptake in tissue, such as brown fat and muscle.

INTERVENTIONAL TECHNIQUES

Interventional radiology is altering the management of several gynaecological disorders and complements surgical and medical treatment of patients. The aim is to provide image-guided, minimally invasive alternatives to traditional surgical and medical procedures in suitable patients. Procedures include image-guided biopsies, nephrostomies and antegrade ureteric stenting for urinary obstruction, pre-operative insertion of inferior vena caval filters in high-risk patients unable to be adequately anti-coagulated to prevent pulmonary emboli, and imaging-guided therapy such as endometrial ablation, embolisation for post-partum haemorrhage, fibroid embolisation, high-frequency ultrasound treatment (HIFU) of fibroids and recanalisation of Fallopian tubes (Fig. 4.19). Percutaneous radiofrequency ablation techniques of liver and lung metastases have survival benefits equivalent to surgical metastectomy but are still sparingly used in gynaecological malignancies.[9] Procedures which previously may have required major surgery can now be performed by interventional radiologists as day case procedures.

Interventional procedures may be conducted using several imaging modalities. Clearly radiation-free modalities, US and MRI, are preferable to minimise radiation exposure of highly radiosensitive ovaries and endometrium (Fig. 4.20). Fluoroscopic and CT guidance is reserved for embolisation techniques, deep pelvic biopsies or drainages and emergency procedures.



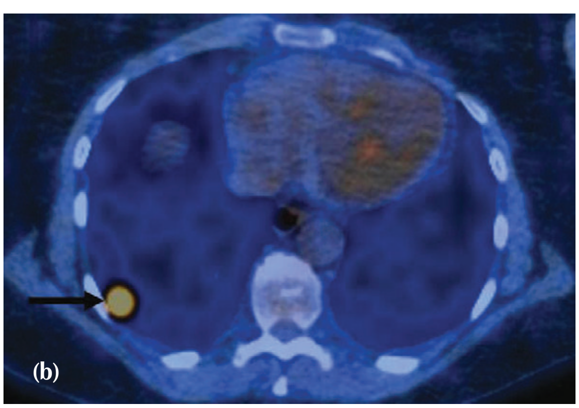


Fig. 4.18: PET-CT: 76-year-old woman with grade 3 endometriod adenocarcinoma of the endometrium. **(a)** Coronal whole body maximum intensity projection ^{18}F-FDG PET image showing an FDG avid lung lesion in keeping with a metastasis during routine surveillance (arrow). The advantage of PET-CT as a whole body imaging modality allows the detection of unexpected distant metastases. **(b)** Fused CT and ^{18}F-FDG PET image confirming the intrapulmonary location of the metastasis.

Role of Imaging in Gynaecological Cancers

OVARIAN CANCER

Imaging has an important role at presentation for confirmation of diagnosis, pre-operative assessment of disease, postoperative or post-chemotherapy assessment of residual disease and for detection of recurrent disease.

Ultrasound, particularly transvaginal ultrasound (TVUS) is the commonest modality used to identify and characterise pelvic ovarian masses at presentation. This is usually during investigations for pelvic pain, menstrual disturbances, as part of investigations of a raised serum CA125 or in advanced disease with ascites and a palpable pelvic mass. Criteria for characterising malignant masses on ultrasound have been described and include masses larger than 10 cm, the presence of soft tissue nodules (soft tissue components) and vegetations, thickened irregular walls, thickened nodular septae, presence of ascites and peritoneal nodules. The sensitivity and specificity of ultrasound including the addition the Doppler ultrasound has been reported between 85%–97% and 56%–95%, respectively.[10] In the authors' experience, the specificity of ultrasound is highly variable and is closer to 56% in clinical practice. The main pathologies lowering the specificity of US are dermoid cysts, endometriomas, inflammatory pelvic disease and fibroids. Contrast-enhanced CT relies on the same criteria as TVUS and has accuracy in detection of ovarian masses of up to 95% and in distinguishing benign from malignant disease of 66%.[11] As for US, the specificity of CT is poor. MRI with gadolinium enhancement has also been shown to have a high sensitivity (95%) and a substantially better specificity of (93%) and accuracy (91%) than TVUS for malignancy in ovarian masses.[12]

With its superior specificity, MRI is now routinely used for the characterisation of sonographically indeterminate adnexal masses. Its role has been formally defined by the female imaging subcommittee of the European society of urological radiologists.[13] Adnexal masses may be sonographically indeterminate if the lesion cannot be confidently placed into either a benign or malignant category, if the site of origin is unclear or the mass is entirely solid. MRI is recommended in young women with a normal or minimally raised CA125 and a low or intermediate risk of malignancy index (RMI). In these patients, the role of MRI is to confirm benignity in the adnexal mass. Surgical resection is recommended for lesions that remain indeterminate on MRI.[13] The advantage of MRI is a high sensitivity and specificity in characterising fat, blood and fibrous tissue difficult to identify definitively on other modalities. MRI provides better anatomical localisation of adnexal masses to organs of origin, e.g. ovarian, tubal or uterine. MRI evaluates the whole pelvis excluding non-gynaecological masses, retroperitoneal pathology, nodal disease or bowel pathology and detects related features of malignancy like ascites, peritoneal disease and visceral metastases.

Surgical staging is the gold standard but inaccurate in 30%–40% with upper abdominal disease being the most

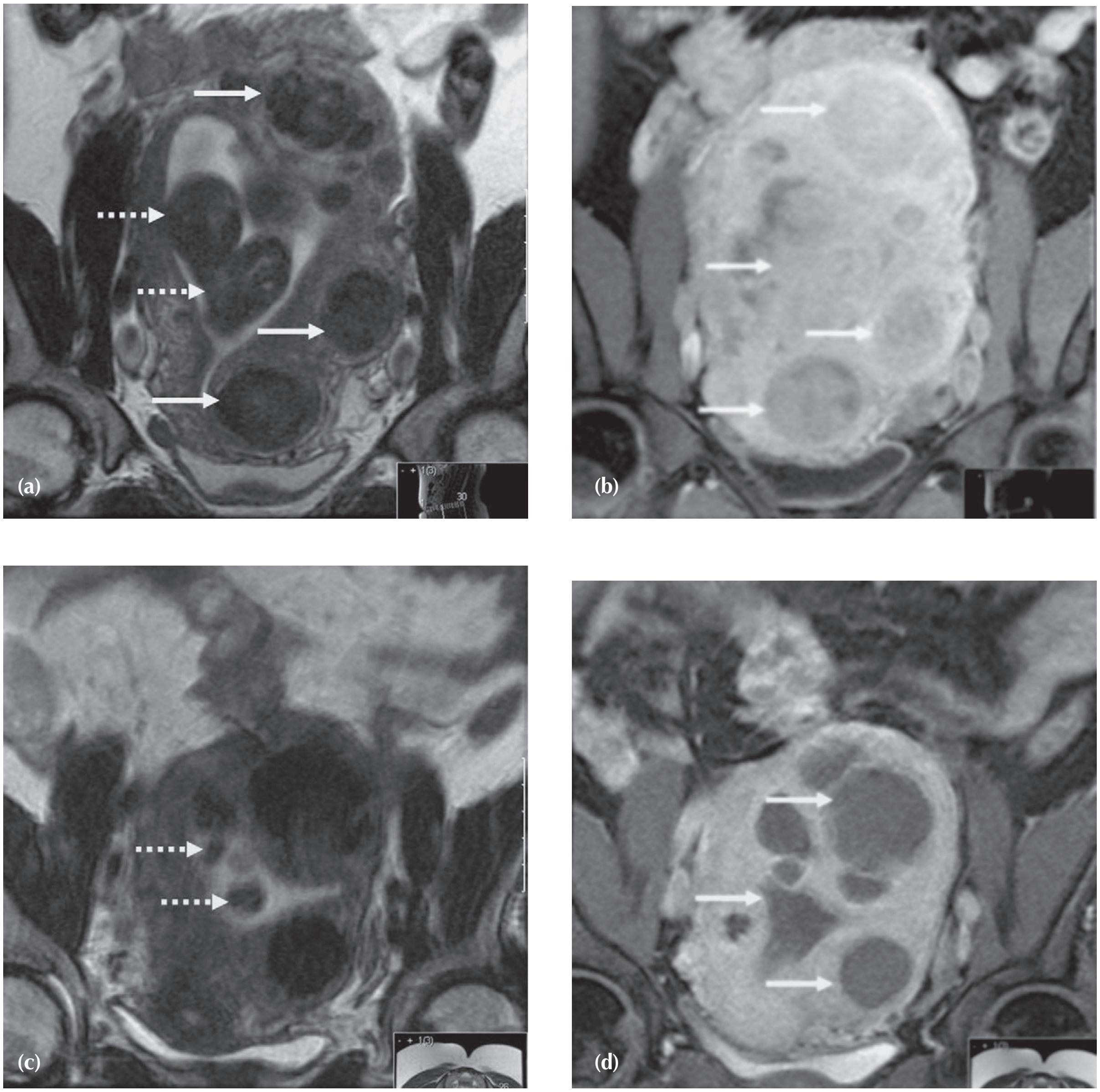


Fig. 4.19: Uterine fibroids before and after uterine artery embolisation. **(a)** Coronal T_2-weighted image of the uterus showing innumerable low T_2-signal intensity fibroids (white arrows) within the uterus. In particular, two large submucosal fibroids are seen extending into the endometrial cavity and distorting the cavity (dashed arrows). **(b)** Coronal T_1-weighted image with fat saturation and intravenous gadolinium contrast enhancement. All the fibroids are demonstrated as vascular enhancing masses thereby suitable for embolisation (arrows). **(c)** Coronal T_2-weighted image acquired 3 months after uterine artery embolisation. The multiple fibroids have decreased in size, in particular the sub-mucosal fibroids which no longer distort the endometrial cavity (dashed arrows). **(d)** Coronal T_1-weighted image with fat saturation and intravenous gadolinium contrast enhancement. Most of the uterine fibroids are now avascular and non-enhancing in keeping with a good response following embolisation (arrows).

frequent site of occult disease. Intravenous and oral contrast-enhanced CT of the abdomen and pelvis is the commonest imaging modality used for radiological pre-operative staging or imaging prior to and following chemotherapy. Computed tomography is useful in detecting ascites, pleural effusions, tumour involvement of intra-abdominal viscera, mesentery, peritoneal reflections and omentum. The major limitation of CT is its inability to detect peritoneal deposits below 1 cm and this drops the staging accuracy of CT between 70% and 90%. MRI with gadolinium enhancement has similar accuracy to CT in detecting peritoneal disease and does not improve the detection of peritoneal disease below 1 cm. It has better accuracy detecting implants on bowel serosal and invasion of the sigmoid colon, bladder and rectum.[14,15] The performance of MRI in the detection of peritoneal deposits improves with the addition of functional imaging, in particular diffusion-weighted

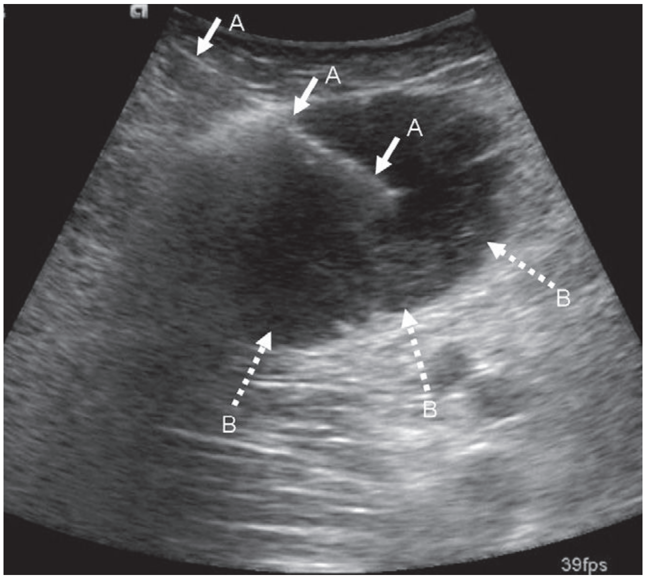


Fig. 4.20: US of deep femoral lymph nodes in a patient investigated for recurrent vaginal squamous cell carcinoma. A large lymph node mass is demonstrated in the deep femoral region (dashed arrows). For histological confirmation of recurrent carcinoma, a cutting biopsy needle is introduced into the mass under ultrasound guidance (arrows) and tissue core biopsy is obtained. Direct visualisation of the needle allows precise placement of the needle tip avoiding adjacent vessels and areas of necrosis within the nodal mass.

imaging, to a high 90% sensitivity and 88% specificity.[16] Increasingly, in patients with irresectable tumour at presentation, CT and US can be used to provide omental or peritoneal tissue biopsy to confirm the diagnosis prior to adjuvant chemotherapy.

Response to treatment may be assessed by serum CA125 levels, by non-invasive imaging (CT or MRI) or by invasive laparoscopy or laparotomy. Computed tomography is most frequently used to document treatment response. Localised disease in the pelvis at the vaginal vault and the Pouch of Douglas is better assessed by MRI.

FDG-PET has been recently used in staging primary disease and detecting recurrent disease. At present the literature reports no improved sensitivity of FDG-PET alone or in conjunction with CT compared to conventional CT alone. In fact FDG-PET is inferior to CT in the demonstration of small peritoneal deposits. False negative FDG-PET has also been reported early after completion of chemotherapy.[17] Current recommendations are the routine use of contrast-enhanced CT with PET-CT reserved for problem solving.[18]

ENDOMETRIAL CANCER

Endometrial biopsy is necessary to establish the diagnosis of endometrial cancer. In endometrial cancer, TVUS shows an increase in endometrial thickness, heterogeneous echotexture and an irregular poorly defined edge. Using endometrial thickness of less than or equal to 5 mm in post-menopausal women with vaginal bleeding, TVUS has a very high negative predictive value in ruling out not only patients with endometrial cancer but also any other endometrial abnormality, such as polyps or hyperplasia.[19,20]

Staging of endometrial cancer is surgico-pathological requiring total abdominal hysterectomy (TAH), bilateral salpingo-oophorectomy (BSO), peritoneal washings, assessment and sampling of pelvic and para-aortic lymph-nodes. Federation Internationale de Gynécologic et Obstétrique (FIGO) recommends pre-treatment imaging evaluation of endometrial cancer with conventional imaging including barium enema, chest X-ray and intravenous urography. The revised FIGO 2009 guidelines recommend pre-operative MRI, when available, for staging and as a substitute for cystoscopy and sigmoidoscopy.[21]

As part of staging, TVUS has been used to evaluate the depth of myometrial and cervical invasion in endometrial cancer. The depth of myometrial invasion is an important prognostic factor in endometrial cancer, the incidence of nodal metastases increasing sharply from 3% in tumours with no or superficial myometrial invasion to 40% in tumours with deep myometrial invasion. TVUS, CT and MRI have all been used to assess myometrial invasion. The performance of TVUS is variable and operator dependent. The reported accuracies for myometrial invasion vary between 77% and 91%.[22] Computed tomography including newer multidetector CT has poor sensitivity and specificity for myometrial and cervical invasion. For the detection of deep myometrial invasion the sensitivity and specificity are 83% and 42%, respectively. For the detection of cervical invasion the sensitivity and specificity are 25% and 70%, respectively. The overall staging accuracy of CT is between 58% and 76%. Computed tomography is therefore of limited value for local staging and unlikely to affect management in early endometrial cancer. In more advanced disease with parametrial and pelvic sidewall disease, CT is highly accurate in detecting local spread beyond the uterus.[23]

Due to its excellent tissue contrast resolution, MRI has established its role in identifying deep myometrial invasion. The use of gadolinium improves the ability to assess depth of myometrial invasion with MRI. With regards to myometrial invasion, the reported sensitivities and specificities are between 84%–87% and 91%–94%, respectively. The PPV is 87% and NPV is 91% for the identification of myometrial invasion greater than 50%.[24]

MRI also performs particularly well in the detection of cervical invasion and sensitivity, specificity, accuracy, PPV and NPV for cervical invasion is 80%, 96%, 92%, 89% and 93%, respectively. Several investigators have reported that macroscopic cervical invasion, detectable on MRI, imparts a worse prognosis than microscopic invasion. Therefore pre-operative assessment for cervical involvement may help in planning surgery and radiotherapy.[25] Also as part of staging, extra-uterine disease including peritoneal deposits in the Pouch of Douglas, omental disease and pelvic or retroperitoneal lymphadenopathy is also readily detected on MRI. Lymphadenectomy remains a component of the surgical-pathological staging of endometrial cancer, although this is currently a topic of debate. Lymphadenectomy carries a significant complication rate of 17%–19%, requires increased anaesthetic and operating times and needs expertise of a specialised oncologic surgeon.[26] The rate of pelvic lymph node involvement in Stage 1 endometrial cancer is low approximately 10%.[27] Although in a recent series, nodal metastases have been detected in up to 29% of patients in intermediate to high-risk categories.[27] Patient selection for primary lymphadenectomy at the time of hysterectomy is therefore presently controversial in oncological gynaecology. The ability to select patients for lymphadenectomy prior to surgery may therefore be of value. Imaging can assist in pre-operative assessment and surgical planning by predicting the depth of myometrial invasion, cervical stromal involvement, distant spread and lymph-node involvement. Pre-operative knowledge of these factors is important as patients with disease greater than FIGO (2009) stage 1A may benefit from lymphadenectomy, but the number of unnecessary lymph-node dissections can also be reduced in low-risk patients by showing that none of these factors are present.

MRI has also been advocated in the detection of recurrent disease to evaluate surgical resectability. Recurrent endometrial cancer may present as a pelvic mass in the hysterectomy bed or as pelvic or retroperitoneal lymphadenopathy. Less frequently, it may manifest as peritoneal carcinomatosis. Distant metastases and early recurrent disease are usually associated with high-grade tumours and advanced stage at presentation. CT performs well in detection of recurrent pelvic disease with an overall accuracy, sensitivity and specificity of 92%, 92% and 80%, respectively. FDG-PET has been evaluated in small studies and reports promisingly high sensitivity of 96% but a low specificity of 57%. Correlation of FDG-PET with CT minimises false positive rates resulting in a higher specificity of 88%. As FDG-PET is a whole body imaging technique all comparative studies report a higher accuracy than both CT and MRI in detection of para-aortic disease bone and lung metastases.[28]

CERVICAL CANCER

Between 85% and 95% of cervical cancers are squamous cell carcinomas arising at the squamo-columnar junction and visible on direct speculum examination as exophytic or ulcerating tumours. In older women, the squamo-columnar junction lies within the endocervical canal resulting in endophytic tumours. Transvaginal ultrasound and CT will only visualise large tumours. Magnetic resonance imaging provides highly accurate information on the morphology, size and staging of the carcinomas.

On MR imaging, cervical cancers appear as hyperintense lesions on T_2-weighted images and iso-intense on T_1-weighted images regardless of the cell type. After administration of gadolinium, cervical tumours demonstrate early and prolonged enhancement compared to poor enhancement of the normal cervical stroma. On diffusion weighted imaging (DWI), cervical carcinoma demonstrates restricted diffusion with low apparent diffusion coefficients (ADC). The ADC values alter with treatment and this technique may have the potential to be used to predict and monitor response to therapy.

The diagnosis of cervical cancer is made clinically and histologically with imaging required to stage the disease.

Both CT and MRI have been used to stage cervical cancer. The cervical carcinoma itself is not seen on CT but staging relies on identifying presence or absence of tumour in the parametrium, detecting ureteric obstruction or pelvic side wall destruction. MRI is the most accurate imaging technique overall for pre-operative staging of cervical cancer significantly better than CT (accuracy 86% versus 63%, respectively).[29] MRI is also cost-effective as it can replace cystoscopy, sigmoidoscopy, barium enema and intravenous urography as suggested by current FIGO staging. The main role of MRI is to separate early stage (1A-11A) disease from advanced disease by detecting parametrial extension of tumour which renders the patient Stage IIB or above. This is critical as small tumours below stage IIB can be treated surgically whilst those that are large stage 1B or stage IIB and above are treated with radiotherapy alone or combined with chemotherapy. The performance of MRI in early cervical tumours was evaluated in a meta-analysis by Bipat et al. showing MRI had a sensitivity of 93% for tumour detection and an overall staging accuracy of 86%. By comparison, clinical FIGO staging performed poorly with an overall accuracy of only 47%.[30] More recently, the joint ACRIN and GOG study reported much improved clinical FIGO staging results with specificity, PPV and NPV of 99%, 91% and 84%, respectively. However in this study, final clinical staging was reported after CT and MRI findings were available, thereby strongly influencing and improving clinical staging. The primary tumour cannot be visualised on CT but can be accurately defined on MRI. Computed tomography is therefore unsuitable for assessing suitability for trachelectomy and limited for planning modern conformal radiotherapy techniques particularly intensity-modulated radiotherapy (IMRT).[31] In advanced tumours, staging depends on invasion of adjacent pelvic structures, pelvic sidewall, ureters and vaginal wall. Magnetic resonance imaging criteria for pelvic side-wall invasion includes tumour less than 3 mm away from the bony side wall, vascular encasement by tumour, ureteric encasement or hydronephrosis, tumour in obturator internus, piriformis or levator ani. The meta-analysis by Bipat et al. showed that MRI had a sensitivity of 91% for bladder invasion and 75% for rectal invasion.[30]

One of the major advantages of visualising the carcinoma on MRI is predicting proximal extension of tumour and thereby predicting feasibility for trachelectomy. An important criterion for surgery is that the proximal end of the tumour should be at least 1 cm distal to the internal os to permit tumour-free re-anastomosis. On MRI, for detection of internal os tumour involvement, the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) have been shown to be 90%, 98%, 86%, 98%, respectively. Imaging, MRI in particular, is routinely used for surveillance in women who have undergone trachelectomy to detect early recurrence in order to institute timely completion curative surgery.[32,33]

Approximately 30% of women die of residual or recurrent cervical cancer after primary treatment. Both CT and MRI have an important role in detection of recurrent disease. The accuracy of CT is up to 85% and it is limited in differentiating post-radiation fibrosis and oedema from recurrent disease. The sensitivity of MRI and FDG-PET for detecting recurrent pelvic disease is a comparable 90%. The early FDG-PET results showed a very high sensitivity for extra-pelvic nodal disease (100%) but a relatively poor sensitivity (75%) and specificity (33%) for small volume lung and bone disease, where CT and MRI perform better respectively. However, later studies show a lower sensitivity (60%) of PET-CT in the detection of extra-cervical disease.[34] The current role of PET-CT includes detection of pelvic and para-aortic nodal disease or distant metastases in patients planned for primary or secondary surgical curative resection.[35,36]

In most institutions, radiotherapy is delivered by CT-guided 3D conformal planning. More recently, intensity-modulated radiotherapy (IMRT), a form of 3D radiotherapy planning has been introduced. Here tumour and nodes are tracked out on either CT or MRI and radiotherapy doses are delivered in a more focused way to affected tumour tissues only. This allows a greater dose delivery to affected sites but also reduces radiation to unaffected pelvic structures limiting unwanted effects. For effective use of IMRT, gross tumour volume (GTV) and affected lymph nodes need to be mapped out accurately. The present system of IMRT relies on tumour measurements on CT. However, in our experience CT tends to overestimate the volume of the tumour and it is therefore crucial that MRI be correlated with CT to define the true GTV. The accuracy of MRI tumour volume estimation in cervical cancer has been established.[32]

Role of Imaging in Benign Gynaecological Disease

Benign gynaecological disorders may cause significant morbidity and adversely affect quality of life. Imaging, particularly TVUS, is used for the diagnosis of fibroid disease, assessment of polycystic ovaries and for the follow-up of known benign adnexal lesions particularly dermoid cysts and endometriomas. Increasingly, applications for MRI in the assessment of extra-ovarian endometriosis and for the pre-treatment evaluation of fibroid disease discriminating between patients suitable for myomectomy or fibroid embolisation have been described. TVUS also has a key role in the investigation of infertility whilst MRI is key in the evaluation of congenital malformations of the female genital tract. Hysterosalpingograms are still used in the investigation of infertility as they relative low cost, readily available and provide good anatomical detail of the endometrial cavity and Fallopian tubes. These are increasingly being supplemented by hysterosalpingo-contrast sonography (HyCoSy), which aims to replace laparoscopic procedures in assessing tubal patency. The advantage of HyCoSy is the lack of radiation and it can be carried out in an out-patient setting.

In this chapter we limit our discussion to the established and emerging roles of imaging in congenital Mullerian malformations, endometriosis and uterine fibroid disease.

CONGENITAL ANOMALIES

Congenital Mullerian duct anomalies in women are often asymptomatic and usually discovered incidentally except infrequently when there is obstruction of the uterine outflow. Consequently, the prevalence of congenital uterine anomalies in the general population is difficult to ascertain, but it appears to be more frequent in patients with recurrent miscarriages or infertility. In these patients, HSG is the first-line investigation being an acceptable and widely available diagnostic tool. It provides valuable information regarding the uterine cavity. HSG, however, does not evaluate the external contour of the uterus and cannot reliably differentiate between a septate and bicornuate uterus. Transabdominal or transvaginal ultrasound is used to supplement HSG. Pooled data from reports comparing 2D US and hysteroscopy suggest US has low sensitivities of under 60% in the detection of uterine anomalies but high specificities of nearly 100%.[37] The combination of HSG and US provides a suitable screening tool. Increasingly 3DUS, HyCoSy, hysteroscopy and MRI are used to further evaluate anatomy when HSG and 2D ultrasound are inconclusive (Fig. 4.21). Comparative data on the performance of these techniques is still limited but small studies from single institutions show promising results. Wu et al. showed a 100% sensitivity and specificity of 3D ultrasound when compared to hysteroscopy. MRI offers a non-invasive approach of assessing the internal and external contour of the uterus.[38] When compared to hysteroscopy and laparoscopy in a study with 24 patients, MRI has 100% sensitivity and 75% specificity in the detection and characterisation of Mullerian duct abnormalities (Fig. 4.22).[39] The accuracy and practicality of MRI has not yet been fully determined, however, its role in screening or diagnosing congenital uterine anomalies may become more important in the future. Currently, the combination of hysteroscopy and laparoscopy remains the gold standard in the investigation of Mullerian anomalies, but the main disadvantage of this strategy is the invasiveness of the procedures.

ENDOMETRIOSIS

The clinical manifestations of endometriosis are protean. The majority of patients with endometriosis are thought to be asymptomatic with the commonest site of involvement being the ovaries. The morbidity associated with endometriosis includes chronic pelvic pain and infertility. Endometriosis involving the gastrointestinal tract usually involves the sigmoid colon and rectum. Endometrial implants first involve the bowel serosa but may erode the muscle and mucosa causing bowel obstruction, pain and rectal bleeding. Typically, on barium enema studies, the lesions result in an irregular contour of the bowel wall and loops of bowel may be tethered together. The commonest site of pelvic endometrial deposits is along the anterior wall of the mid rectum. Endometriosis more commonly involves the urinary tract with adhesions or endometriomas obstructing the ureters just below the pelvic brim and bladder deposits causing cyclical haematuria or chronic cystitis. Rare manifestations include intrathoracic deposits causing cyclical pneumothoraces.[40]

A variety of techniques including TVUS, transrectal US, CT and MRI have been used to evaluate deep pelvic endometriosis.

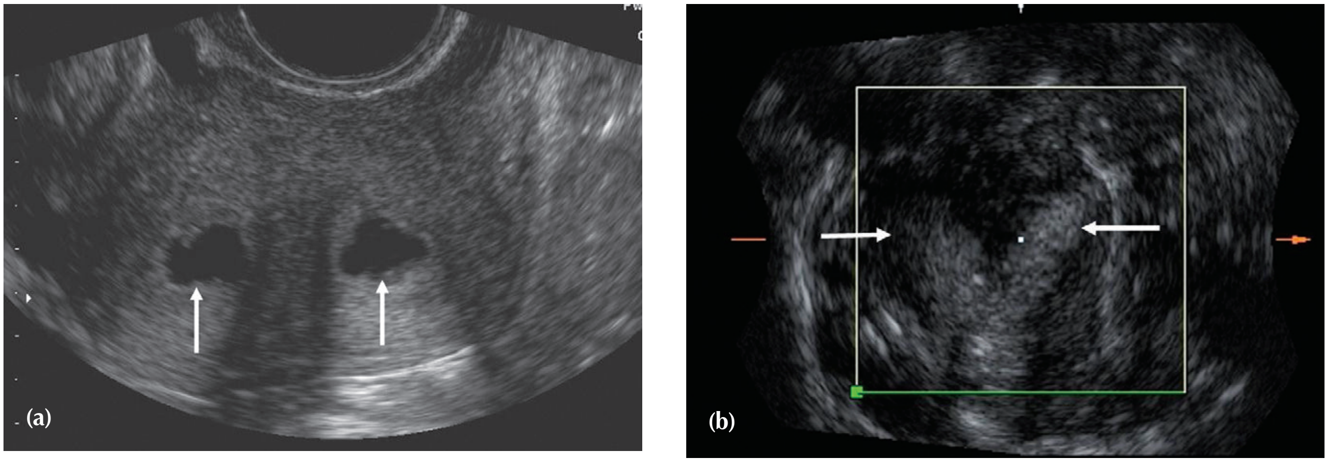


Fig. 4.21: Bicornuate uterus. **(a)** Transverse US image of the uterus at the fundus showing two endometrial cavities (arrows). **(b)** 3D image of the uterus showing two endometrial cavities (arrows) with a convex myometrial contour. The appearances are typical of a bicornuate uterus.

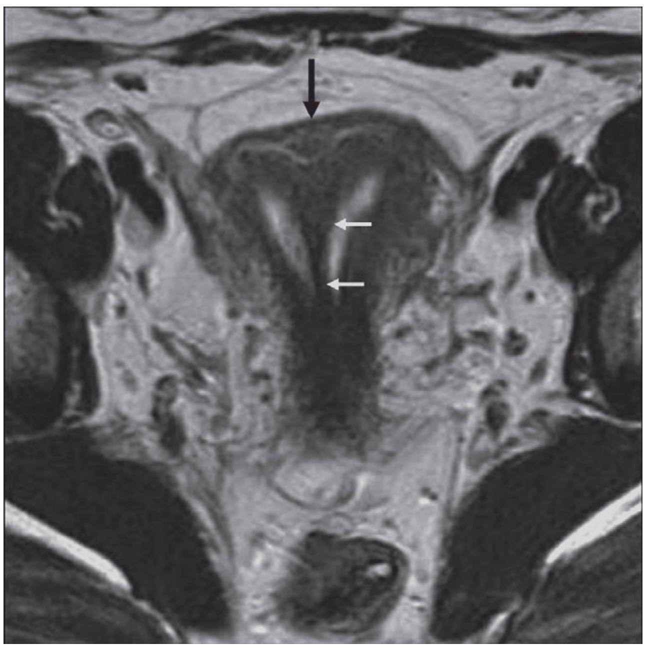


Fig. 4.22: MRI septate uterus. Axial oblique T_2-weighted image demonstrating a normal convex border of the uterine fundus (black arrow). There is a low T_2-weighted septum within the endometrial cavity (white arrows) extending from the fundus to the internal os. The convex fundal border distinguishes a septate uterus from an arcuate uterus.

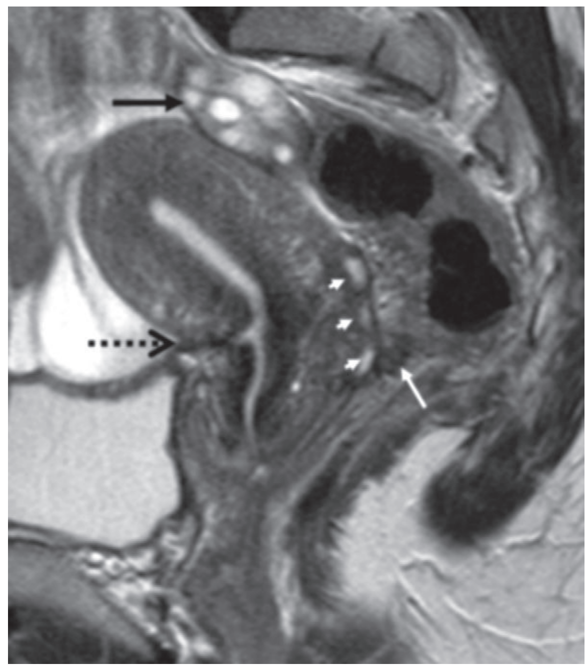


Fig. 4.23: Uterine surface endometrial deposits. Sagittal T_2-weighted image demonstrating high T_2-signal intensity punctate endometrial deposits along the posterior uterine surface (arrow heads) typical of active deposits of endometrial tissue. In addition there is a fibrotic band between the cervix and the anterior wall of the rectum (arrow) with a low T_2-signal intensity typical of fibrosis. The left ovary is medially displaced stuck to the posterior margin of the uterus, a typical feature of extra-uterine pelvic endometriosis (black arrow). A lower segment caesarean section scar is noted (dashed arrow).

Microscopic and small deposits of endometriosis are not well seen on imaging and hence laparoscopy remains the gold standard for diagnosis. Scattered small deposits within the pelvis are not seen on transvaginal ultrasound or CT. Magnetic resonance imaging improves the sensitivity to 68% for lesions diffusely scattered in the pelvis, lesions typically along the posterior uterine surface and in the rectovaginal septum (Fig. 4.23).[41] Surrounding active foci of endometriosis, characteristically fibromuscular hyperplasia occurs. In deep pelvic endometriosis, fibrotic changes due to inactive fibrous tissue and scarring, results in distortion of the posterior vaginal fornix, uterus and uterosacral ligaments. This distortion is clearly seen with a high sensitivity (94%) along with extra-ovarian endometriomas and haematosalpinges (Fig. 4.24).[42] The use of gadolinium contrast agents is useful to increase the sensitivity for detection of active endometrial deposits and secondly to distinguish between active endometrial tissue and fibrosis (Fig. 4.25).

Fig. 4.24: Posterior cul-de-sac lesions. Sagittal T_2-weighted image demonstrating a widened and irregular junction zone of the uterus in keeping with adenomyosis (arrowheads). The posterior vaginal fornix is superiorly displaced and the uterus is retroverted and tethered to the posterior fornix by a dense low T_2-signal intensity fibrotic plaque (arrows).

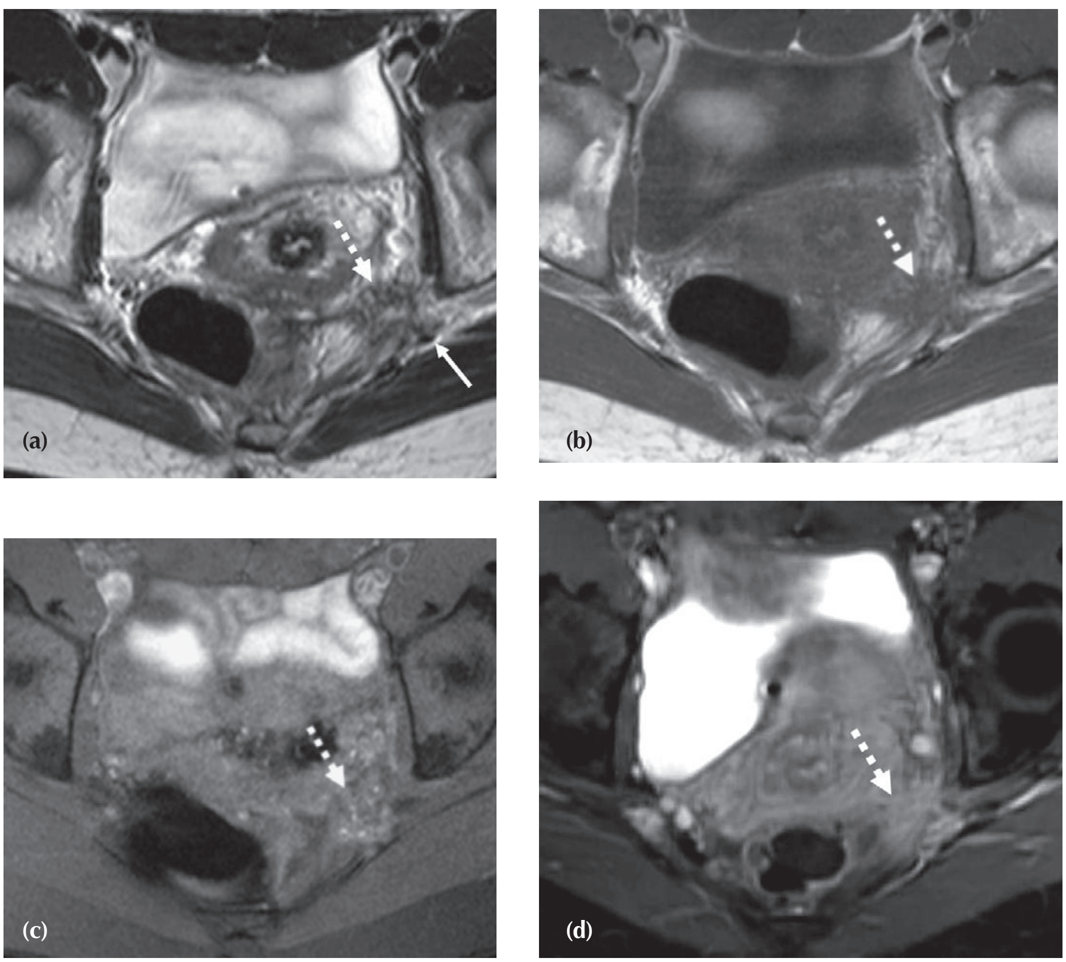


Fig. 4.25: Active extra-uterine endometriotic deposit. **(a)** Axial T_2-weighted image showing an irregular mixed signal intensity lesion in the left sciatic canal and posterior pelvic wall (dashed arrows). The sciatic nerve is seen as the very low T_2-signal intensity structure within the canal and posterior to the endometrial deposit (solid arrow). **(b)** Axial T_1-weighted image demonstrating the irregular margins of the deposit and stranding into the surrounding fat. **(c)** Axial T_1-weighted images with fat saturation. The deposit has punctate areas of high T_1-signal intensity in keeping with haemorrhage and active endometrial tissue. **(d)** Axial T_1-weighted images with fat saturation and following intravenous administration of gadolinium. The deposit enhances avidly typical of a deposit with active endometrial tissue.

Three patterns are observed on MRI in diffuse deep pelvic endometriosis excluding endometriomas, bladder and intestinal lesions: most frequent is involvement of the rectosigmoid junction where the rectum is displaced anteriorly and converges with the posterior uterus. The second most frequent pattern is linear or nodular thickening of the uterosacral ligaments which obliterate the cul-de-sac of the Pouch of Douglas. The third pattern is an extension of the second, with lesions extending from the lower part of the Pouch of Douglas into the rectovaginal septum. The therapeutic options for patients depend on the location and extent of disease and the relative proportion of active and fibrous endometriosis. Active endometriotic deposits are receptive to medical hormone treatment whilst scarring fibrous endometriosis, when symptomatic requires surgical lysis. Increasingly in clinical practice, this information is provided by detailed and high-resolution MR imaging of the pelvis.

LEIOMYOMAS (FIBROIDS) OF THE UTERUS

The role of imaging studies in women with fibroids is to: (*a*) confirm diagnosis of fibroids, (*b*) exclude other causes of uterine enlargement or pelvic masses such as adenomyosis, uterine malignancy and ovarian masses, (*c*) exclude renal obstruction due to fibroid uterus, (*d*) precisely determine number, size and location of fibroids. Conventional radiographs have a limited role in the diagnosis or management of uterine fibroids. Unless heavily calcified, fibroids are not depicted on radiographs. Very large fibroids result in a non-specific soft-tissue masses arising from the pelvis which may displace the bladder or loops of bowel. Computed tomography similarly has a limited role. Fibroids are usually indistinguishable from normal myometrium unless they are calcified or necrotic. Transvaginal ultrasound is the imaging modality of choice in the detection and confirmation of uterine fibroids. The most frequent US appearance is that of a concentric, solid, hypoechoic myometrial mass. However TVUS is very operator dependent and appreciation of the relationship between fibroids and remaining structures of the pelvis is limited. Its main role is to confirm the presence of suspected benign fibroids and exclude significant sub-mucosal fibroids. Detailed evaluation of sub-mucosal fibroids can be performed using instillation of saline into the endometrial cavity which clearly outlines sub-mucosal fibroids.

Comparative studies have shown MRI has a better histological correlation than TVUS for detection and assessment of fibroid size, providing a better estimation of the overall fibroid burden.[43] In addition, MRI can exclude and characterise other pelvic masses, detect adenomyosis and exclude renal obstruction in a single study. Hence, MRI is used for stratification of treatment options in fibroid disease. Magnetic resonance imaging has an important role in defining the anatomy of the uterus and ovaries, as well as planning myomectomy, selective surgical removal or planning selective fibroid therapies like uterine artery embolisation, radiofrequency ablation, HIFU, etc. With the emergence of these selective percutaneous ablation procedures, such as cryotherapy and HIFU, MRI is used in pre-procedural planning, administering therapy by means of open MRI scanners and in follow-up of patients. Uterine artery embolisation (UAE) is now a well-established technique for treating fibroids and is suitable for the majority of women. The technique is clinically successful in the majority (80%–85%) of women following UAE, requiring no further treatment.[44,45] Magnetic resonance imaging is routinely used to plan UAE and for post-procedural surveillance. Intravenous gadolinium is not usually necessary unless assessment of fibroid vascularity is required.

Fibroids have an inconsistent appearance on MRI due to the different types of degenerative changes and variable enhancement patterns (Figs. 4.26 and 4.27). This often leads to myometrial masses being indistinguishable from malignant leiomyosarcomas (Fig. 4.28). The role of MRI in these myometrial masses is to confirm a benign fibroid but cannot reliably exclude malignant leiomyosarcomas although the latter is very rare. The appearances of uterine sarcomas are varied

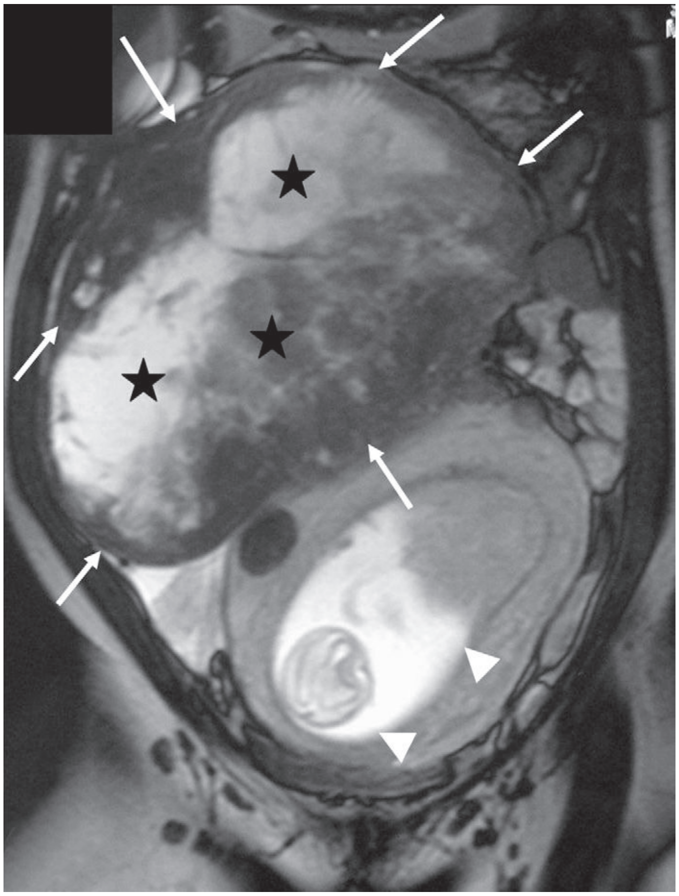


Fig. 4.26: Degenerating fibroid in pregnancy: Sagittal T_2-weighted image showing a large fundal fibroid (arrowed) undergoing cystic degeneration in pregnancy. The fibroid retains low T_2-signal intensity in the periphery (arrowheads) whilst centrally, high T_2-signal intensity in keeping with cystic changes is demonstrated (asterix). The uterine pregnancy and foetus are shown (arrowheads).

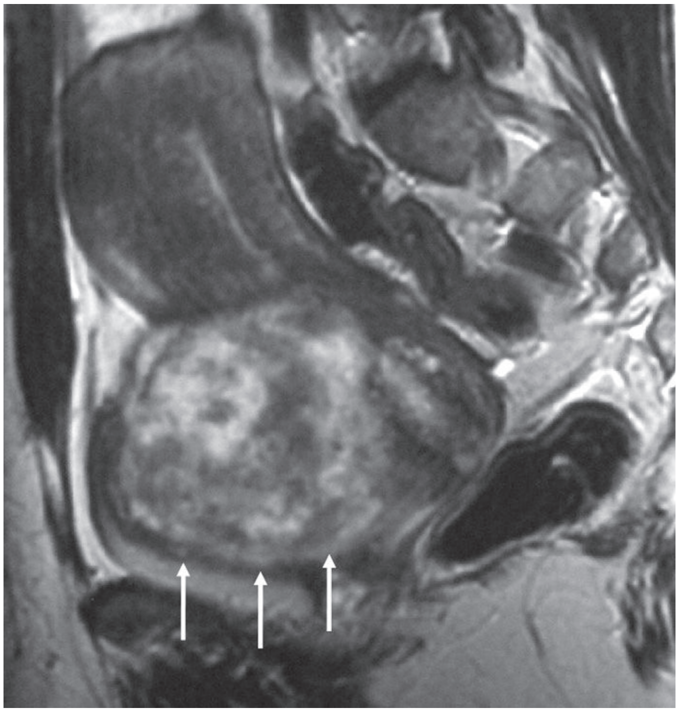


Fig. 4.27: Benign degenerating fibroid: Sagittal T_2-weighted image demonstrating a large anterior cervical fibroid. There is a heterogenous mottled T_2-signal intensity throughout the fibroid. These were shown to be myxoid changes on histological specimen. These appearances are indistinguishable from a leiomyosarcoma.

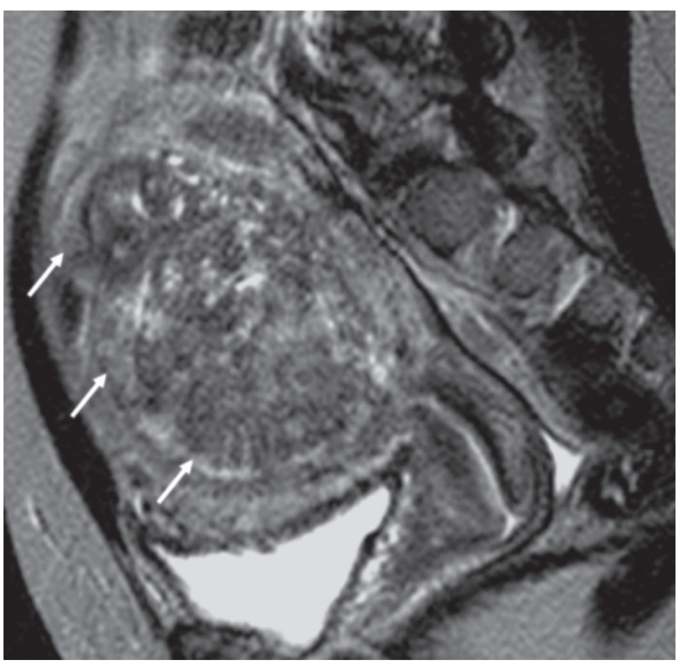


Fig. 4.28: Leiomyosarcoma of the uterus: Sagittal T_2-weighted image showing a large heterogeneous anterior myometrial mass (arrows). The mass is indistinguishable from a degenerating fibroid but a clinical history of rapid growth prompted surgical resection that confirmed a leiomyosarcoma.

with leiomyosarcomas being myometrial-based masses. They have poorly defined margins and contain multiple pockets of high T2 signal intensity which enhance following administration of intravenous gadolinium.[46] Rapid or unexpected growth after menopause, raise the level of suspicion that the mass may be a sarcoma. Also, with advanced malignant lesions there may be evidence of local invasion. Should there be any uncertainty of the diagnosis after ultrasound and MR imaging, surgery is indicated.

Conclusion

Imaging plays an increasing role in the management of patients with gynaecological disorders. Each modality has unique properties that dictate its use in gynaecological pathology. Ultrasound is a real time, easily available, relatively inexpensive, non-radiation-based modality, making it suitable for first line use in young women or for repeated imaging. Transvaginal ultrasound provides very good anatomical detail of the uterus and ovaries. These properties make ultrasound the first line imaging technique for evaluation of the endometrium and adnexal pathology. Although CT is a radiation-based imaging modality, it remains widely used in staging, surveillance and treatment delivery of cancer. Its speed, ease of availability, excellent tissue characterisation and reproducibility are its main strengths. Magnetic resonance imaging provides exquisite anatomical information and has the best tissue characterisation properties for gynaecological imaging. Its role has expanded in all aspects of cancer management and it is likely to continue this growth with the emergence of functional MRI. Functional information provided by PET-CT is increasingly relevant to the detection of early recurrent disease and at staging gynaecological cancers as it improves the detection of distant disease.

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Learning Basic Surgical Skills

5

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Introduction

With the introduction of the European Working Time Directive and subsequent loss of team-based working, the traditional apprenticeship system of training is disappearing. We find ourselves working with a wide range of colleagues, all of whom must be confident that we can equip ourselves well in theatre.

The acquisition and demonstration of a sound skill base signals to your seniors a readiness to accept new surgical challenges—opportunity will invariably be given to those best prepared.

This chapter aims to set out the basic skills a surgeon should have, and how we can best learn them.

What to Learn?

Surgeons should not only know the operation they are about to perform but also the team assembled and the equipment available. As surgeons, we are not soloists and should be able to communicate with our teams clearly and succinctly. How can we ask for an appropriate instrument if we do not know its name, or ask for assistance if we cannot describe the anatomy of the area?

Instruments

To perform an operation safely we need to be able to see what we are doing. This involves choosing an appropriately sited and sized incision, dissecting tissue planes clearly, retracting and manipulating tissues in a safe manner and achieving haemostasis throughout the procedure.

When handed and handling instruments the surgeon's priority is safety for themselves, their patient and assistants; this is best achieved through correct handling, predictable economical movements and thoughtful transfer of instruments between staff.

SCALPELS

During skin incisions hold the scalpel as a dinner knife, with the index finger along the back. The finger should be clear of the tip by at least 3–5 cm and the palm should support the handle securely. Incisions should be made with the full length of the blade rather than the tip and the wrist should be firm rather than flexed. This enables an even pressure and predictable depth to be achieved.

Transfer of scalpels between staff should be done in a kidney dish; or if they must be passed directly, with the handle proffered first.

SCISSORS (FIG. 5.1)

Held with the thumb and ring fingers inserted no further than the distal phalanges, the index finger supports the instrument over the joint. Cuts should be made with the tip of the scissors, which should be under direct vision at all times to avoid inadvertent tissue damage.

Scissors may be curved or straight; curved are usually reserved for tissue, while straight scissors are more normally used for sutures.

The practised surgeon can use scissors in either hand, ambidexterity being a skill surgeons should try to acquire in order to improve efficiency in theatre.

Some assistants may also 'palm' their scissors to keep them handy for cutting sutures. Removing their thumb from one ring, the scissors are rotated to be supported on only the ring finger, with the shaft held across the palm by the little finger.

NEEDLE HOLDERS (FIG. 5.2)

Held in the same way as scissors, the main movement should come from the wrist and forearm. A rotation at the wrist should provide enough energy to pass needle through tissue, if not the initial placement of the suture tip should be questioned.

When returning a needle-holder to your scrub nurse first guard the needle. It is also good practice to announce the passing of all sharps—'guarded needle back', 'unguarded needle in bowl'—especially with unfamiliar teams.

HAEMOSTATS (FIG. 5.3)

Held as scissors or needle holders, the tip is used to grasp vessels, with the target vessel in direct vision the haemostat is applied and pressure increased by virtue of the ratchet lock. Manipulation to allow placement of sutures or application of diathermy should be minimal to avoid damage to the vessel. Removal should be possible with left or right hand, a skill that should again be practised. During removal it is important that the ratchet is released before the haemostat is pulled on to avoid tissue damage.

Fig. 5.1: Scissors.

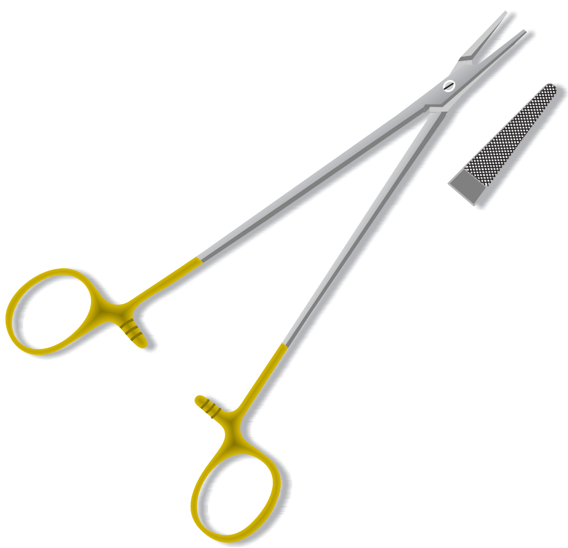

Fig. 5.2: Needle holders.

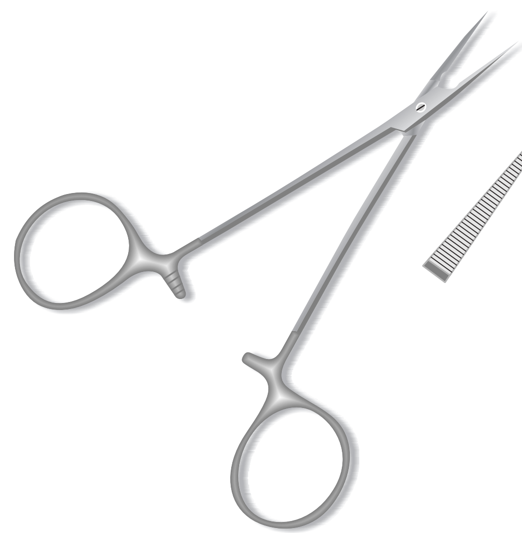

Fig. 5.3: Haemostats.

CLAMPS (FIG 5.4)

These are heavier instruments than haemostats, used to grasp blocks of tissue that require division and ligation. Depending on the location and access clamps may be straight, curved or semi-curved. As the tissue being divided often contains large blood vessels it is imperative that the clamp has a good grip of the contained tissue without causing damage that could cause bleeding prior to ligation. The tip of the clamp should also be considered—if toothed then it should be placed clear of any vessels. Removal of clamps should only be done at the specific request of the lead surgeon, as only they will know whether the suture is in place or knot ready to tighten. As with haemostats it is important that the ratchet lock is released prior to pulling away.

RETRACTORS (FIG. 5.5)

The safest surgery is done under direct vision and retractors should be used to achieve this. They allow visualisation of the target area but can also ensure that tissues are protected from damage. Depending on the area being operated on different retractors may be used. For vaginal work, a Sims' or Langdon may be useful, for deeper pelvic work a self-retaining or ring retractor might be more appropriate.

All of the above instruments come in many variations. When starting to operate, spend some time with the scrub nurse and familiarise yourself with the instruments that make up the minor, major and vaginal sets at your hospital. All sets come with a checklist that can be used to test your

Fig. 5.4: Clamps.

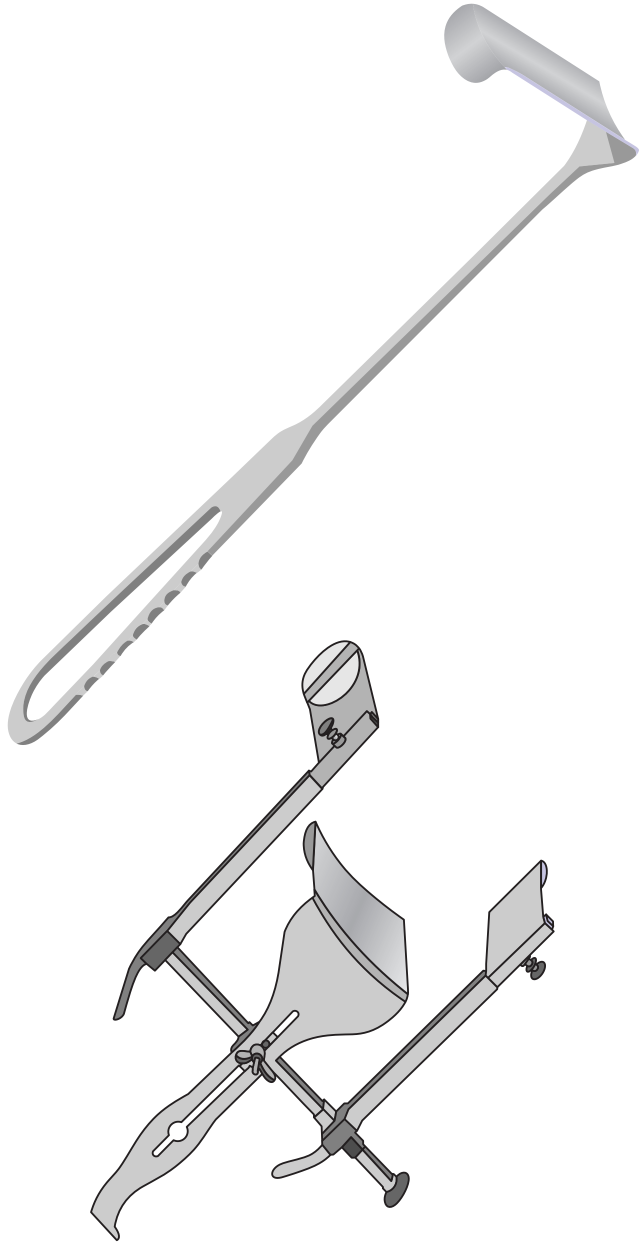

Fig. 5.5: Retractors

knowledge (once the scrub nurse has confirmed the count is correct).

SUTURES

Sutures are used to hold wounds in apposition until healing can occur to a degree sufficient to support the tissues, also obliterating dead space and distributing tension evenly.

This description should be held in mind when selecting the suture and technique appropriate to a wound.

Material

Sutures can be absorbable or non-absorbable, the former having a relatively predictable breakdown profile with gradually

Table 5.1: Suture composition and breakdown – data from Ethicon[1]

	Suture	Material	Construction	Colour	Strength reduction profile	Absorption profile
Absorbable synthetic sutures	Vicryl rapide	Polyglactin 910	Braided	Undyed	50% at 5 days 0% at 10–14 days	42 days
	Vicryl	Polyglactin 910	Braided/ monofilament	Violet/ undyed	75% at 2 weeks 50% at 3 weeks 25% at 4 weeks	56–70 days
	Monocryl	Poligecaprone 25	Monofilament	Violet/ undyed	Undyed Dyed 50–60% 60–70% 1 week 20–30% 30–40% 2 weeks	91–119 days
	PDS II	Polydioxane	Monofilament	Violet/ undyed	4/0 3/0 60–80% 2 weeks 40–70% 3 weeks 35–60% 4 weeks	183–238 days
Absorbable non-synthetic	Surgical gut – chromic 'cat-gut'	Beef serosa or sheep submucosa	Virtual monofilament	Brown/blue dyed	21–28 days	90 days
Non-absorbable	Prolene	Polypropylene	Monofilament	Blue/clear	Non-absorbable	
	Perma-hand silk	Silk	Braided	Black/white	Non-absorbable	

reducing strength. The material of the suture determines the time to breakdown but also the degree of tissue reaction to the suture. The construction of the suture should also be considered—with monofilaments less likely to harbour infection than a braided suture, but braided sutures being more tolerant of handling and easier to securely knot (Table 5.1).

Needles

Once the appropriate suture has been chosen we also have to consider how to introduce it to the tissue. The needle should have the smallest profile required for the suture, be stable and easy to grasp in the needle holder, remain sharp after several passes through tissue and cause minimal trauma to the tissue.

Needles may be traumatic or atraumatic. Traumatic needles need to be threaded; atraumatic needles are swaged to the suture permanently or as a 'pop-off' (separating with a sharp tug).

Cutting Used for penetration of thick/dense tissue
- Conventional – 3rd cutting edge on concave surface – 'surface seeking'
- Reverse – 3rd cutting edge on convex surface – 'depth seeking'
- Side-cutting – flat on top and bottom to reduce tissue injury

Taperpoint Stretches tissue as it passes instead of cutting. Used for easily penetrable tissue and to reduce the chance of fascial tearing.

Blunt Rounded blunt tip to dissect rather than cut. Used for friable tissue and also to reduce needle stick injuries.

Knot Tying and Suturing

Tying a safe efficient knot allows the surgeon to sleep well at night. There are many techniques but all should aim to achieve the following: a small solid knot, tied with minimal thread handling and tensioned evenly. This will give good haemostasis, maintain tensile strength and avoid tissue damage. Techniques for tying single handed, double handed and instrumentally tied knots are shown in Figures 5.6, 5.7 and 5.8, respectively.

- **Reef knot:** The commonest knot used in surgery as it is secure and can be tied using one or both hands.
- **Instrument tie:** Useful when there is a short end that cannot be cleanly manipulated over a finger in order to tie a knot. Always try to manipulate the suture material at the end to avoid damage.
- **Aberdeen knot (Fig. 5.9):** Used to tie a loop and free end, such as is generated at the end of a continuous suture.

- **Interrupted sutures:** These should be placed equidistant from each other and the wound edge, distributing tension equally. When used to close long wounds the first suture should be placed in the middle and then further sutures placed halving these gaps – this ensures that wound closure is even and there isn't an excess of tissue left at one end, resulting in an ugly 'dog-ear'.

  Placed at right angles to the wound, the knot should be laid to one side (with the same side used for all sutures in a row).
- **Mattress sutures:** Placed vertically or horizontally, these are used to ensure eversion or inversion of a wound edge.
- **Continuous sutures:** One end of the suture is secured at the angle of a wound. The length is then used to provide a

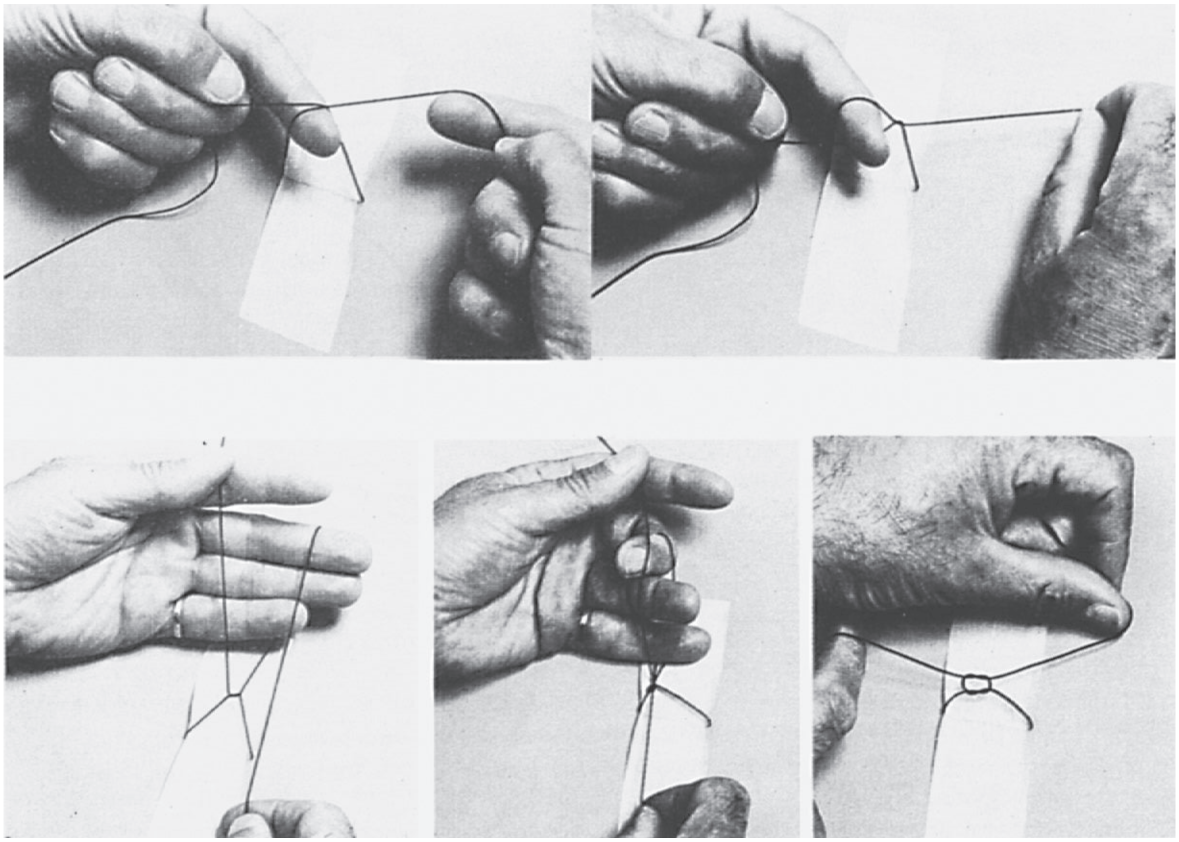

Fig. 5.6: Single handed variety of surgeon's knot.

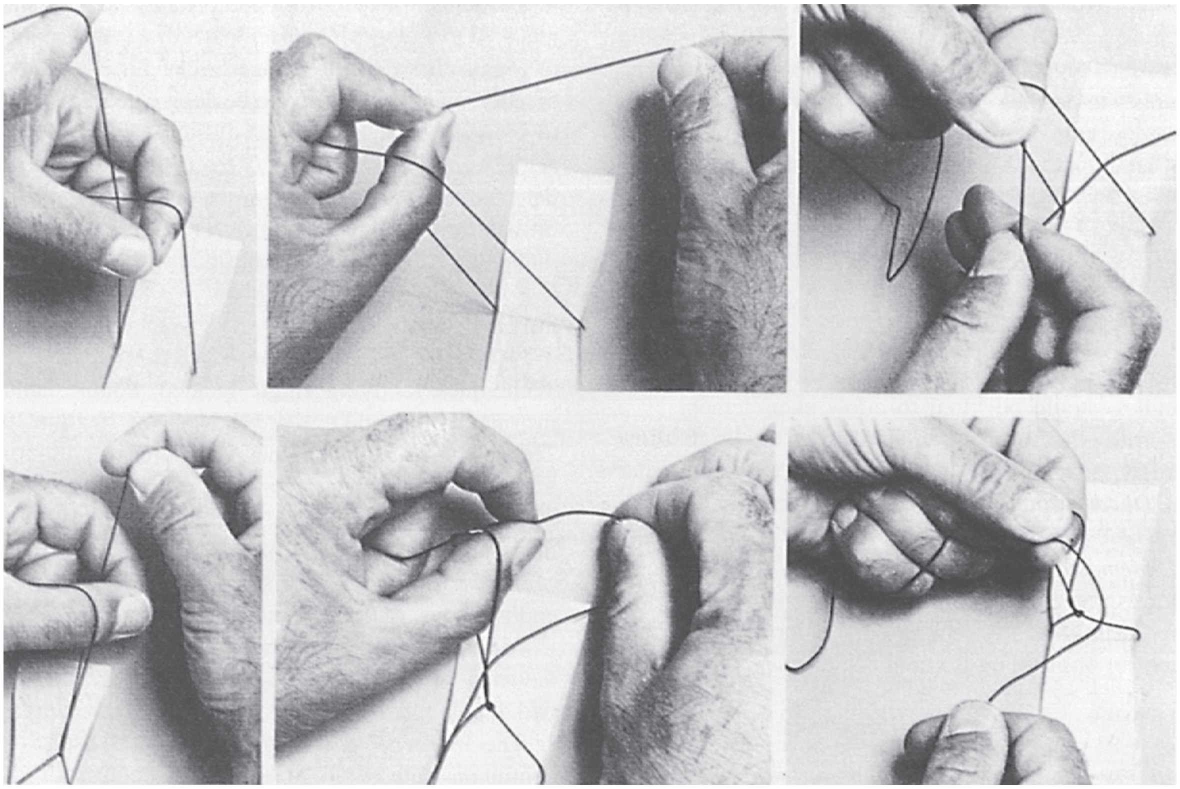

Fig. 5.7: Double handed variety of surgeon's knot. This knot should be used for all major pedicles. It is easier to maintain appropriate tension between throws and to ensure that a true reef knot is tied rather than two half hitches (sliding knot).

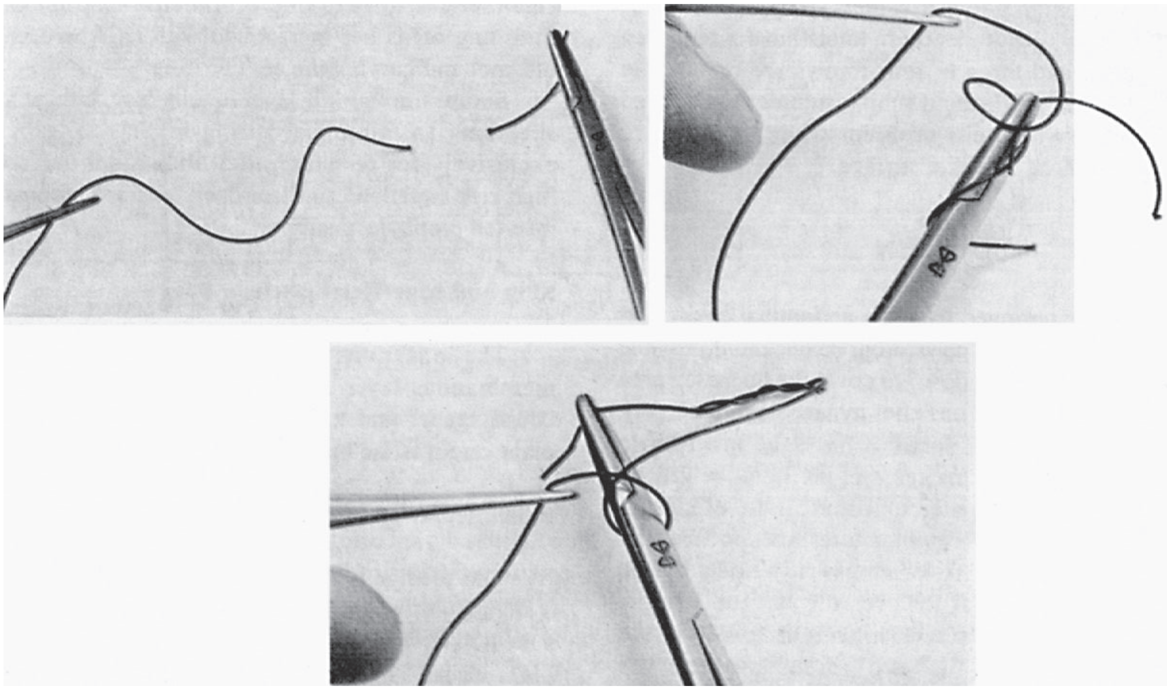

Fig. 5.8: Instrumental method of surgeon's knot. This is essential for microsurgical procedures. Note the length of free suture material which is left after insertion of the suture and the direction in which it lies. The loop should be formed approximately three times the free length in order to achieve accurate placement of the throw. Efficient knot tying depends upon correct positioning in the initial stages.

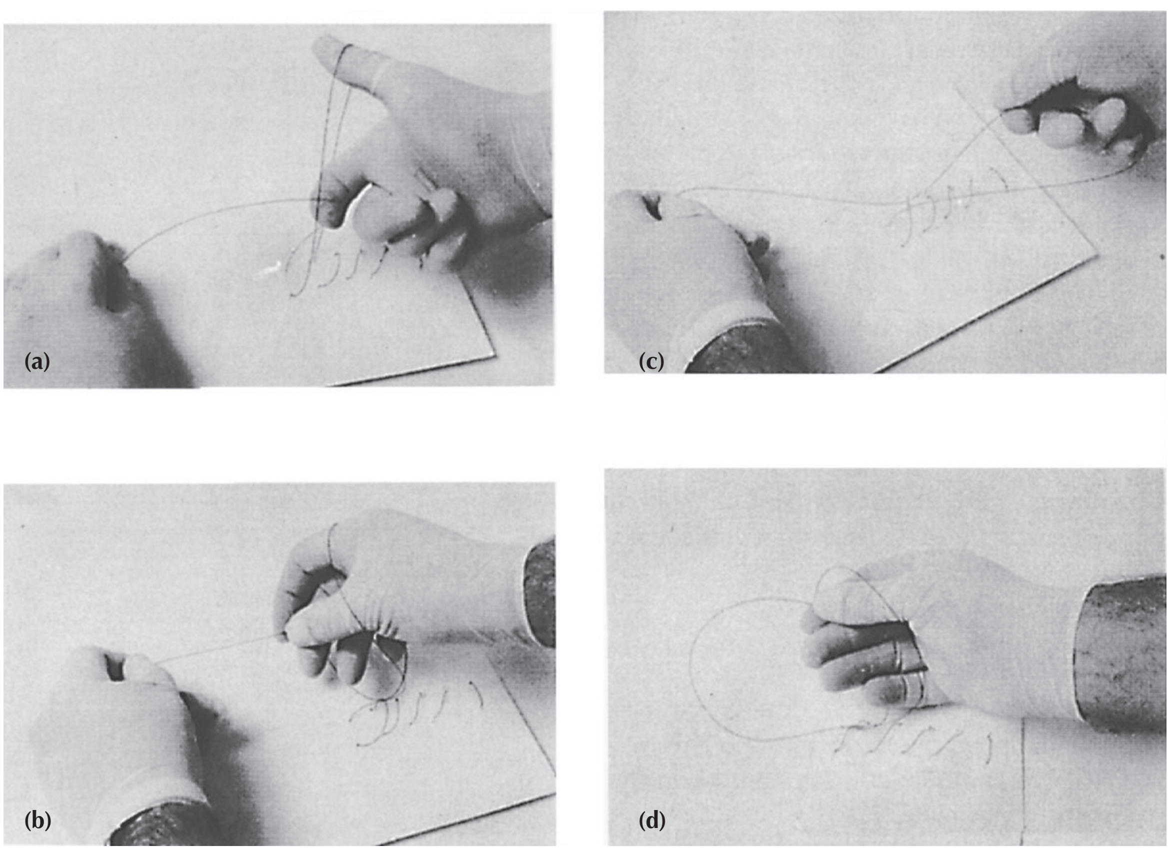

Fig. 5.9a–d: Aberdeen casting off knot. Traction should only be applied to the lower ("afferent") limb of the loop; this tightens the throw without the risk of friction damage.

'running' stitch. The strength of this type of suture is dependent on tension being maintained evenly throughout, usually via an assistant 'following' and holding the suture material taut.

- **Sub-cuticular sutures:** A variation of a continuous suture, here the material stays in the sub-cuticular layer, with sutures placed to ensure direct apposition of the wound edges.

Electrosurgery: Use and Safety

Adequate haemostasis is a constant concern for the surgeon. As surgeons of old would use cautery through the application of heated tools, the modern surgeon relies on electricity. The application of voltage across a material produces an electrical field that causes a flow of charge carriers, electrical current. As current flows, the resistance of the tissue converts some of the original electrical energy into heat energy.

BIPOLAR

A pair of similar sized electrodes are used – usually a pair of forceps. One prong is attached to one pole of the AC generator, while the other is connected to the other pole of the generator. High-frequency electrical current flows from one to the other heating the tissue held between.

MONOPOLAR

The surgeon uses a single electrode to deliver the energy, which returns to the generator via a larger return electrode attached to the patient. Current density and therefore the heating potential drops rapidly with increasing distance from the active electrode so heating only occurs in a localised area.

Typically electrosurgical equipment operates in the radiofrequency range (200 kHz–3.3 MHz). This minimises muscle and neuronal stimulation. Electrosurgery can cut, coagulate or fulgurate tissue.

Cutting (yellow pedal)	The electrode touches the tissue and sufficient energy density is applied to explosively vapourise the water content. The vapour cannot normally conduct current and therefore the effect is self-limiting. Cutting is normally performed with a continuous high current and low-voltage sine waveform
Coagulation (blue pedal)	The sine waveform is interrupted, and therefore voltage in periods of flow increases, generating a greater heating and coagulation effect. Protein denaturation and fibrinous tissue bonding is triggered, sufficient to seal small and medium diameter blood vessels
Fulguration (blue pedal)	The electrode is held away from the tissue. An arc is generated and as the current is spread over a wider area a more superficial depth of heating is achieved. This is typically used on surface lesions rather than individual vessels.

SAFETY

Safe return of current (completion of circuit) is essential to avoid inadvertent damage to the patient. Potential pitfalls are outlined below. Electrocautery will also generate smoke; there are concerns that this is potentially carcinogenic and so it should be sucked away from the field as efficiently as possible.

Grounding pad wrongly placed	Insufficient contact with the grounding pad can lead to third degree burns in areas where the contact was poor, or in other areas of the patient in contact with metal objects that provide an alternative grounding pathway. Pads should always be placed as closely to the operating site as is practical, typically on the outer aspect of the thigh in gynaecology surgery.
Metal-work not recognised	If the patient has any metallic implants, such as a hip replacement, the grounding pad should be placed on the opposite side of the body from the metal to prevent current passing through selectively on the way to ground.
Unintentional thermal damage	The electrode should always be firmly placed on tissue, with the whole electrode under direct vision to prevent inadvertent damage. An unwanted current path can also develop if another conducting instrument is present and in contact with the electrode, leading to damage distant to the electrode. The electrode may also retain some heat so should be handled with care. When not in use the electrode should be kept in an insulated holder.
Insulation failure	If there is a break in the insulation of the electrode then thermal effect will occur wherever current can flow.

How Do We Learn?

Learning and education have long been fertile areas for research. When looking at educational theory it is important to use it as a lens through which to perceive our own learning behaviours and as a catalyst for increasing their efficiency.

We first have to prepare to learn. Hopefully our years of study at Medical School will have equipped us with an ability to assimilate facts and exposed us to a surgical environment for long enough that we have a basic familiarity to build on. Armed with that familiarity it becomes easier to see the usefulness of the abstract skills we have to acquire. Considering the application of each skill allows us to place it within a growing network of knowledge that will become increasingly interconnected.

Once prepared, we then start to acquire skills through several methods:

- **Changes in the way we behave**
  - ***Respondent conditioning:*** This is the association of a behaviour with a stimulus. Pavlov trained his dogs to salivate to a number of non-food stimuli because they

were all initially presented in conjunction with food. This requires repetition but no analysis.

If a surgeon always asks for a certain suture when they are concerned about bleeding, the anaesthetist eventually starts to check the patient's blood pressure in response to overhearing a request for that suture type.

- ***Operant conditioning:*** This requires a trigger and response – an operant and reinforcement. B. F. Skinner developed this theory, stating that rewards speed up learning if they come directly after the behaviour, but the effect lasts longer if rewards are only intermittent.

  The trainee places a suture well (operant) and is sometimes allowed to start the next procedure (reinforcement).

- **Changes in the way we think**
  Using the theories of Jean Piaget,[2] who worked primarily on child learning, we look at assimilation and accommodation—interpreting new information in view of pre-existing knowledge and concepts, then revision of pre-existing concepts in light of new information. This is the way that the self-directed learner works. With changes in training encouraging more formal education and instruction we find Jerome Bruner's theory more relevant that guidance in the form of 'instructional scaffolding' can speed and heighten the acquisition of knowledge.[3]

  We will look at an incision site in view of our pre-existing knowledge of the paths of nerves in the area (assimilation), alter our 2D concept of anatomical relations as we operate more (accomodation), and progress through this more quickly if our lead surgeon explains the reasoning behind his approach while quizzing our knowledge (instructional scaffolding).

- **Changes in our procedural ability and psychomotor skills**
  A common model for skill acquisition is that outlined by Dreyfus & Dreyfus.[4] Building on work initially funded in part by the US Air Force they developed a five-stage model of the mental activities involved in directed skill acquisition.

Novice	Rigid adherence to taught rules or plans Little situational perception No discretionary judgement
Advanced beginner	Guidelines for action based on attributes or aspects Limited situational awareness All attributes and aspects treated separately and equally
Competent	Conscious deliberate planning Standardised routine for procedures
Proficient	Holistic perception of situations Can perceive and respond to deviations from an established pattern Able to perceive the important aspects of a situation
Expert	No longer relies on guidelines or rules Intuitive grasp of situations Analytical approach only used for novel situations

The aim of training is to accelerate progression up this scale, while ensuring that patients do not suffer at the hands of the trainee. Taking the example of wound closure:

- Knows the steps involved in placing a sub-cuticular suture.
- Able to close skin when prompted with a sub-cuticular suture.
- Aware that skin is normally closed with a sub-cuticular suture and can perform this from start to finish without prompting.
- Able to see that a wound may benefit from an alternative method of closure and select a better alternative after consideration
- Automatically alters technique to the situation without needing to analyse, based not only on wound characteristics but also patient need.

We aim to move from 'controlled processing' to 'automatic processing'.[5] This involves the transition from complete immersion in a step-by-step process that demands our full attention, to being able to complete a set of tasks automatically while also being aware of the wider situation and having the capacity to plan our next step. We have all been in situations where ourselves or others were so focused on the correct application of a suture or device that other considerations, such as blood loss or correct use of assistants was forgotten.

How to Learn

TRAINING PROGRAMMES

Modernising Medical Careers (www.mmc.nhs.uk) has changed post-graduate medical training in the UK completely. Driven by a need to reflect the changing environment in which care is delivered, MMC acknowledged the importance of effective teams and multidisciplinary working, while acknowledging that service provision and personal development had to be balanced. The process established key principles for any training programme (see box).

Key Principles and Standards for Postgraduate Medical Education Training Programmes[6]
High-quality patient care depends on sound education and training.
Programmes must follow the guidance set out in the General Medical Council's guidance 'Good Medical Practice'.
Programmes must have a defined curriculum to enable trainees to achieve that Programme's learning outcomes.
Programmes must be sensitive to the trainee's individual needs.
Selection for entry to Programmes must be fair.
Programmes must promote equality and value diversity within the profession.
Programmes must have explicit quality assurance processes.
Those who have responsibilities for training must develop the skills, attitudes and practices of a competent teacher and ensure that trainees are properly supervised.
Programmes must be resourced to achieve the Programme's learning outcomes.
Programmes must take place within the regulatory framework laid out in UK law.

This led to the development of a new training scheme in the UK. After 2 years in a Foundation programme there are 7 years of speciality training; ST1-2 at an SHO level, then ST3-5 to develop core skills, leading to ST6-7 where advanced training in specific areas is pursued, after which the Certificate of Completion of Training is awarded. The key principle which underpins the new approach to Speciality training is a seamless single programme where basic and higher competencies are acquired progressively.

In US, medical students apply directly to a Residency programme, and if accepted as a categorical trainee will proceed through the years of training in much the same way as in the UK system.[7]

SIMULATION IN TRAINING

'Simulation is a technique – not a technology – to replace or amplify real experiences with guided experiences that evoke or replicate substantial aspects of the real world in a fully interactive manner.'

—Professor David M Gaba, Stanford University

Simulation training covers everything from a low-fidelity simulation of skin for suturing practice to a virtual reality high-fidelity interactive programme for practising laparoscopy.

Why Use Simulation?

The Chief Medical Officers report in 2008 called for simulation to be more fully integrated into the health service as it had demonstrated an ability to train surgeons in a way that reduced error and improved technical accuracy. Simulator training in laparoscopic salpingectomy increased proficiency levels and halved operating time compared to traditional teaching methods.[8]

Simulation appears to achieve this through the theory of 'deliberate practice'. Proposed by Ericsson,[9] the learner focuses on individual tasks chosen by a teacher. Repeated practice accompanied by immediate feedback and teaching leads to the attainment of expertise in a predictable way. This situation is hard to achieve in the operating theatre as it requires the repetition of tasks in quick succession. The Dreyfuss model of skill acquisition shows that simulation should allow us to achieve competence with our basic skills, thereby ensuring we can make the most of valuable theatre time.

Simulators allow slow, deliberate, repetitive practice in a safe and non-threatening environment where mistakes can be recognised and rectified without impact on patients.

Types of Available Simulator Training

Tasks presented in a concrete everyday manner are easier to grasp and solve. Simulators attempt to reproduce, to a greater or lesser extent, the clinical situation. They can be divided into low and high fidelity (Table 5.2).

- **Low fidelity:** Reproduce aspects of a task using some of the usual equipment.
- **High fidelity:** Reproduce a clinical situation using realistic materials and equipment.

Both box trainers and virtual reality simulators allow the trainee to develop one of the most important skills in laparoscopy – effective navigation of a 3D environment while guided by 2D visual feedback. Specific tasks, such as camera and instrument handling, hand-eye coordination and precise movement and manipulation[10] have been shown to improve with targeted box trainer use, while virtual reality simulators have improved blood loss and operating time in simulated procedures.[11]

The trainee should use simulation technology only where there is access to feedback – either directly from the software or via a trainer being present. All the studies showing positive effects on training have been based around specific tasks. Goal setting and feedback improve skill levels in the simulated environment and in the theatre.[12,13]

Table 5.2: Types of simulators

Type of simulator	Description and examples	Assessment	Advantages	Disadvantages
Bench models – low fidelity	Static, usually single task, models. Suturing practice – perineum models	Observation by supervisor, comparison to completed models	Cheap Mass produced and available from a variety of providers Portable	Requires presence of a trainer Disparity between model and reality Usually limited to one task
Box trainers – low fidelity	Endoscopy trainer using a closed box with insertion points for instruments and camera	Observation by supervisor Comparison to video of 'ideal' technique	Can be purchased or improvised from existing equipment Can use real surgical instruments	Better with presence of a trainer Sensory feedback different to real tissue
Virtual reality simulators – high fidelity	Computer-based system where an interface based on real surgical instruments feeds data to a life-like display	Direct from software using ideal parameters for specific tasks	Allows trainee to practice without direct supervision Multifunctional – can be used for single tasks or whole procedures	Expensive equipment Not all systems have tactile feedback Usually static due to cost and size

5

5

USING ASSESSMENT TO DRIVE LEARNING

To proceed through the new speciality training programmes requires each trainee to prove their acquisition and mastery of skills. While this may be viewed by many as a time-consuming paper exercise, it can be harnessed to improve learning. Feedback allows us to improve our techniques, and formal assessment can provide structure to that process.

Case Logs

Measuring activity and hours spent in the operating theatre is a traditional method of assessing a trainee, undermined by recent reductions in working hours. We would suggest an addition to this system.

Start to develop your own 'ideal' method for an operation. Within this text you will find guidance on how to perform certain procedures. These are safe and effective methods that have been honed overtime. From theoretical texts, such as this, build knowledge of the steps required. Master the basic skills that will allow you to be an efficient assistant, then watch your seniors. Take the best parts of their techniques and add them to your own, building not only a log of cases but also the best surgical methods.

OSATS

Objective Structured Assessment of Technical Skills (OSATS) are forms used as a framework for assessing a procedure performed by a trainee. They have been validated[14] and adopted widely. By breaking tasks into acquirable competencies they allow tracking of skill development overtime.

Educational Resources

No matter which of these methods you utilise, it is important that time is directed well. Feedback is essential – only those more competent than ourselves can point out the extraneous step or awkward movements that would otherwise become barriers to efficiency.

WEBSITES

www.stratog.net Available as online access or a DVD, StratOG provides a wide theoretical knowledge based on UK guidelines and training requirements. Regular evaluation of knowledge via MCQ style questions encourages learning.

www.anatomy.tv A subscription service (free for Athens users) that provides interactive 3D models of the human body, with many specific gynaecological sections.

www.laparoscopy.com An American-based website with pictures and videos of laparoscopic procedures.

www.surgicalskills.net This covers basic techniques, such as knot tying and suturing, as well as general information on surgical instruments, consent, etc. Most content is accessed with a subscription.

www.winkingskull.com Contains detailed anatomical drawings and radiological imaging.

www.google.co.uk Not a resource in itself, but a portal to numerous instructions in how to construct your own box trainer for practising laparoscopic skills, or tissue simulations for suturing practice.

www.youtube.com and **www.medicalvideos.us** Not peer-reviewed but a source for many suturing technique videos, as well as footage of operative procedures and anatomy demonstrations. Use with caution.

COURSES

Basic Practical Skills

With a curriculum set by the RCOG, the Basic Practical Skills course covers a wide range of skills. It is an essential requirement for transition to ST3 level. Details of times and locations can be found at http://www.rcog.org.uk/event. Skills covered include the following:

- Principles of safe and effective surgery
- Handling instruments
- Knot tying
- Suturing
- Handling tissues
- Principles of haemostasis and dissection
- Principles of electrosurgery
- Principles of gynaecological examination
- Anatomy of pelvic floor
- Endoscopic equipment
- Principles of safe hysteroscopy
- Principles of safe laparoscopic entry
- Episiotomy repair
- D&C evacuation of uterus
- Management of normal and breech delivery
- Fetal blood sampling
- Caesarean section
- Ventouse and forceps delivery
- Management of shoulder dystocia
- Management of massive obstetric haemorrhage
- Surgical documentation

Challenges to Learning

We cannot ignore the fact that economic pressures on healthcare mean that all provision must be cost effective.

Private care providers have no obligation or incentive to provide training but will be removing the straightforward cases from the NHS and therefore the trainees view.

Not all hospitals will be able to provide all services. The Royal College of Obstetricians and Gynaecologists produced a report that considered how future workforce considerations would impact on training.[15] Trainees will have to harness the opportunities offered where they are employed and increasingly may have to consider their educational needs when considering their next placement. We may also have to cope more often with the challenges of working across sites. When designing rotations within training programmes it will be up to the trainees to push for fair exposure to all areas.

These changes may make formal trainees seem an expensive luxury for trusts to support, although this short-term view could lead to a future shortage in appropriately skilled consultants.

Conclusion

The move from a consultant-led to consultant-delivered model of care has reduced the volume of operating available to junior doctors, but it also gives us an opportunity to see the different techniques and approaches employed by our seniors.

The best surgeons never stop learning and their techniques will change overtime to take advantage of new technology and advances in knowledge.

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Postoperative Care and Prevention of Complications

6

Claire Mellon, Emma Kirk

In recent times there have been changes to the pre- and postoperative care of the gynaecological surgical patient to reflect changes in surgical practice. Endoscopic procedures are commonly performed and patients have a much shorter stay in hospital. Many procedures are performed as day cases. As a consequence, patients are often only admitted a few hours pre-operatively whether they are day cases or planned inpatient admissions. Clear protocols for patient selection are therefore extremely important. It is also important to have clear protocols and pathways for the management of these women postoperatively and in order to plan discharge. The early recognition of any postoperative complication is of great importance, both in order to institute prompt corrective treatment and to reduce the possibility of patients needing readmission following an early discharge.

Table 6.1: Levels of postoperative care

Level of Care	
0	Patients whose needs can be met through normal ward care in an acute hospital
1	Patients at risk of their condition deteriorating, or those recently relocated from higher levels of care, whose needs can be met on an acute ward with additional advice and support from the critical care team
2	Patients requiring more detailed observation or intervention including support for a single failing organ system or postoperative care and those 'stepping down' from higher levels of care
3	Patients requiring advanced respiratory support alone or basic respiratory support together with support of at least two organ systems. This level includes all complex patients requiring support for multi-organ failure.

Immediate Postoperative Care

At the end of a surgical procedure, it is the role of the anaesthetist to determine when the patient is fit to be removed from the operating table. If the procedure has been performed under general anaesthesia, this will usually require reversal of muscle blockade and the re-establishment of spontaneous respiration. The patient will then be transferred to a recovery area within the theatre suite until consciousness has returned. The following parameters are closely monitored: pulse rate, blood pressure, respiratory rate, temperature, peripheral oxygen saturation, urine output, level of consciousness and pain score. Careful monitoring of vital signs and the use of an early warning score such as the modified early warning score (MEWS) during the recovery period is essential.[1,2] In the first hour following surgery, these observations may be monitored every 15 minutes, reducing to every 30 minutes for the next 2 hours and then hourly. Depending on the clinical situation, other forms of monitoring may also be required, such as central venous pressure (CVP), arterial blood pressure, arterial blood gases, electrocardiogram (ECG), hourly urine output and drainage from wounds. The intensity of monitoring required will determine to what level care the patient is transferred. Levels of care range from a normal surgical ward (levels 0 and 1) to intensive care (level 3) (Table 6.1).

Most complications that arise in the initial postoperative period are of an anaesthetic nature, resulting in respiratory or cardiac compromise. However, some surgical complications may arise in this immediate recovery phase, which is why it is essential to produce comprehensive operative notes detailing any intra-operative complications and giving a clear postoperative management plan to hand over to the recovery staff.

ANALGESIA

Postoperative patients require effective pain relief because it leads to a smoother postoperative course and has important physiological benefits. The site of the surgery has a profound effect on the degree of pain experienced and the consequent physical limitations. Any abdominal procedure may affect the ability to cough and clear secretions from the lung, and this may lead to a chest infection. Prolonged pain may also reduce physical activity and lead to venous stasis resulting in an increased risk of venous thromboembolism (VTE). There can also be effects on gut and bladder function, with the development of postoperative ileus, nausea, vomiting or urinary retention.

The aim of postoperative pain management is not only to minimise patient suffering but to also reduce morbidity and facilitate rapid recovery and early discharge from hospital. Postoperative management should be step-wise. The World Health Organisation Analgesic Ladder (Fig. 6.1) was introduced to improve pain control in patients with cancer, but is now universally employed for the management of pain relief.

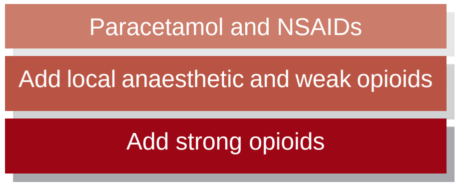

Fig. 6.1: WHO analgesic ladder.

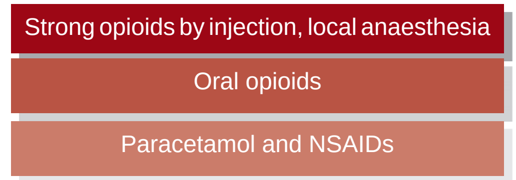

Fig. 6.2: WFSA analgesic ladder.

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Management starts with simple peripherally acting drugs such as aspirin, paracetamol and non-steroidal anti-inflammatory drugs (NSAIDs). If pain control is not achieved, the second part of the ladder is to introduce weak opioid drugs such as codeine. If this is still ineffective, the final rung of the ladder is to introduce strong opioid drugs such as morphine. The World Federation of Societies of Anaesthesiologists (WFSA) has developed another ladder for guidance of postoperative pain management (Fig. 6.2).[3] Initially, when the pain is expected to be severe, strong analgesics in combination with local anaesthetic blocks are used. These will usually be administered avoiding the oral route. As postoperative pain decreases with time, the need for drugs to be given by injection should cease and the oral route can be used. This will initially be with paracetamol, NSAIDs and weak opioids. The final step will be for the pain to be controlled with just paracetamol and/or NSAIDs.

The choice of analgesia will depend on the site and extent of surgery (Table 6.2). Infiltration of a wound with a long-acting local anaesthetic can provide effective analgesia for many hours. If a strong opioid is needed, this can be administered via a patient-controlled analgesia (PCA) pump. It is known that patients' requirements for opioids vary considerably and so administration via a PCA allows a patient to titrate the dose to their own requirements, hopefully minimising side effects.

Excessive pain in the early hours after an operation, or apparent failure of analgesia, may be an early sign of a serious postoperative complication such as intra-abdominal bleeding or a perforated viscus, particularly if it is associated with deterioration in vital signs or excessive restlessness. Early surgical review is mandatory in such circumstances.

Table 6.2: Analgesic options depending on severity of surgery and pain

<table>
<tr><th>Mild pain</th><th>Moderate pain</th><th>Severe pain</th></tr>
<tr><td rowspan="3">e.g. laparoscopy hysteroscopy</td><td rowspan="2">e.g. hysterectomy</td><td>e.g. pelvic exenteration radical cancer surgery</td></tr>
<tr><td>1. Paracetamol and wound infiltration with local anaesthetic
2. NSAIDs
3. Epidural or PCA</td></tr>
<tr><td colspan="2">1. Paracetamol and wound infiltration with local anaesthetic
2. NSAIDs
3. PCA</td></tr>
<tr><td colspan="3">1. Paracetamol and wound infiltration with local anaesthetic
2. NSAIDs
3. Weak oral opioid, if necessary</td></tr>
</table>

OXYGEN

There is little evidence to suggest the routine use of oxygen in the postoperative patient, but some studies have suggested supplemental oxygen reduces the incidence of wound infection. Hypoxaemia is common after surgery due to impaired gas exchange and ventilatory control following a general anaesthetic. Supplemental oxygen should only be used routinely in those at high risk of developing complications or who have oxygen saturations less than 92%. Those at increased risk of developing complications who may need prolonged monitoring and oxygen therapy include the obese, those with acute or chronic pulmonary disease, and those requiring sedative drugs or systemic opiates in the postoperative period.

TEMPERATURE

A postoperative patient is at risk of both hypothermia and pyrexia in the immediate postoperative period. Hypothermia may occur during surgery due to anaesthetic-impaired thermoregulation, open body cavities, the administration of unwarmed intravenous fluids and a cold-operating environment. It may also be a sign of sepsis in the acutely unwell.

Active warming is appropriate for patients who are hypothermic. Forced air warming, used both intra-operatively and postoperatively to maintain a normal body temperature has been shown to be associated with fewer cardiac events in the postoperative period.

FLUID BALANCE

In the postoperative period, patients are vulnerable to fluid and electrolyte imbalance due to many factors including intra-operative blood loss, fasting for long periods, pre-operative bowel preparation and exposure during surgery. It is therefore important to accurately measure the patient's fluid balance in the recovery period. This should include recordings of the output of drains as well as of urine and vomit, and the measurement of fluid intake (oral and intravenous). The surgical wound and wound drainage sites should also be inspected regularly for excessive loss.

The standard principles of fluid balance in the postoperative patient are to correct any pre-existing deficit, to supply basal needs, to replace any unusual losses (e.g. due to surgical drains and pyrexia) and to use the oral route whenever possible.[4] The basal requirements of a healthy adult are approximately 30 mL/kg/day of water, 1.0–1.4 mmol/kg/day of sodium and 0.7–0.9 mmol/kg/day of potassium.

Those with large peri-operative fluid losses are most at risk of fluid and electrolyte imbalance within the postoperative period, as are the elderly, those with pre-existing cardiovascular, cerebrovascular or renal disease, and those that have suffered acute myocardial ischaemia or infarction in the peri-operative period. All patients should be monitored for hypotension, tachycardia, oliguria, signs of fluid overload (e.g. pulmonary oedema) and for more subtle signs such as confusion or tachypnoea. Oliguria is defined as a urine output of less than 0.5 mL/kg/hour for two consecutive hours. Hypotension, tachycardia, oliguria, confusion and tachypnoea may all be signs of hypovolaemia. These may also be signs of sepsis or a primary cardiac problem, but in a postoperative patient it is vital to first consider blood loss as a possible cause.

CATHETERS

Urinary catheterisation is commonly performed prior to gynaecological surgical procedures for a variety of reasons. An 'in and out' catheter may be inserted just to empty the bladder for the start of the operation, or an indwelling catheter may be used to minimise trauma to the bladder during surgery and to monitor urine output intra- and postoperatively. A Foley catheter may also be left in if spontaneous voiding is likely to be difficult in situations such as the use of vaginal pack, where epidural anaesthesia has been used or if the patient is likely to be immobile.[5]

An indwelling catheter is usually left in to allow drainage of the bladder until the patient is mobile and this is usually less than 24 hours. If the catheter is left in for longer than 72 hours, the risk of infection rises from <5% to 70%–90%.

Urinary retention may occur postoperatively whether catheterisation has been performed or not. Pain, over-distension of the bladder, traumatic instrumentation, operations adjacent to the bladder neck, epidural anaesthesia and pharmacological agents such as opioids are thought to play a role. Acute retention should be managed by immediate and complete drainage of the bladder by urethral catheterisation. If urethral catheterisation is not possible, it may be necessary to insert a suprapubic catheter.

A period of prolonged catheterisation may be necessary if there has been a bladder injury which is the most common visceral injury sustained in gynaecological surgery. Most cases are recognised at the time of surgery and the bladder will have been repaired. It should then be drained continuously for 10–14 days, and some clinicians recommend a cystogram prior to removal of the catheter; a urological opinion may be appropriate in some circumstances.

A longer period of catheterisation may be indicated in other situations where the bladder has been opened intentionally or inadvertently, or following fistula surgery. The choice between a urethral and a suprapubic catheter may be optional depending on the nature of the surgery. A suprapubic catheter is particularly useful when voiding difficulties are prolonged, as it can be intermittently clamped to allow attempted voiding. The practice of teaching patients intermittent self-catheterisation has grown in popularity as it allows the patient to manage her own bladder at home. Ultrasound bladder scans have become a very useful aid to measure the residual volume post-micturition in patients who have had delayed voiding postoperatively.

DRAINS

There are few absolute indications for the use of surgical drains nowadays other than, for example, to drain lymphatic fluid after a pelvic lymphadenectomy. Whilst they should not be used as an alternative to good haemostasis, it may be wise to insert one when there has been difficulty in securing perfect haemostasis after myomectomy, or surgery for chronic pelvic inflammatory disease. The timing of removal of a drain will depend on the indication for its insertion. In general, removal of drain will be timed when any serosanguinous loss is less than 100 mL in the preceding 24 hours.

RECOGNISING EARLY COMPLICATIONS

Reactionary (or continuing) haemorrhage following vaginal or cervical surgery is usually revealed soon after the patient leaves the operating table and is usually a result of inadequate haemostasis intra-operatively. Vaginal packing may provide compression and arrest of venous bleeding, and bleeding from the abdominal wound requires careful inspection of the wound before deciding to apply a pressure dressing.

The decision as to whether and when to return a patient to theatre is often a difficult one. Small vault haematomas are common after hysterectomies and vaginal surgery and such bleeds will often settle with compression. However, delay can lead to rapid deterioration of the patient's condition and the development of severe clotting disorders, or later abscess formation from larger haematomas with further morbidity, leading to prolonged recovery. Simple observations of a fall in blood pressure, a rising pulse rate and a rising respiratory rate and low urine output are suggestive of concealed haemorrhage. The use of an intraperitoneal drain will give the surgeon an early alert to internal haemorrhage. Too often simple fluid boluses are given to correct presumed dehydration when proper clinical examination will reveal a distended, tender abdomen or blood loss vaginally.

General Postoperative Considerations

THROMBOPROPHYLAXIS

The prevention of deep vein thrombosis and pulmonary embolism [venous thromboembolism (VTE)] remains an important consideration for all gynaecological surgeons as the incidence following major pelvic surgery is second only to orthopaedic surgery. The risk of a gynaecological patient developing VTE depends on the patient's condition and/or the procedure which she is undergoing as well as any predisposing

Table 6.3: Risk factors for the development of VTE in gynaecological patients

• Surgical procedure with total anaesthetic and operating time >60 mins when operating in the pelvis
• Acute admission with inflammatory or intra-abdominal condition
• Expected significant reduction in mobility
• Active cancer or cancer treatment
• Age >60 years
• Critical care admission
• Dehydration
• Known thrombophilia
• Obesity (BMI >30 kg/m^2)
• One or more significant co-morbidity, e.g. cardiac disease, respiratory pathology, inflammatory condition.
• Personal history or first degree relative with history of VTE
• Use of hormone replacement therapy
• Use of oestrogen containing contraceptive therapy
• Varicose veins
• Pregnancy or delivery within last 6 weeks

risk factors (such as age, obesity and concomitant conditions) (Table 6.3). The positioning of the patient on the operating table is also important. Lithotomy position is known to decrease venous blood flow in the lower limbs and increase the risk of VTE. The semi-lithotomy 'ski' position seems to confer some benefit by adding the effect of gravity to venous return without the inhibitory effect of knee flexion in the standard lithotomy position.

In order to reduce the risk of VTE, women should be advised to stop oestrogen-containing contraceptives or hormone replacement therapy 4 weeks before elective major surgery. The risks and benefits of stopping pre-existing established anti-platelet therapy 1 week before surgery should also be assessed. Regional anaesthesia carries a lower risk of VTE than general anaesthesia, so should be considered in at risk patients. However, if regional anaesthesia is used, the timing of pharmacological VTE prophylaxis should be planned to minimise the risk of epidural haematoma.

Mechanical VTE prophylaxis should be started in all gynaecological surgical patients on admission. This may be in the form of anti-embolism stockings (thigh or knee-length), foot impulse devices or intermittent pneumatic compression devices. These should be continued until the patient no longer has any significantly reduced mobility. Pharmacological VTE prophylaxis should also be prescribed for patients with a low risk of major bleeding, taking into account individual patient factors. The type of pharmacological VTE prophylaxis used will depend on local policies and those individual patient factors, but will include: low molecular weight heparin (LMWH), unfractionated heparin and fondaparinux sodium heparin (LMWH). Pharmacological VTE prophylaxis should be continued until the patient no longer has significantly reduced mobility, generally 5–7 days. However, it may need to be continued to 28 days postoperatively for patients who have had major cancer surgery in the abdomen or pelvis. It is important to reassess the patients' risks of bleeding and VTE within 24 hours of admission and whenever the clinical situation changes, to ensure the current methods of VTE prophylaxis are suitable and that there are no adverse events resulting from its use.

Most hospitals have a VTE policy and protocol based on NICE or other national guidelines.[6] (See Chapter 3)

PREVENTION OF INFECTION

The gynaecological surgical patient may be affected by infection at number of different sites, the most important of which are chest, wound, operative site (i.e. abdomen or pelvis) and the urinary tract. There are number of factors that increase the risk of postoperative infection, see Table 6.4.

Surgical site infection is thought to occur in at least 5% of patients undergoing a surgical procedure. Most are caused by contamination of an incision with microorganisms from the patient's own skin, intestinal or respiratory system. A number of measures can be taken to reduce the risk of infection.

Hair removal should not be used routinely to reduce the risk of surgical site infection. If hair does have to be removed prior to surgery, razors should not be used as they increase the risk of infection. Hair should be removed on the day of surgery using electric clippers with a single-use head. Before incision the skin at the surgical site should be cleansed using an antiseptic (aqueous or alcohol-based) preparation, povidone-iodine or chlorhexidine solution being most suitable. The surgical incision should also be covered with an appropriate occlusive dressing at the end of the operation.[7]

Some consideration should also be given to the use of antibiotic prophylaxis. However, antibiotics should only be used for prophylaxis where evidence of benefit exists (Table 6.5).

The most common site of postoperative infection is the urinary tract. The incidence of urinary tract infection is not

Table 6.4: Factors increasing the risk of postoperative infection

• Complicated surgery
• Prolonged operation time
• Emergency surgery
• Prolonged postoperative stay
• Obesity (BMI >30 kg/m^2)
• Coexisting infections at other sites
• Hypothermia
• Blood transfusion
• Diabetes mellitus
• Poor nutritional state
• Increased age
• Use of invasive procedures, e.g. urinary catheter and drains
• Patients receiving chemotherapy, radiotherapy, steroids and immunosuppressants

Table 6.5: Recommendations for antibiotic prophylaxis in gynaecological operations

Operation	Antibiotic prophylaxis recommendation
Abdominal hysterectomy	Recommended*
Vaginal hysterectomy	Recommended*
Caesarean section	Highly recommended**
Perineal tear	Recommended* for third and fourth degree tears
Termination	Highly recommended**
Surgical evacuation of miscarriage	Not recommended***

*Recommended – decreased short-term morbidity.
**Highly recommended – unequivocally reduces major morbidity.
***Not recommended – no clinically proven benefit.

changed by the use of prophylactic antibiotics and is mostly associated with peri-operative catheterisation. In short procedures, such as a hysteroscopy or diagnostic laparoscopy, catheterisation can be avoided by encouraging patients to void pre-operatively. When an indwelling catheter has been used, it can usually be removed 12–24 hours post operatively, unless mobility is restricted. When the bladder may have been traumatised, for example in dissection from a Caesarean section scar at hysterectomy, it may be advisable to leave the catheter in longer.

Septicaemia is not common in gynaecological patients, but is more prevalent in high-risk groups such as the immunocompromised, the elderly and patients who have had radical cancer surgery. Patients with septicaemia are likely to deteriorate very rapidly, and rapid response to identify organisms and commencement of appropriate antibiotics is essential. Transfer to a Critical Care Unit may be required, and involvement of a microbiologist can be life saving. The use of early warning charts are invaluable in alerting staff to the development of severe sepsis.

EATING AND DRINKING

Formerly, patients undergoing major abdominal gynaecological surgery were denied food and fluids until the return of bowel sounds because of the fear of paralytic ileus and vomiting with subsequent aspiration pneumonia and wound dehiscence. A number of studies have evaluated early versus delayed initiation of oral intake of food and fluids. These have shown that early commencement of oral fluids and food is associated with a higher risk of nausea but a reduced length of hospital stay.

There was, however, no significant difference in the rates of postoperative ileus, vomiting and abdominal distension, time to passage of flatus, time to the first passage of stool, postoperative nasogastric tube placement, febrile morbidity, wound complications and pneumonia. The policy to adopt early oral intake should be individualised but appears safe.[4]

WOUND CARE

Risk factors for wound problems are very similar to infection risks, i.e. comorbidities such as obesity, malignancy, contamination and advancing patient age.

Superficial breakdown is best managed by drainage and debridement. Antibiotics are usually not needed but enrolling with the help of a wound-care specialist nurse can be beneficial. Secondary suturing is usually unnecessary and the wound is left to granulate.

A complete dehiscense is an alarming and potentially life-threatening occurrence. Saline swabs are used to keep the bowel clean and protected, whilst the patient is placed in the supine position and made ready for surgery. Necrotic tissue will need to be debrided and the bowel carefully inspected. Primary closure is usually possible with a non-absorbable suture using a mass closure technique. On occasion, if the abdomen is under tension, or there is concern about intestinal pathology or tissue necrosis, the assistance of a general surgeon may be helpful.

Late wound breakdown may occur much later, one study showed that 35% of incisional hernias occurred 3 years after the initial surgery.

INFORMATION/DEBRIEFING

Following a gynaecological operation, patients should be informed fully and promptly about the findings and exactly what has been done, what the expected consequences may be and the recovery time. Relatives may wish to be party to this information, provided the patient gives their consent. If a complication has occurred it is important to give a full explanation and apology if appropriate. Debriefing may take several stages depending on the complication and involvement of a relative is often desirable.

It is also useful to brief staff/general practitioners looking after the patient early and accurately so that there is consistency in what is said to the patient. Staff may also need support themselves in the case of a serious event and where appropriate an internal enquiry and report should be conducted. Such an inquiry should be conducted openly and honestly against a background of a 'no blame culture'.

Having an operation is a stressful experience and patients vary in their ability to cope with this. Patients who are undergoing investigation or operations for cancer will particularly need extra support. Good psychological support has been shown to reduce analgesia requirements and anxiety.

Explanation and reassurance may need to be given in several stages. Day case patients may still be drowsy from the anaesthetic when being spoken to about their operation and fail to absorb what they are told. Consent to talk to a relative and giving a written explanation of the findings is particularly important in these cases. A clear plan of management must be laid out so to the patient so that she is aware of the next steps.

The availability of a telephone helpline should be available is useful for patients who need reassurance of their emotional and gynaecological findings.

Special Considerations

DAY SURGERY

The short time of admission with day surgery cases means that leaflets, telephone numbers and facilities for re-admission must be available for patients postoperatively. They must be warned of symptoms to expect postoperatively and what should prompt them to seek advice. And how to obtain it.

LAPAROSCOPIC SURGERY

The advantages of laparoscopic surgery include rapid recovery, less, blood loss, tissue damage/adhesion formation, less pain and impaired mobility and hence a quicker recovery compared to open procedures. Most of the complications related to laparoscopic surgery are related to the method of entry into the peritoneal cavity. To minimise the risk, a number of recommendations have been made for a safe entry technique (see Chapter 3). The most common complications are bowel injury (0.4–3 per 1000) and vascular injury (0.2–1 per 1000).[8] Failure to recognise and deal with these immediately, often by laparotomy, will lead to greatly increased morbidity and even mortality.

HYSTEROSCOPY

The most frequent complications associated with hysteroscopy are uterine perforation (which may be associated with damage to bowel or blood vessels) and fluid absorption. If perforation is suspected, early recourse to diagnostic laparoscopy is necessary, leading to laparotomy and assistance from a surgical colleague if intestinal or difficult vascular damage is found.

Excessive fluid absorption at hysteroscopy is more common if the procedure has been lengthy, or when large vessels have been opened at endometrial or fibroid resection. It is always important to monitor fluid input and output of the hysteroscopic fluid. Excessive fluid absorption can lead to hyponatraemia and hypo-osmolality. This may be characterised clinically by nausea, vomiting, seizures and coma. It is therefore important to closely monitor those at risk of developing such a complication.

THE OBESE PATIENT

Obesity considerably increases the operative and postoperative risks. In particular, there is an increased incidence of thromboembolism, infection and anaesthetic complications. Extra care with all aspects of care is needed to reduce these risks to a minimum.

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SECTION B

Benign Conditions: The Cervix, Vagina and Vulva, Uterus, Ovaries and Fallopian Tubes

SECTION OUTLINE

Cervix, Vagina and Vulva

7

Carl Chow

During the last few decades, there have been enormous improvements in the equipment used in both the investigation and surgical treatment of diseases of the lower genital tract. We have also seen significant advances in high-resolution imaging including both ultrasound and magnetic resonance imaging, which have aided in the subsequent surgical management of lower genital tract disease.

However, the need to undertake surgical diagnostic procedures remains. Improved camera optics and digital technology have greatly improved real-time imaging. New modalities of treatment have enabled many procedures to now be undertaken in an out-patient setting under a local anaesthetic, rather than general anaesthesia.

Operations of the Cervix

DILATATION

Dilatation of the cervix is required to permit both diagnostic and therapeutic procedures of the uterine cavity. With the use of high-resolution optics, one is able to use smaller diameter instruments in order to visualise the uterine cavity and hence the need to dilate the cervix rarely needs to exceed 5–6 mm, thereby minimising potential trauma to the cervix itself.

Therapeutic dilatation of the cervix to larger diameters may be required for vaginal termination of pregnancy, especially in the late first and early second trimester of pregnancy. However, it is essential to consider the use of hormonal agents such as prostaglandins (e.g. misoprostol) to aid softening of the cervix and therefore minimise the force required to achieve the necessary dilatation.

In the non-pregnant state, dilatation of the cervix is a treatment for pyometra (and occasionally haematometra) and as a prelude to therapeutic insertions of devices such as intra-uterine contraceptive devices or radioactive sources.

EXCISION BIOPSY

Local lesions such as cervical polyps may need excision if sessile. Colposcopically directed punch biopsy is essential for the diagnosis of cervical intra-epithelial neoplasia (CIN). Excision biopsy, i.e. LLETZ/large loop excision is now the most common method of treatment for high-grade CIN.

AMPUTATION (TRACHELECTOMY)

Total removal of the cervix may be required for the development of cervical pathology following sub-total hysterectomy. Radical trachelectomy is now increasingly being undertaken in the treatment of young women with early stage cervical cancer, where there is a desire to preserve fertility (see Section D, Chapter 16).

Techniques

DILATATION

Standard vaginal and cervical toilet is required.

Bimanual Examination of the Patient: This examination is essential prior to any form of surgical instrumentation. The objective is to determine the precise size and position of the uterus, in particular whether it is acutely anteverted/retroverted. It is also important to examine the adnexae, in order to identify the presence of any masses.

Exposure of the Cervix: A Sims' speculum is introduced into the posterior vagina to expose the cervix. The anterior lip of the cervix is grasped with either a tenaculum or vulsellum forceps and drawn down.

The Introduction of the Dilator: There is some variation in the technique, according to the type of case. In nulliparous patients, a uterine sound may be introduced into the cervical canal and passed through the internal cervical os. If the uterus is anteverted, the curvature of the sound is directed anteriorly to conform with the curvature of the uterus, while if the uterus is retroverted, the curvature of the sound is directed posteriorly. Undue pressure on the sound must never be used to determine the direction of the uterine cavity and position of the internal cervical os. If the cavity of the uterus cannot be found with the sound, a small blunt-pointed probe can instead be used. With patience and care, the internal os will eventually be passed and the cavity of the uterus entered. A sound can subsequently be introduced and the length of the uterine cavity measured, after which the cervix can be gradually dilated using metal dilators. Various types of dilator are available, although the original Hegar type is still the most commonly used. Other dilators are available which increase in size along their length. The operator should always be certain that the internal os has been passed by the dilator, and should also be able to tell exactly when the tip of the dilator comes into contact with the fundus of the uterus.

One must be careful to avoid exerting excessive force, thereby increasing the risk of either uterine or cervical perforation. Particular care should be exercised in both nulliparous and post-menopausal patients. The dilatation should be performed slowly, and the metal dilator should remain in the cervical canal for a short time after it has been introduced. If the dilator cannot then be removed easily, or if it is still grasped firmly by the cervix, it should be left in position until it may be removed with ease. The cervix can be dilated in this way to No.8 Hegar for a diagnostic curettage procedure. Dilators which increase by only 0.5 mm should be used for termination of pregnancy in order to minimise the risk of cervical trauma.

During a routine procedure, little difficulty is usually experienced in finding the internal os. Small dilators can usually be passed quite easily, particularly if the patient is multiparous.

In order to minimise the risk of perforation, the following technique is suggested. The surgeon holds the vulsellum in the left hand and only gentle downward traction is applied. This reduces the risk of the vulsellum teeth cutting through the cervix. The dilator is held like a pencil in the right hand and the ulnar border of this hand is firmly pressed against the patient's left buttock (Fig. 7.1). This reduces the force which can be applied to the dilator and the patient's left buttock acts as a buffer should obstruction to the passage of the dilator suddenly gives way followed by a jerk forward. If a given dilator will not pass without undue force, the operator should drop back one size, re-insert it and wait for a short interval before proceeding again up the scale. In pregnancy, the cervix is softer, therefore more susceptible to trauma from the vulsellum. Dilatation is often easier after delivery or spontaneous abortion. Cervical ripening is to be recommended before attempting dilatation during pregnancy.

Dilatation of the cervix up to Hegar 4 can usually be achieved without anaesthesia in a multiparous patient before insertion of an intra-uterine device or endometrial biopsy. Otherwise, a para-cervical block using local anaesthetic, e.g. 2% Lidocaine may be used. Dilatation of the cervix can very occasionally result in an acute vasovagal episode and in rare cases, even cardiac arrest. It should not therefore be regarded as a minor procedure and resuscitation equipment/staff must be immediately available, especially in the out-patient setting should the need arise.

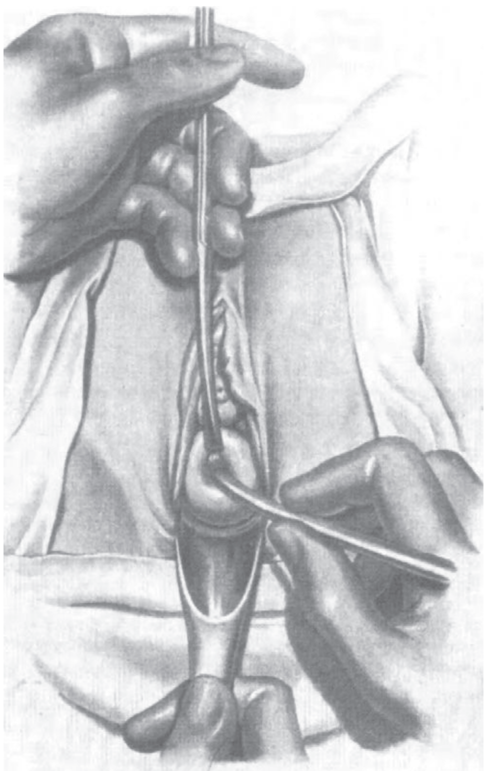


Fig. 7.1: Dilatation of the cervix. A Sims' speculum has been introduced and is held in position by an assistant. The anterior lip of the cervix is drawn down with vulsellum forceps and kept in position by the left hand of the surgeon. The dilator is held in the right hand of the surgeon.

CERVICAL CERCLAGE

Introduction

Prematurity is the leading cause of perinatal death and disability. Preterm birth before 37+0 weeks of gestation accounted for 7.6% of all live births in England and Wales in 2005. Although preterm birth is defined as delivery before 37+0 weeks of gestation, the majority of prematurity-related adverse outcomes relate to birth before 33+0 weeks of gestation. Mortality increases from about 2% for infants born at 32 weeks of gestation to more than 90% for those born at 23 weeks of gestation. Two-thirds of preterm births are the consequence of spontaneous preterm labour and/or preterm pre-labour rupture of membranes (PPROM). The rate of spontaneous preterm birth continues to rise globally despite efforts aimed at prevention, and interventions aimed at reducing preterm birth have been largely disappointing.

Cervical cerclage was first performed in 1902 in women with a history of mid-trimester abortion or spontaneous preterm birth suggestive of cervical 'incompetence', with the aim of preventing recurrent loss. Cervical incompetence is an imprecise clinical diagnosis frequently applied to women with such a history where it is assumed that the cervix is weak and unable to remain closed during the pregnancy. However, recent evidence suggests that rather than being a dichotomous variable, cervical 'competence' is likely to be a continuum influenced by factors related not solely to the intrinsic structure of the cervix but also to processes driving premature effacement and dilatation. While cerclage may provide a degree of structural support to a 'weak' cervix, its role in maintaining the cervical length and the endocervical mucous plug as a mechanical barrier to ascending infection may be a more important function.

Definitions

Previous terminology (prophylactic, elective, emergency, urgent, rescue) of cervical sutures (cerclage) can be ambiguous. More appropriate nomenclature based on indication for cervical suture is recommended. The terms below are increasingly used in the scientific literature.

History-indicated cerclage: Insertion of a cerclage as a result of factors in a woman's obstetric or gynaecological history that increase the risk of spontaneous second-trimester loss or preterm delivery. A history-indicated suture is performed as a prophylactic measure in asymptomatic women and normally inserted electively at 12–14 weeks of gestation.

Ultrasound-indicated cerclage: Insertion of a cerclage as a therapeutic measure in cases of cervical length shortening seen on transvaginal ultrasound. Ultrasound-indicated cerclage is performed on asymptomatic women who do not have exposed fetal membranes in the vagina. Sonographic assessment of the cervix is usually performed between 14 and 24 weeks of gestation.

Rescue cerclage: Insertion of cerclage as a salvage measure in the case of premature cervical dilatation with exposed fetal membranes in the vagina. This may be discovered by ultrasound examination of the cervix or as a result of a speculum/physical examination performed for symptoms such as vaginal discharge, bleeding or 'sensation of pressure'.

Transvaginal cerclage (McDonald): A transvaginal purse-string suture placed at the cervicovaginal junction without bladder mobilisation.[1]

High-transvaginal cerclage (Shirodkar): A transvaginal purse-string suture placed following bladder mobilisation to allow insertion above the level of the cardinal ligaments.[2]

Transabdominal cerclage: A suture performed via a laparotomy or laparoscopy, placing the suture at the cervicoisthmic junction.[3]

Occlusion cerclage: The occlusion of the external cervical os by placement of a continuous non-absorbable suture. This intervention is based on the theory behind that it is the retention of the mucous plug which is important in the prevention of preterm labour.

Pre-operative Management

There is absence of data to support genital tract screening before cerclage insertion. However, in the presence of a positive culture from a genital swab, a complete course of sensitive anti-microbial eradication therapy before cerclage insertion would be recommended. There are no studies evaluating the benefit of screening for genital tract infection before insertion of a cerclage.

Before any type of cerclage insertion, the patient should be informed of the following:

- There is a small risk of intra-operative bladder damage, cervical trauma, membrane rupture and bleeding during insertion of cervical cerclage. Shirodkar cerclage usually requires anaesthesia for removal and therefore carries the risk of an additional anaesthetic. Cervical cerclage may be associated with a risk of cervical laceration/trauma if there is spontaneous labour with the suture in place.
- Cerclage insertion is associated with a doubling in risk of maternal pyrexia but no apparent increase in chorioamnionitis. Cerclage insertion is not associated with an increased risk of PPROM, induction of labour or Caesarean section. The insertion of a cervical suture is not associated with an increased risk of preterm delivery or second trimester loss.

It is good practice to offer a first-trimester ultrasound scan and screening for aneuploidy before the insertion of a history-indicated suture, to ensure both viability and the absence of lethal/major fetal abnormality. Before an ultrasound-indicated or rescue cerclage, it is good practice to ensure that an anomaly scan has been performed recently.[4]

Technique

Prophylactic cervical cerclage may be carried out after first trimester screening (11–14 weeks). Regional anaesthesia is generally preferable. Trauma to the cervix is minimised by using sponge-holding forceps. A small transverse incision is made at the junction of the smooth vaginal portion of the cervix with the rugose vagina of the anterior vaginal wall. A small incision is made in the posterior fornix diametrically opposite to allow the insertion of an aneurysm needle or some other suitable curved suture passer. A band of non-absorbable material is passed around the cervix and tied anteriorly. It is necessary to make a second incision posteriorly where the ligature may be extracted and reinserted to complete the tour. In practice it is rather easier to use a needle on a needle holder and pass the stitch round in a series of bites. At the onset of labour, the ligature is divided and removed. If delivery is undertaken by Caesarean section, the cervical suture should be removed. The choice of material is personal. Both wire and monofilament nylon tend to cut through the cervix. A tape of nylon is preferable. Thick braided nylon is also acceptable (Fig. 7.2).

McDonald[5] reported the results of the operation in 269 patients in which he achieved at least 70% success (Fig. 7.3).

There is no evidence to support the use of routine peri-operative tocolysis. In most of the existing randomised studies, the majority of women allocated cerclage also received peri-operative tocolysis, most commonly indomethacin. Consequently, there is no control group available for comparison. However, a retrospective cohort study involving 101 women who underwent ultrasound-indicated cerclage reported that the rate of preterm birth before 35 weeks of gestation was not significantly different in women who received indomethacin for 48 hours following the procedure compared with those who did not (39% versus 34%).

If 'a rescue' cerclage is being performed when cervical dilatation has already occurred, many obstetricians advocate the use of a tocolytic agent, e.g. Atosiban both before and after the cerclage procedure.

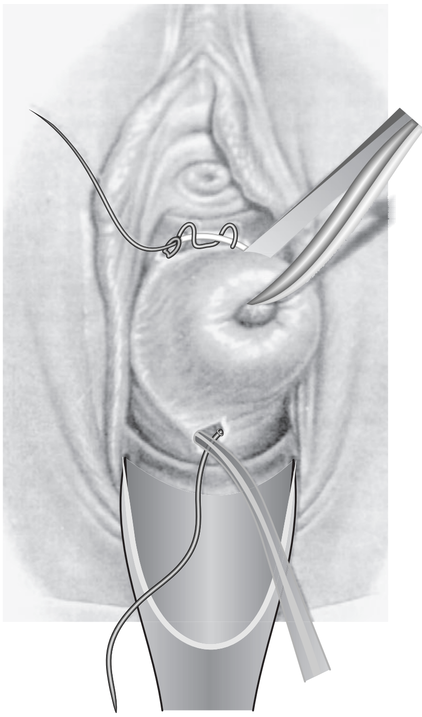


Fig. 7.2: Cervical cerclage (Shirodkar method). The cervix is drawn downwards with a vulsellum. A small incision has been made in the anterior fornix and a similar one in the posterior fornix. An aneurysm needle has been passed from the posterior incision round the cervix so that its point presents in the anterior wound, where it is threaded with the ligature. When withdrawn through the posterior incision one half of the cervix is circumnavigated by the ligature and a similar manoeuvre on the other side will completely enclose the cervix in the ligature which is then tied with the requisite degree of tension, thus effectively closing the incompetent canal.

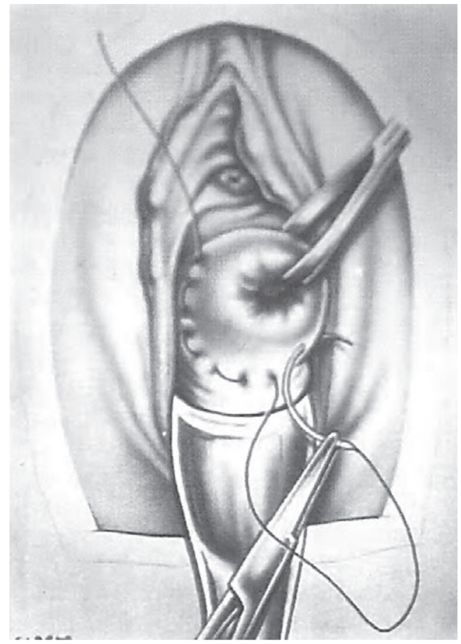


Fig. 7.3: Cervical cerclage (McDonald's method). This gives equally satisfactory results and is technically somewhat easier than inserting a Shirodkar suture. Good surgical exposure with adequate retraction is essential for both methods of cervical cerclage.

COLPOSCOPY

In 1925, Hans Hinselmann devised the original colposcope from which the modern day instrument has been derived (Fig. 7.4).[6] He developed an instrument that allowed visual inspection of the uterine cervix to be undertaken under magnification. The modern colposcope consists of a binocular microscope with different powers of magnification ranging from approximately 6 to 40 times. The lowest magnification (6×) provides a view of the whole cervix and part of the vagina. Higher magnifications allow assessment of finer colposcopic details, such as atypical vessel patterns, e.g. mosaicism and punctuation, after the application of acetic acid (3–5%) to the cervix. The greater the magnification, the smaller the diameter of the observed field visualised. A suitable colposcope should provide excellent image definition, which should not be lost upon increasing magnification, particularly when observing fine details. The focal length (the distance between the front of the lens of the colposcope and the surface of the cervix) should be 250–300 mm. This distance is necessary to allow for manipulation of instruments without interfering with the visual field. Many colposcopes are also fitted with a green filter, which can be useful for highlighting vascular patterns. The colposcope can equally be used to conduct a detailed examination of both the vagina and vulva.

Initially, colposcopy was restricted almost exclusively to German-speaking countries. However, by the 1970s, the technique began to gain wider acceptance and in the modern

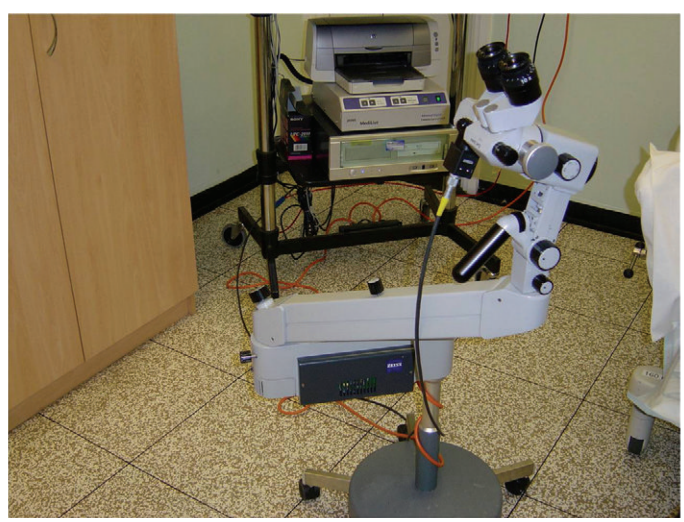


Fig. 7.4: A modern day colposcope, mounted on a mobile stand, with a movable arm and cold light source. It offers binocular magnification from 6× to 40×.

era, together with cytology and now HPV testing, colposcopy is fundamental to the detection of both precancerous and cancerous lesions of the cervix. It is used in the diagnosis of cervical lesions determining the location, size and extent of such lesions; at the same time it serves for directing the site of biopsies and for selecting the most appropriate treatment.

Instrumentation

1. **The colposcope consists of a series of magnifying lenses together with a potent light source** (Fig. 7.4). The intensity of light is adjustable and is provided by a cold light source, which offers bright illumination and clarity of image, indispensable for capturing both still and moving images (video capture). The instrument is mounted on a mobile arm. This enables smooth, efficient and fine movements to be undertaken, thus facilitating examination of the area under investigation. The arm on which the optical part of the apparatus is mounted has been designed to enable free and easy movement in both vertical and horizontal directions, as well as inclination of the head of the colposcope to follow the axis of the vagina.
2. **Other imaging equipments:** Digital image capture can be achieved with the aid of a three chip CCD camera (Fig. 7.5a), attached to the colposcope (Fig. 7.5b). This is extremely useful, not only for teaching purposes, but because it also allows objective comparisons between examinations undertaken at different times and by different colposcopists. Digital image capture systems are now widely available and are proving to be an invaluable aid in the training of new colposcopists. At the same time, such a system can help to minimise the number of observers present during an examination, thereby reducing the level of anxiety/discomfort to a patient in what is, after all, an intimate examination. Digital image capture and storage can also be used to help audit colposcopic accuracy and practice. Video colposcopy and capture can also be undertaken with appropriate hardware and software. Such systems have been used in remote settings and the resultant images and video files have been transmitted over long distances for expert colposcopic review.
3. **Clinic equipment:** An appropriate couch must be available in the clinic with lithotomy leg supports and the ability to rise/fall/tilt in various planes, to enable an optimal view of the cervix to be obtained (Fig. 7.6a). When performing a diagnostic colposcopy, the following items should also be available: Different sizes of Cusco speculae; materials for taking liquid-based cervical smears, endocervical forceps (e.g. Desjardins, Kogan), punch biopsy forceps (e.g. Eppendorfer or Tischler forceps), small cotton wool tips or buds, cotton wool balls, 3% or 5% acetic acid solution, Lugol's iodine solution, single tooth tenaculum, silver nitrate sticks and Monsel's solution (see Fig. 7.6b).

Technique of Colposcopic Examination

A colposcopy examination should ideally be undertaken in the absence of menstrual or indeed any vaginal bleeding and before any other gynaecological examination, which might potentially cause trauma to the cervix. The steps are detailed as follows:

1. The patient is placed in the lithotomy position; an appropriate sized Cusco speculum is carefully inserted into the vagina, taking care to avoid any trauma to the cervix. In situations where the vagina is lax or the patient is pregnant, the introduction of a latex glove over the speculum and the cutting of the end of the 'finger' will assist with lateral retraction of the vaginal walls as seen in Fig. 7.7.
2. After gentle swabbing, to remove any mucus or blood, the cervix is inspected at 'low power' magnification in order to assess its shape and size, evidence of laceration and the presence of any overt abnormality. A cervical smear or endocervical swab (infection screen) may be taken at this stage.
3. Following preliminary inspection of the cervix, some colposcopists choose to apply normal saline and then attempt to visualise the underlying blood vessel patterns by applying the green filter to the colposcopic lens.
4. Application of 3–5% acetic acid. The cervix is washed with an aqueous solution of 3–5% acetic acid. Depending upon

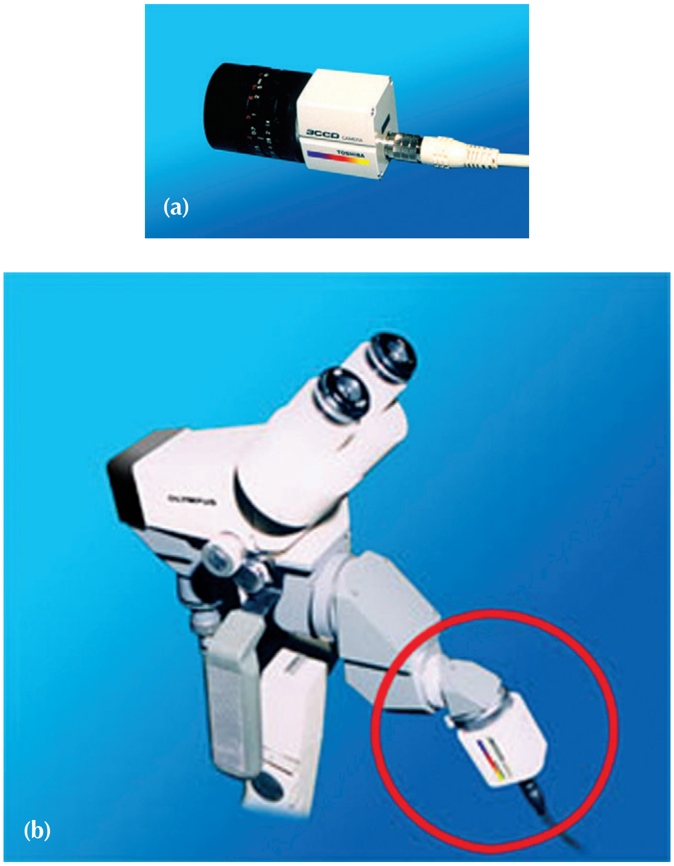


Fig. 7.5: **(a)** A small, light-weight three chip CCD camera. **(b)** A CCD camera attached to colposcope.

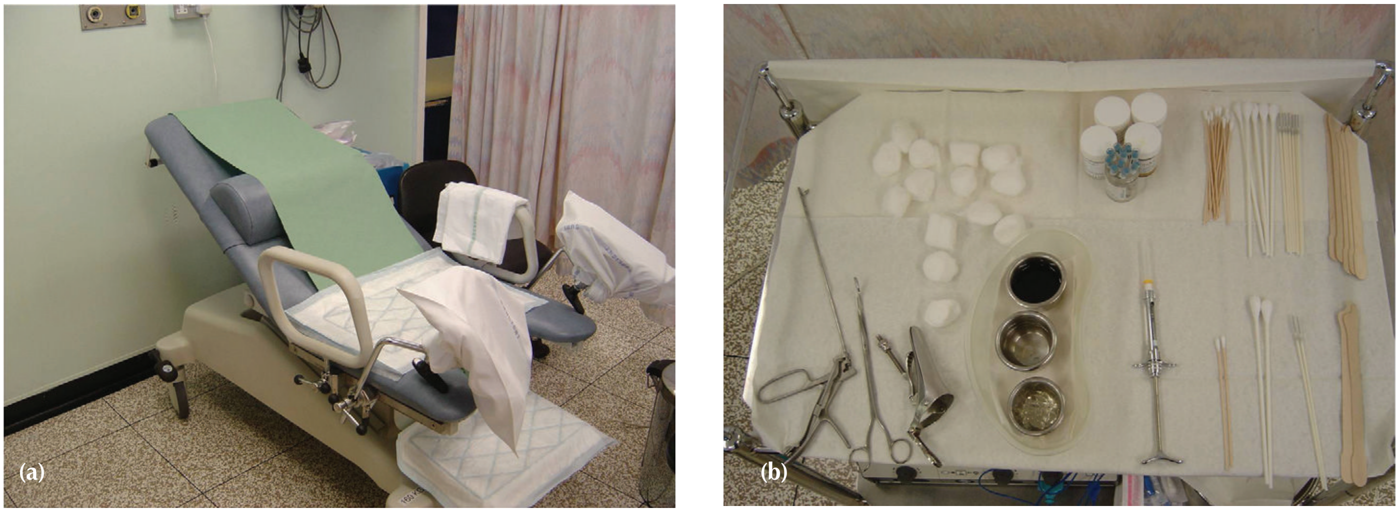


Fig. 7.6: **(a)** An examination couch with lithotomy supports. **(b)** A trolley containing equipment required to undertake a colposcopy examination.

Fig. 7.7: A 'gloved' Cusco speculum—used to deal with laxity of the vaginal walls which will impair complete visualisation of the cervix.

the strength used, areas of acetowhite change may appear on the ectocervix within 15–20 seconds, allowing clear observation of morphological details, the normal process of squamous metaplasia as well as features perhaps indicative of HPV infection or indeed CIN. The acetic acid precipitates nucleoproteins and abnormal epithelium may appear white. However, these changes are reversible and will disappear with time. If the colposcopic examination takes a particularly long time, additional acetic acid should be re-applied. Normal mature squamous epithelium will remain unaltered as opposed to metaplastic or abnormal epithelium, which will take up the dye and appear white. The intensity of acetowhite change, its duration, as well as speed of uptake and disappearance are directly related to the severity of CIN. An attempt should be made to visualise the endocervical canal and define the upper limit of the transformation zone, which may be assisted through the use of endocervical forceps, e.g. Desjardins and Kogan forceps (see Fig. 7.8a,b).

5. Schiller's test is where a solution of iodine (Lugol's iodine solution) is applied to the cervix following the application of 3–5% acetic acid. This procedure allows a clear distinction between normal mature squamous epithelium, which stains mahogany brown and other types of epithelium, including immature squamous epithelium, abnormal epithelium (CIN) and columnar epithelium, all of which tend to take up the iodine stain relatively poorly. Although many colposcopists consider that the application of Lugol's iodine adds little value to the overall colposcopic impression, positive iodine staining can help to differentiate normal from abnormal tissue and also acts as a guide to ectocervical excision margins during treatment.
6. After examining the cervix, the vagina and vulva should also be carefully inspected. The speculum is slowly removed under colposcopic vision so that epithelium of both the anterior and posterior, as well as the lateral walls of the vagina, can be visualised.
7. Following completion of the examination, the colposcopic findings should be carefully documented. The final assessment should include a recording of the colposcopic findings, either by hand or through the saving of digital images and annotation. The site of any colposcopically directed biopsies should also be recorded. In addition, the type of transformation zone should be noted, i.e. whether the upper limit of the transformation zone can be fully visualised.

The Transformation Zone

This is defined as that area enclosed between the original squamo-columnar junction at its outermost margin and the new squamo-columnar junction at its innermost aspect

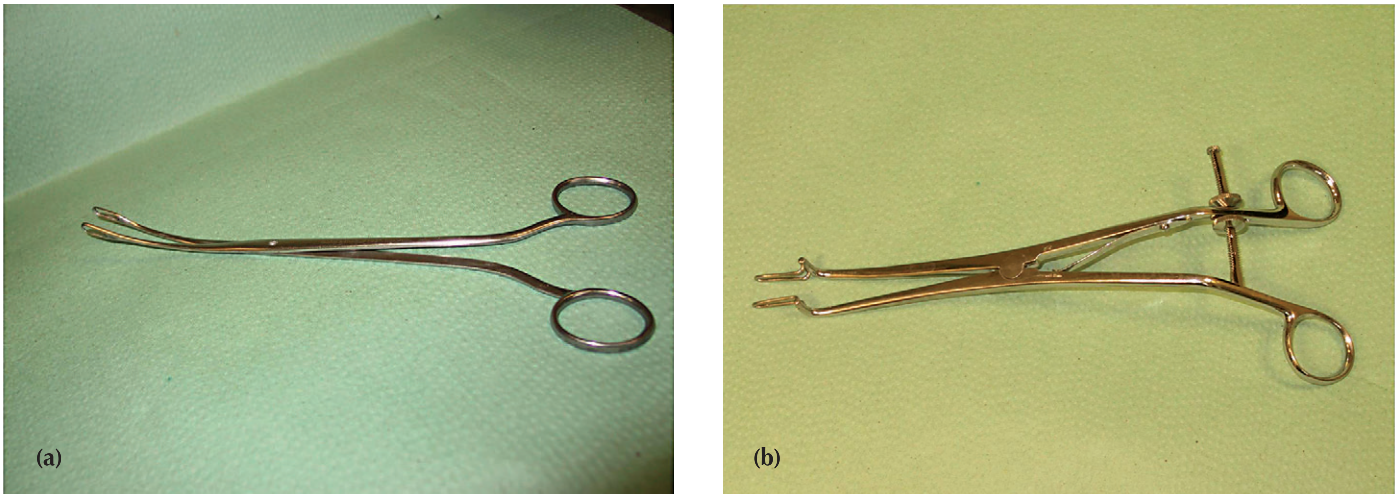


Fig. 7.8a,b: Endocervical forceps – Desjardins and Kogan forceps, which can be used to remove mucus, visualise the endocervical canal and attempt to define the upper limit of the transformation zone.

(Fig. 7.9a). During late fetal life and in adolescence, but mainly during the first pregnancy, the more caudal area of the original columnar epithelium is partially or completely replaced with squamous epithelium, by the physiological process of squamous metaplasia (Fig. 7.9b). This dynamic change introduces instability to the junctional interface between the two original epithelial types and it is this process that is subject to disruption by HPV infection and hence the potential development of cervical neoplasia.

The colposcopic features of the transformation zone are dependent upon both age and a woman's hormonal status. In the pre-pubertal cervix, eversion of the cervix is minimal. In contrast, during pregnancy there is much greater eversion, which may result in the formation of a cervical ectropion (Fig. 7.10a,b). The size of the transformation zone can vary significantly and it is always important to undertake a thorough examination of the whole cervix and upper vagina. Only when one has been able to visualise the **whole transformation zone** can the colposcopy examination be deemed satisfactory.

In a small number of women (4%) the transformation zone extends onto the walls of the vaginal vault. Figure 7.11 illustrates this situation. This Mullerian duct epithelium is subject to the same acidic environment as the rest of the ectocervix and will undergo metaplasia, hence the fine acetowhite changes visible after the application of 3–5% acetic acid. This area has been termed the congenital transformation zone and since it may undergo metaplasia, it is also vulnerable to neoplastic change. This will have implications in terms of treatment, should a high-grade lesion be found within the transformation zone on the ectocervix.

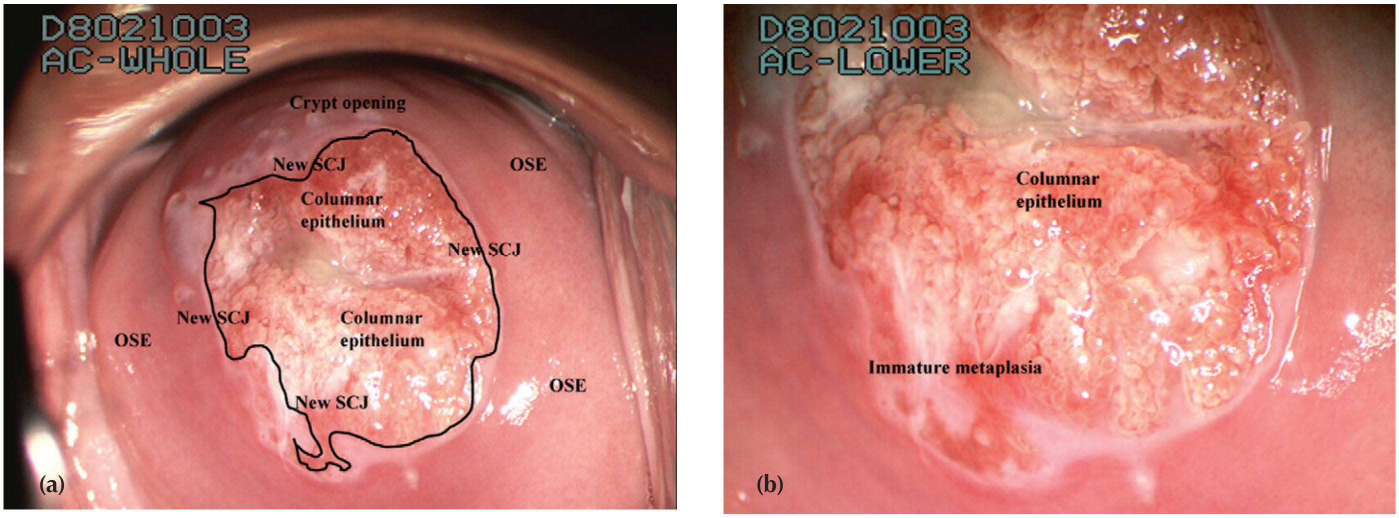


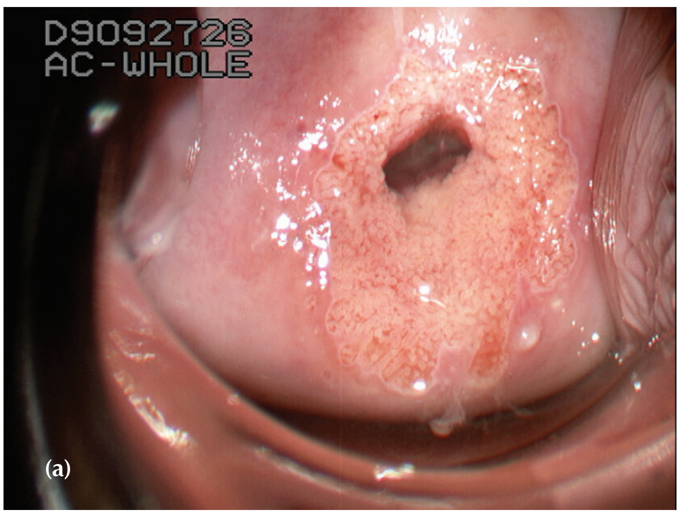
Fig. 7.9a,b: An illustration of the different types of cervical epithelium (original squamous, original columnar), the presence of immature squamous metaplasia and the position of the new squamo-columnar junction.

During the metaplastic process, the epithelium is vulnerable to a genetic change that may result in the tissue acquiring a neoplastic potential. This type of epithelium has distinctive morphological characteristics and possesses the same topographical arrangement within the transformation zone as the physiological epithelium. The transformation zone in this situation is termed the atypical transformation zone and within its area will reside the precursors of squamous cervical cancer.

MICROCOLPOHYSTEROSCOPY

Microcolpohysteroscopy (MCH) was first described by Hamou in 1980.[7] It allows the gynaecologist to perform either a panoramic or in vivo microscopic visual inspection of the cervix and to combine colposcopic, cytological and histological findings in the course of the same examination. The Hamou microcolpohysteroscope is an endoscope, 4 mm in diameter (5.2 mm sheath), 25 cm length, with 90° field angle and 30° forward oblique scope, allowing the instrument to be used in a panoramic or contact mode at different magnifications. The system of lenses includes two ocular, one being directed in line (with magnifications ×1 in panoramic vision and ×60 for contact work) and one lateral (with magnifications of ×20 for panoramic vision and ×150 for contact work). Light is provided by a standard 150 W cold light source.

In vivo examination of the surface cells of the ectocervix and cervical canal is facilitated by additional stains, i.e. Lugol's iodine 2% for visualisation of mature squamous cells containing glycogen and Waterman's blue ink for the detection of dysplastic and metaplastic cells. Examination of the cervix involves careful cleansing of the cervix with saline-soaked cotton swabs (acetic acid causes denaturation of proteins altering the appearance of cells through the optic instrument) followed by staining of the cervix with Lugol's iodine and Waterman's blue. There is no need for focusing because the objective is always in contact with the mucosa. Examination should be performed in a clockwise direction, which facilitates the endoscopist's orientation when the tissue is biopsied as well as the identification of the site of lesions and the squamo-columnar junction. Initially, the lowest magnification should be used for a general inspection followed by the highest magnification for detailed examination. Microcolpohysteroscopy allows detection of normal metaplastic changes, HPV and the spectrum of cervical intraepithelial neoplasia. It is certainly capable of showing some lesions within



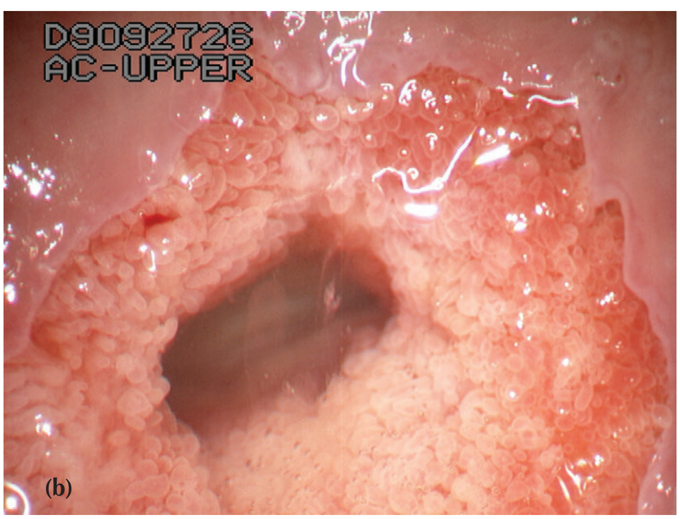


Fig. 7.10a,b: Cervical ectropion—the presence of columnar, endocervical epithelium on the ectocervix. This phenomenon is particularly common during puberty and in pregnancy. It may also be seen in young women taking the combined oral contraceptive pill. Patients often present with symptoms of excess vaginal discharge or post-coital bleeding.

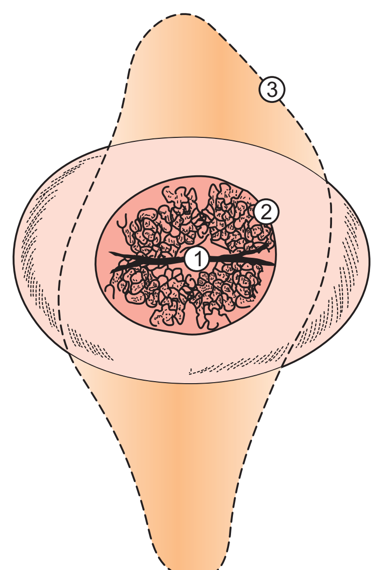


Fig. 7.11: The endocervix is marked at (1) and the original squamo-columnar junction is shown at (2). The squamo-columnar junction (3) encloses a shaded area that denotes where columnar epithelium has extended onto the vaginal vault. (Modification of the diagram originally produced by the late Dr Ellis Pixley of Perth, Western Australia.)

the endocervical canal which are undetectable by colposcopy. Biopsies can then be taken accordingly.

Cervical Biopsy

INTRODUCTION

The major aim of all organised cervical screening programmes around the world is to reduce the incidence of cervical cancer. In countries, where organised screening takes place, patients with abnormal cytology are referred for colposcopy examination. Where an abnormality is identified, a colposcopically directed biopsy may be taken and the histology result used to guide subsequent management, which may involve excision treatment. However, in many countries around the world, colposcopy is still often used as a primary screening tool.

Naked-eye visual inspection (VI) of the uterine cervix, after application of 5% acetic acid (VIA) and/or of Lugol's iodine (VILI), provides simple tests for the early detection of cervical precancerous lesions and early invasive cancer in the developing world/low-resource settings. VILI is similar to the Schiller's iodine test, which was used for early detection of cervical neoplasia in the third and fourth decades of the twentieth century, but discontinued after the advent of cervical cytology testing. The potential difficulties in implementing cervical cytology-based screening in such environments have prompted the investigation of the accuracy of alternative low-technology tests such as VIA and VILI in the early detection of cervical neoplasia. The advantages of such techniques are that the results of inspection are immediately available and do not require any laboratory support. The categorisation of the results of VIA or VILI depends upon the colour changes observed on the cervix. A clear understanding of the anatomy, physiology and pathology of the cervix is absolutely essential to understand the basis and to interpret the outcome of screening using VIA and VILI, hence the need for rigorous training and educational support.

Other conditions may cause confusion to the untrained eye. *Leukoplakia* (hyperkeratosis) is a well demarcated white area on the cervix (before the application of acetic acid), due to keratosis, visible to the naked eye. Usually leukoplakia is idiopathic, but it may also be caused by chronic foreign body irritation, HPV infection, or squamous neoplasia. Condylomata or genital warts are often multiple, exophytic lesions that can occur on the cervix (Fig. 7.12a,b) and also within the vagina and on the vulva, caused by infection with HPV, commonly with subtypes 6 and 11. They may also present as a diffuse, greyish-white, lesion involving areas of the cervix and vagina. Condylomata may be obvious to the naked eye (before the application of acetic acid).

PUNCH BIOPSY

This method is used to obtain small quantities of cervical tissue with little, if any, anaesthetic requirement (Fig. 7.13a,b). Following biopsy, there may be a small amount of bleeding which can usually be stopped using silver nitrate sticks (Fig. 7.13c) or if persistent, a small application of Monsel's solution. Rarely, diathermy cauterisation may be required. Directed biopsies are performed under colposcopic guidance, which should therefore render a high degree of diagnostic accuracy. On occasion, multiple biopsies may be required, in order not to miss a high-grade lesion. There are many different types of biopsy instruments, all of them formed by a fixed arm and a mobile cutting part. Examples below include Eppendorfer and Tischler biopsy forceps (Fig. 7.14a–c). In order to take biopsies of lesions on the margin of the external os, the fixed part of the forceps should be introduced into the endocervical canal, with the mobile part lying outside (Fig. 7.13b). Where more than one sample is required on both anterior and posterior lips of the cervix, the area within the posterior lip should be biopsied first, in order to prevent problems with visualisation of lesions related to bleeding from the superior-most biopsy site.

A single or multiple colposcopically directed punch biopsies may be required to confirm the diagnosis of a clinically visible

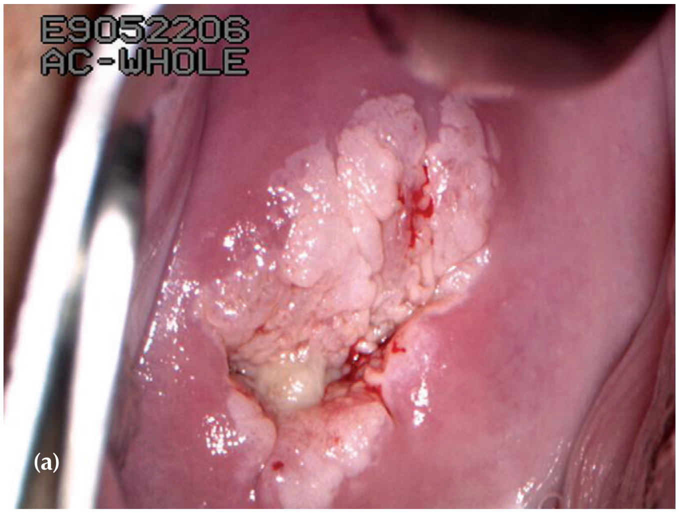


Fig. 7.12a,b: A cervical wart. Despite the obvious appearance of the wart, it is important to exclude the possibility of significant pre-cancerous or indeed invasive changes in the epithelium below.

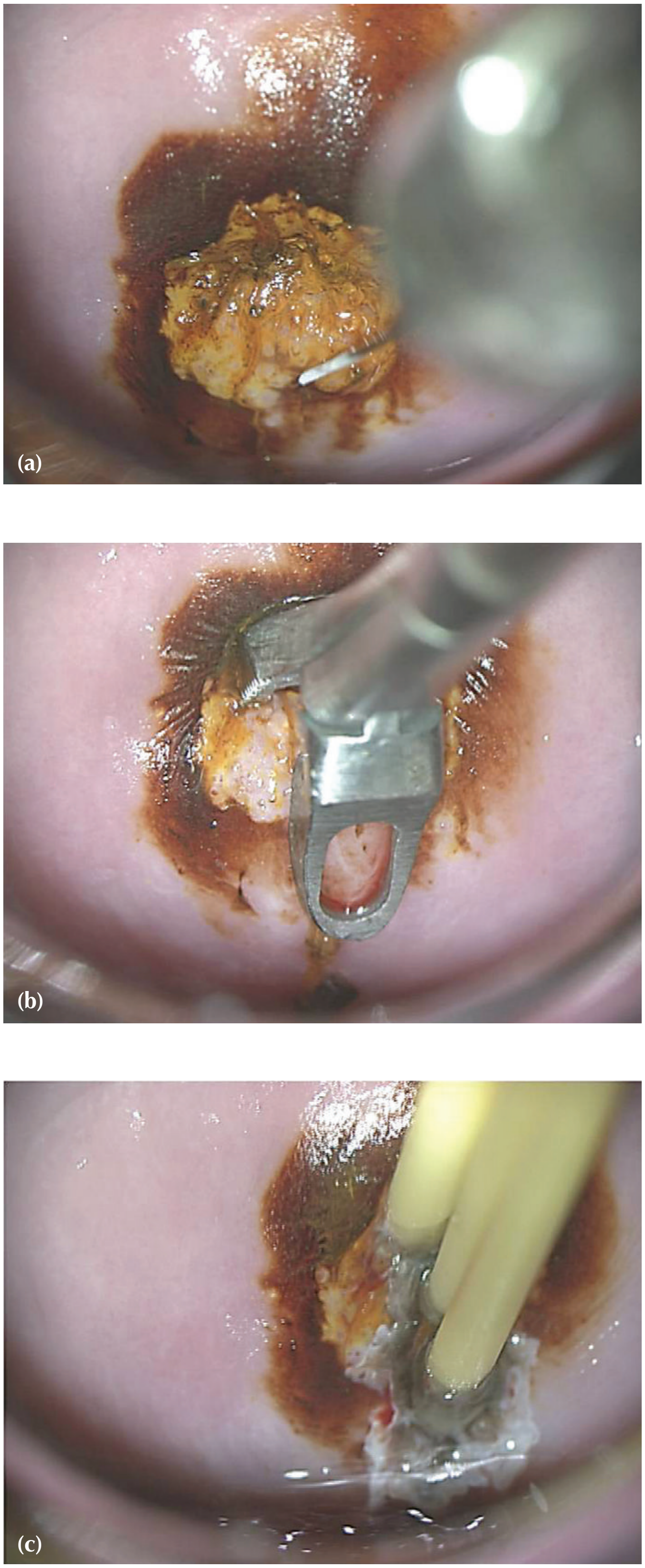


Fig. 7.13: **(a)** Infiltration with 2% lidocaine. **(b)** Fixed part of Eppendorfer forceps in endocervical canal. **(c):** Cautery using silver nitrate sticks.

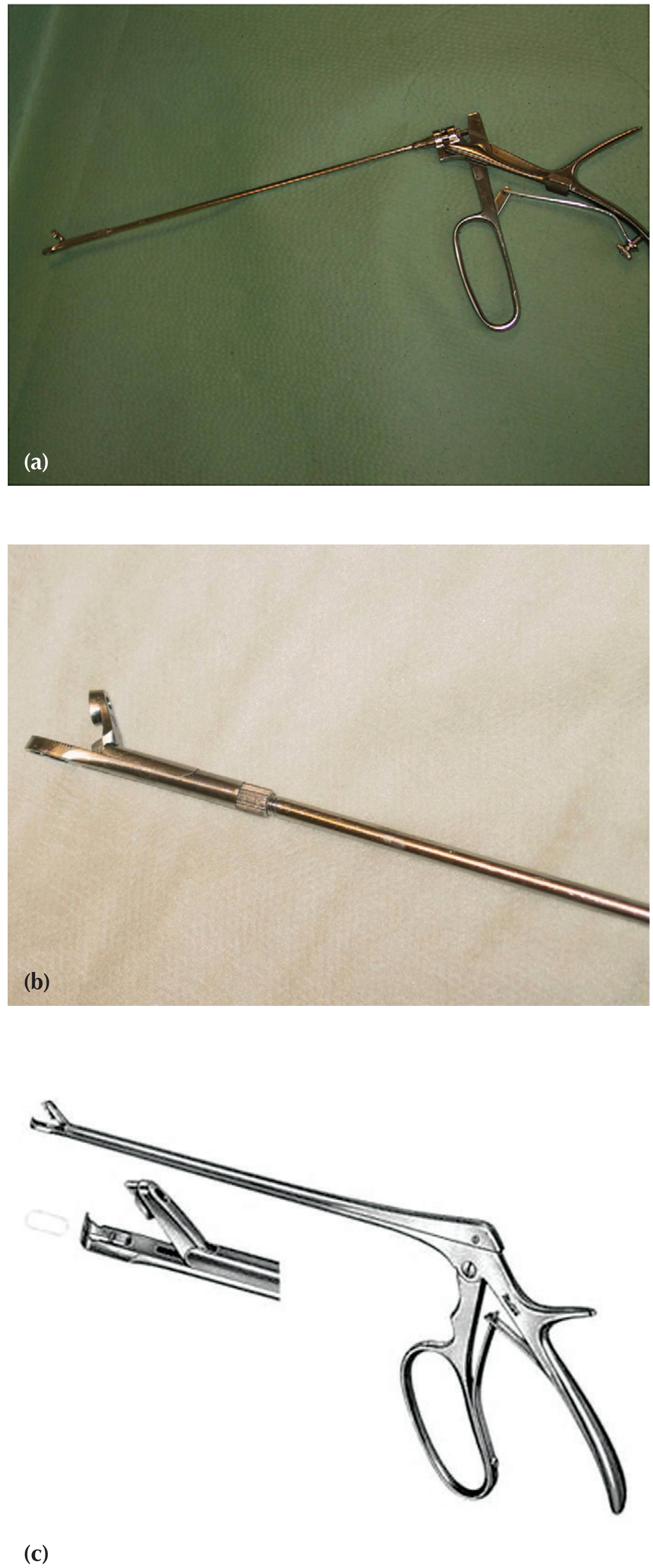


Fig. 7.14: **(a)** Eppendorfer forceps. **(b)** Fixed arm and a mobile cutting part. **(c)** Tischler forceps.

lesion. Complete excision of the transformation zone is not always required in every instance, e.g. the management of low-grade disease.

CONE BIOPSY

For most patients where the squamo-columnar junction is fully visible, they may be treated by a standard LLETZ procedure, which will be discussed later. However, there are a group of patients with significant intra-epithelial abnormalities, in whom even with careful colposcopic evaluation, the squamo-columnar junction is not fully visible. They, in particular will need to undergo some form of cone biopsy of the cervix.

The objective of undertaking such a biopsy is to excise the entire transformation zone and any abnormal glandular epithelium, so that comprehensive histological analysis may be undertaken and excision margin status determined.

Common indications for cone biopsy are listed below:

1. Suspicion of micro-invasive carcinoma or occult invasive carcinoma.
2. Suspicion of high-grade glandular disease.
3. Incompletely visible transformation zone in women with high-grade CIN (CIN 2/3).
4. Significant disparity between cytology and colposcopy.
5. Positive endocervical excision margins, particularly in women over 50 years of age, who have already undergone treatment of high-grade CIN.

The potential morbidity of cone biopsy is such that the routine use of this procedure is to be avoided. Appropriate colposcopic assessment, together with the additional use of endocervical forceps may identify the upper limit of the transformation zone and hence allow the depth of excision to be tailored accordingly. Complete excision with clear margins (endocervical and ectocervical) is regarded as adequate treatment for high-grade CIN and also in cases of very early micro-invasion of the cervix (Stage 1A1 disease), especially where it is desirable to retain reproductive function. Clear guidance has been issued by the NHS Cervical Screening Programme (NHSCSP) with regard to the follow-up of women who have been treated for CIN (all grades).

Technique

Using a knife is the traditional and in some ways the best method of obtaining a large cone biopsy of the cervix. This modality of treatment ensures that the tissue biopsy margins are free from diathermy artefact and provide the best possible specimen for histological examination.

3–5% acetic acid and Lugol's iodine are applied to the cervix in order to identify the transformation zone and allow the excision margin to be determined. 4–5 mL of 2% lidocaine and 1 in 80,000 adrenaline are then injected intracervically to aid haemostasis (adrenaline causes vasoconstriction). The anterior lip of the cervix is grasped with a single-toothed vulsellum, applied well above the area to be excised. A circular incision is made with a sharp-pointed thin-bladed knife, such as a long tenotome, around and well outside the area of abnormality (Fig. 7.15). A small tenaculum is then applied to the base of the cone and gentle downward traction applied, whilst the vulsellum on the cervix exerts traction in an upward direction. The incision is then deepened with circular sweeps until the region of the internal os is reached which forms the apex of the cone. It is important to make a wide excision of the whole length of the endocervix, in order to include any potential areas of abnormality within the endocervical canal. Bleeding from the base can be quite considerable after removal of the specimen, but more usually there is a general oozing from the base of the cervix. Haemostasis is often achieved using local diathermy coagulation (rollerball), although occasionally the cavity may have to be closed by a double Sturmdorf suture (Fig. 7.16). A deep suture at both three and nine o'clock will help secure haemorrhage from the cervical branch of the uterine artery.

In the upper left diagram, the blood vessels which lie laterally are underpinned and ligated. A long suture is introduced as shown in the vaginal wall posteriorly. In the upper diagram on the right side, the needle has then been passed through the whole thickness of the cervix to emerge through the vaginal wall. The needle is then threaded through the other end of the suture and passed as shown. When the suture is tied, the posterior part of the raw area is covered. A similar suture is introduced anteriorly; finally lateral sutures are placed to cover the raw area completely.

Alternatively a series of 'reefing' sutures may be applied to approximate ectocervical and endocervical epithelium. The advantage of this method is that the new transformation zone

Fig. 7.15: Cervical cone biopsy. Hysterectomy specimen incised to indicate the depth of the excision biopsy.

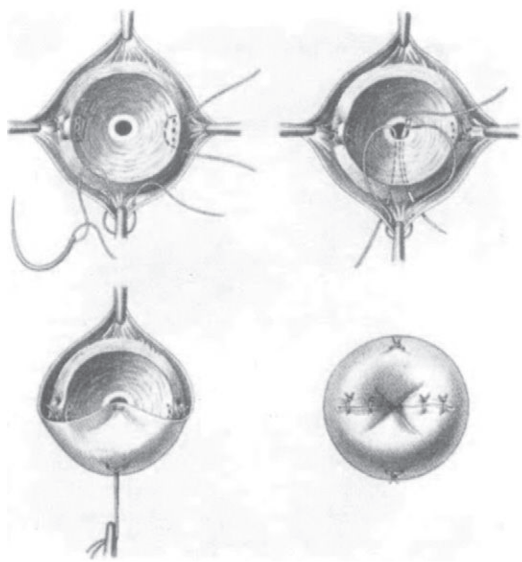


Fig. 7.16: Extensive cone biopsy of the cervix—method used to achieve haemostasis.

Fig. 7.17: Carbon dioxide laser machine.

formed after healing has been completed should be accessible to colposcopic examination.

Alternative Methods

LASER CONISATION

Laser therapy (Fig. 7.17) may also be used for vaporisation of both low and high-grade CIN, subject to certain defined conditions being fulfilled and also for conisation.

LARGE LOOP EXCISION OF THE TRANSFORMATION ZONE

In 1981, at the fourth World Congress of Colposcopy and Cervical Pathology, Cartier reported his experience using a small loop to take directed biopsies and to remove the transformation zone in strips.[8] This technique provided a comprehensive specimen for histology but was associated with minimal morbidity. It became known as the large loop excision of the transformation zone (LLETZ) procedure and building on Cartier's work, further work led to the utilisation of larger loops in order to excise the entire transformation zone in a single specimen.

LLETZ uses modern low-voltage diathermy electrosurgical units and insulated loops. It was also ideal as the procedure could be performed under local anaesthesia. It was introduced into clinical practice in Bristol in the early 1980s and rapidly gained widespread acceptance. The technique is known as LLETZ in the UK but its name was changed to LEEP in the USA. The major advantage of the procedure is that it achieves excision of the transformation zone using a technique that preserves histological integrity. The resulting biopsy can therefore be comprehensively examined, micro-invasive disease ruled out, excision margins assessed and over-treatment recognised. Also, the treatment can be applied to every circumstance where the transformation zone has to be treated, i.e. endocervical/ectocervical, large or small, containing squamous or glandular abnormalities. Lastly, the technique is outpatient-based and carries lower morbidity than the traditional cold knife cone biopsy.

It is by now far and away the most common treatment procedure performed in the colposcopy clinic. It is inexpensive compared to other treatment methods and gives excellent results (95% success rates). Again, it is important to use the technique correctly in order to obtain clear excision margins and minimise diathermy artefact. One should aim to provide a single specimen rather than multiple small loop specimens in order to allow accurate interpretation of the histological changes within the specimen. The target tissue is excised with a scooping motion rather than by twist and rotation.

Incomplete excision of the transformation zone is known to be associated with a higher incidence of residual disease. The fact that incomplete excision does not always (or even usually) result in residual disease is likely to be due to the combined effect of diathermy damage and the inflammatory response associated with the healing wound.

Why should incomplete excision occur at all? It is likely to be due to a combination of the following factors: (*a*) excision biopsies being too shallow for the particular transformation zone, (*b*) an inability to reliably recognise the upper limit of the transformation zone, (*c*) an inability to recognise margin status due to diathermy damage of the specimen biopsy or perhaps (*d*) the use of inappropriate electrodes for different procedures.

The issue is further complicated by the various meanings of the nomenclature used in the literature. The term cone biopsy can mean different things in different studies and indeed countries. Most colposcopists tend to reserve the term where the transformation zone extends some millimeters out of view up the endocervical canal. It is in this scenario that incomplete excision is most likely to occur.

To try and achieve clarity and to allow comparison of results of treatment between various studies/centres, an international classification system (IFCPC) has been adopted by colposcopists reporting treatment series in the literature. This classification system is designed to be both simple to use and acceptable to practicing colposcopists, as well as being able to accommodate every treatment circumstance arising in routine clinical practice.

The system has three indices by which the transformation zone may be classified. These are: (*i*) the size of the ectocervical component of the transformation zone, (*ii*) the position of the upper limit of the transformation zone, (*iii*) the visibility of the upper limit of the transformation zone.

The three types of transformation can be characterised as being completely ectocervical, fully visible with an endocervical component, or not fully visible (see Fig. 7.19a–c).

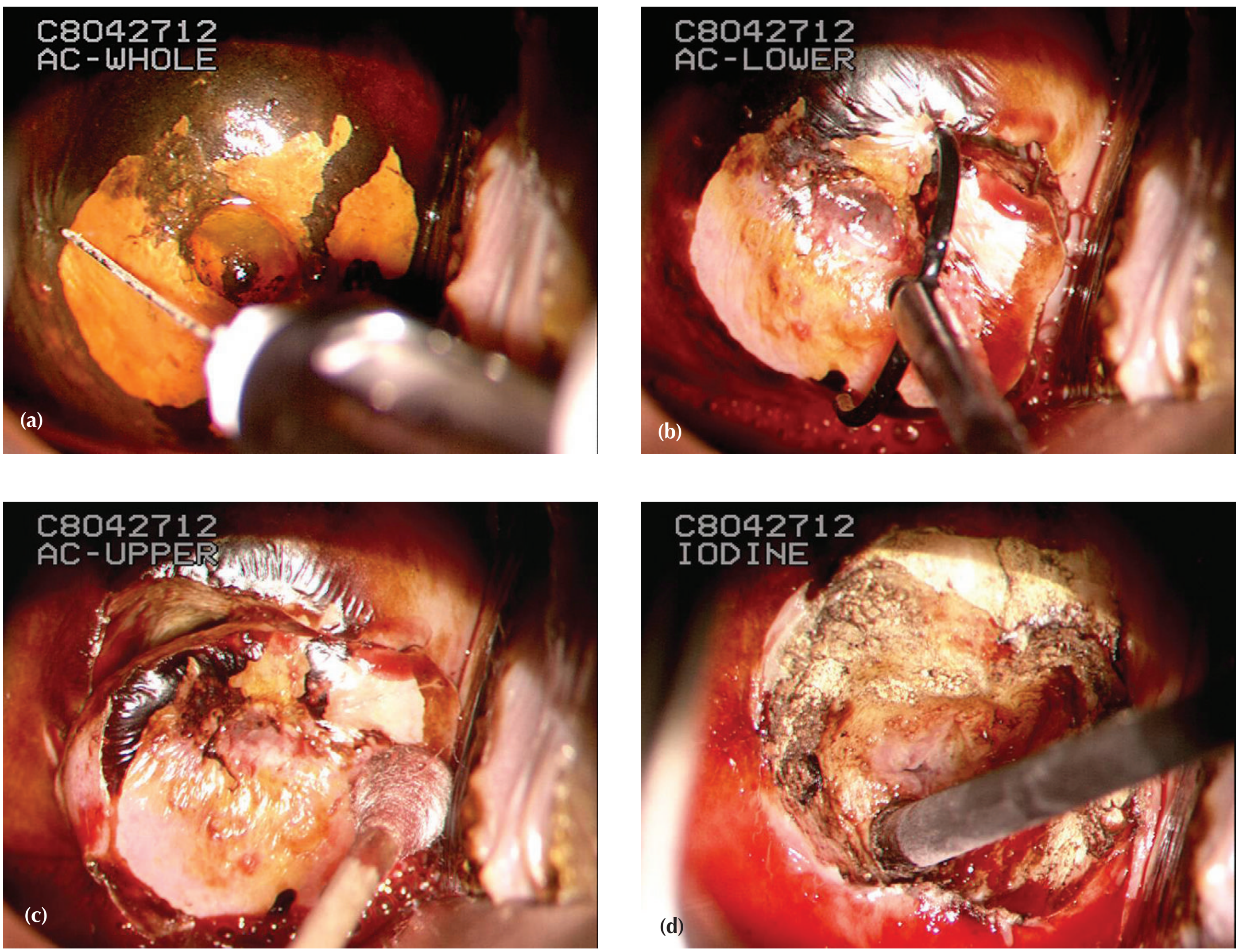


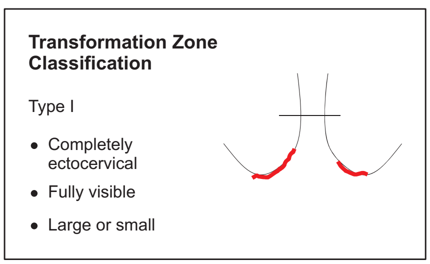
Fig. 7.18: LLETZ procedure. **(a)** Local infiltration with 2% lidocaine and 1 in 80,000 adrenaline, **(b)** single diathermy loop excision, **(c)** removal of loop specimen, **(d)** rollerball diathermy to base to achieve haemostasis.

ENDOCERVICAL CURETTAGE

Lesions in the endocervix can be biopsied by undertaking endocervical curettage using a sharp spoon-shaped or similar grooved instrument. The volume of the material obtained is often small and mixed with blood and mucus. Endocervical curettage has been used in the investigation and follow-up of patients with cervical intra-epithelial glandular disease. Its use is not widespread in the UK but it is used much more extensively in North America.

CRYOTHERAPY (FIG. 7.20)

The first report of cryosurgical therapy for cervical neoplasia was published in 1967 by Crisp et al.,[9] followed by several others during the 1970s. In many countries, it rapidly became the most popular treatment for CIN. This technique is a destructive/ablative technique and freezes the cervical epithelium using a cryosurgical probe. The destruction of tissue is based on achieving a temperature of -20°C with subsequent crystallisation of the intracellular water. Crystallisation in the nucleus disrupts the cell membrane, resulting in cell death.



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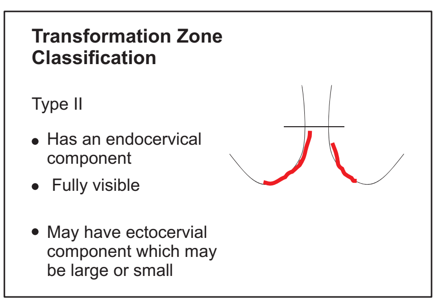

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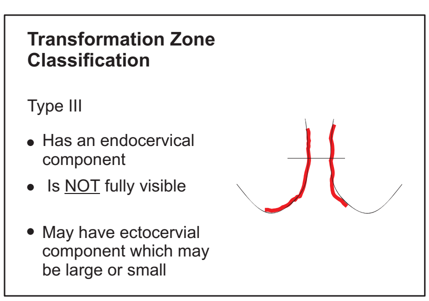


(c)

Fig. 7.19a–c: Classification of transformation zone.

Many different cryosurgical probes are available and several studies have evaluated the interaction of the cryoprobe with the cervix, the necessary freeze time in order to destroy the tissue and the effectiveness of this once popular outpatient treatment modality. The refrigerant gas which cools the probe may be carbon dioxide or nitrous oxide. Nitrous oxide has been described as the preferred gas because it has a colder freezing point (-90°C) than carbon dioxide gas (-60°C). The gas tank must be kept at a constant pressure (750–830 mmHg) to adequately freeze the cryoprobe.

However, in common with other ablative techniques, cryotherapy is only suitable when the following criteria are fulfilled:

1. The entire transformation zone is fully visualised.
2. There is no evidence of glandular abnormality.
3. There is no evidence of invasive disease.
4. There is no major discrepancy between cytology and histology.

Only in exceptional circumstances should ablative treatment be considered for women over 50 years of age.

According to national guidelines, cryotherapy should only be used to treat low-grade CIN and a double freeze–thaw–freeze technique must be used. A number of studies have documented that the rate of clearance of CIN 3 appears to be poorer with this particular destructive technique. The double freeze technique has a lower incidence of residual disease compared with a single freeze technique.

Complications associated with cryotherapy are rare and post-treatment infection appears to be the most common. However, it appears that cryotherapy has increasingly fallen out of use, in favour of LLETZ, which is able to provide a tissue specimen for histological analysis.

Amputation of the Cervix

TRACHELECTOMY

Now that local treatment of the cervix is well established, there is rarely the need for amputation of the cervix, except in a

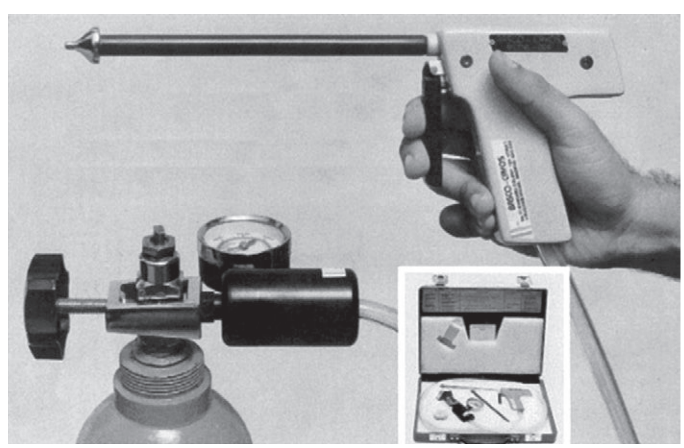


Fig. 7.20: Cryotherapy. Cryoprobe with attachment suitable for treatment of the cervix.

patient who has had a previous sub-total hysterectomy and abnormal cytology.

Partial amputation differs only in a degree from an extensive cone biopsy, and the technique is precisely similar.

Complete amputation of the cervix is often an extremely difficult operation to perform if the cervix cannot be pulled down as far as the introitus. A Sims' speculum should be introduced and the lateral vaginal walls retracted by an assistant using vaginal retractors. The anterior lip of the cervix is pulled down with vulsellum forceps and the cervix dilated with Hegar dilators.

Technique: A circular incision is made around the cervix cutting through the squamous epithelium together with the subjacent cervical fascia. Difficulty may be experienced in deciding upon the level at which the circular incision should be made. It is necessary to remove all unhealthy tissue, yet sufficient tissue must be left behind to cover the raw surfaces. Anteriorly the incision must lie well below the level of the bladder sulcus, otherwise it will be necessary to mobilise the bladder by dividing the vesicocervical ligament. The cervix is then pulled to one side and posteriorly, and the endopelvic fascial tissues (which run down laterally along the cervix) exposed. A curved clamp is fixed firmly to this mass of tissue and the tissue divided with a scalpel distal to the clamp. A similar procedure is carried out on the opposite side. Operators are advised to transfix and ligate these pedicles at this stage of the operation. The fibromuscular tissue of the cervix is then cut through and the cervix amputated. It will be found most convenient to excise a cone-shaped piece of cervix, the apex of the cone lying high up in the cervical canal. Bleeding areas in the tissue of the cervix can be controlled only by the introduction of mattress sutures into the substance of the cervix. Great care must be taken to obtain complete haemostasis. Subsequently, the raw surfaces of the cervix are covered by the Bonney–Sturmdorf technique.

Other Cervical Pathology

CERVICAL POLYPS (FIG. 7.21)

It is usual/common practice to avulse even a large cervical polyp as an out-patient procedure.

If undertaken in the out-patient clinic, certain conditions should be satisfied:

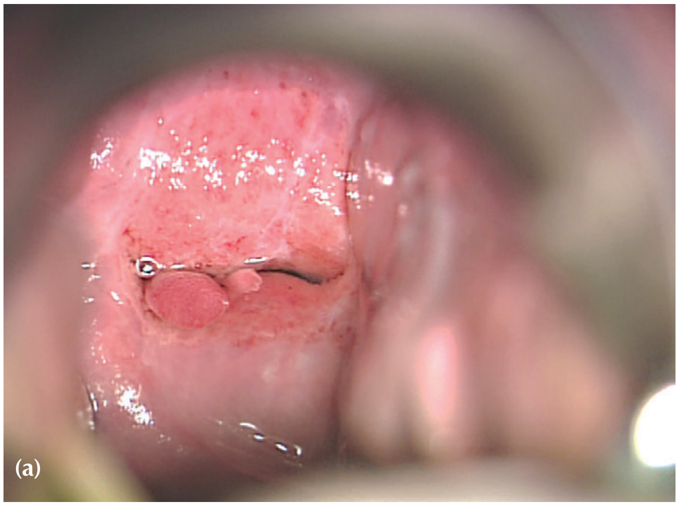
1. The polyp should be sent for histology.
2. The base should be destroyed by cauterisation.
3. There must have been no disturbance of menstruation or post-menopausal bleeding.

The presence of such symptoms may require further investigation by ultrasound and perhaps diagnostic hysteroscopy. It is not unusual to find a second polyp further up the endocervical canal.

Endometrial polyps can also occur co-incidentally, hence the need to exclude uterine pathology in all cases of abnormal or unusual vaginal bleeding. In post-menopausal patients, endometrial carcinoma can very occasionally be seen in association with a cervical polyp, hence the importance of fully investigating such a patient by ultrasound and diagnostic curettage.

CERVICAL STENOSIS

This can result in the development of a haematometra or pyometra which can be detected by ultrasound. Dilatation and drainage of fluid on its own is insufficient; if drainage of altered blood becomes obstructed once the contents have been exposed to the air there is a potential risk of infection. The cervix should be slowly dilated to Hegar 15 and a small polythene drainage tube can be sutured in place. In the case of pyometra, the uterine wall may be very soft and uterine perforation may easily occur using a dilator. If perforation of an infected uterus is suspected, it would be prudent to undertake a diagnostic laparoscopy to confirm the diagnosis and may subsequently require an abdominal laparotomy in order to repair the damage and achieve haemostasis.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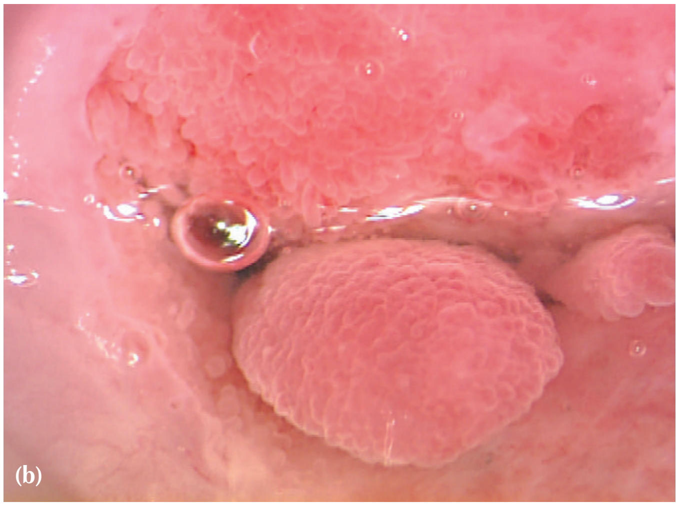
(b)

Fig. 7.21a,b: Small cervical polyps sitting within the endocervical canal.

7

Complication of Cervical Procedures

LACERATIONS OF THE CERVIX

Laceration of the cervix should always be suspected if the cervical canal bleeds briskly after the passage of a large dilator. The difficulty is to assess the degree of the laceration. If the external haemorrhage is severe and arterial in type it is most likely that a cervical branch of the uterine artery has been damaged. It may become necessary to split the cervix laterally to open up the base of the broad ligament and to expose the bleeding vessels, which must then be ligated. The procedure, though serious, should present no great difficulty to surgeons familiar with the operation of vaginal hysterectomy. The most serious cases are those in which the uterine artery has been lacerated and when the bleeding is internal. An enormous haematoma may form in the broad ligament and spread upwards to the loin and perinephric region. Fortunately, this complication is extremely rare. The haematoma may be managed expectantly, alternatively one might consider selective embolisation and should consult with an interventional radiologist.

Instances have, however, been recorded where the bleeding was progressive and uncontrolled and in such, laparotomy is indicated as soon as the true state is realised.

Benign Vaginal Conditions Requiring Surgery

ANTERIOR VAGINAL CYSTS

Cysts and solid tumours may be found beneath the vaginal epithelium. These may be related to anterior, posterior and lateral walls. Evans and Hughes,[10] in a study of 42 cysts, concluded that the majority were of Müllerian (paramesonephric) origin, the epithelium showing all the possibilities present in Mullerian-derived ovarian tumours.

Cysts arising from the mesonephric duct (Gartner's duct) are usually anterolateral in position and have a characteristic flattened epithelium. The basement membrane is well defined and unstriated muscle is often present in the surrounding tissue.

Gartner's duct passes downwards along the lateral border of the uterus, and subsequently extends anteriorly so that ultimately it lies in the anterior vaginal wall. Very rarely small cysts develop from relics of Gartner's duct deep to the vaginal wall in the situation of the lateral fornix. Most of the cysts are small and are recognised for the first time on routine vaginal examination performed for some other reason unconnected with the cyst. Small cysts require no treatment, but sometimes they become distended with fluid, particularly when they lie in the anterior vaginal wall, or protrude at the vaginal orifice. A cyst must be distinguished from a cystocoele, urethrocoele, ectopic ureterocoele and diverticulum of the urethra. It is a cardinal error to mistake an ectopic ureterocoele or diverticulum of the urethra for a vaginal wall cyst and to excise it without closing the urethral stoma or identifying the ectopic ureter. A fistula will thereby result. Surgical removal is a simple procedure, since the cyst is encapsulated and can be shelled out without much difficulty (Figs. 7.22 and 7.23). Occasionally, marsupialisation may be appropriate.

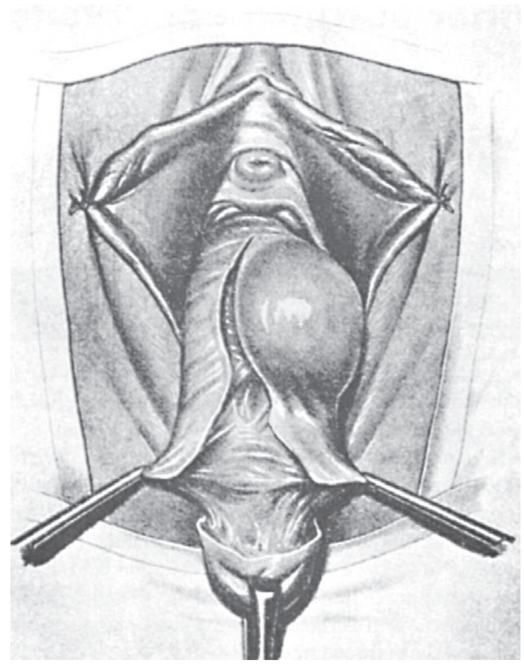

Fig. 7.22: Removal of a cyst of the anterior vaginal wall. A case associated with prolapse.

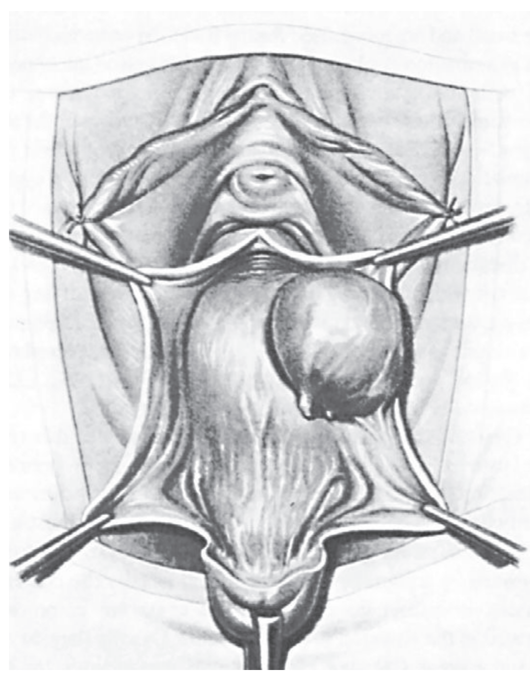

Fig. 7.23: Removal of a cyst of the anterior vaginal wall. The vaginal wall has been reflected and the cyst exposed.

CYSTS OF THE POSTERIOR VAGINAL WALL

Cysts of this type are usually implantation cysts and result from perineal laceration during childbirth. Small pieces of squamous epithelium are buried in the deeper tissues and as a result of their proliferation cause the formation of a cyst. The cysts are lined by squamous epithelium, and usually the contents consist of sebaceous material. The cysts are commonly located in the situation of perineal scars. Usually they do not attain a great size, but most patients are anxious for the removal of any tumour, whether cystic or not, in the region of the vulva. The cyst can be removed without difficulty and no special technique is required. Very rarely dermoid cysts are found in the rectovaginal septum. They are lined by squamous epithelium which contains sebaceous glands, so that the cyst is filled with greasy material. The cysts are recognised without difficulty because the tumour is circumscribed and tense and has a different feel from either a rectocoele or an enterocoele. Removal of a dermoid cyst of the rectovaginal septum offers no technical difficulty. The posterior vaginal wall should be incised by a longitudinal incision and the tumour shelled out. Bleeding points are ligated, after which the wound in the vagina is closed by a series of interrupted sutures. A dermoid arising behind the posterior vaginal wall may, however, be a benign cystic teratoma of sacrococcygeal origin. A very careful rectal examination should be performed, and the surgeon should beware lest an operation which begins as a simple enucleation should escalate beyond all recognition.

ENDOMETRIOSIS OF THE VAGINA

Typical 'blue domed' cysts may be seen, usually in the posterior fornix (see Chapter 11).

VAGINAL ADENOSIS

Much interest has been focused on this unusual condition since Herbst and Scully[11] demonstrated an association with maternal ingestion of non-steroidal synthetic oestrogens in the relevant pregnancy. In this condition, there is a patchy distribution of glandular epithelium in the vagina mostly beneath intact squamous epithelium but with innumerable gland mouths present. On the cervix there is a resemblance to a classical erosion but there is often an associated epithelial 'hood'. To the naked eye, the vaginal wall may show a red 'cobblestone' in appearance, but often the overlying squamous epithelium is intact, hence the failure of cytology to give much help. Colposcopy is important to delineate the extent of the disease. The importance of the condition lies in the fact that a small number of adolescent girls and young women develop adenocarcinoma in such areas.[11]

LEIOMYOMA OF THE VAGINA

These tumours are extremely rare and take the form of round projections into the vagina. They are either spherical or oval in shape with the characteristic firm consistence of a fibroid. In due course the tumour ulcerates and becomes infected, and may be mistaken for a carcinoma of the vagina. It can be shelled out without much difficulty and surgical removal is a simple procedure, though it may be accompanied by severe bleeding.[12]

STENOSIS OF THE INTROITUS

Inadequate rupture of the hymen: This important condition occurs in varying degrees. Typically a young woman is unable to allow penetration or even use a tampon because of rigidity of the hymen. Sometimes there has been partial stretching of the hymen, but tender scarring or fissures persist, leading to secondary vaginismus because of the expectation of pain and discomfort. Instructions in the use of vaginal dilators may overcome the problem, but on occasion it may be necessary to perform a hymenectomy as in cases of imperforate hymen (see Chapter 8), or an enlargement of the vaginal introitus (see below).

Iatrogenic introital stricture is regrettably not rare. The commonest cause is inexpert suture of childbirth injury, either perineal laceration or episiotomy. The commonest cause is a failure to recognise the concurrence of a partial annular or circumferential tear of the posterior vestibule, with a subsequent radial laceration or episiotomy incision. The resultant injury is cruciate, but if this is not recognised and is sewn up as a single vertical repair, this will effectively narrow the introitus causing significant superficial dyspareunia once coitus has been resumed following post-natal examination.

A second iatrogenic cause of introital stenosis is excessive reduction of the introital size during the perineorrhaphy part of a posterior vaginal repair (see Chapter 14). Routine reduction in introital size should be avoided. It is often unnecessary and, in any case, should be tailored to the exact local condition.

Other acquired causes of introital stenosis are post-menopausal vulval atrophy (at one time termed kraurosis) or the end stage of lichen sclerosus et atrophicus (LSAV). In this, the labia minora disappear and the labia majora shrink and the introitus undergoes considerable shrinkage.

Functional stenosis results from muscular spasm, for which the underlying cause may be psychological or a response to severe local tenderness (vulvodynia).

Surgical Treatment of Introital Stenosis (Fenton's Procedure and its Modifications)

Broadly speaking there are two clinical varieties. The first is a simple arcuate skin flap, which may in fact conceal a virtually absent perineal body beneath it. The other situation is more complex where scarring extends cranially from the fourchette across the vestibule (navicular fossa) to the hymen, or the vestibular skin may be thin, inflamed and liable to fissures (vestibulitis).

Technique:

1. A skin flap is fairly easily dealt with by a short median 'episiotomy' which is then repaired transversely (Figs. 7.24

and 7.25). According to the findings, it may be necessary to perform a small perineal body reconstruction beneath this repair. Alternatively, in some cases of 'idiopathic' vaginismus, the superficial muscle (bulbospongiosus) is divided (Fenton's operation). It is very important that the transverse introital skin suture line be closed with very fine high polymer sutures (or non-absorbable sutures which can be removed) to prevent re-occurrence of the tender scar.

2. Complex 'post-surgical' vestibular scarring requires excision down to healthy tissue. If this is left to granulate, there is a risk of shrinkage and stricture re-formation. Under these circumstances, a small posteriorly based pedicled flap graft maybe utilised (Fig. 7.26).[13]

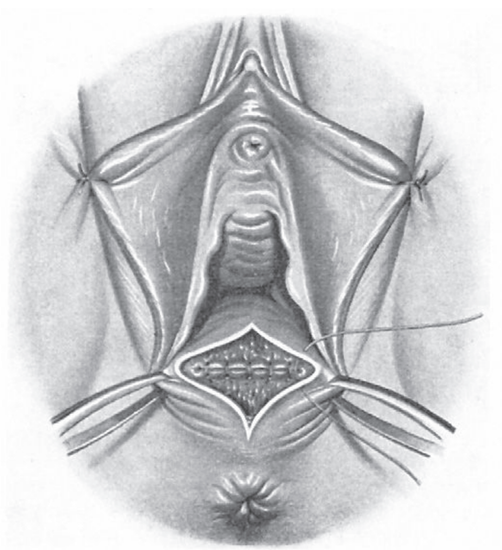

Fig. 7.24: Enlargement of the vaginal introitus. The edges are drawn apart and the deeper tissues are drawn together with interrupted Vicryl sutures to produce a horizontal layer. Subsequently the skin edges are brought together with interrupted sutures.

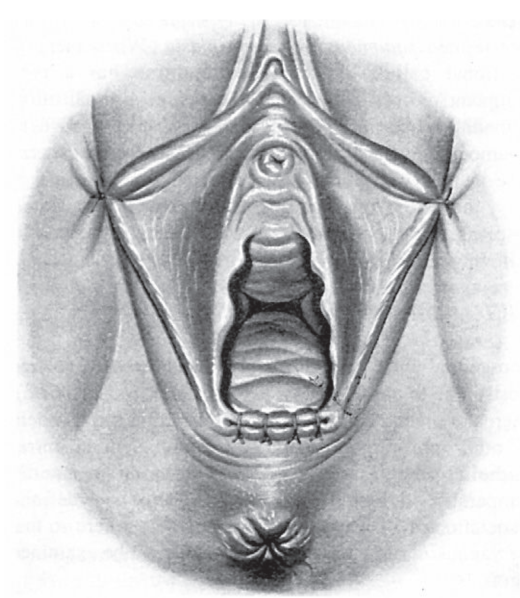

Fig. 7.25: Enlargement of vaginal introitus. Completion of the operation.

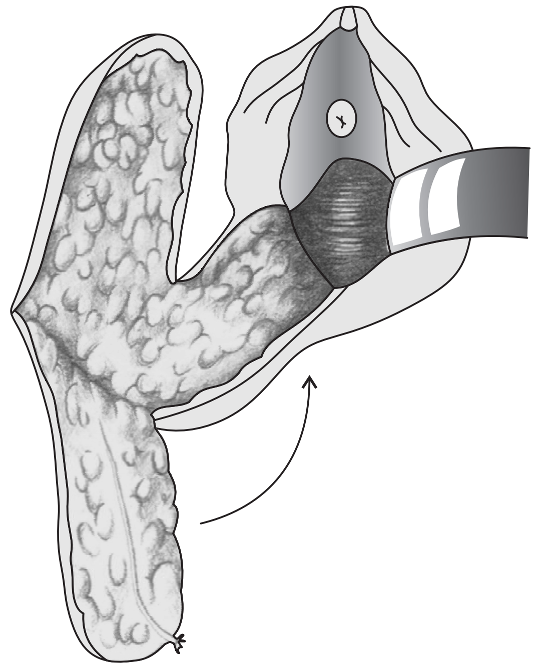

Fig. 7.26: Transposition flap to cover the area from which all scar tissue has been excised.

Diseases of the Urethra

PROLAPSE OF THE URETHRAL MUCOUS MEMBRANE

A minor degree of prolapse of the urethral mucous membrane is not uncommonly seen in adult women, though it is symptomless and necessitates no treatment. Severe degrees of prolapse are restricted to children and the aged. The condition is circumferential and in many ways comparable to prolapse of the mucous membrane of the rectum. In children there is usually a history of bronchitis or of worms, while a chronic cough may be one of the complaints met with the elderly patients. In addition to the factor of raised intra-abdominal pressure brought about by coughing, it must be assumed that the urethral tissues are lax so that the mucous membrane can separate from the muscle layer. The prolapsed mucous membrane becomes oedematous and congested and may cause severe local discomfort with frequency and tenesmus. If the prolapse becomes infarcted, a blood-stained discharge results. If the condition is not treated surgically, the prolapse will eventually slough.

Treatment: The simplest surgical procedure is to excise the prolapsed mucous membrane and to suture the healthy margin of the urethra to the skin by a series of interrupted high-polymer sutures. Great care must be taken in placing the sutures accurately to prevent stenosis developing at the meatus. There is some risk of recurrence after this operation though the immediate results are satisfactory. Better results can be obtained if the prolapsed mucous membrane is excised with a diathermy knife. It seems that scar tissue which forms around the meatus after diathermy excision tends to prevent a recurrence, particularly if radial incisions are made in the skin of the adjacent vestibule.

CYST OF SKENE'S TUBULES

These small cysts are very rarely seen and take the form of a small cystic swelling to one or other side of the urethral meatus. The cyst can be excised and shelled out without much difficulty.

Non-malignant Conditions of the Vulva

LOCAL SKIN CONDITIONS

It is important to recognise when a vulval skin condition is a manifestation of a more generalised dermatological disorder. The situation is made more difficult by scratching artefacts (lichenification, hyperkeratosis). Conditions such as threadworm infestation (oxyuris vermicularis) need to be borne in mind, especially in children and scratching artefacts should not be mistaken for evidence of sexual abuse.

The nomenclature for vulval skin disorders has been revised by the International Society for Diseases of the Vulva. Although lichen planus and lichen simplex can affect the vulva, the commonest lichenification is lichen sclerosus et atrophicus (LSAV).[14] This is a potent source of vulval irritation (pruritus). In the past, this condition with severe irritation has been treated by local vulvectomy with some relief of symptoms. Vulvectomy is, however, a mutilating operation, which interferes with sexual function and whose benefit is often short-lived. The clinical dilemma, however, is that severe pruritus may indicate the co-existence of a hyperplastic component, now termed squamous cell hyperplasia. When there is additional cellular atypia, the condition has a pre-malignant propensity and may merge into vaginal intraepithelial neoplasia (VIN), (see Chapter 15 or undergo direct change to squamous cell cancer; more than half of all vulval cancers arise in this way. Surgery for vulval lichen sclerosus is only indicated for histologically proven associated dysplasia or failure of adequate medical treatment.[15]

1. **Paget's disease of the vulva:** Extra-mammary Paget's disease has a localised eczematous appearance. It is often, but not always, associated with an underlying adenocarcinoma of apocrine origin or of rectum, colon, ovary, cervix or breast.[16]
2. **Labial cysts, fibromas, multiple sebaceous cysts:** These may be removed for cosmetic reasons because of diagnostic doubt, or because they have shown a tendency to become infected.
3. **Hidradenoma:** These small tumours of sweat glands, if ulcerated, may be mistaken for malignancy. Local excision will suffice.
4. **Viral warts (condyloma acuminatum):** These can vary from a few delicate fronds scattered over the vulva and adjacent areas, to a massive tumour-like condition, giant condyloma of the vulva.[17] Local treatment of warts consists of topical applications, laser therapy, cryotherapy and cautery. Rather less painful is multiple scissor excision.[18] The association of wart virus infections with immunosuppressed states, including human immunodeficiency virus infection, needs to be remembered. Warts tend to regress after pregnancy, so that aggressive therapy applications should be avoided.
5. **Vulvar vestibulitis:** In this condition, there is exquisite local tenderness over a 'horse-shoe'-shaped arc of the posterior vestibule with rather unremarkable physical signs. Local excision of this area has been recommended as a treatment often using the hymen to close the defect.[19]

   Other benign conditions which may require local intervention are a lipoma, deposits of endometriosis or even large varicose veins filling from a saphena-varix.

LOCAL VULVECTOMY

Total (local) vulvectomy is very rarely indicated for non-malignant conditions. The principal indication would be vulval elephantiasis and the operation in such cases is not a minor one. Closure may be by an inverted 'racquet' or by an advancement flap from the mons (Figs. 7.27–7.29).

Chronic granulomatous conditions of the vulva not fully responsive to antibiotics may retain a pre-malignant potential and therefore be considered for prophylactic local vulvectomy.[20]

Fig. 7.27: Vulval lymphoedema. This lesion was probably secondary to old tuberculous inguinal lymphadenitis. (By courtesy of the late Professor John Lawson).

Bartholin's Abscess and Cyst

INTRODUCTION

Although infection of Bartholin's gland responds extremely well to chemotherapy and even acute abscesses may undergo resolution without surgical intervention, there is a great tendency for recurrence of the infection. Some patients may have had several abscesses which swell up, burst and become quiescent only to repeat the process a few months later. The condition is extremely painful and may render walking unbearable. Dyspareunia is a common complaint. The usual treatment of a Bartholin's abscess is marsupialisation. A Bartholin's cyst results from blockage of the duct of the gland. Chronic inflammatory conditions are responsible for the occlusion of the duct, but the origin is not necessarily gonococcal. Quite a common cause of a Bartholin's cyst is a misplaced episiotomy incision in the posterolateral position. The duct is thereby either cut or, if not transected, it becomes involved in the subsequent scar tissue. This complication should be avoided by strict attention to starting all episiotomy incisions at the midline (six o'clock) position.

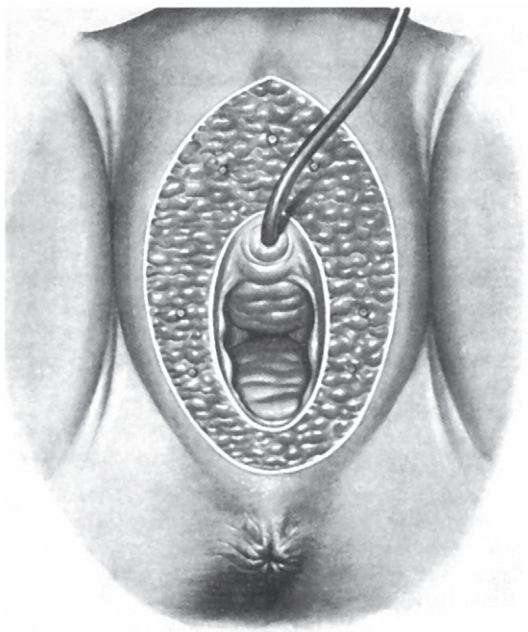

Fig. 7.28: Local vulvectomy. The affected skin has been excised. Bleeding points have been picked up and ligatured. A catheter has been introduced into the urethra.

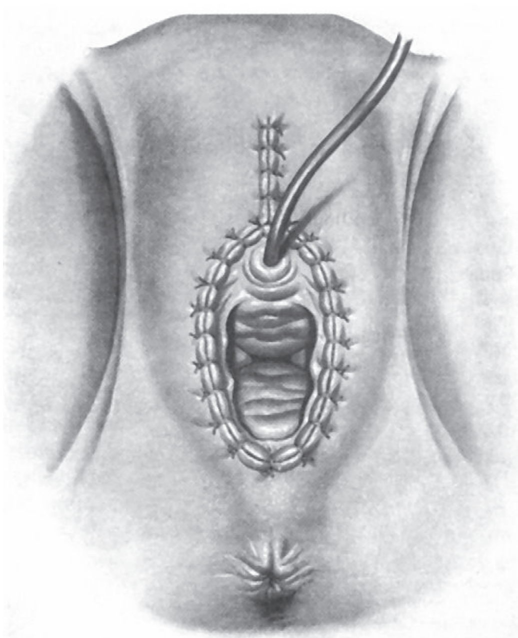

Fig. 7.29: Local vulvectomy. The skin edges are brought together with interrupted catgut sutures. If the skin of the perineum is grossly affected, a much wider dissection is required. In such cases, the flap can be fashioned from the posterior vaginal wall.

MARSUPIALISATION OPERATION

The treatment of Bartholin's cysts and abscesses by marsupialisation is now the method of choice. The advantages of marsupialisation over excision are as follows:

1. It is an extremely simple operation requiring only a few minutes for its performance, whereas excision is nearly always difficult, tedious and time consuming.
2. Haemorrhage is minimal and easily controlled, whereas the reverse certainly applies with excision. Haematoma formation after marsupialisation should not occur, whereas with excision it frequently occurs, even when drainage or packing is applied.
3. It is applicable to the treatment of the acutely inflamed gland with abscess formation as an alternative to incision and drainage.
4. It is claimed that some functional activity may be regenerated in the gland which thereby supplies lubrication to the vagina. One of the main disadvantages of bilateral excision of Bartholin's gland and cyst is that it leaves the patient with a dry vagina, thereby causing friction dyspareunia.

Technique:

1. The exact situation of the incision varies according to whether there is an abscess pointing, or simply a cyst. Ideally, it should ultimately heal with a stoma in the position where Bartholin's duct normally opens. It is best, therefore, made on the vaginal side of the hymeneal ring. In this situation, when healed, there is less likelihood of an introital scar causing dyspareunia. The length of the incision must not be too short in order to avoid closure of the aperture during the process of healing, whereby a recurrence of the cyst or abscess is likely.
2. The incision includes the vaginal skin and cyst or abscess wall, both of which are picked up together by a pair of Allis' forceps placed laterally and medially.
3. Two semicircles of skin and cyst wall are excised on each side of the incision and the edges trimmed to leave an aperture 1 cm in diameter (Fig. 7.30).

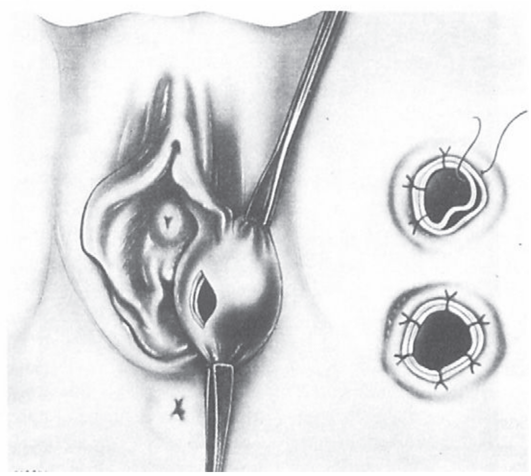

Fig. 7.30: Marsupialisation of Bartholin's cyst. Left: position of incision, top right: excision of disc of cyst and overlying skin, Bottom right: suture of cyst wall to skin.

4. The edges of the skin and cyst wall are again secured with Allis' forceps and a series of fine interrupted sutures applied circumferentially at 1 cm intervals. These sutures secure apposition of the cyst wall and vaginal skin to leave a clean circular scar.

After treatment: Unless the cyst is infected or a frank abscess is being treated, chemotherapy is unnecessary and all that is required is twice daily baths. If the patient is discharged early, she should be seen at the end of a week to ensure that no loculation has occurred in the cavity. It is rarely necessary to pack the cavity at the time of operation though this is good practice if haemorrhage is troublesome.

Complications:

1. Failure to secure the cyst wall with Allis' forceps may result in bleeding from the tissues intervening between the cyst wall and the vaginal skin.
2. Recurrence is usually due to a too small incision and an inadequate removal of skin and cyst wall as a result of which the stoma becomes constricted and blocked. Postoperative examination is equally important to ensure that no loculation occurs in the cavity and that this becomes obliterated from below upwards.

EXCISION OF A BARTHOLIN'S GLAND

Technique: Opinions differ as to the position of the skin incision. A longitudinal incision on the inner surface of the labium minus gives the best exposure, but the subsequent scar may be painful and cause dyspareunia. If the incision is placed over the convexity of the swelling immediately lateral to the labium minus these objections do not arise, but the exposure is not so satisfactory. After the gland has been removed complete haemostasis must be obtained. Deep sutures may be used to obliterate the cavity. Considerable difficulty may be experienced in controlling all oozing from the erectile tissues of the operation area. Subsequently, the skin incision is closed with a series of No. 0 interrupted high polymer sutures. If haemostasis is not satisfactory, a small suction drain should be inserted in the wound and left in for 24 hours. A very considerable haematoma can develop if this precaution is omitted and such a haematoma may take weeks to absorb and be most uncomfortable and time wasting for the patient.

Tissue should be sent for histology if there is chronic thickening and fibrosis, as carcinoma of the gland may develop following chronic infection.

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Congenital Anomalies of the Genital Tract

8

Adam Balen

Introduction

Congenital anomalies of the lower genital tract are often referred to as 'disorders of sexual development (DSD)' and encompass both conditions known formerly as 'intersex conditions' or variations in the fusion of the Müllerian structures. Disorders of sexual development may result in ambiguous genitalia or anomalies of the internal genital tract and may be due to genetic defects, abnormalities of steroidogenesis and dyssynchrony during organogenesis.

The age of presentation will depend upon the degree of dysfunction caused. Ambiguous genitalia occur in approximately 1:30,000 newborns. The rate with which other congenital anomalies present varies depending upon the population studied and the age at which the problem is likely to be noticed. Population-based statistics are still lacking for many conditions—largely because patients present to different specialists (e.g. gynaecologists, paediatric endocrinologists, urologists, etc.) and there are rarely clear pathways for communication between the different professional groups to create a comprehensive service both for provision of treatment and collection of data. In the United Kingdom, the British Society for Paediatric and Adolescent Gynaecology (BritSPAG) has formed networks of specialist care in order to overcome these problems (www.britspag.org).

Puberty and adolescence are recognised as periods involving marked endocrine changes that regulate growth and sexual development. The mechanisms which control the precise timing of the onset of puberty, however, are still not clearly understood but are influenced by many factors including general health, nutrition, exercise, genetic influences and socioeconomic conditions. Most of the changes during puberty are gradual, although menarche is a single event that can be dated in girls. Normal puberty involves a fairly regular sequence of events between the ages of 10 and 16 years. A detailed description is beyond the scope of this chapter.

In broad terms, once a girl has passed menarche, she is potentially fertile and should be considered as a young woman. The degree of sexual and reproductive maturity is not always mirrored by emotional and psychological maturity and so consideration must be made of the particular needs of adolescent girls when they attend clinics and hospital with gynaecological problems.

It is recognised that adolescents with medical problems have special needs. Adolescents with gynaecological problems have additional needs and require a degree of privacy and sensitive handling. Many of the gynaecological problems encountered relate to intimate bodily functions at a time when the individual is maturing sexually and having to deal with issues that are embarrassing and may be considered taboo. Furthermore, there needs to be consideration made of ethnic and cultural differences and potential problems with communication—particularly as amongst the parents from ethnic minorities it is often the father and not the mother who can speak English. Hence there is a need for interpreters and information written in different languages.

Patients with complex disorders of sexual development require sensitive care by an expert multidisciplinary group that includes: gynaecologists, paediatric endocrinologists, paediatric surgeons and urologists, plastic surgeons, psychologists, specialist nurses, geneticists and urologists. A network of support should be provided both to the patient and her parents and family. The adolescent period is a particularly sensitive time as the individual becomes aware of her diagnosis and its impact on her sexuality, sexual function and fertility. It is important to provide a seamless handover from paediatric to adult services at this time and dedicated adolescent clinics have an important role.

Imaging

The uterus grows in concordance with somatic growth, with differential increased growth of the corpus starting from about the age of 7 years. However, the main differential increase of uterine size compared with somatic growth is obvious only after oestradiol secretion is measurably increased and tends to occur between Tanner breast stage 3 and 4. Awareness of this comparatively late relative increase in uterine size has clinical relevance in the differentiation of arrested puberty and Müllerian agenesis and also in the diagnosis of causes of precocious puberty. Ultrasound is the most suitable imaging technique for the examination of the internal genitalia of girls as it is free from the risks of radiation and involves a quick, quiet and non-invasive procedure. Whilst higher resolution images can be obtained of the ovaries and uterus using transvaginal ultrasonography we can only use the transabdominal approach in young girls and it may not always be possible to visualise both ovaries; furthermore, a full bladder is required. Nonetheless transabdominal ultrasonography is an invaluable tool for the delineation of normal changes before and through puberty and also the evaluation of paediatric disorders, such as pelvic masses and abnormal pubertal development.

As girls go through puberty the ovaries have been described as characteristically becoming multicystic due to low levels of follicle-stimulating hormone stimulating only partial folliculogenesis. The multicystic ovary differs from the polycystic ovary in that the cysts are larger (6–10 mm) and the stroma is of normal echogenicity. The morphological appearance of the multicystic ovary heralds the onset of menstrual activity and may be helpful when planning surgery (or alternatively menstrual suppression with hormone therapy) in cases where obstructed menstruation is anticipated.

Whilst ultrasound is usually the first-line imaging modality for the assessment of the pelvis, it is often necessary to get more detailed images in cases of Müllerian dysgenesis - as provided by magnetic resonance imaging (MRI).[1] The assistance of a skilled radiologist is required in order to assess the differences between a pre-pubertal, under-developed uterus and a vestigial uterine remnant that will not have the potential to develop. Sometimes serial scans at intervals of 6–12 months (depending upon the child's age) are required.

Labial Anomalies

LABIAL ADHESION

Adhesion of the labia minora is a minor condition commonly seen in young girls under the age of 7 years. It can appear as if the child has no vaginal opening. Usually there are no symptoms, and the vagina may simply look different. Older children may experience discomfort when passing urine or spraying of urine. Sometimes the urine may collect within the lower vagina and the stream of urine may trickle and continue with a post-micturition dribble. Occasionally, a child with labial adhesion may have repeated urinary tract infections or vaginal discharge.

If the child is asymptomatic no action is required, and the problem is self-correcting with separation of the labia at puberty in response to natural oestrogen production. A pelvic ultrasound to reassure parents that a uterus is present can be very helpful.

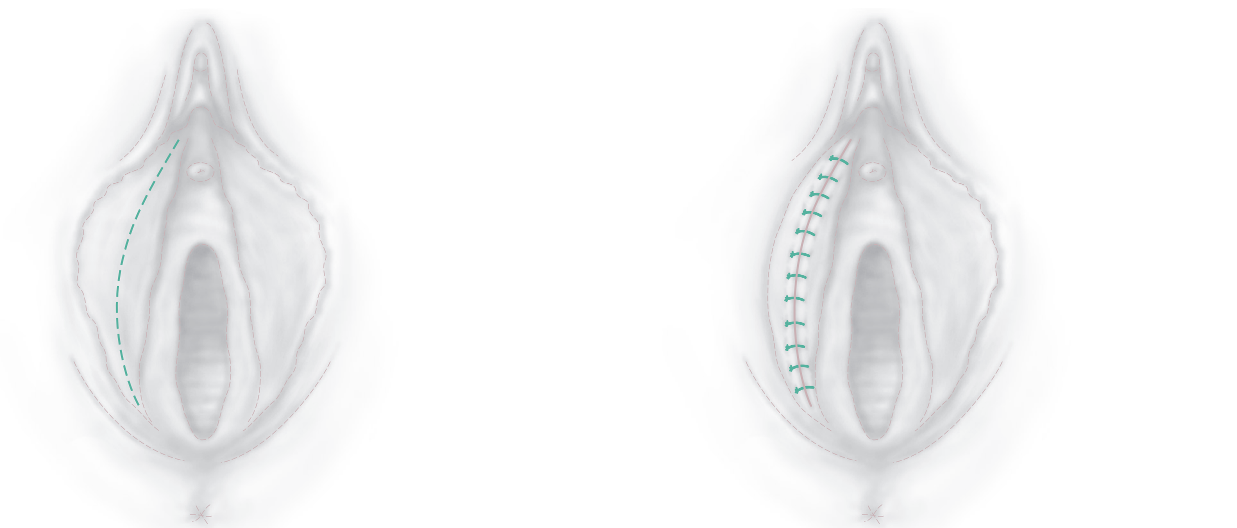
If there are symptoms, adhesions may be treated using topical oestrogen cream thinly applied to the midline at night over a period of 2–4 weeks.[2] It is rarely necessary, or indicated, to resort to surgical separation. Gentle separation under general anaesthetic after a course of topical oestrogen may be performed, but surgical incision through the adherent skin is inadvisable as the consequent scarring may then cause long-term problems.

Occasionally, labial adhesion may be associated with lichen sclerosus, which can be confirmed by biopsy and treated by topical steroids.

REDUCTION LABIOPLASTY/LABIAPLASTY

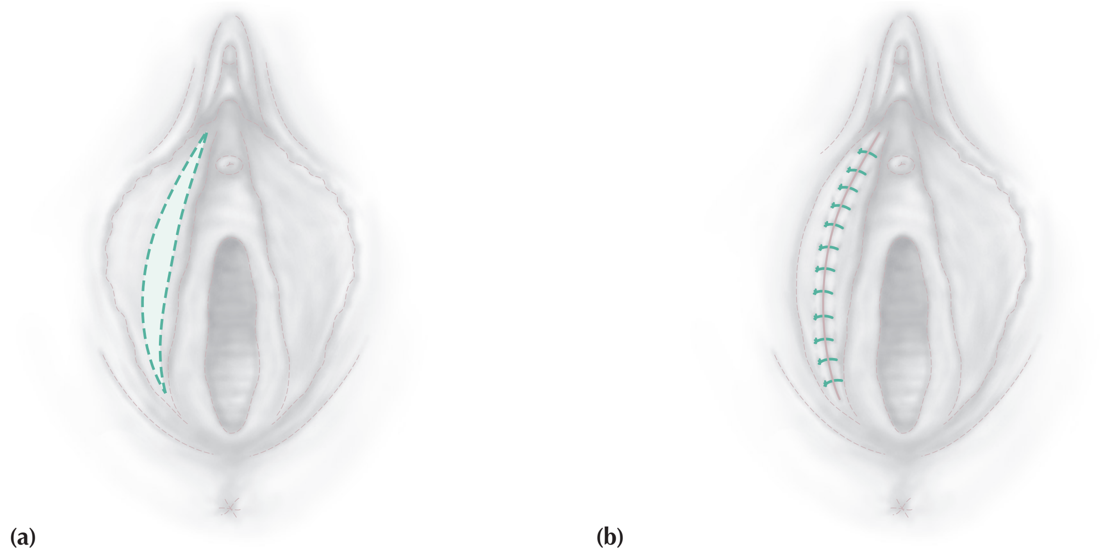
Cosmetic vulvovaginal surgery is controversial and whilst this may encompass a number of procedures that are often performed in the private sector under the label 'vaginal rejuvenation surgery', here we focus on labial reduction surgery, which is increasingly being requested by adolescent girls and young women. There are, however, wide natural variations in vaginal, labial and clitoral dimensions, positions, symmetry and rugosity.[3] When the labia majora are thin, which can be related to body fat distribution, the labia minora may appear more prominent; whereas when the labia minora are smaller, the clitoris and introitus may appear more prominent. Overall impressions will be affected by the volume, texture and pigmentation of adjacent body tissue.

A number of different techniques have been described, ranging from the simple 'trimming' of the edge of the labia minora, the edge of which is then sutured (Fig. 8.1). This is a less satisfactory method as a scarred labial edge remains which may be cosmetically unsatisfactory.



(a) (b)

Fig. 8.1: Labial trimming.


(a) (b)

8.2: Labial wedge resection.

An aesthetically and cosmetically preferable procedure is to remove a triangular wedge in order to preserve the labial edge, preserving the nerves and reducing the risk of hypopigmentation of the scar line (Fig. 8.2).[4] One large retrospective series of 407 women reported a 4.4% rate of significant complications including revision.[5]

It has also been suggested that the appearance of pre-pubescent labia, commonly represented in pornographic imagery, is often considered the ideal by women seeking genital cosmetic surgery.[6] A detailed study of 17 women found that the main reason they requested surgery was because they viewed their pre-surgery appearance as 'defective' and sought a 'normal' genital look.[7] The women tended to base their view of 'normal' on social norms projected in the media that female genitalia should be 'invisible', with no protruding labia, and they requested the operation because they found their situation stigmatising. The study also highlighted that health professionals are delivering mixed messages about what is 'normal'. The women's perception of being 'abnormal' was inadvertently reinforced by being given reassurance of normality, alongside referral to a specialist for further investigation or surgical intervention. Another common theme was that the women felt their appearance impacted negatively on their sex lives and relationships. Although the operation did have the effect of making the women less self-conscious, expectations of improved sex-life and relationships were not met for all women.

There is significant concern about the practice of female genital cosmetic surgery[8,9] as expressed by position statements from both the American and British Colleges.[10,11] In its statement the Royal College of Obstetricians and Gynaecologists (RCOG) indicates its concern 'that requests for labioplasty surgery may be made by women who do not realise that the appearance of the external genitalia varies from one woman to another. Furthermore, there is the potential for a woman to be harmed by these procedures, with very little scientific evidence regarding their benefits'.

Congenital Uterine Anomalies

In the absence of a Y chromosome, testis and testosterone, the Wolffian duct regresses after the 6th week of embryonic life. The Müllerian ducts then develop into the uterus and Fallopian tubes and fuse caudally with the urogenital sinus to form the vagina. Abnormalities in the process of fusion may be either transverse or vertical and result in primary amenorrhoea; complete or partial Müllerian agenesis may also occur. Renal developmental abnormalities are commonly seen in association with abnormalities of the genital tract so assessment by appropriate imaging (usually ultrasound or MRI) is advisable before attempting corrective surgery.

CLASSIFICATION OF MÜLLERIAN ANOMALIES

Uterine anomalies occur in between 3% and 10% of the fertile female population. The more common anomalies have been reported in 2–3% of fertile women, 3% of infertile women and 5–10% of those with recurrent miscarriage.[12] Uterine anomalies can be subdivided according to the nature of the abnormality and were originally classified by the American Fertility Society [AFS, now the American Society for Reproductive Medicine (ASRM)] into seven groups (Fig. 8.3)[13]:

1. **Segmental agenesis or hypoplasia** – which may involve vagina, cervix, uterine corpus or Fallopian tubes. Mayer–Rokitansky–Kuster–Hauser syndrome is included here.
2. **Unicornuate uterus**, with or without a rudimentary horn that may or may not contain endometrium and be connected to the main uterine cavity. On the affected side the kidney and ureter are generally absent.

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3. **Uterus didelphys:** due to partial or complete failure of lateral Müllerian duct fusion leading to partial or complete duplication of the vagina, cervix and uterus.

4. **Bicornuate uterus:** with a single vagina and cervix and two uterine bodies that may be completely separated or fused centrally with a partial septum.

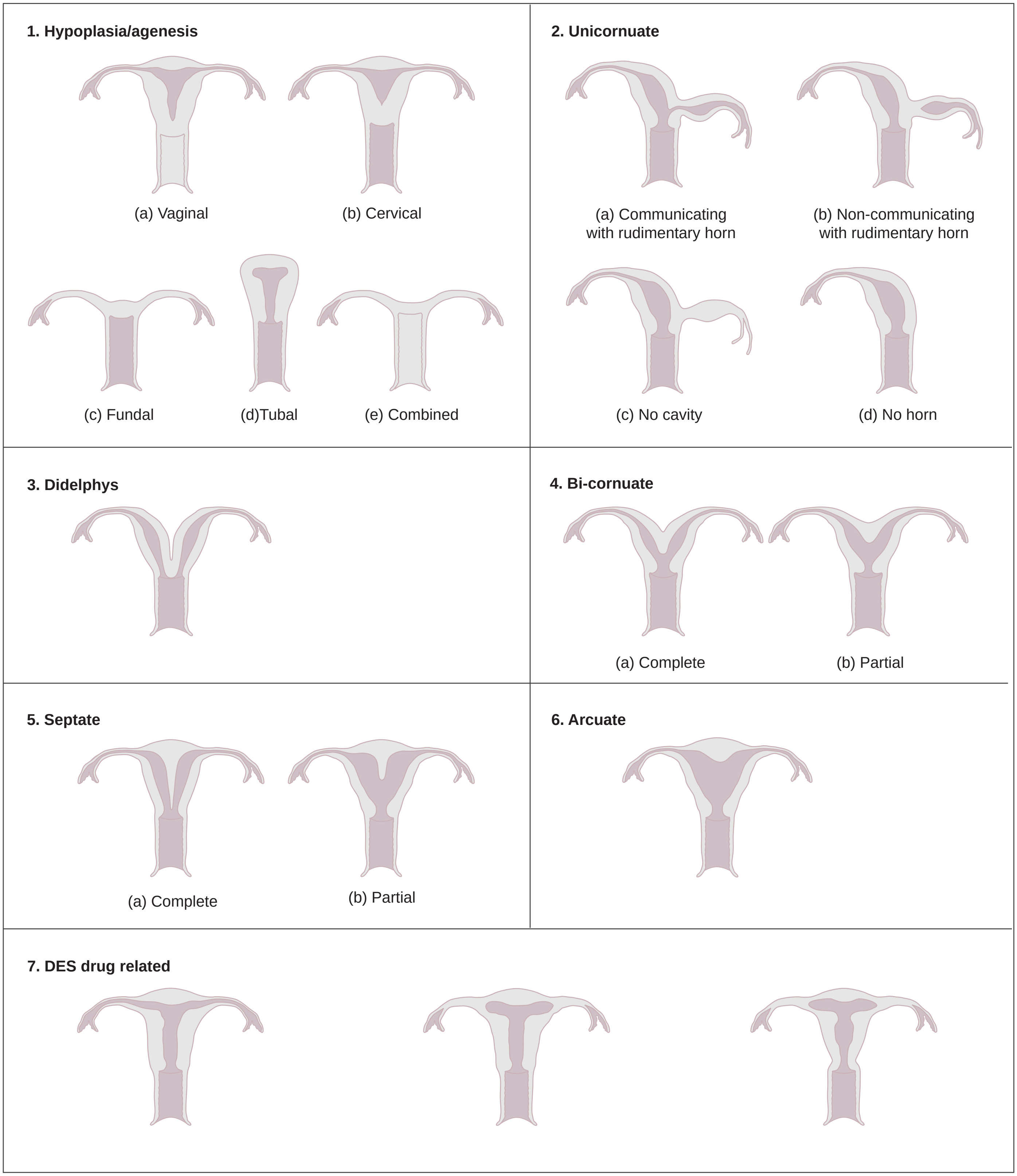

Fig. 8.3: American Fertility Society (AFS) classification of uterine anomalies.

5. **Septate uterus**, with a septum that may be partial or complete.
6. **Arcuate uterus**, with a mild indentation at the level of the fundus.
7. **Diethylstilbestrol-related anomalies**, which might demonstrate various shapes (often 'T-shaped') due to the effect of diethylstilbestrol, which was administered to prevent recurrent miscarriage in the 1950s and whose effects are still observed, although in fewer cases as time goes on.

It is important to remember the common association between unilateral uterine dysgenesis and ipsilateral aplasia of the renal tract. The AFS classification is simple and concentrates predominantly on the description of the uterine malformations. There have been further attempts to extend the AFS classification with the recognition of additional complex malformations.[14] Indeed case reports of previously undescribed anomalies continue to be published. To this end a more comprehensive classification has been proposed, which subdivides the anomalies based upon precise organ subgroups together with associated malformations, which are present in up to 30% of cases. This is the VCUAM (Vagina Cervix Uterus Adnexa – associated Malformation) classification (Table 8.1)[15]:

Table 8.1: The VCUAM (Vagina Cervix Uterus Adnexa-associated Malformation) classification

Vagina (V)	0	Normal		
	1a	Partial hymenal atresia		
	1b	Complete hymenal atresia		
	2a	Incomplete septate vagina <50%		
	2b	Complete septate vagina		
	3	Stenosis of the introitus		
	4	Hypoplasia		
	5a	Unilateral atresia		
	5b	Complete atresia		
	S1	Sinus urogenitalis (deep confluence)		
	S2	Sinus urogenitalis (middle confluence)		
	S3	Sinus urogenitalis (high confluence)		
	C	Cloacae		
	+	Other		
	#	Unknown		
Cervix (C)	0	Normal		
	1	Duplex cervix		
	2a	Unilateral atresia/aplasia		
	2b	Bilateral atresia/aplasia		
	+	Other		
	#	Unknown		
Uterus (U)	0	Normal		
	1a	Arcuate		
	1b	Septate <50% of the uterine cavity		
	1c	Septate >50% of the uterine cavity		
	2	Bicornuate		
	3	Hypoplastic uterus		
	4a	Unilaterally rudimentary or aplastic		
	4b	Bilaterally rudimentary or aplastic		
	+	Other		
	#	Unknown		
Adnexa (A)	0	Normal		
	1a	Unilateral tubal malformation, ovaries normal		
	1b	Bilateral tubal malformation, ovaries normal		
	2a	Unilateral hypoplasia/gonadal streak (including tubal malformation if appropriate)		
	2b	Bilateral hypoplasia/gonadal streak (including tubal malformation if appropriate)		
	3a	Unilateral aplasia		
	3b	Bilateral aplasia		
	+	Other		
	#	Unknown		
Associated Malformation (M)	0	Normal	N	Neurological
	R	Renal system	+	Other
	S	Skeleton	#	Unknown
	C	Cardiac		

The VCUAM classification is complex and difficult to memorise. Furthermore it has been criticised because there is no attempt to weight the severity of each of the anatomical variants, which are therefore given the same importance. There are therefore proposals to further enhance the system for classification.

Women with uterine anomalies are usually asymptomatic, unless there is obstruction to menstrual flow, when cyclical pain may be experienced. Whilst infertility per-se is rarely caused by uterine anomalies, they may be associated with endometriosis if there is retrograde menstruation secondary to obstruction. Furthermore recurrent miscarriage may be experienced by some women with uterine malformations. Uterine anomalies may present with painful menstruation due to partial obstruction of a hemi-uterus but are often discovered by chance during investigations for infertility. The diagnosis is made by a combination of ultrasound (nowadays often 3-D or 4-D), magnetic resonance imaging and X-ray hysterosalpingography (the latter during the course of an infertility work up).

Surgery is reserved for those cases where there is obstruction, for example, the removal of a rudimentary uterine horn or excision of a vaginal septum. The excision of a uterine septum has also been shown to improve pregnancy outcome and should be performed by an experienced hysteroscopist. On the other hand, metroplasty (Strassman procedure) of the horns of a bicornuate uterus is seldom performed nowadays as its benefit has been questioned.

VAGINAL AGENESIS

Women with Mayer–Rokitansky–Kuster–Hauser syndrome (MRKH or Rokitansky syndrome) have a 46,XX genotype and a normal female phenotype with spontaneous development of secondary sexual characteristics, as ovarian tissue is present and functions normally. The Müllerian ducts have failed to fuse and so there is vaginal agenesis. The original description of MRKH syndrome also described the presence of Fallopian tubes, which may also be attached to vestigial uterine remnants (anlagan) on the pelvic sidewall. The diagnosis of Rokitansky

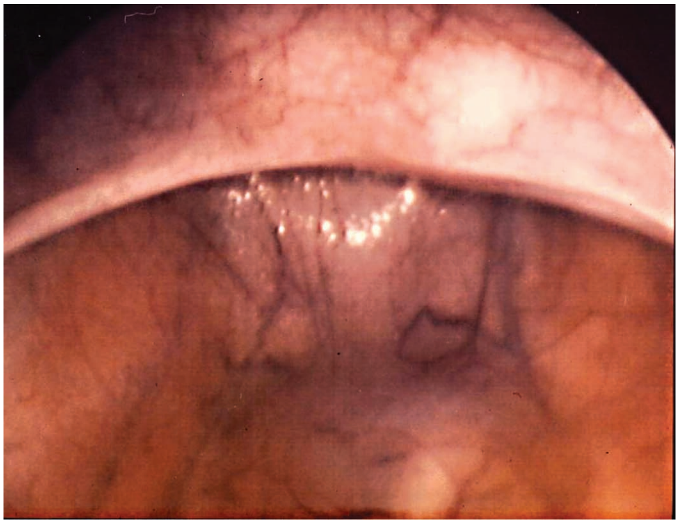

Fig. 8.4: Laparoscopic view of absent uterus in MRKH syndrome.

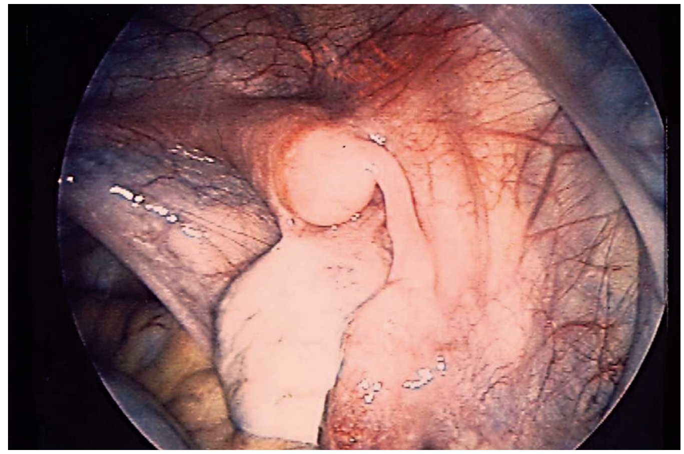

Fig. 8.5: Uterine anlagan in MRKH syndrome.

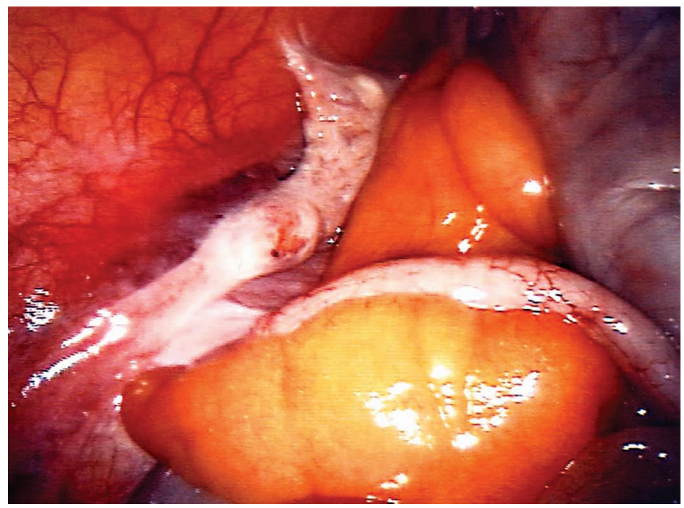

Fig. 8.6: High ovary adjacent to appendix in a case of MRKH syndrome.

syndrome can usually be made without the need for a laparoscopy (Figs. 8.4–8.6). Sometimes, however, an ultrasound scan will reveal the presence of a uterine remnant (anlagan) which is usually small and hardly ever of sufficient size to function normally. The anlagan may contain functioning endometrial tissue and whilst these do not present any possibility of re-construction they may have to be removed if the patient experiences cyclical pelvic pain, which may also be associated with endometriosis due to the retrograde menstruation. The removal of an anlagan may be achieved easily by laparoscopic surgery. In cases of total Müllerian aplasia there are neither tubes nor anlagans.

The incidence of Rokitansky syndrome is about 1:5000 female births[16] and may be associated with renal tract anomalies (15–40%) or anomalies of the skeletal system (10–20%). The external genitalia have a normal appearance, but the vagina is short and blind ending, such that either surgery or gradual dilatation is necessary to achieve a capacity appropriate for normal sexual function. Hormone treatment is not required as ovarian oestrogen output is normal. Indeed ovulation occurs and ovarian stimulation followed by oocyte retrieval can be performed in order to achieve a 'biological' pregnancy through the services of a surrogate mother.[17,18]

The vaginal dimple can vary in length from just a slight depression between the labia to up to 5–6 cm. Vaginal dilators, made of plastic or glass, are used first to stretch the vaginal skin and the patient is encouraged to apply pressure for 15 minutes twice daily with successive sizes of dilator (Fig. 8.7). This method was described by Frank[19] and is our preferred approach for the vast majority of patients (Fig. 8.8a,b). An adequately sized vagina is usually formed by 6 months but this may take longer and long-term use of dilators may be required, depending upon the frequency of sexual intercourse. We have a series of 92 women with Rokitansky syndrome, of whom 33 required help to create a vagina, as many had been able to achieve comfortable intercourse without assistance (although some had received treatment before coming to see us) and presented requesting surrogacy treatment. Of those who proceeded with therapy 95% were successful using vaginal dilators.[20]

A number of surgical approaches have been employed to create a neovagina. The Vecchietti procedure uses the same principle of progressive dilatation with the application of pressure from a plastic sphere ('olive') in the vagina which is attached to two wires that have been passed from the top of the vagina through to the anterior wall of the abdomen where they are attached to a traction device that is tightened daily in order to pull the olive upwards (Figs. 8.9a–c). The creation of a neovagina by this method usually takes 7–8 days. The original description was by laparotomy,[21] although in recent years

Fig. 8.7: Vaginal dilators (sometimes referred to as 'trainers').

minimal access surgery has enabled a simpler approach with discharge from hospital after 48–72 hours and management as an outpatient for the increase in tension of the traction sutures.[22] Once the neovagina has reached 7–8 cm in length the traction device is removed and the patient instructed to use vaginal dilators until sexual activity is satisfactory. Around Europe this has become a very popular method,[23,24] although its use in the UK is limited to the occasional case for whom the Frank's method is unsuccessful. If the angle of traction is incorrect or too much pressure applied there is the potential risk of damage to the urethra and bladder.

Plastic surgical techniques include: (*a*) the McIndoe Reed vaginoplasty in which a split skin graft is placed over a mould which has been inserted into a space created where the vagina should be; (*b*) tissue expansion vaginoplasty in which expansion balloons are inserted into the labia and inflated with water over a period of 2 weeks in order to stretch the labial skin folds sufficiently to be used to fashion a vagina; (*c*) an artificial vagina created from bowel – a technique less favoured nowadays because of problems with persistent unpleasant discharge; (*d*) an artificial vagina created from peritoneum – the Davydov technique; and (*e*) the William's vaginoplasty in which the labia are used to create a pouch – also rarely used nowadays because of problems with a poor anatomical result and an awkward angle for intercourse.

McIndoe Reed Vaginoplasty

With this procedure, a space is dissected between the urethra and rectum, into which a mould is inserted that has been covered with a split thickness skin graft (Fig. 8.10a–k). The mould is left in place for 7–12 days and subsequently the use of vaginal dilators is required. Although the dissection is through the perineum and therefore there is no scar on the abdominal

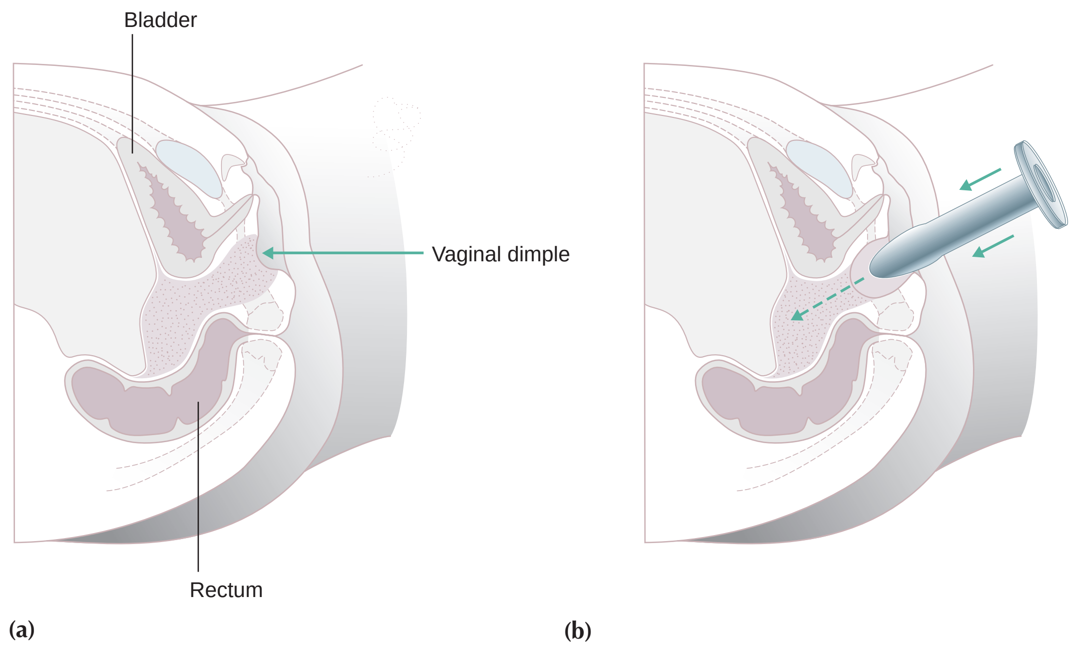

Fig. 8.8a,b: Frank's method of pressure dilatation.

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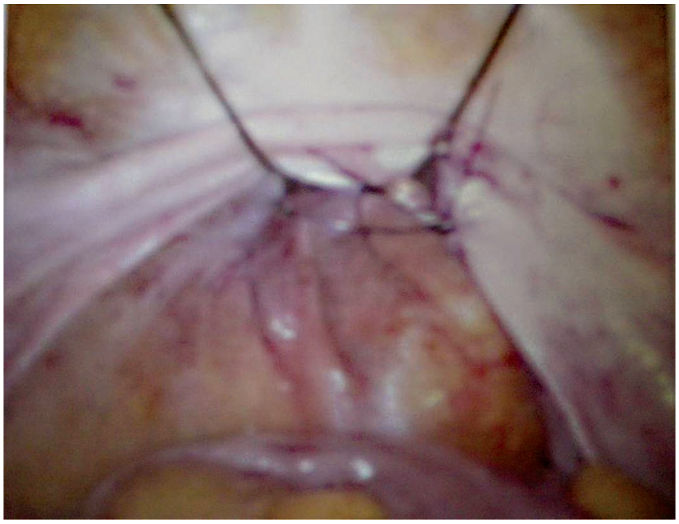


Fig. 8.9a: The Vecchietti procedure – laparoscopic view.

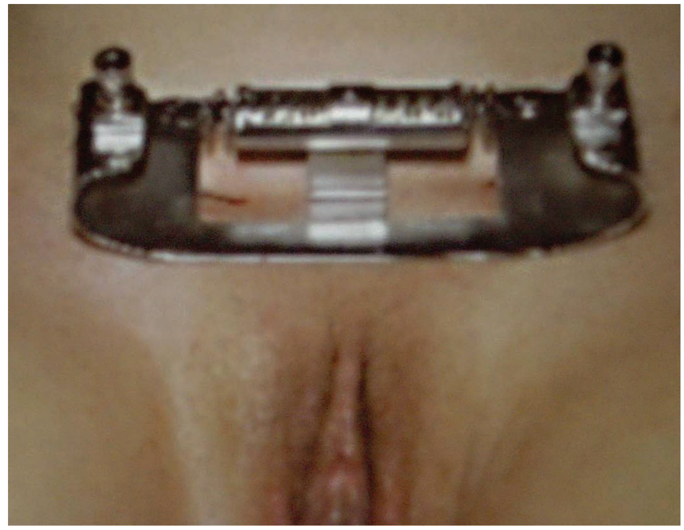


Fig. 8.9c: The Vecchietti procedure – tension screw device.

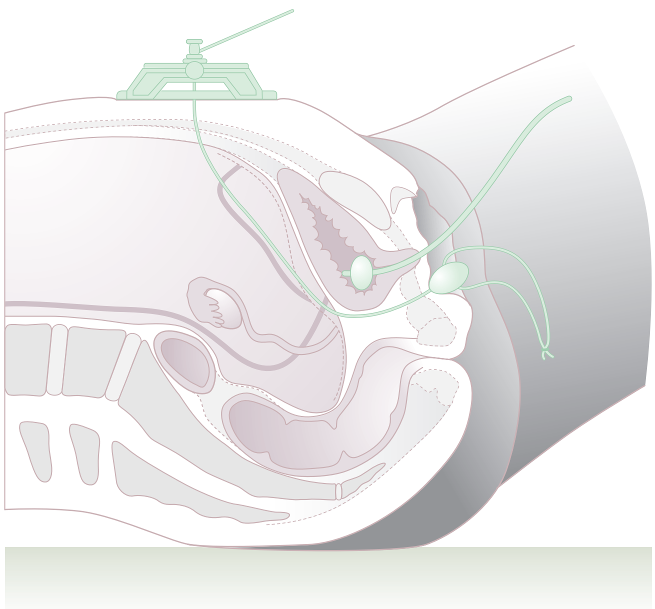


Fig. 8.9b: The Vecchietti procedure – laparoscopic approach.

wall, there may be significant scarring at the site of origin of the skin graft. Problems encountered with this procedure are that the neovagina may be dry, strictures may occur and there is also a risk of squamous carcinoma developing.[25]

Bowel Transposition Vaginoplasty

The use of segments of small bowel, descending colon, sigmoid colon or caecum have all been described for the creation of a neovagina (Fig. 8.11). Sometimes this is performed together with suspension of the vault of the neovagina. Whilst good outcomes have been reported by some,[26,27] this is not a procedure that we recommend routinely due to the association with constant, unpleasant mucus discharge and the risk of adenocarcinoma in the graft. Indeed it has been suggested that intestinal vaginoplasty should be reserved for the small number of women who have undergone extensive reconstructive surgery for complex cloacal anomalies.[28]

Davydov Vaginoplasty

The Davydov approach was initially described by laparotomy (Fig. 8.12a–k) but has now been modified to use laparoscopic surgical techniques.[29,30] First the urinary bladder and rectum are separated and the pelvic peritoneum opened transversely at the base of the pouch of Douglas, either in front of or behind the transverse fibrous bundle that connects the Fallopian tubes and ovaries. A Hegar dilator is directed upwards through the vaginal dimple and dissection onto this achieves the vestibulotomy. The two borders of the peritoneal incision are then drawn downwards and stitched to the edges of the vestibulotomy. A purse string suture is then placed laparoscopically at the vault of the neovagina, by taking the peritoneum of the bladder, round ligaments, utero-ovarian ligaments and rectum, taking care not to include the ureters. A mould may be left in the neovagina until epithelialisation has occurred (2–3 weeks) or alternatively the patient uses vaginal dilators 2–3 times daily until epithelialisation.

Epithelialisation may be assisted using an artificial dermis (atelocollagen sponge) and human recombinant fibroblast growth factor.[31]

William's Vaginoplasty

The William's procedure to create a vaginal pouch involves a deep U-shaped incision in the vulva, across the perineum and up to the medial side of the labia to the level of the

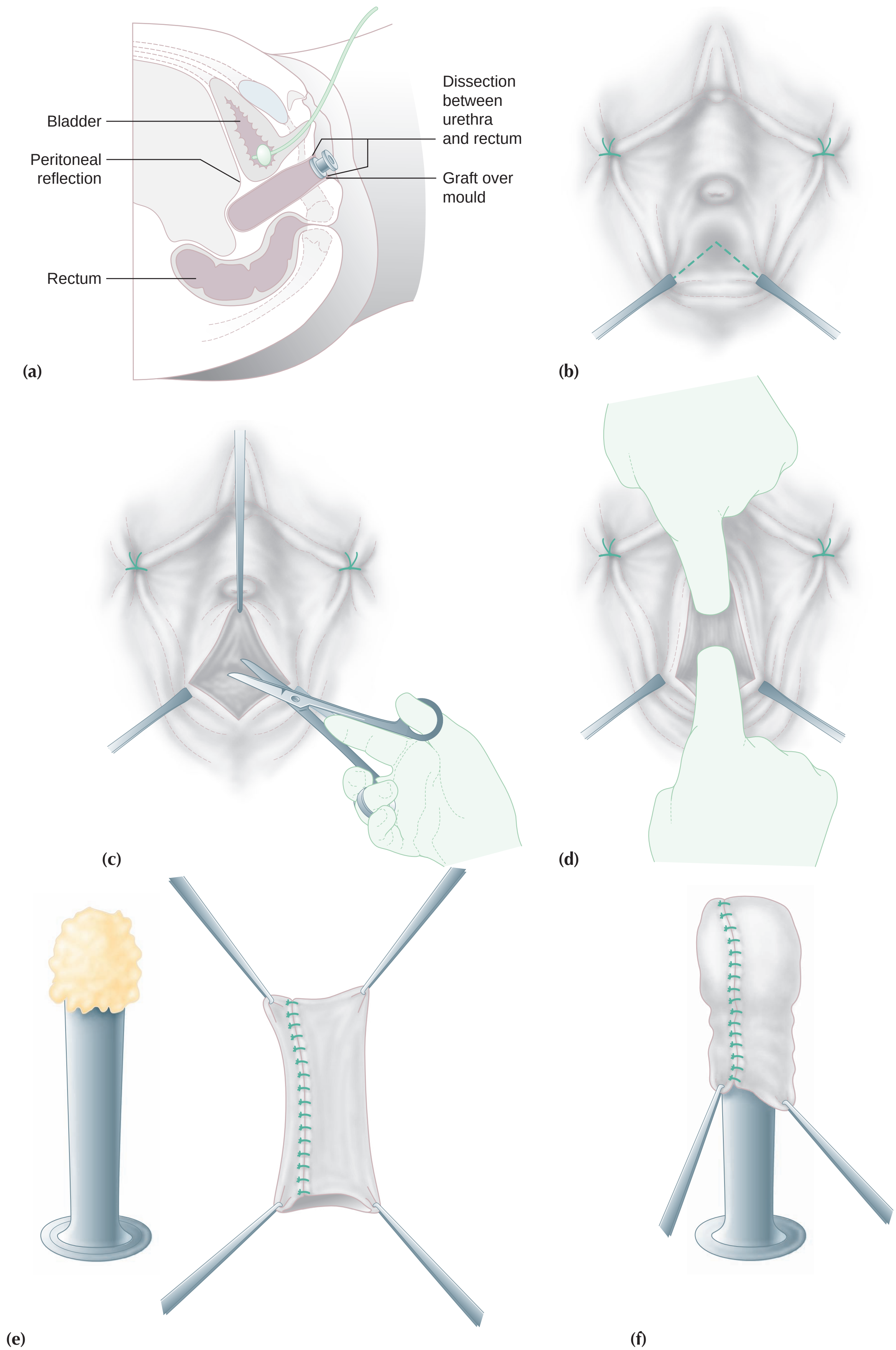


Fig. 8.10a–k: McIndoe Reed vaginoplasty *(continued on next page)*.

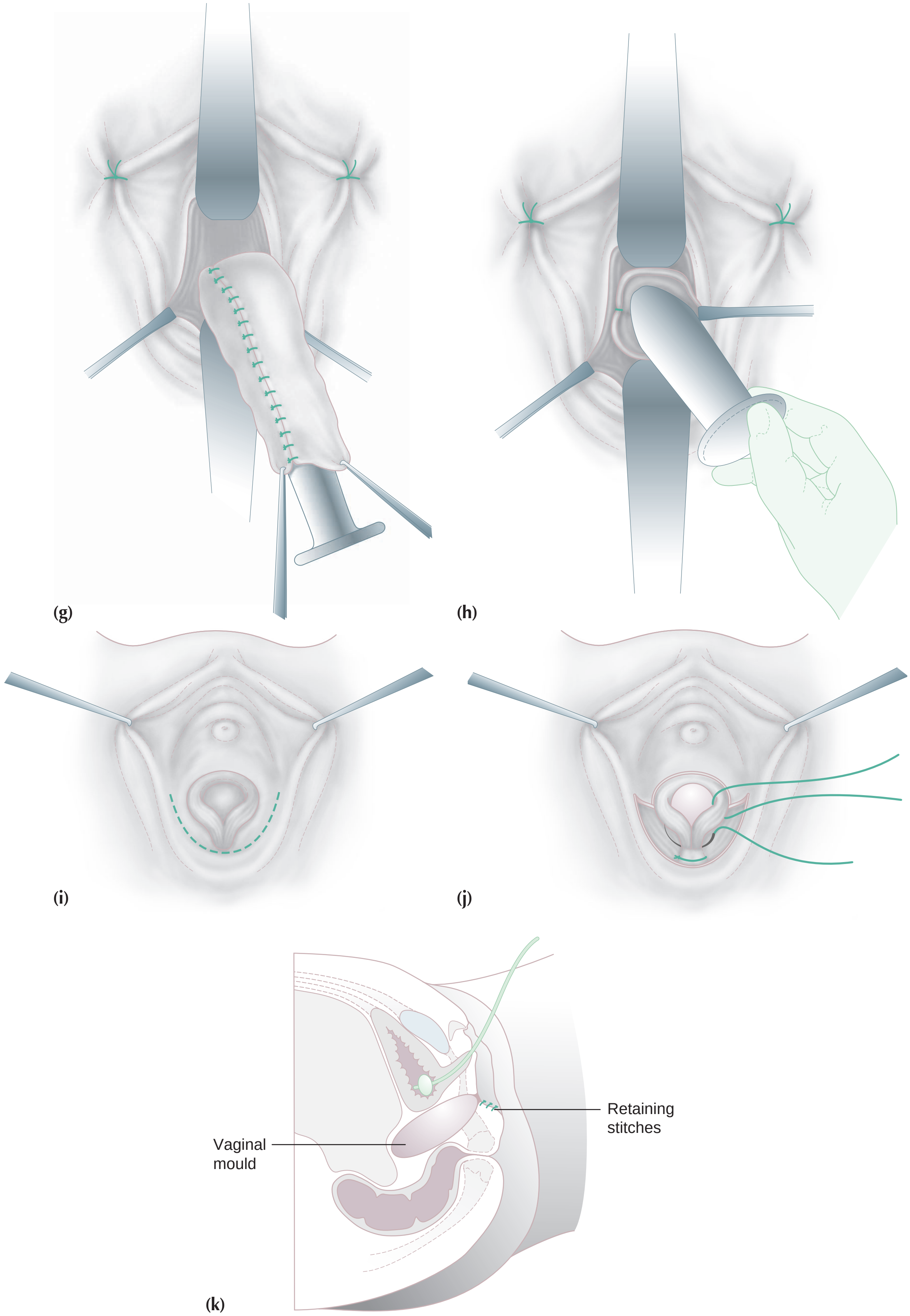


Fig. 8.10a–k: McIndoe Reed vaginoplasty.

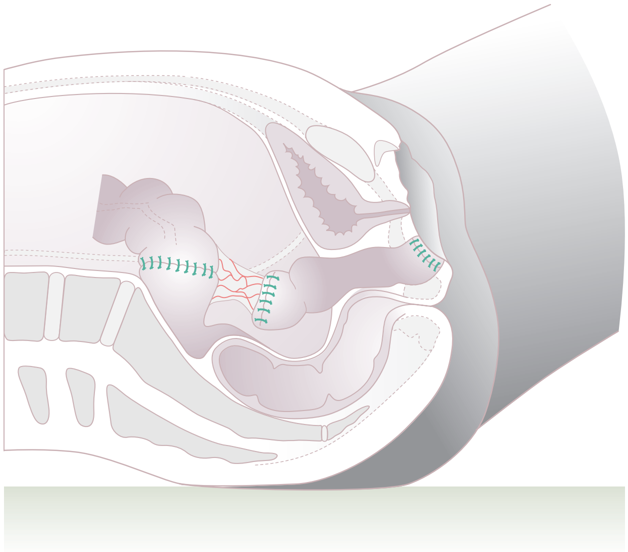


Fig. 8.11: Bowel transposition vaginoplasty.

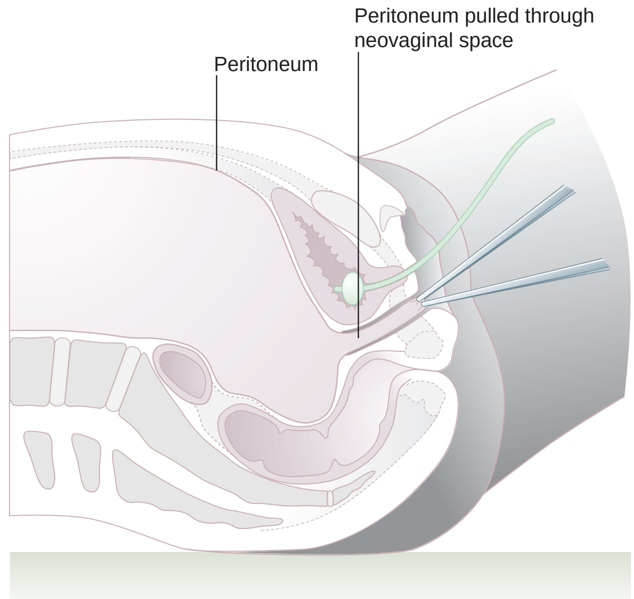


Fig. 8.12a: Davydov vaginoplasty.

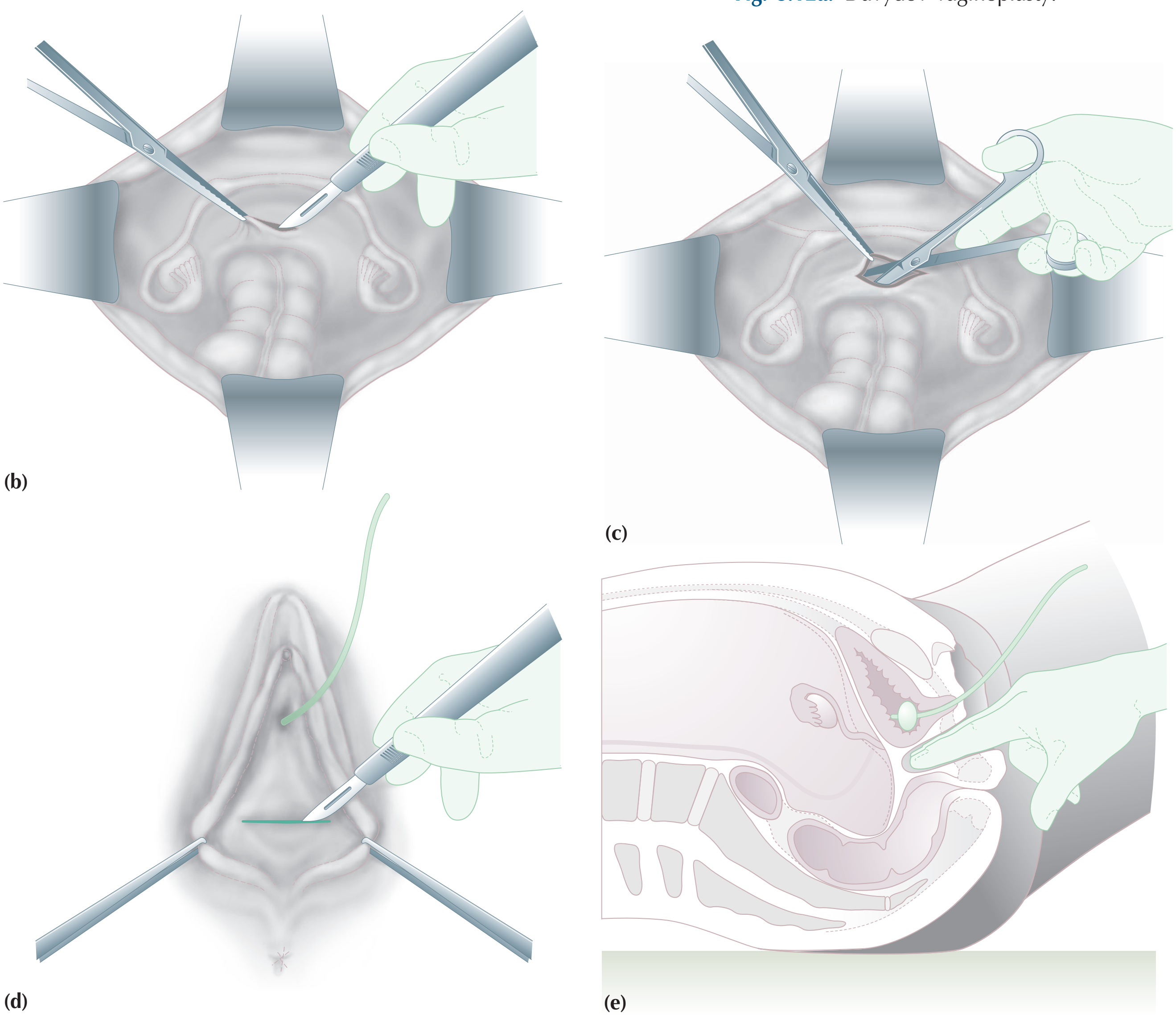


Fig. 8.12b–k: Procedure of Davydov vaginoplasty *(continued on next page)*.

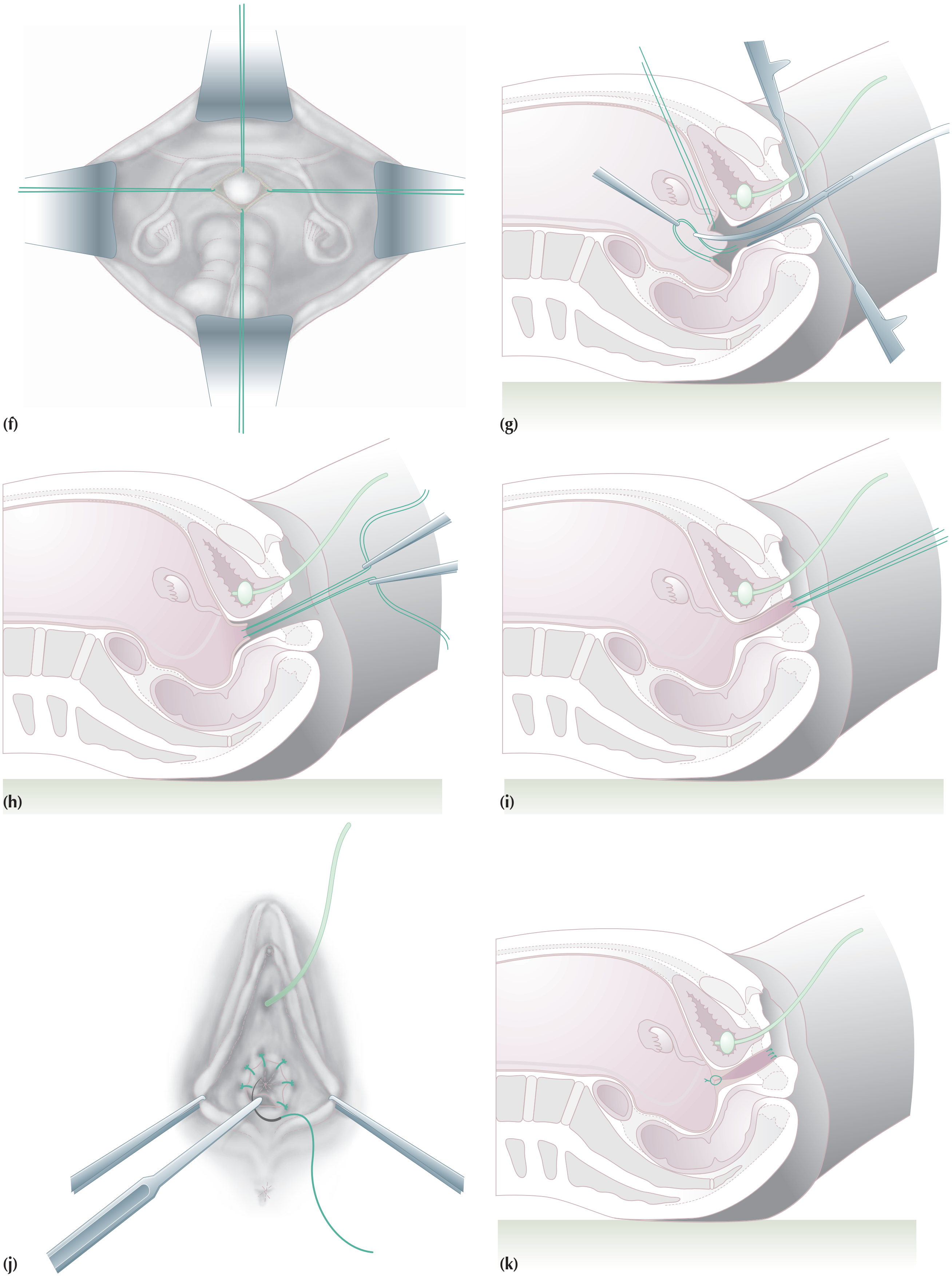


Fig. 8.12b–k: Procedure of Davydov vaginoplasty.

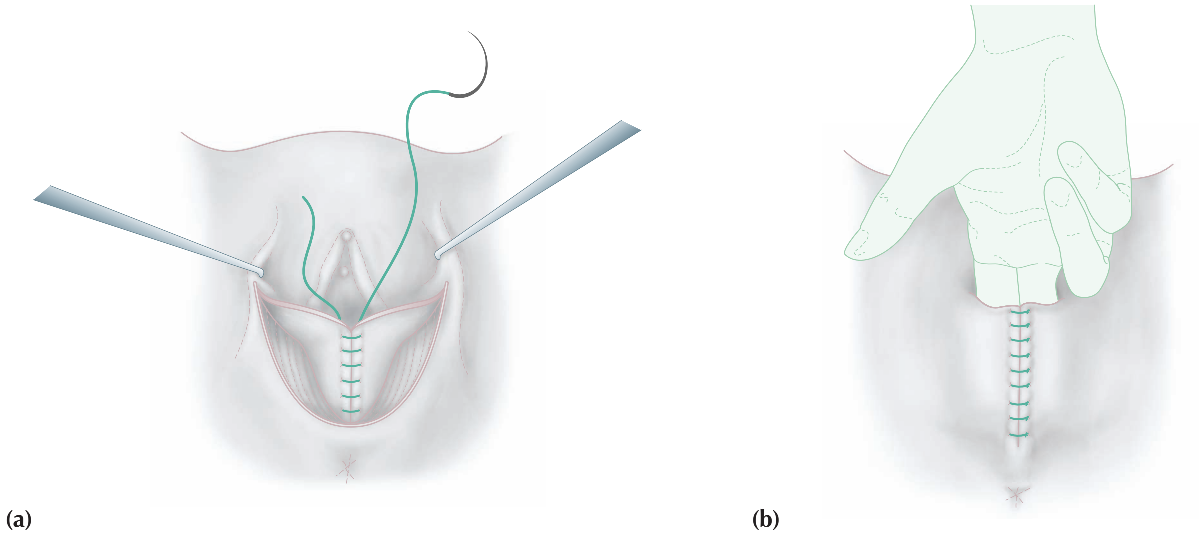


Fig. 8.13a,b: William's vaginoplasty.

urethral meatus (Fig. 8.13).[32] The skin is mobilised and a layer of sutures placed to join the inner skin margins, from posterior to anterior. A second layer of sutures is used to approximate the sub-cutaneous fat and perineal muscles. The external skin edges are then sutured to complete the pouch. This procedure has been modified slightly by Creatsas with the use of more modern suture materials.[33] Although good outcomes have been reported, the technique is not favoured in the UK because of the inevitable posterior angle of the pouch which is anatomically difficult for comfortable intercourse. Indeed after sexual relations are established the vagina is usually further extended by natural pressure in a more anatomical direction, as would be achieved simply by the Frank's method of pressure dilatation.

Outcomes of Vaginoplasty Surgery

Frank's method of pressure dilatation is recommended as the first-line approach for the management of vaginal agenesis, as it is successful in the vast majority of cases. Surgical vaginoplasty is now rarely required. There are potential risks and long-term side effects of all procedures and we would reserve their use for patients in whom either pressure dilatation has been unsuccessful or when there is the need for more complex vaginal reconstructive surgery for patients who have required surgery for cloacal anomalies or for survivors of childhood pelvic malignancy. There is still a paucity of long-term outcome data for all of these procedures.[34]

UTERINE TRANSPLANTATION

It is beyond the scope of this book to describe the surgical techniques proposed for uterine transplantation, which is still

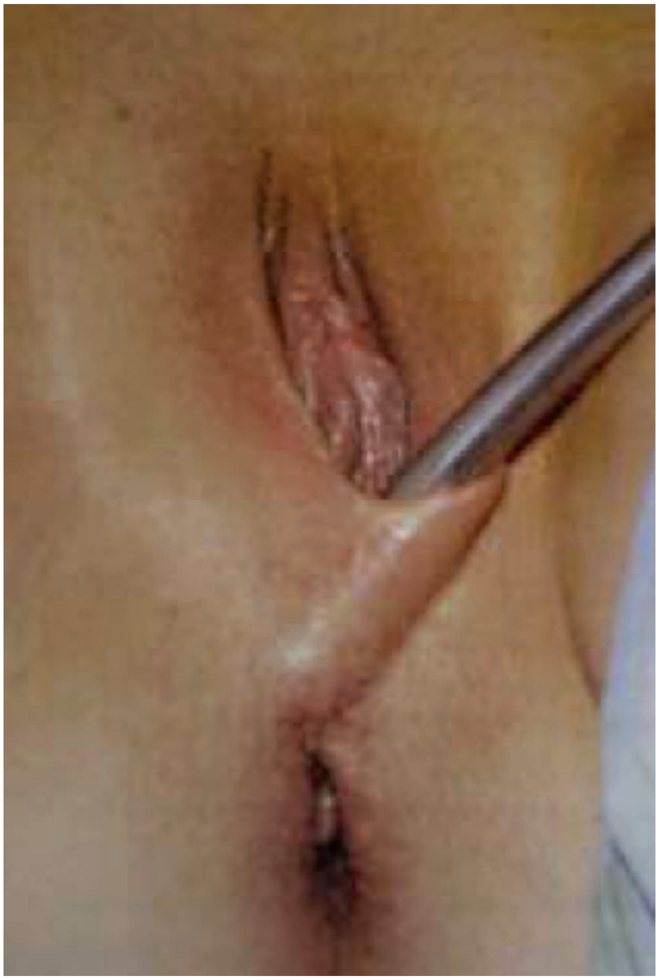


Fig. 8.13c: William's vaginoplasty.

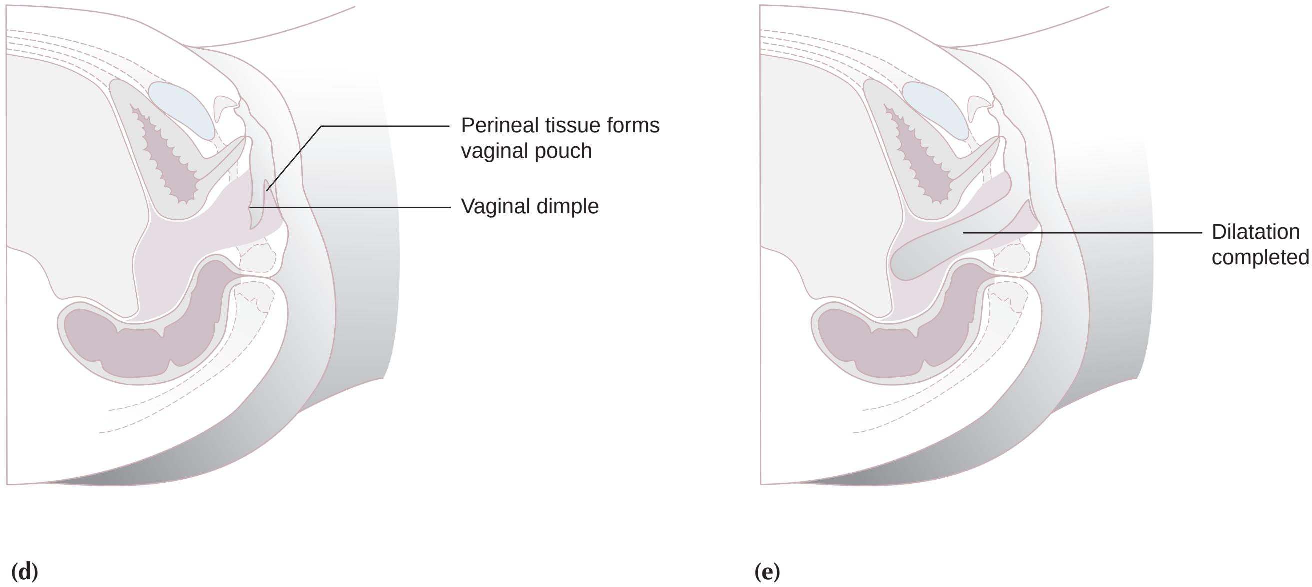


Fig. 8.13d,e: William's vaginoplasty.

within the remit of ongoing research.[35] Studies in various animal species have been encouraging, although the first attempt in a human in 2000 was unsuccessful. Nonetheless, a recent review was optimistic about the potential for success in the future.[36]

IMPERFORATE HYMEN

Girls with an imperforate hymen present with primary amenorrhoea, normal secondary sexual characteristics and cyclical abdominal pain. This may not necessarily be monthly as initial ovarian activity is often not in a regular monthly cycle. Gentle examination of the external genitalia reveals a bulging hymenal membrane with a blue/purple colour due to the retained menstrual blood, which when released often has a dark brown sticky 'chocolate' appearance (Fig. 8.14a–f).

Cryptomenorrhoea may occur unnoticed in girls with other developmental anomalies, especially those with learning difficulties who may not be able easily to express themselves. These cases may present in extremis, with severe lower abdominal pain, lower abdominal swelling and even urinary retention due to the pressure of the huge haematocolpos. Obstructed menstruation should always be considered in children with severe disabilities who present with primary amenorrhoea and normally developed secondary sexual characteristics.

Surgical correction is by a cruciate incision through the hymen and a circumferential excision of the four 'triangles' of hymenal skin. Sutures are rarely required. Suprapubic pressure facilitates drainage of the haematocolpos. The vagina itself should, however, not be irrigated or instrumented in case this should precipitate retrograde pelvic infection.

Fig. 8.14a: Imperforate hymen.

HYMENAL VARIANTS

There are a large number of natural variations in the formation of the hymen. Sometimes the hymen may appear imperforate with simply a tiny opening, often situated just below the urethral meatus, thereby permitting menstruation. More commonly there are fenestrations or hymenal bands, which

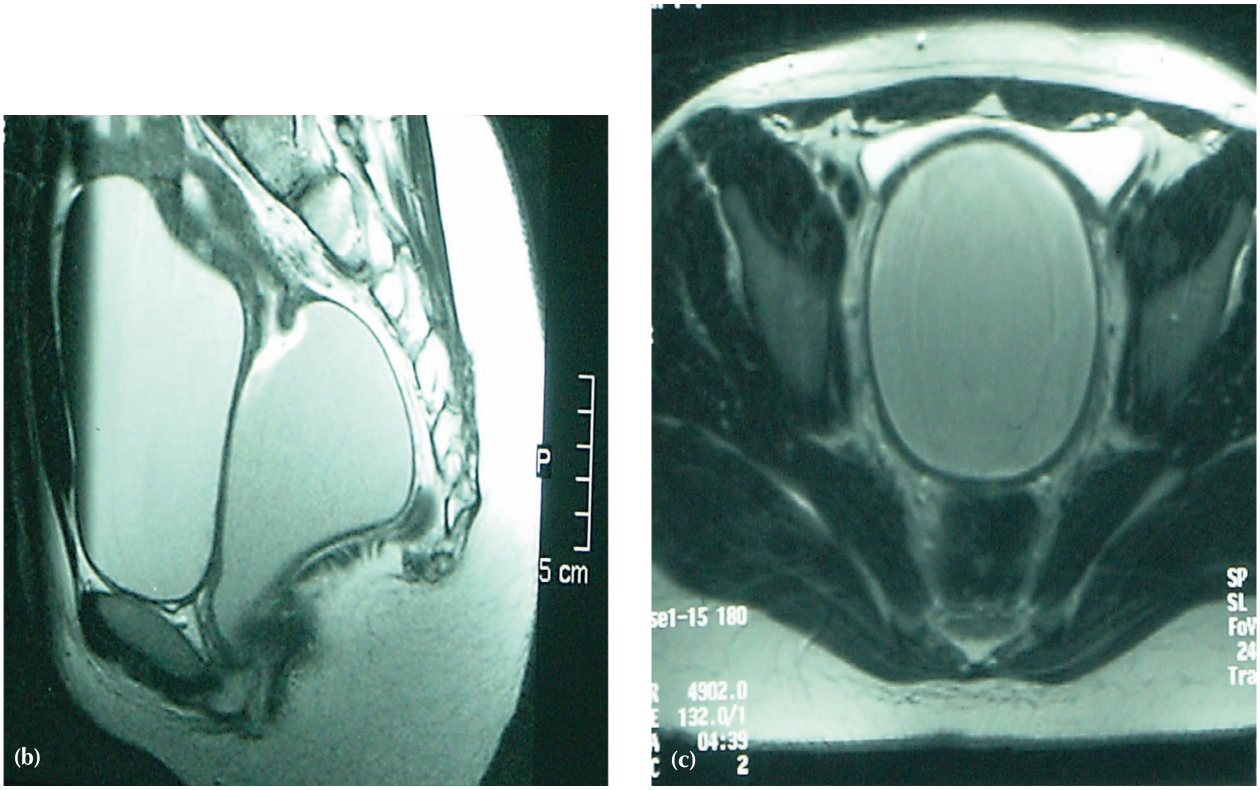


Fig. 8.14b,c: Lateral and anterior views at MRI scan of massive haematocolpos in a case of imperforate hymen.

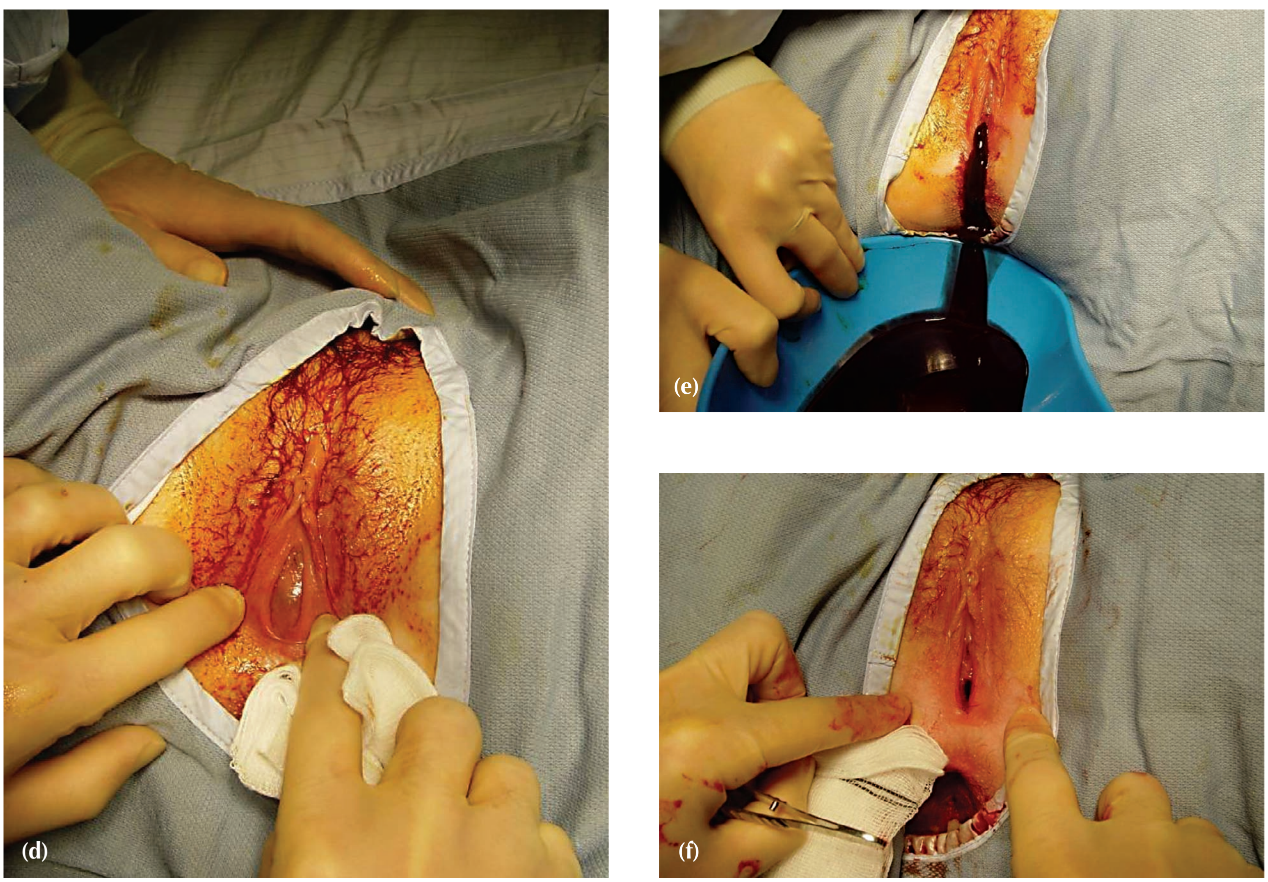


Fig. 8.14d–f: Surgical drainage of imperforate hymen.

may be broken during first sexual activity, but may present with either inability to have penetrative sexual intercourse or painful sexual intercourse, or the inability to insert a sanitary tampon. Simple excision is easily achieved.

TRANSVERSE VAGINAL SEPTA

Transverse fusion abnormalities usually present with primary amenorrhoea and require careful assessment before surgery. Surgery should be performed when the diagnosis is made to prevent too big a build up of menstrual blood, which may lead to a haematometra and consequent increased risk of endometriosis, secondary to retrograde menstruation. Alternatively menstrual suppression with hormone therapy may be provided until surgery can be performed.

A transverse vaginal septum due to failure of fusion or canalisation between the Müllerian tubercle and sinovaginal bulb may present like an imperforate hymen but is associated with a pink bulge at the introitus as the septum is thicker than the hymen. Greater care must be taken during surgery to prevent annular constriction rings and the procedure should only be performed in dedicated centres by experienced surgeons. When there is a transverse septum it has been found to be high in 46% of patients, in the middle of the vagina in 40% and low in the remaining 14% (Fig. 8.15a–c). It is the patients in the last two groups who have greater success and higher pregnancy rates after surgery.

Excision of a low septum is a relatively easy procedure (see Fig. 8.16), although care is required to fully mobilise the vagina around the site of the septum and perform careful repair in

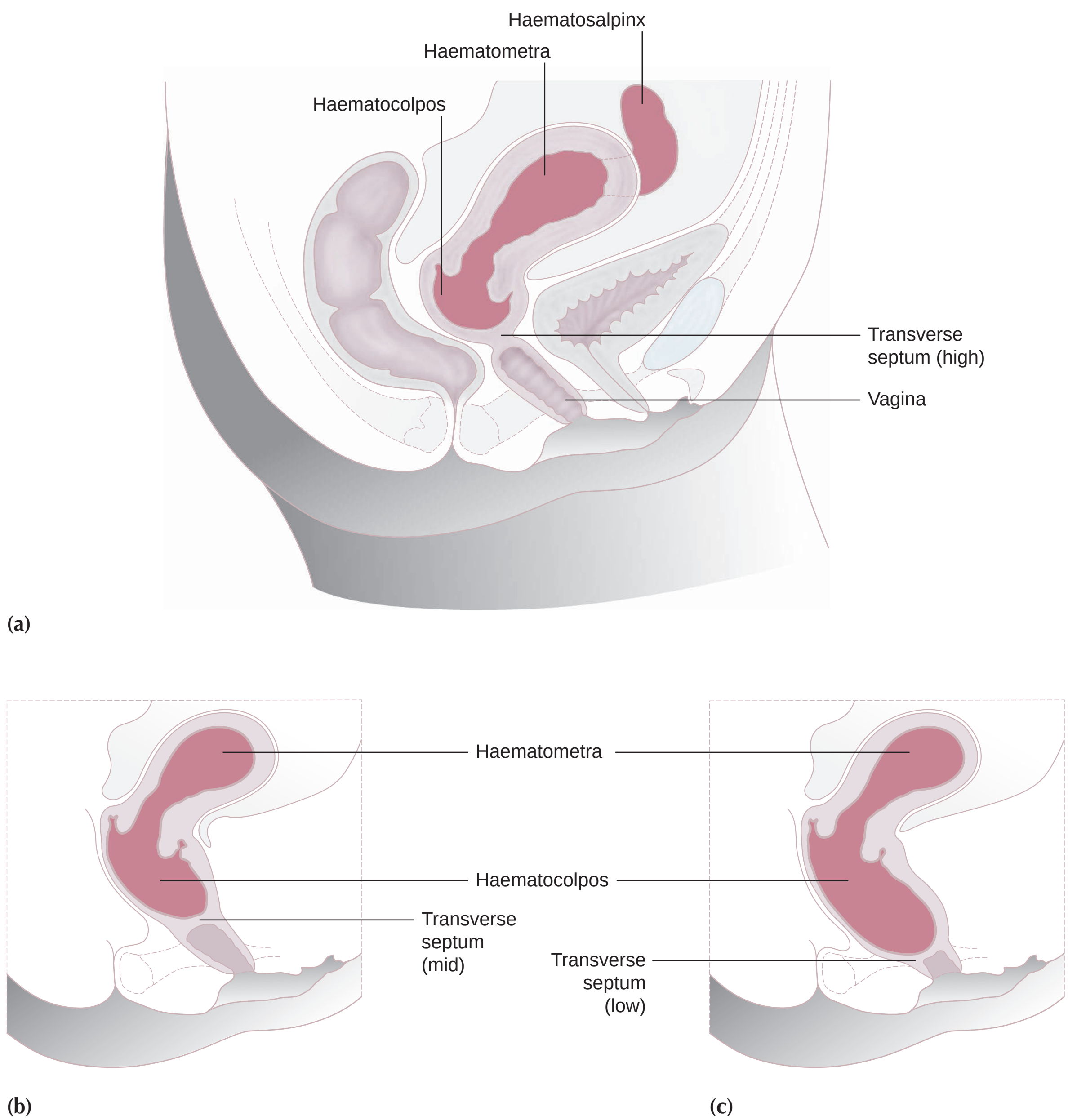


Fig. 8.15a–c: Positions of transverse vaginal septa (upper, middle and low).

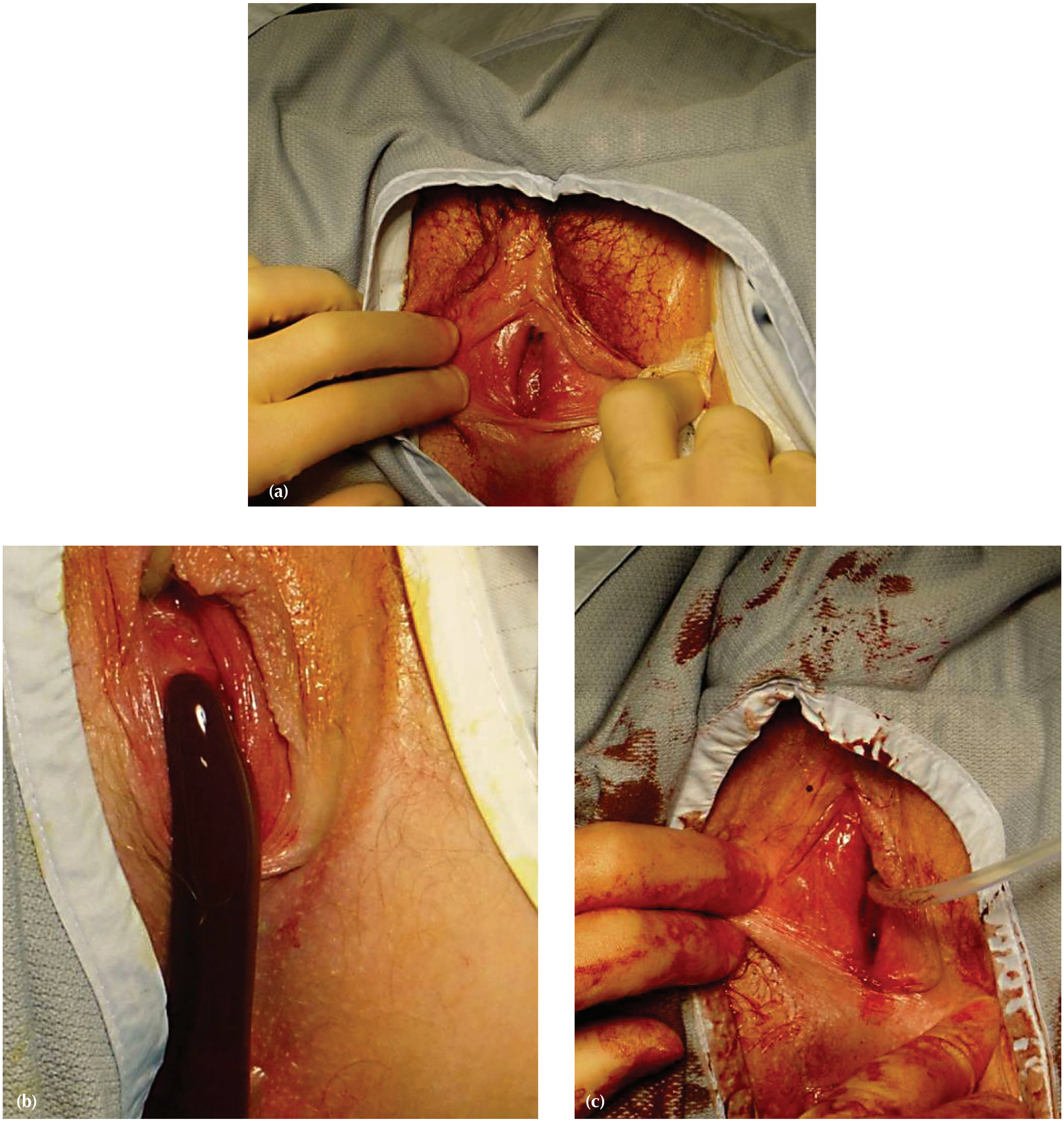


Fig. 8.16a–c: Lower transverse septum: incision and drainage.

order to avoid an annular constriction ring. A ‘Z-plasty’ may be helpful to minimise the tension between the opposing ends of the vagina.[37] The trilaminar septum comprises the lower vaginal mucosa, intermediate areolar tissue of variable depth and the upper vaginal mucosa, retaining the haematocolpos. Two oblique crossed incisions are made through the lower vaginal mucosa and the four resultant triangular flaps are dissected free of the areolar tissue, which is then excised. (See Figs. 8.17, 8.18) Two further crossed incisions are made through the upper vaginal mucosa and a further four triangular flaps are formed. The rectal mucosa is protected by a finger placed in the rectum and anteriorly a urinary catheter helps identify and protect the urethra and bladder. The lower and upper incisions are rotated 45° against each other and the upper and lower flaps joined

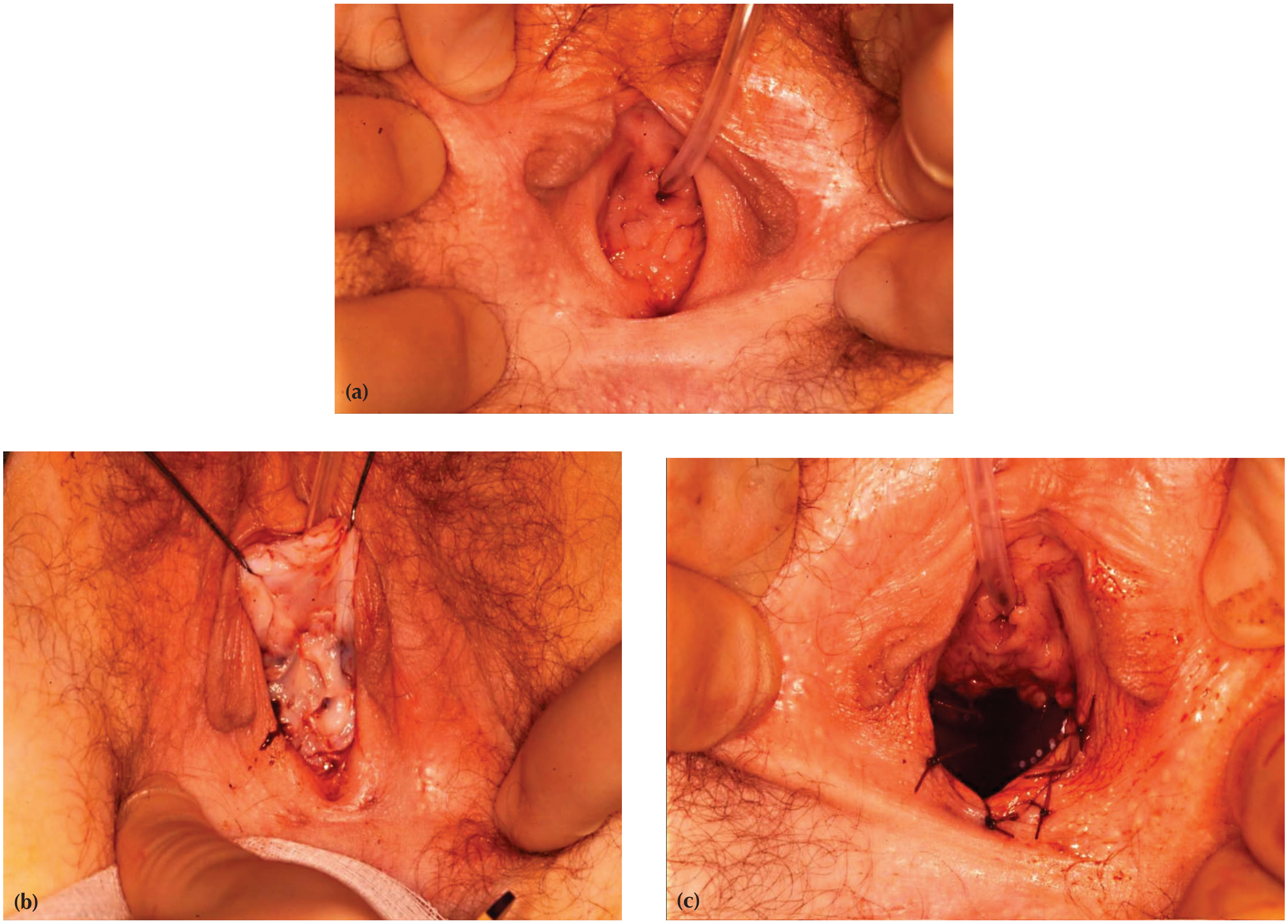


Fig. 8.17a–c: Surgical correction of thick mid-vaginal septum.

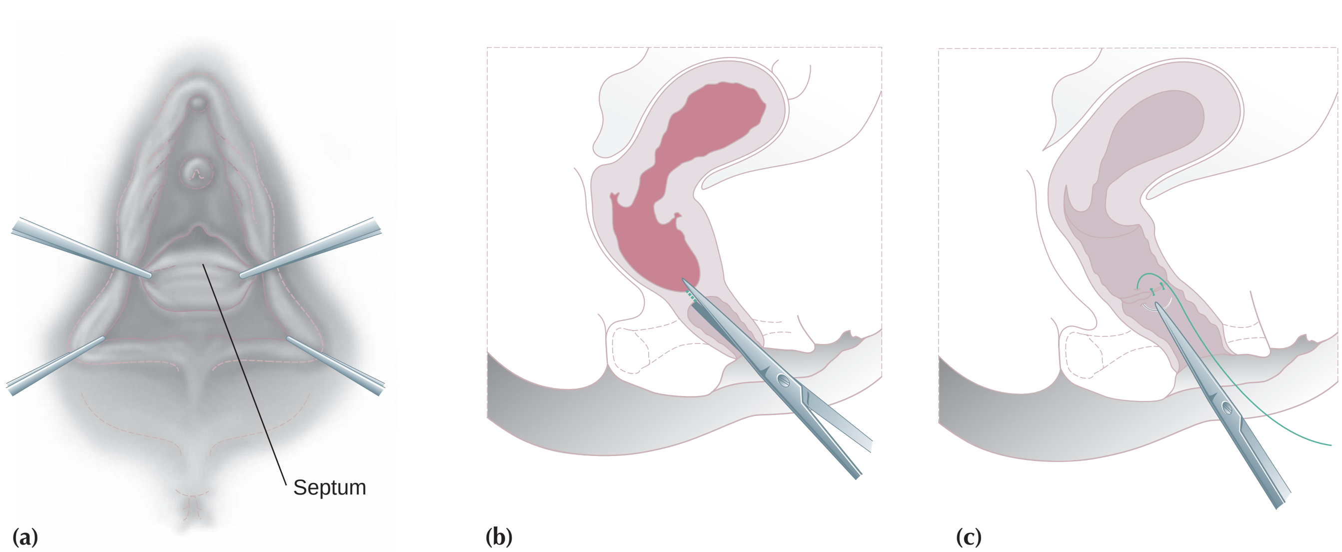


Fig. 8.18a–c: Repair of a middle third transverse septum.

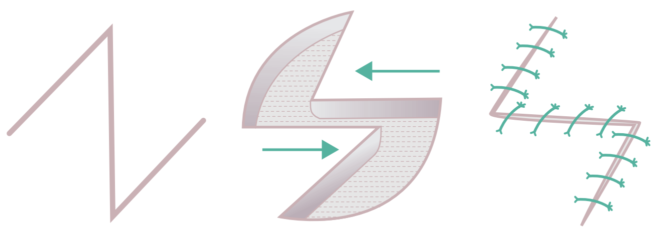
together at their free edges to form the Z-plasty. (See Fig. 8.19) Sometimes a vaginal mould is inserted and left for 2–8 weeks or alternatively vaginal dilators can be used from 2 weeks post surgery.

VERTICAL VAGINAL SEPTA

Longitudinal fusion abnormalities may lead to a complete septum that may be associated with two complete uterine horns with two cervices or a partial septum causing a unilateral obstruction. Excision is required both to prevent retention of uterine secretions and permit sexual intercourse.

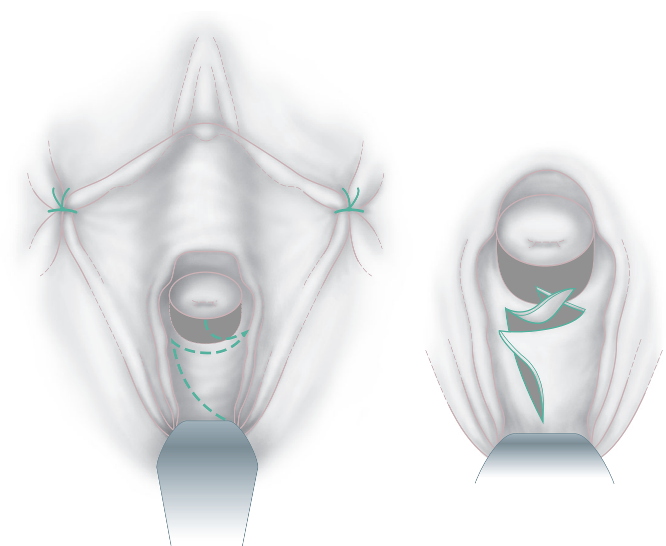
A vertical septum without obstruction may present with difficulty during intercourse or persistent menstrual loss despite the use of a tampon, which of course has been inserted in one side of the hemi-vagina. Excision of the septum is easily achieved with either sharp dissection or monopolar cutting diathermy. Care must be taken to protect the rectal mucosa and the bladder. Bleeding points may be sutured or sealed with diathermy.

A partial septum that obstructs a hemi-uterus may present more of a challenge (see below '*bicornuate uterus with unilateral obstruction*'). The haematocolpos on the obstructed side will bulge into the vagina and also displace the obstructed hemi-uterus cranially. (See Fig. 8.20) A large elliptical incision is made through the septum and the vaginal mucosa excised. Sutures are usually required to achieve haemostasis. In our experience a 'second look' procedure may be required to reassess the anatomy after a period of 6–8 weeks and further excision of additional septal skin may be required at that time.



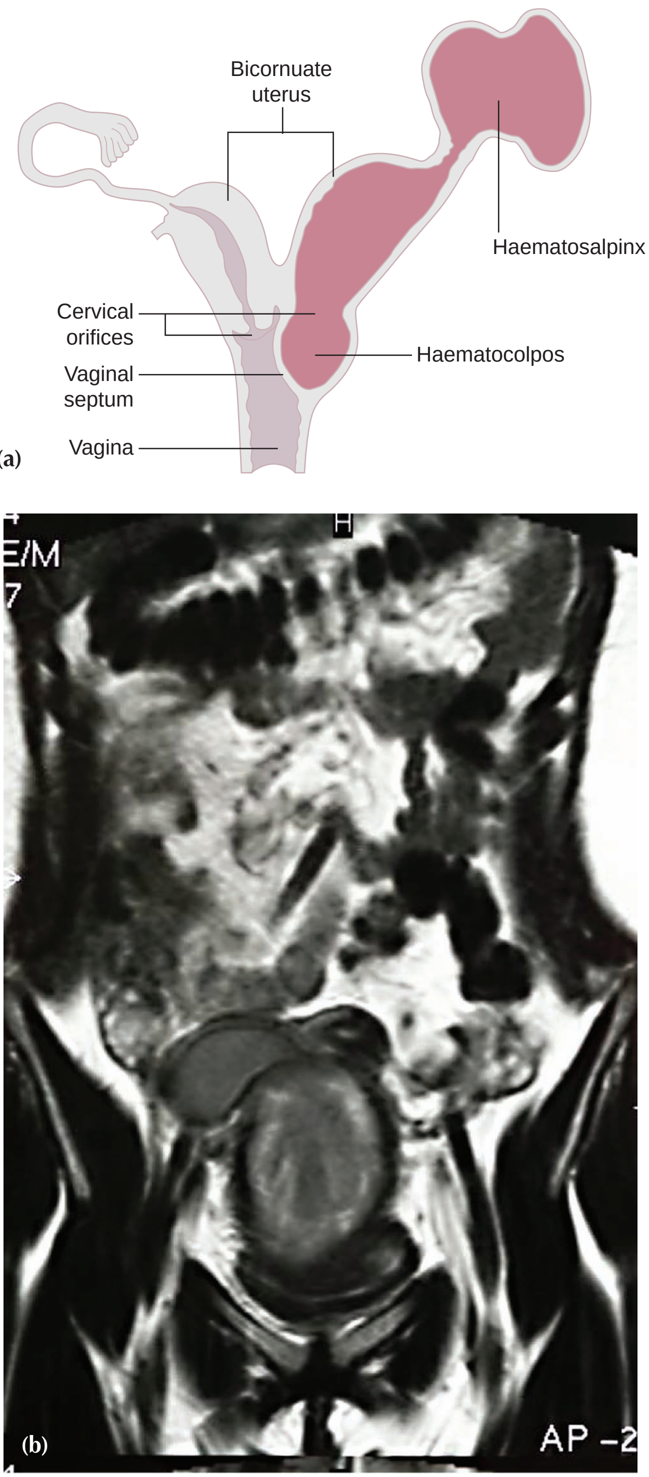
(a)

Fig. 8.19a: Z-plasty technique.



(b) (c)

Fig. 8.19b,c: Z-plasty within the vagina.



(a) (b)

Fig. 8.20: **(a)** Unilateral vaginal septum obstructing hemi-uterus, **(b)** MRI image.

Retrograde menstruation may have resulted in both a haematosalpinx, which may prevent normal tubal function and put the patient at risk of ectopic pregnancy and tubal infertility on that side. If recurrent obstruction occurs or the hemi-uterus fails to function normally a hemi-hysterectomy is usually easily performed.

CERVICOVAGINAL AGENESIS

Agenesis of the uterine cervix in the presence of a functioning uterus (class IB in the American Fertility Society classification) is considered to be the most difficult uterine anomaly to correct. Indeed traditionally a hysterectomy has been recommended because of the high incidence of complications or failure. We consider, however, that it is worth considering vaginoplasty and re-implantation of the uterine corpus into the top of the neovagina after resection and canalisation of the isthmus of the cervix. A small number of natural conceptions have been reported, all of which have of course required delivery by elective Caesarean section.[38]

Initially, it is worth considering menstrual suppression, with either a GnRH agonist or the combined oral contraceptive pill (COCP) taken continuously, whilst surgery is planned. It may be beneficial to teach the adolescent girl how to use vaginal dilators at this stage, as they will certainly be required postoperatively and by using pressure dilation pre-operatively the introital skin can be stretched to facilitate the subsequent surgery.

A combined vaginal and abdominal approach is required. At laparotomy the lower pole of the uterus is mobilised and the bladder deflected caudally. A hysterotomy is performed by making an incision in the uterine fundus large enough to accommodate a size 8 Hegar dilator, which is inserted towards the lower uterine pole, which in turn is opened to accommodate the passage of the dilator.

The vaginal dissection will require the rotation of bilateral musculo-cutaneous pudendal thigh flaps, which are fashioned into a cylinder and sutured circumferentially around the 'neocervix'.[39] It has also been reported that the skin flap created by the initial inverted U-shaped incision on the perineum can be used to assist the vaginal-cervical anastomosis.[40] Some authors have described the use of a segment of bowel, although this is less secure and more likely to result in unpleasant discharge and consequent failure. A size 14–16 Foley catheter is then passed into the uterine cavity from below and inflated to maintain cervical patency over the next 10 days whilst healing takes place. Antibiotic prophylaxis is required during this time.

RUDIMENTARY UTERINE HORN

A rudimentary uterine horn may have developed with active endometrial tissue or may be only myometrium. There may be ipsilateral renal agenesis. In the presence of active endometrium, retrograde menstruation may lead to the development of endometriosis. Pregnancies have been reported whereby the spermatozoa have travelled through the contralateral, non-obstructed hemi-uterus and Fallopian tube and achieved fertilisation in the tube of the rudimentary horn. This causes significant obstetrical problems and rupture is common in the mid-trimester.[41] When the endometrial cavity has developed it is recommended that a rudimentary horn should be excised. This would usually necessitate laparotomy and a 'hemi-hysterectomy'. Care should be taken to leave a sufficient margin of myometrium for the non-obstructed contralateral hemi-uterus, which should be repaired in two layers of interrupted sutures.

UTERINE SEPTUM

The most common congenital uterine anomalies are the septate uterus (35%), bicornuate uterus (25%) and arcuate uterus (20%) (Fig. 8.21). The most accurate diagnostic procedures to adequately assess the anatomy are a combination of hysteroscopy with laparoscopy, sonohysteroscopy and possibly three-dimensional ultrasound. Magnetic resonance imaging (MRI) may also be very useful. Two-dimensional ultrasound and X-ray hysterosalpingography are insufficient in their diagnostic accuracy but can be used as initial screening tools.[42] The comprehensive review by Saravelos et al. suggests that the prevalence of congenital uterine anomalies is approximately 6.7% (95% confidence interval [CI] 6.0–7.4) in the general population, 7.3% (95% CI 6.7–7.9) in the infertile population and 16.7% (95% CI 14.8–18.6) in women with recurrent miscarriage.

There is evidence that by reducing the size of the uterine

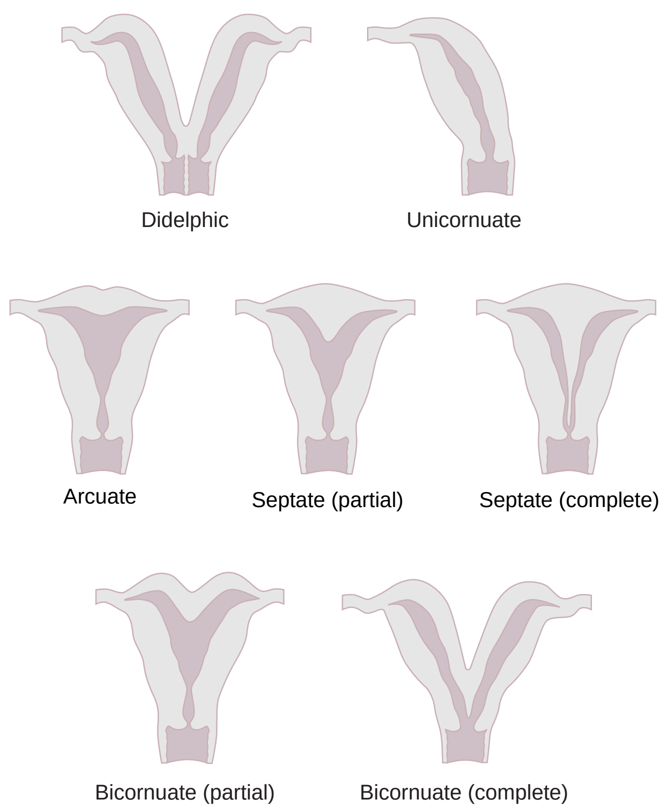


Fig. 8.21a: Common congenital uterine anomalies.

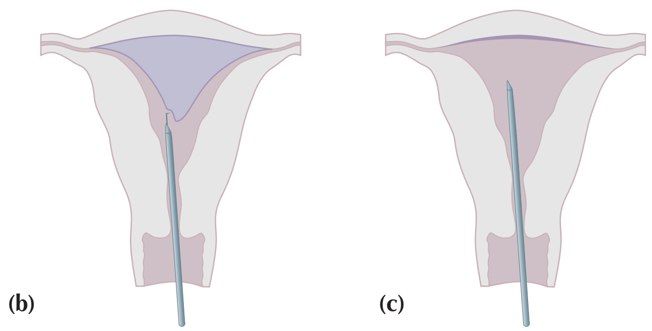


Fig. 8.21b,c: Hysteroscopic metroplasty: (b) Resection of septum. (c) End result.

cavity a septate uterus increases the likelihood of a second trimester miscarriage or premature delivery. Uterine anomalies are also associated with fetal malpresentation and an increased requirement for Caesarean delivery. A uterine septum is thought to be associated with recurrent miscarriage more often than the bicornuate uterus and may be associated with both first trimester and second trimester pregnancy loss.[43] Classically, a septum is thought to be more likely to lead to pregnancy loss in the second trimester. Whilst a septum should be excised hysteroscopically, there are no prospective randomised controlled trials of such surgery.[44]

The current debate is therefore whether or not to resect a septum when it is seen in a patient with or without recurrent miscarriage because there are currently no results of RCTs that are available. A recent European Society for Human Reproduction and Embryology (ESHRE) Campus Workshop held in Manchester in November 2009 on congenital uterine anomalies and reproductive outcome concluded that uterine surgery ideally should only be performed in the context of a clinical trial, although in reality many practitioners would resect a septum hysteroscopically when it is seen. Some surgeons resect a small septum, even if the uterine cavity is only minimally distorted. Furthermore some even advocate the 'shaving' of the fundus of the cavity of an arcuate uterus, although there is no clear evidence of benefit and certainly no randomised studies in this field.

Hysteroscopic resection of a uterine septum is relatively straightforward.[45] The septum is usually avascular and should be divided up to the level of the fundus. It may be beneficial to perform this surgery with concurrent laparoscopic visualisation to prevent uterine perforation. The hysteroscope will transilluminate the uterus and facilitate safe location of the diathermy blade, hysteroscopic scissors or fibre-optic laser. A copper intra-uterine contraceptive device (IUCD) is inserted and left in situ for 6 weeks in order to prevent intra-uterine adhesion formation. Some surgeons advocate the use of anti-adhesion gels, although there are no data from large prospective studies of their efficacy.

BICORNUATE UTERUS WITH UNILATERAL OBSTRUCTION

Also see above the section '*vertical vaginal septa*'. The haematocolpos on the obstructed side will bulge into the vagina and also displace the obstructed hemi-uterus cranially. A large elliptical incision is made through the septum and the vaginal mucosa excised. Sutures are usually required to achieve haemostasis. In our experience, a 'second look' procedure may be required to re-assess the anatomy after a period of 6–8 weeks and further excision of additional septal skin may be required at that time. Retrograde menstruation may have resulted in both a haematosalpinx, which may prevent normal tubal function and put the patient at risk of ectopic pregnancy and tubal infertility on that side. If recurrent obstruction occurs or the hemi-uterus fails to function normally, a hemi-hysterectomy is usually easily performed.

Disorders of Sexual Development

CONGENITAL ADRENAL HYPERPLASIA

Congenital adrenal hyperplasia (CAH) is the most common cause of female disorders of sexual development (DSD)—formerly known as intersex conditions or pseudohermaphroditism (both terms that are no longer used). Androgenisation of the female external genitalia may lead not only to clitoromegaly but also to fusion of the labioscrotal folds. The vagina commonly enters the caudal third of the urethra, distal to the external sphincter, which will require careful repair at the time of an introitoplasty. In cases of high vaginal atresia, the urethrovaginal fistula may be proximal to the external urethral sphincter and this will present a far greater surgical challenge. Clitoral reduction should be undertaken with care to preserve the neurovascular bundle and sensation.

Surgery has historically been performed in early infancy by paediatric surgeons and urologists, although over 90% require additional surgery during adolescence.[46] As with all surgery for DSD, the precise timing is open to debate, as is the degree to which the patient—as opposed to her parents or physicians—is involved. The current vogue is to defer surgery, whenever possible, until adolescence or early adulthood as the results are likely to be better and the patient herself can be involved in the decision-making process.[47]

Adrenal androgen overproduction may occur when a congenital enzymatic defect appears in one of the steroid synthetic pathways. The commonest cause of CAH is due to 21-hydroxylase deficiency and occurs in 1 in 14,000 births. Such an enzyme defect is usually inherited as an autosomal recessive trait. Severe enzyme deficiencies present with virilisation as a neonate or child; however, partial enzyme deficiencies may not present until adolescence or early adulthood. In a female baby, CAH may present with ambiguous external genitalia, such as an enlarged clitoris or fusion of the labia and in the male, enlarged genitalia may occur. (See Fig. 22a) Later-onset CAH may present with virilisation in the female (see Fig. 22b) or precocious puberty in the male. Late-onset CAH may also present with a clinical picture similar to polycystic ovary syndrome (PCOS).

Glucocorticoids are required for all virilising forms of CAH, in order to replace the glucocorticoid deficit and decrease ACTH secretion. Consequently, androgen production is decreased.

Treatment has to be monitored carefully and overtreatment should be avoided, as excessive glucocorticoid doses may cause linear growth restriction, delay puberty and lead to cushingoid signs. In babies and infants, hydrocortisone is administered, usually twice daily. Monitoring comprises clinical evaluation of growth during childhood, bone age and pubertal development and signs of hyperandrogenism and regularity of menstrual cycle during adult life. Treatment of adults may be with hydrocortisone or the longer acting prednisolone (usually preferred) or dexamethasone. Mineralocorticoid replacement is with fludrocortisone.

Management of this complex condition requires a multidisciplinary approach involving an endocrinologist, paediatric gynaecologist, paediatric surgeon/urologist, counsellor/psychologist and nurse specialist. Surgical treatment of anatomical abnormalities should be performed in a specialist unit. Care should be taken to minimise scarring and preserve sensation. Vaginoplasty and correction of labial fusion and anomalous urethral positions is now usually delayed until adolescence. There is debate about the appropriate timing and necessity for clitoral reduction. Psychological support and counselling are required, especially during adolescence when truculent behaviour may result in poor drug compliance and an exacerbation of the symptoms of hyperandrogenism and irregularities of the menstrual cycle.

Fig. 8.22a: Congenital adrenal hyperplasia. Virilised baby girl with clitoromegaly, labial fusion, scrotalisation of labia and common urogenital opening.

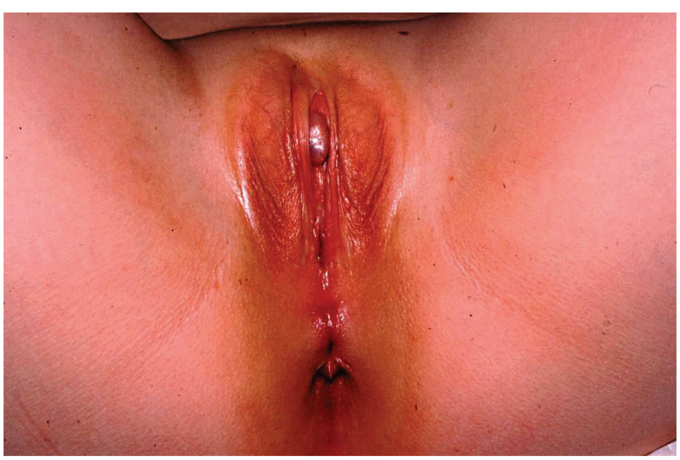


Fig. 8.22b: Adolescent with clitoromegaly, scrotalisation of labia and common urogenital opening.

Vaginoplasty

First a Foley balloon catheter is inserted into both the urinary bladder and a fine Fogarty catheter through the urethrovaginal fistula into the vagina. The latter may require careful guidance with a cystoscope.

The vaginoplasty (see Fig. 8.23) is commenced with an inverted U flap, with its posterior margins level with the rectum. The poste-

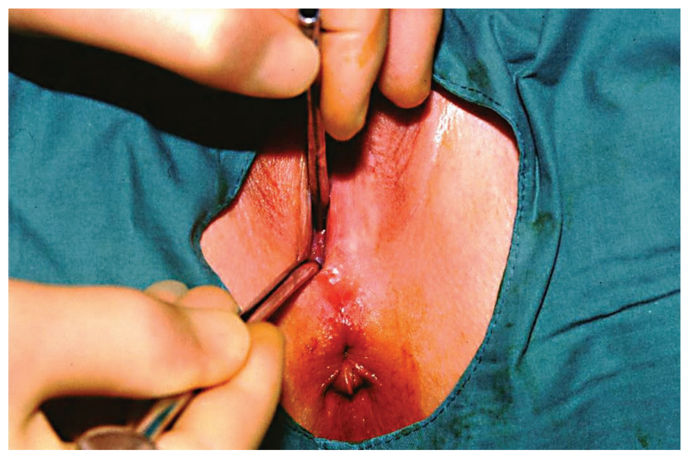


Fig. 8.22c: Adolescent with probe in urethra and vagina—low confluence.

Fig. 8.22d: Adolescent with poor outcome from surgery in infancy.

rior vaginal wall is mobilised from the anterior rectal wall, with care and the vaginal walls mobilised laterally.

The distal vagina is opened just below its confluence with the proximal urethra. The vagina is opened over the Fogarty balloon.

The external urethral sphincter is identified using a nerve stimulator and is then retracted, following which the vagina is opened.

The Fogarty balloon is deflated and passed through the vaginal opening such that it can act as a retractor. The posterior wall of the fistula is then circumscribed.

The urethra is repaired with interrupted sutures. The anterior vaginal wall is mobilised from the bladder neck. The posterior vaginal wall is opened with a vertical incision into which is laid the posterior inverted U flap. The mobilised vagina is then sutured to the introital opening.

Clitoral Reduction

The clitoral skin is circumscribed just below the glans. (See Fig. 8.24) The skin is then carefully dissected off the corpora cavernosa, dorsally down to the corporal bifurcation. The skin

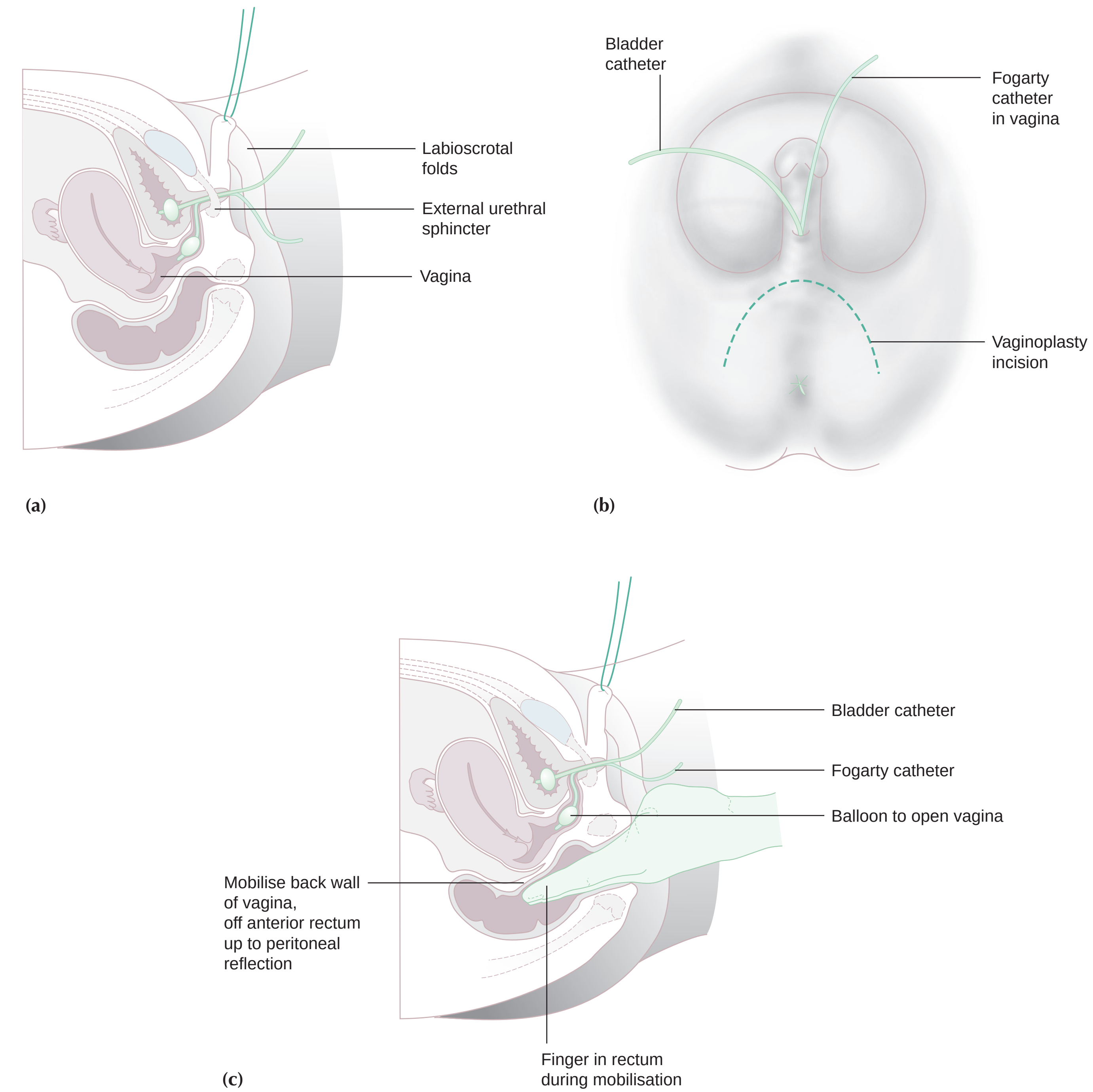
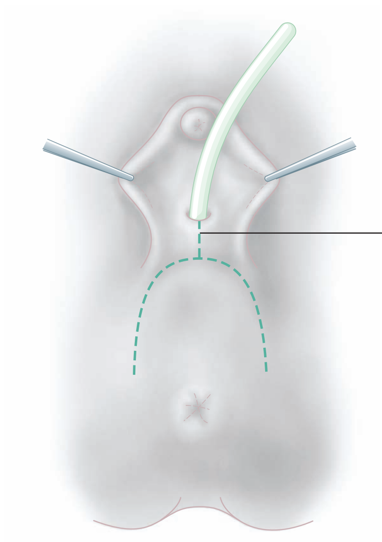
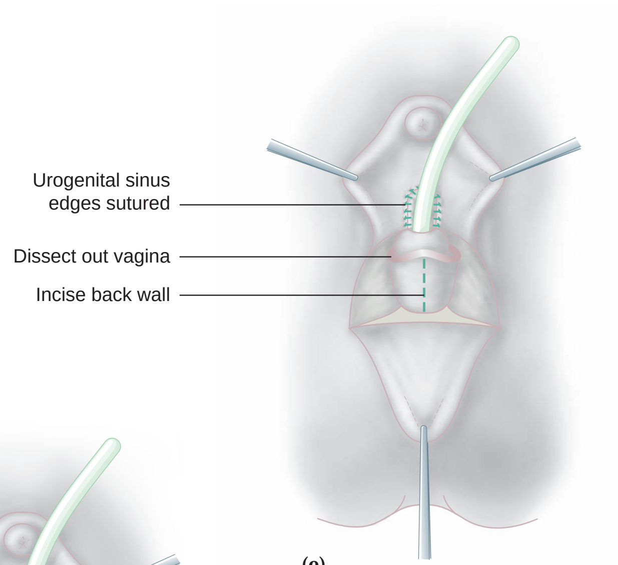


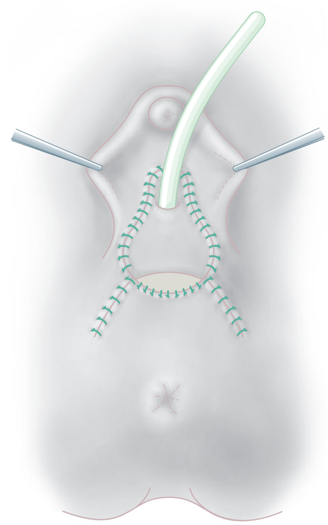
Fig. 8.23a–m: Vaginoplasty for CAH *(continued on next page)*.



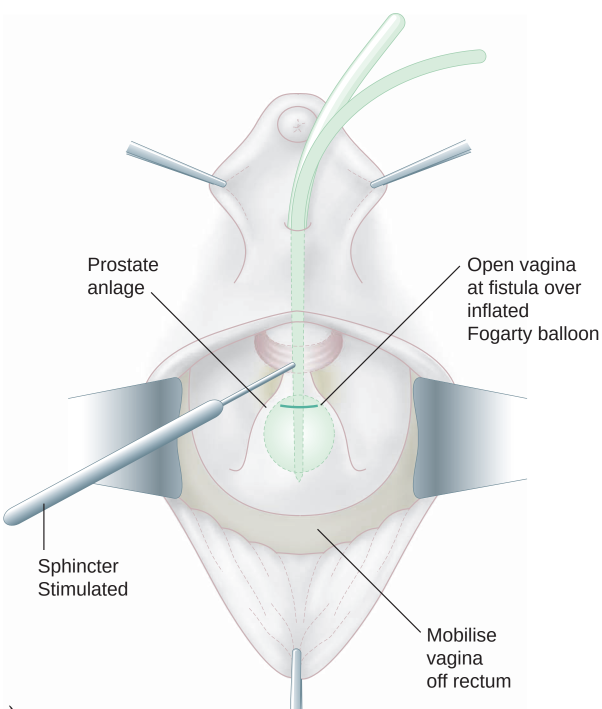
(d)



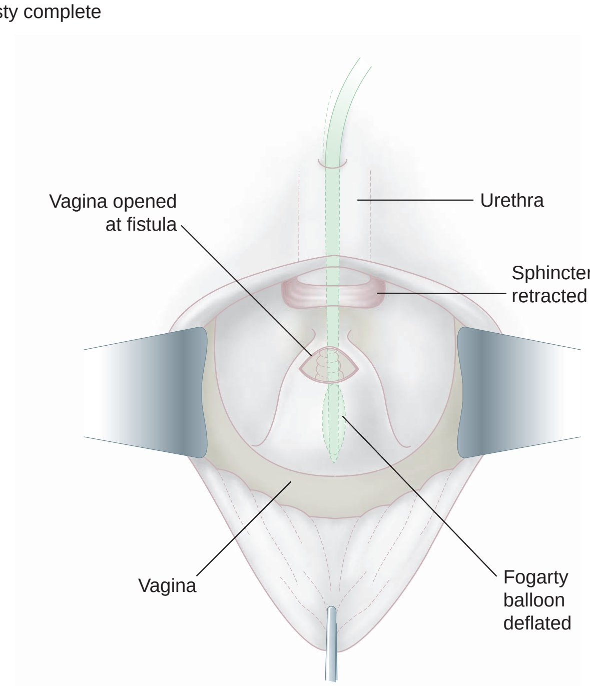
(e)



(f) Vaginoplasty complete



(g)



(h)

Fig. 8.23a–m: Vaginoplasty for CAH *(continued on next page)*.

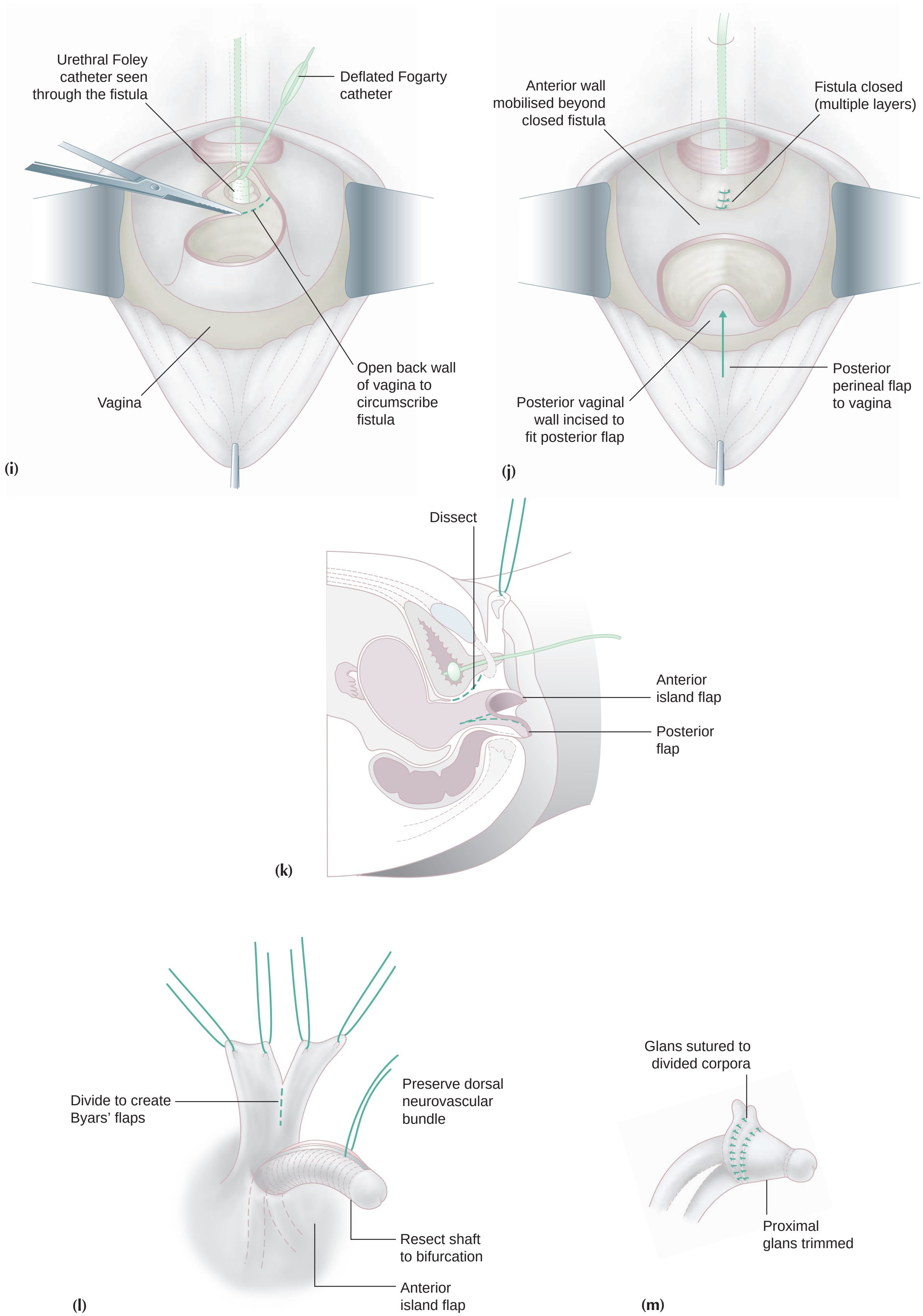


Fig. 8.23a–m: Vaginoplasty for CAH.

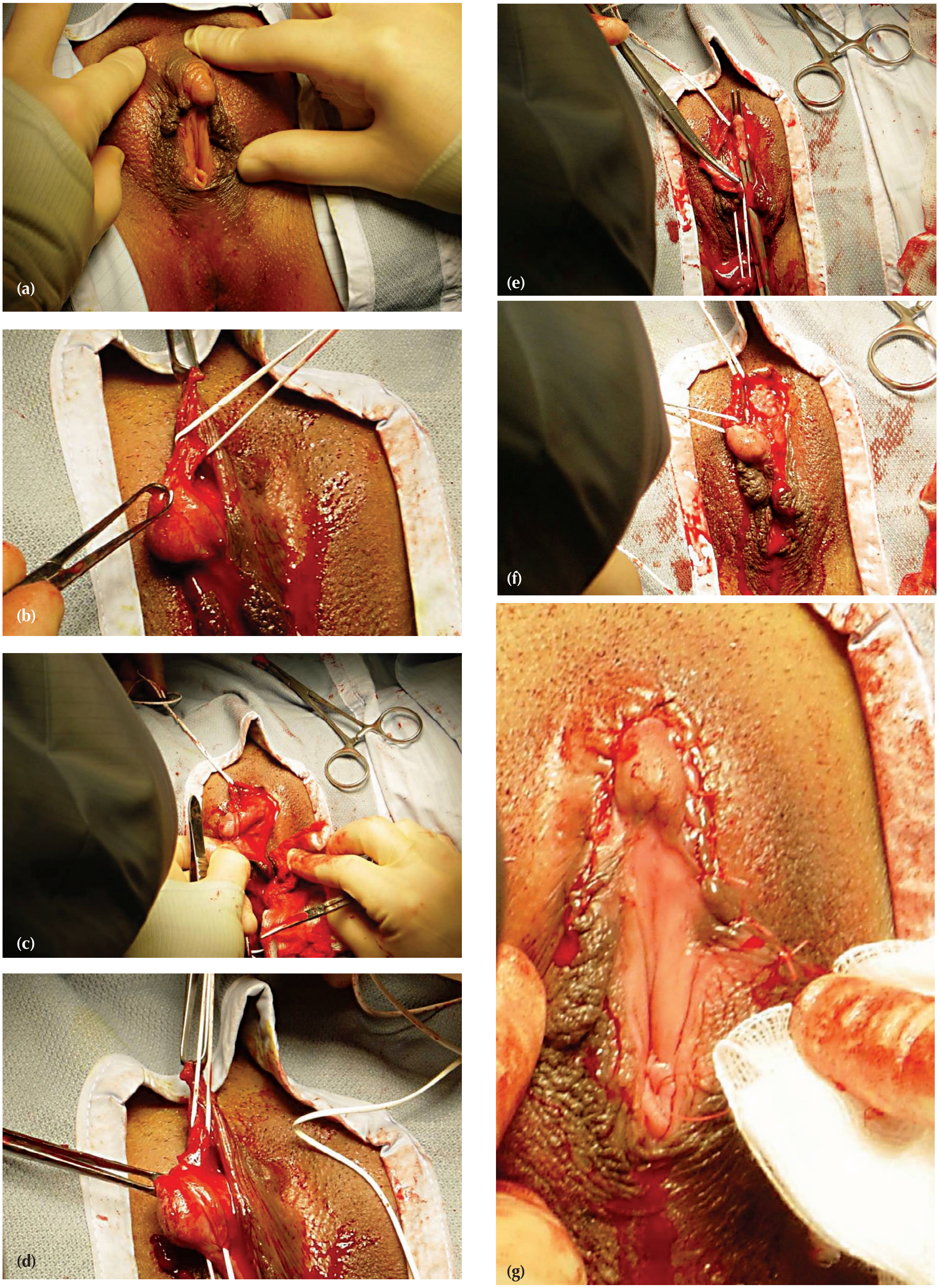


Fig. 8.24a–g: Clitoral reduction in a young woman with CAH.

can be preserved and bisected in the midline to create Byars' flaps, which may be used to fill the perineal defect and create additional skin around the 'labial' area.

The dorsal and ventral neurovascular bundles are carefully separated from the corpora and held gently to one side with a rubber thread. The dorsal neurovascular bundle is the more prominent.

The corpora cavernosa are transected beneath the glans and at their base, to which the glans is sutured, sometimes after removing a triangular wedge to reduce its size.

The skin is repaired with interrupted sutures around the clitoral hood and down the lateral margins of the vagina/labia.

ANDROGEN INSENSITIVITY SYNDROME

Girls who are phenotypically normal but have absent pubic and axillary hair in the presence of normal breast development are likely to have complete androgen insensitivity syndrome (CAIS, formerly known as testicular feminisation syndrome – a term that is no longer favoured). In this condition, the karyotype is 46,XY and, whilst testes are present, there is an insensitivity to secreted androgens because of abnormalities in the androgen receptor. The incidence is approximately 1:60,000 'male' births. Anti-Müllerian factors prevent the development of internal Müllerian structures and the Wolffian structures also fail to develop because of the insensitivity to testosterone. The external genitalia appear female. In about 10% the defect is incomplete (PAIS—partial androgen insensitivity syndrome) and the external genitalia may be ambiguous at birth, with labioscrotal fusion and virilisation may sometimes occur before puberty. Indeed in some cases of partial AIS the external genitalia appear male, there may be micropenis and bifid scrotum or some cases minor hypospadias and even spermatogenesis with potential for fertility.

In cases of complete AIS, testicular tissue should be removed after puberty to prevent malignant transformation (dysgerminoma), which occurs in about 5% of cases. Exogenous oestrogen should then be prescribed: cyclical treatment is obviously not required because the uterus is absent. The syndrome may be diagnosed in infancy if a testis is found in either the labia or an inguinal hernia, in which case both testes should be removed at this time because of the potential risk of malignancy. Any girl presenting with bilateral inguinal herniae should raise the suspicion of AIS. Some cases, however, only present at puberty with primary amenorrhoea, minimal or absent breast development and scanty or absent pubic hair. Removal of abdominal/inguinal testes should then be performed. This can usually be achieved laparoscopically without difficulty. The vagina is usually very short and can be developed by pressure dilation using Frank's method (see *vaginal agenesis* above).

Careful psychological assessment and counselling are obligatory to allow an understanding of the gonadal dysfunction and necessity for hormone treatment. In general, a completely honest approach is favoured so that the individual is provided with full information about her condition, its origins and management. It is certainly our experience that the vast majority of patients desire a full explanation of their condition and respond better to treatment if they are included in the decision making processes. Patients with these problems should be referred to centres where there are specialists experienced in their management so that a comprehensive team approach can be provided.

There are many less common DSDs which may be associated with ambiguous genitalia at birth or may present with primary amenorrhoea. Their management must be individualised and is beyond the scope of this book. We refer the interested reader to: *Paediatric and Adolescent Gynaecology, A multidisciplinary approach*. Editors A Balen, S Creighton, M Davies, MJ MacDougall, R Stanhope; Cambridge University Press, 2001.

CLOACAL ANOMALIES

Cloacal anomalies may take a variety of forms depending upon the relative contribution of gastrointestinal, genital and renal tracts. The common cloacal chamber comprises the confluence of the urinary, genital and gastrointestinal tracts. A persistent cloaca and cloacal extrophy present significant challenges for the paediatric surgeon, which are beyond the scope of this text. The cloaca should be divided anteriorly into the urogenital sinus and posteriorly into the rectum. Major surgery is often required during the neonatal period in order to provide anterior abdominal wall integrity and continence of faeces and urine. Several operations may be required and the uterus and genitalia, if present, may be adversely affected such that at puberty there is obstruction to menstrual flow and also an increased rate of ovarian cyst formation—presumably due to ovarian entrapment preventing normal follicular growth and ovulation.

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8

9 The Uterus

Tom Setchell, Tariq Miskry

Introduction

Recent years have seen great changes in the extent and nature of surgical interventions for uterine conditions. Apart from the range of medical and non-surgical treatments available for benign uterine problems, there are now far greater surgical solutions. Traditionally uterine surgery encompassed the blind 'D&C' (both diagnostic and therapeutic), and abdominal operations such as repair of perforations, myomectomy and hysterectomy. Today, the only remaining blind uterine operations are confined to emptying the pregnant uterus, inserting contraceptive devices, and some forms of endometrial ablation. Hysteroscopic surgery has revolutionised treatment of disease within the cavity. Fibroids, polyps, uterine septae and indeed the entire endometrium can now be treated under direct vision – in many cases as an outpatient procedure.

The development of sophisticated laparoscopic instruments and equipment, and increasing surgical experience, has resulted in an ever-increasing breadth of procedures that are technically feasible to perform laparoscopically. Most abdominal operations for benign uterine pathology can now be done laparoscopically, apart from the largest of fibroids, some complex cases of endometriosis or dense pelvic adhesions from severe infection. However, the laparoscopic surgeon must have the training and ability to perform abdominal operations when circumstances dictate, and know when to convert to laparotomy. In some parts of the world, operating theatres are not yet equipped to carry out complex laparoscopic surgery, and surgeons must retain their competency in open surgery.

Hysterectomy used to be the ultimate therapeutic option for benign uterine disease and for the resolution of intractable menstrual symptoms. It has become one of the commonest operations performed in westernised society, as there is little or no cultural objection to removal of the uterus. In England, although the number of procedures is now declining, around 40,000 hysterectomies are performed annually, making it the commonest major gynaecological operation. Indeed, some 20% of women have undergone the procedure by the age of 60 years, whilst in the USA, around 600,000 hysterectomies are performed annually, at a rate of 5.1 per 1000 women. It is estimated that about 20 million US women have undergone the operation. The majority of hysterectomies are performed for benign disease, with dysfunctional uterine bleeding and leiomyomata accounting for 50–70% of cases.[1]

Table 9.1: Pharmaceutical options for the management of heavy menstrual bleeding[2]

Levonorgestrel-releasing intra-uterine system (LNG-IUS)
Antifibrinolytics (tranexamic acid)
Non-steroidal anti-inflammatory drugs (e.g. mefenamic acid)
Combined oral contraceptives
Oral progestogens (e.g. norethisterone)
Injected progestogens
Gonadotrophin-releasing hormone analogues (GnRH analogues)

Recently, several factors have combined to produce a marked change in professional and patient attitudes to the operation (see Chapter 1). There are now alternative treatments for dysfunctional uterine bleeding. Aside from the various forms of endometrial ablation and resection, laparoscopic myomectomy is becoming more commonplace in the UK, and there are alternative treatments for fibroids, such as uterine artery embolisation and MRI-guided focused ultrasound therapy. Medical treatments can be useful alternatives for managing endometriosis (see Chapter 11). Likewise, there is a range of pharmaceutical options for the control of menstrual disturbance (see Table 9.1).

Operations on the Uterine Cavity

The majority of surgical procedures performed on the uterine cavity can be performed under direct vision, using the technique of hysteroscopy. Diagnostic hysteroscopy allows assessment of the uterine cavity, the tubal ostia and the endocervix. This allows for greater awareness of the dimensions of the uterine cavity, and the presence of any pathology, prior to blind or directed tissue sampling (see Chapter 3). Therapeutic procedures on the uterine cavity are largely performed under hysteroscopic guidance (see Table 9.2).

HYSTEROSCOPIC PROCEDURES

Diagnostic Hysteroscopy

This procedure can be performed as an outpatient procedure without anaesthesia, or in the operating theatre. It is frequently used prior to blind or directed tissue sampling of the endometrium or endocervix. Diagnostic hysteroscopy is discussed in Chapter 3.

Table 9.2: Therapeutic procedures on the uterine cavity

Blind procedures	Hysteroscopic guidance	Open or laparoscopic procedures
Polypectomy Removal of lost IUCD Insertion of IUCD Endometrial ablation ERPC (including molar pregnancy) TOP	Resection of submucous fibroids or polyps Rollerball diathermy/ resection of the endometrium Division of intra-uterine septum or adhesions Hysteroscopic sterilisation	Correction of chronic uterine inversion (rare) Repair of uterine perforation or rupture

Abbreviations: IUCD, intra-uterine contraceptive device; ERPC, evacuation of retained products of conception; TOP, termination of pregnancy.

Hysteroscopic Distension Media

The uterine cavity can be distended with either liquid or gas media. There are a number of different liquid media that can be used for hysteroscopy, but in principle 0.9% normal saline is used in the majority of diagnostic procedures. This and other aqueous solutions are also normally used for operative hysteroscopy using mechanical instruments (e.g. scissors) or laser. These fluids conduct electricity, however, and hence are not suitable for use with monopolar electrical devices. Electrolyte-free solutions are compatible with monopolar electrosurgery, but increase the risk of dilutional hyponatraemia secondary to fluid absorption. Some media also carry a small risk of anaphylaxis. Careful observation of distension fluid inflow and outflow are important. A deficit in excess of 1–1.5 litres may be associated with intravascular fluid overload, hyponatraemia and intoxication of the patient. Severe cases of hyponatraemic encephalopathy (serum sodium <120 mEq/l) can rapidly result in seizures, congestive heart failure, coma and death. Prompt recognition and treatment are essential. More recently, bipolar systems for operative hysteroscopy have been developed, which can be used with 0.9% saline. This prevents dilutional hyponatraemia, markedly reducing the risks of fluid overload. It is important to remember that large volumes of even isotonic fluid overload can still cause congestive cardiac failure.

The use of gaseous distention has declined in recent years as saline is readily available and cheap. In addition, CO_2 is a poor choice for distension in the presence of even small amounts of vaginal bleeding. However, if used, carbon dioxide is available in many units and can allow good optical views in most cases. Administration requires a specialised hysteroscopic insufflator to restrict the flow rate to <100 ml/min to reduce the potential risk of CO_2 embolism. A laparoscopic insufflator should never be used.

Polypectomy

Hysteroscopy allows visualisation of endometrial or endocervical polyps (see Fig. 9.1). These can then be removed blindly with polyp forceps, following dilatation of the cervix, with subsequent repeat hysteroscopy to confirm complete removal and to check for uterine perforation. Alternatively, polypectomy can be performed using hysteroscopic scissors, hysteroscopic grasping forceps or monopolar or bipolar electrosurgical devices.

Foreign Body Retrieval

The commonest intra-uterine foreign body is an intra-uterine device (IUD). Hysteroscopy can be employed to locate displaced IUDs prior to retrieval, either with polyp forceps or hysteroscopic grasping forceps (see Fig. 9.2).

Transcervical Resection of Fibroids (TCRF)

The development of hysteroscopic instrument systems over the last 30 years now allows the majority of polyps, fibroids, and endometrium to be treated effectively and safely. Nevertheless, there are serious potential complications with these forms of minimal access surgery. Supervised training, well-maintained equipment, and attention to detail of technique are as important as in open surgery.

For operative hysteroscopy, a larger diameter instrument is required with channels for continuous flow irrigation and energy delivery, whether electrical diathermy or laser power is being used. As with laparoscopic surgery, a high-resolution video camera system should be used. This allows image capture, the surgeon to work from a monitor and aids teaching and training.

Whilst laser can be used hysteroscopically, in the majority of units electrosurgery will be the modality of choice as it is widely

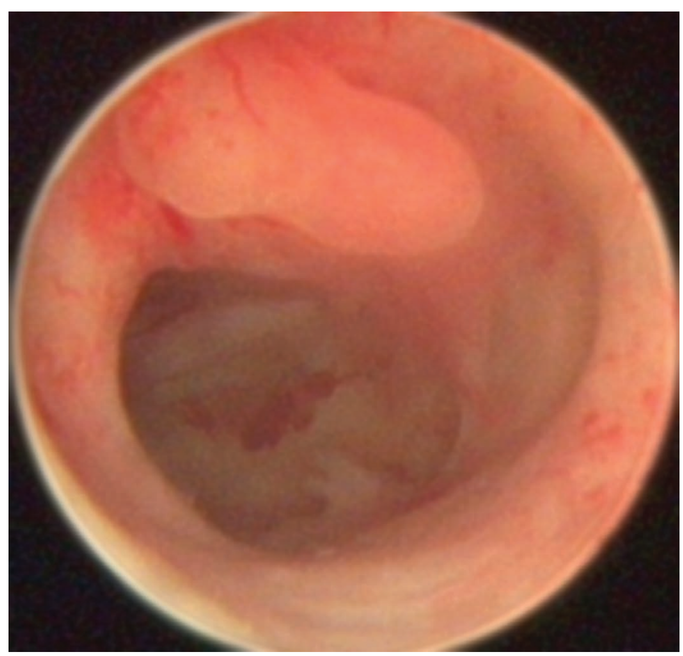


Fig. 9.1: Magnified hysteroscopic view of an endometrial polyp.

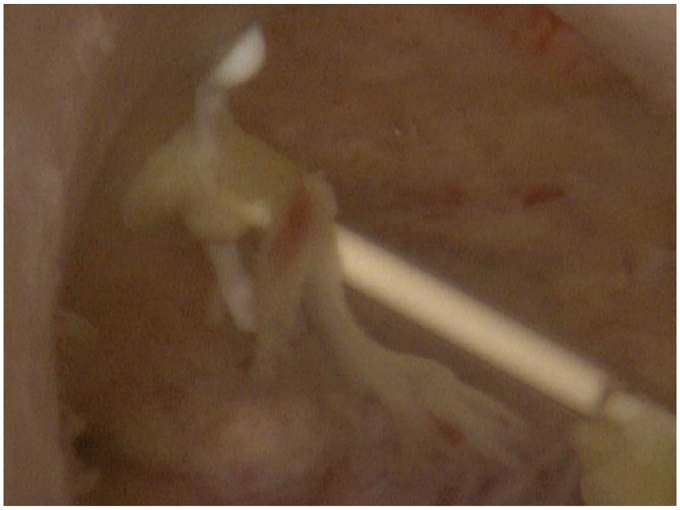


Fig. 9.2: Hysteroscopic view of a displaced Mirena IUS. The threads were coiled up inside the uterine cavity.

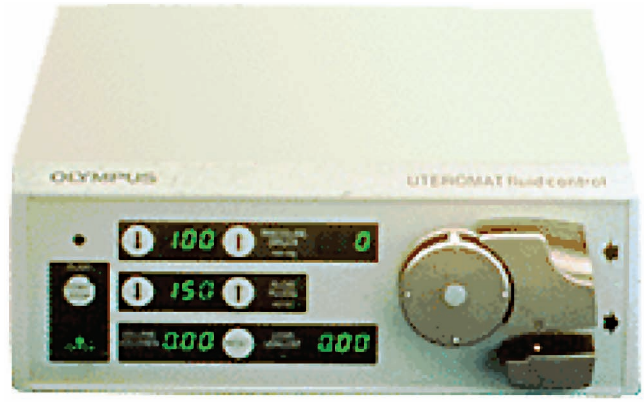


Fig. 9.3: 'Uteromat' rotary pump for pressure-controlled fluid delivery during operative hysteroscopy (Olympus).

available and relatively cheap. Historically monopolar systems have been the standard, but more recently bipolar resectoscopes have become available, which are potentially safer in terms of fluid overload.

As previously discussed, electrolyte-free solutions such as glycine, sorbitol or mannitol are obligatory for monopolar systems. Typically 3 litre bags of glycine with wide-bore giving sets are used for distension. Suspending glycine on an adjustable stand to allow a gravity feed is much safer than using pressure bags, which increase the risk of fluid overload. Normally, the outflow channel of the resectoscope is connected to a low-pressure suction pump and collecting system. A second system is also connected via an under-buttock pouch to collect spilled glycine. It is essential that there is a system for continuous recording of input versus output. The simplest method is to have glycine suspended from spring-loaded scales, which allow the weight (1 ml of glycine is approximately equivalent to 1 g of weight) to be easily read by an assistant. This can then be compared with the volume collected within the suction pumps for instant and accurate fluid balance. Some manufacturers can provide automated suction-irrigation systems that perform these calculations but are clearly more expensive (e.g. 'Uteromat' Fig. 9.3).

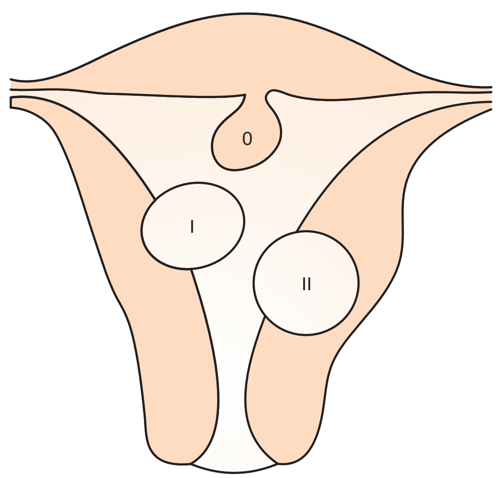
A low pressure system is essential as fluid absorption is potentially rapid at high pressures both via direct vascular absorption and loss to the peritoneal cavity. Passage of fluid via the Fallopian tubes becomes significant once intra-uterine pressure exceeds 70 mmHg.

Even a deficit of one litre may be associated with hyponatraemia and tissue oedema secondary to fluid overload. This will depend to an extent on the BMI of the patient and concurrent medical conditions. It would be reasonable to continue operating at this stage provided careful monitoring and measurement of serum electrolytes is carried out. If the deficit increases to 1.5 litres or greater, the surgeon should stop operating and treat the patient without waiting for the sodium result. In our unit, we would administer 20 mg of IV frusemide and place an indwelling urinary catheter to assess response to treatment. When fluid overload has occurred, it is essential to repeat the serum sodium after 4 hours to ensure it has normalised – particularly as in some cases significant transtubal loss may have occurred leading to delayed absorption and further dilutionary hyponatraemia.

Intracavitary fibroids may be classified into three types according to the proportion of the fibroid which is within the uterine cavity (Fig. 9.4).

Patient Selection

As with all surgical procedures patient selection is critical for safe, effective surgery. Pre-operative imaging (normally by



Type 0	Pedunculated. The whole of the fibroid is within the uterine cavity
Type I	Submucosal fibroid in which >50% of the fibroid protrudes into the cavity
Type II	Submucosal fibroid in which < 50% protrudes into the cavity

Fig. 9.4: Classification of sub-mucosal fibroids.[3]

9

transvaginal ultrasound) may identify submucosal fibroids, but the definitive test is hysteroscopy. Most fibroids are approximately spherical making it straightforward to assess what percentage of fibroid is within the cavity. Where the angle at the junction of fibroid and endometrium is less than 90º, more than 50% of the lesion must be within the uterine cavity (i.e. a type 0 or type I fibroid). Conversely, if the angle is greater than 90º, less than half of the fibroid is within the cavity (type II fibroids) (Figs. 9.5, 9.6).

Types 0–I may readily be treated hysteroscopically, particularly if they are less than 5 cm in diameter. In principle fibroids larger than this will either need to be shrunk by pre-treatment with GnRH analogues, or be treated by open or laparoscopic myomectomy. In experienced hands, it is sometimes possible to safely treat larger fibroids but this may need to be undertaken as a two-stage procedure.

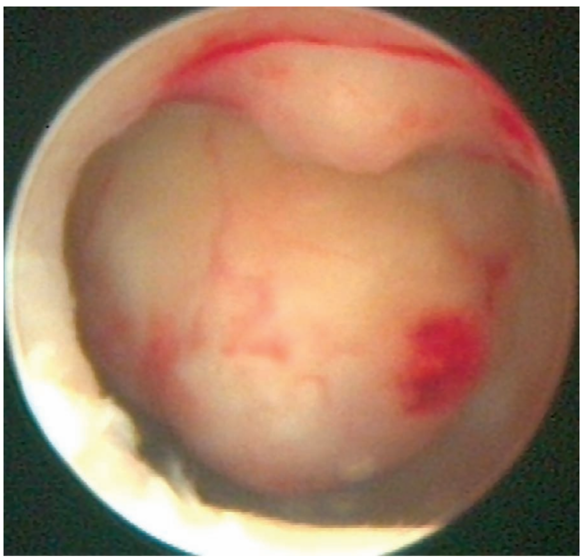


Fig. 9.5: A large type 0 submucous fibroid with a tiny type II fibroid in the foreground.

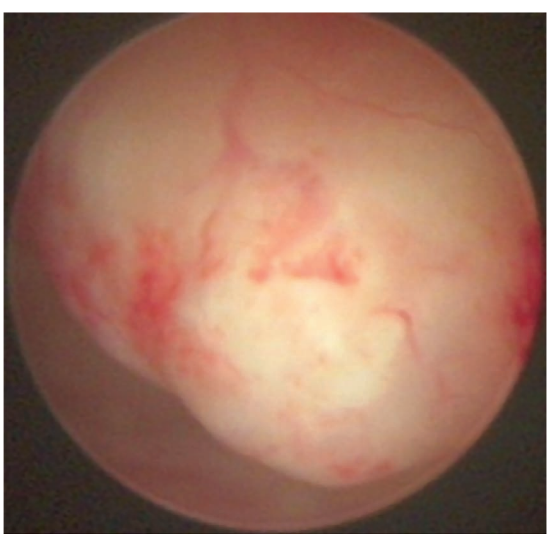


Fig. 9.6: A close-up image of the same type 0 fibroid.

Type II fibroids are potentially unsuitable for hysteroscopic resection and should only be dealt with by very experienced hysteroscopic surgeons. In the authors' experience, it is usually best to plan these cases as two-stage procedures. Typically at the first procedure, the visible fibroid is resected to below the level of the endometrium. A second stage procedure is then carried out 6–8 weeks later, and in most cases the bulk of the residual fibroid will have extruded into the uterine cavity becoming essentially a type I fibroid, which can be resected safely. Resection of type II fibroids carries an increased risk of uterine perforation (which can cause intra-abdominal organ damage or catastrophic vascular injury when using electrosurgical instruments) and fluid overload. An alternative surgical approach for these fibroids may be required.

Operative Technique

Having mapped the fibroid hysteroscopically, the cervix is dilated to a Hegar size 10, and the modified urological resectoscope is introduced (typically with a zero or 12º scope) with a backward pointing loop. Resection should be systematic and the loop orientated at right angles to the surface of the fibroid at all times. Initially the loop is passed beyond the fibroid and then withdrawn to make contact thereby protecting the endometrium superior to the lesion. Energy can then be deployed whilst slowly withdrawing the loop ensuring that it is in continuous view (Fig. 9.7). The slower the loop is withdrawn, the more coagulative effect is achieved, which is particularly important as the base of the fibroid is reached. With small fibroids the resultant chippings can be left at the top of the cavity until the end of the procedure. With larger fibroids it may be necessary to remove chips intermittently to allow a good view. Adjusting inflow and outflow settings can also be helpful both for maintaining distension and clarity of view. It is normally possible to identify the junction of fibroid and normal myometrium by the presence of the 'pseudocapsule' to know when to stop resecting. It is essential to perform a 'check' hysteroscopy following removal of the last chippings to exclude perforation.

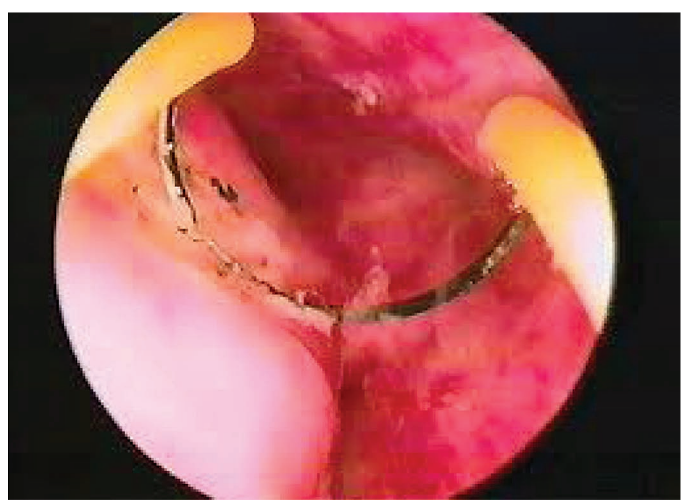


Fig. 9.7: Hysteroscopic resection of a fibroid.

Prolapsing Fibroid Polyps

A submucosal fibroid can become polypoidal over time as uterine contractions attempt to expel it from the cavity. The cervical canal becomes dilated and the vaginal portion of the cervix is drawn up to allow the passage of the maximum diameter of the fibroid polyp, whilst it remains attached to the myometrium by a pedicle. Patients often experience colicky, cramp-like pains or an ongoing blood-stained vaginal discharge, which can be responsible for a profound anaemia, seemingly out of proportion to the reported blood loss. A fibroid polyp consists of a firm, non-friable, globular mass. It may be possible to feel the pedicle above the level of the polyp passing upwards into the cervical canal. The differential diagnosis includes inversion of the uterus; very rarely the two conditions can co-exist. Inversion can be excluded by ultrasound scan or by passing a uterine sound alongside the protruding mass.

Most fibroid polyps can be removed by torsion with gentle traction. This is not normally appropriate in an outpatient setting due to the risk of bleeding. In some cases, it may be possible to ligate the pedicle prior to transecting it. In many cases, hysteroscopic resection will be more appropriate. A hysteroscope can usually be passed beyond the mass in order to identify and resect the pedicle. Maintaining adequate distension can be difficult, as the cervix is often dilated beyond the diameter of the scope. This drawback can be overcome by tying a temporary suture around the cervix. Hysteroscopic resection is clearly the best treatment in cases where the prolapsing fibroid does not reach the external cervical os. In settings without access to this technology, skilled vaginal surgeons can remove large partially prolapsed fibroids by incising and dividing the cervix and lower uterine body via a vaginal approach (Fig. 9.8). A large tumour might require morcellation (Fig. 9.9). This operation may still be performed as a prelude to vaginal hysterectomy in the presence of an obstructing isthmic mass.

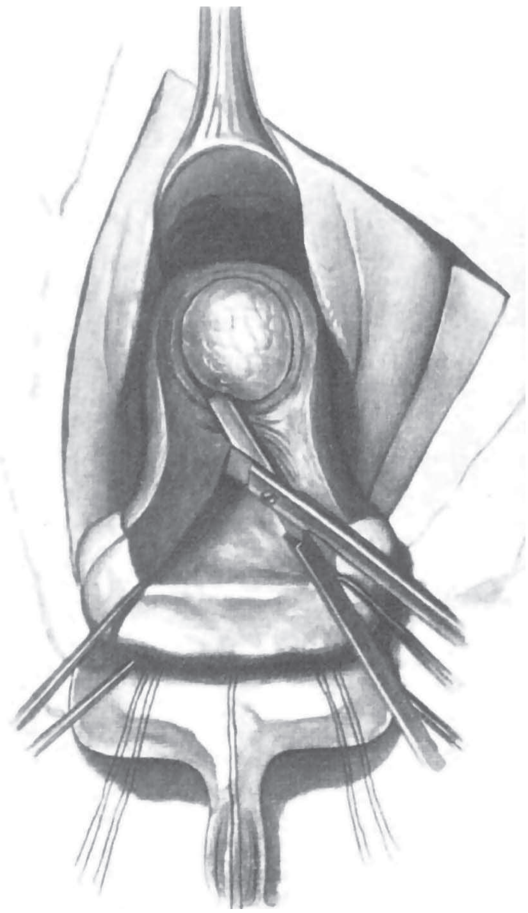


Fig. 9.8: Vaginal hysterotomy for myomectomy. The cervical canal has been located after the uterus has been pulled down through the uterovesical pouch. The bladder is being retracted away with a vaginal retractor. The tissues intervening between the cervical canal and the capsule of the fibroid are being cut through with scissors.

Endometrial Ablation and Resection

Destruction of the endometrium to below the basal layer can induce amenorrhoea or hypomenorrhoea, presenting an increasingly attractive alternative to hysterectomy.[4,5] Various methods have been developed, and are broadly classified into first and second generation. Most of these techniques are best suited to women over 40 years of age with dysfunctional uterine bleeding, whose family is complete, and where the uterus is only minimally enlarged. Diagnostic hysteroscopy or endometrial biopsy is imperative prior to ablation in women with abnormal bleeding. Patients should be aware that amenorrhoea is not a guarantee (amenorrhoea rates from 15% to 50%), but that satisfaction rates are in the region of 80–90%. There is a 15–25% second procedure rate, including repeat ablation and hysterectomy. Endometrial ablation is not appropriate for women wishing to preserve their fertility, nor is it a valid method of contraception. Appropriate contraceptives should therefore be discussed at the time of pre-operative counselling.

First-Generation Endometrial Ablation

First-generation techniques rely on hysteroscopic guidance. The first techniques described include laser ablation of the endometrium and endometrial resection with diathermy.[6,7] Rollerball diathermy (see Fig. 9.10) has been used alone and in conjunction with diathermy resection. The laser method involves dragging an Nd:YAG fibre over the whole surface of the cavity of the uterus, destroying the endometrium to a depth of 4–5 mm. Pre-treatment thinning of the endometrium may be advantageous, but does not reduce the chance of operative complications.

Endometrial resection requires the use of a modified urological resectoscope, with a cutting loop in which strips of endometrium are resected to a level just reaching the myometrium (Fig. 9.11). This ablation technique employs the same equipment and distention media as that used in TCRF (see above). It carries the advantage of not only being performed under direct vision, but also allowing for samples of endometrium to be taken for histological diagnosis.[8] Great care must be taken when resecting near the uterine cornu, where the myometrial layer is at its thinnest. The authors prefer the use of the rollerball diathermy in the cornu and across the top of the endometrial cavity at the fundus, and resection for the remainder of the cavity to the level of the internal cervical os.

Both methods produce satisfactory results with more than 50% of women having complete amenorrhoea. Endometrial resection remains the gold standard against which other ablation techniques are compared.

Complications of laser and electrodiathermy ablation include uterine perforation (with potential damage to intra-abdominal viscera or vasculature), haemorrhage and fluid overload with pulmonary oedema and hyponatraemia.[9,10] Complication rates have been quoted at 4.4%, with a 1.3% risk of further emergency surgery (including laparotomy and hysterectomy). Combined rollerball diathermy and loop resection has been found to be safer than loop resection alone, but the MISTLETOE study found that laser and rollerball ablation were the safest first-generation techniques.[10]

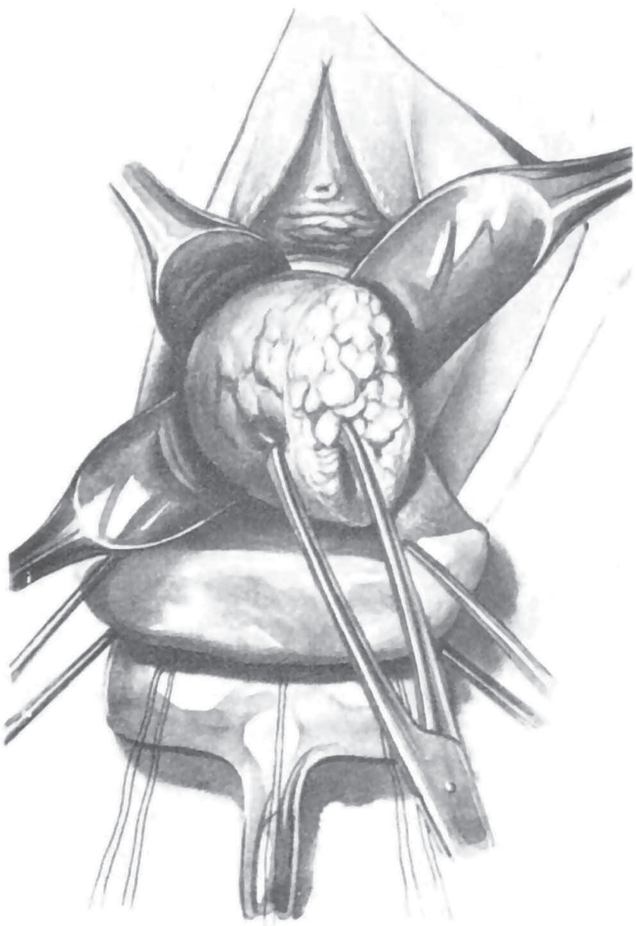


Fig. 9.9: Vaginal hysterotomy for myomectomy. The fibroid is being morcellated to reduce it in size. Its substance is grasped with heavy toothed clamps, drawn down and cut away in sections.

Second-Generation Endometrial Ablation

Drawbacks of first-generation ablation include potentially fatal complications, and the need for hysteroscopic visualisation, anaesthesia and an experienced surgeon. The learning curve is so steep that it has been estimated that 200 cases are required to reach proficiency. With these drawbacks in mind, a variety of second-generation techniques have been developed (see Table 9.3). They are simpler to perform and potentially more appropriate for the outpatient setting.[9] Endometrial pre-treatment does not affect success and patient satisfaction.

In principle, they all rely on causing tissue damage to the endometrium. Many include built in safety features to prevent excessive depth of tissue destruction, which could lead to serious complications. They include various balloon thermal ablation techniques (Fig. 9.12), microwave endometrial ablation (MEA), hydrothermablation (hysteroscopic-guided, using warmed saline), impedance controlled bipolar radiofrequency endometrial ablation (Novasure®), cryotherapy, Gynelase®

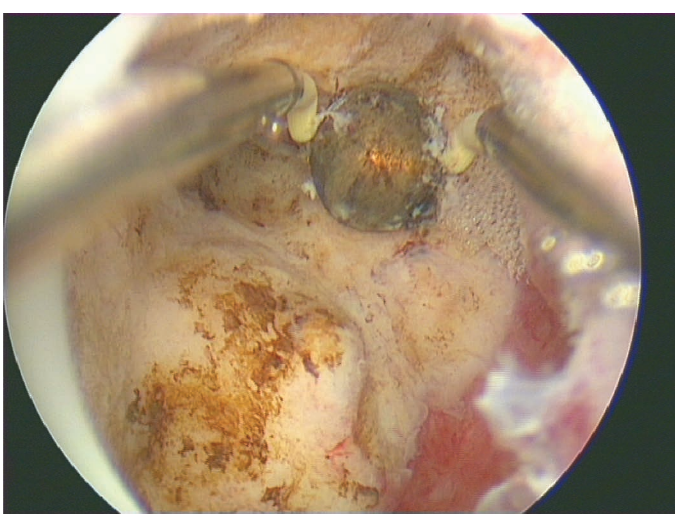


Fig. 9.10: Rollerball diathermy of the endometrium. Treated areas appear paler in colour and show signs of charring.

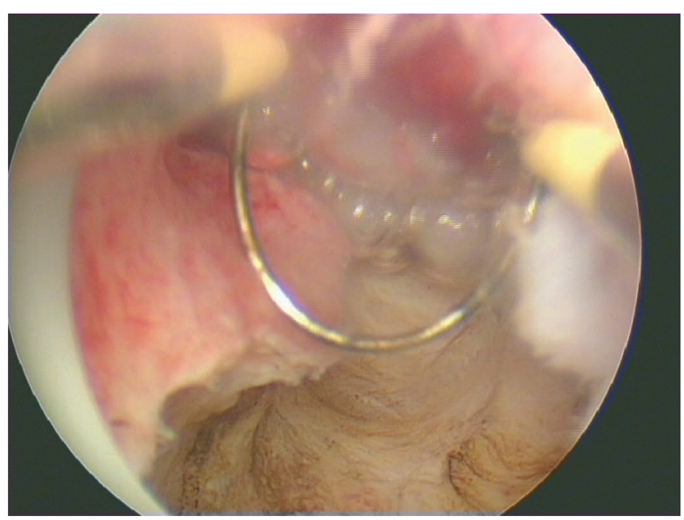


Fig. 9.11: Transcervical resection of the endometrium.

Table 9.3: Endometrial ablation techniques

First-generation techniques	Second-generation techniques
Laser	Balloon thermal ablation
Rollerball diathermy	Hydrothermablation
Diathermy resection	Novasure® impedance controlled endometrial ablation system
	Microwave endometrial ablation
	Gynelase® endometrial laser intra-uterine thermal therapy (ELITT)
	Photodynamic therapy
	Cryotherapy
	Chemoablation

endometrial laser intra-uterine thermal therapy (ELITT) and photodynamic therapy.[9,11,12]

Balloon thermal ablation involves inserting a small inflatable balloon into the uterine cavity, which is then filled with a fluid that is maintained at a constant temperature for 2–10 minutes (device-dependent). Results of the thermal balloon methods suggest comparable outcomes to the hysteroscopic methods, but with lower complication rates.[12]

Microwave endometrial ablation is carried out by passing a graduated applicator rather like a straight uterine sound into the cavity, up to the fundus of the uterus. The device is then energised to produce a temperature of 90–100° centigrade within the uterine cavity for 2–3 minutes. Hydrothermablation involves instillation of warmed saline at a temperature of 80–90°C for 10 minutes. The saline pressure is maintained below 55 mmHg electronically, as higher pressures risk causing warmed fluid to flow through the tubal ostia and into the peritoneal cavity. The technique is suitable for large or abnormal uterine cavities, but it is painful and carries the risk of vaginal and perineal skin burns in the event of fluid leakage.

The Novasure® system consists of a disposable, expandable electrode array, which conforms to the contours of the endometrial cavity, and delivers bipolar radiofrequency energy to ablate the endometrium (Fig. 9.13). The system delivers carbon dioxide prior to treatment to check for leakage, which may indicate uterine perforation. The depth of ablation is governed by tissue impedance, which increases after vapourisation of the endometrium. Once the myometrium is reached, altered impedance triggers automatic cessation of treatment. Treatment time is 90–120 seconds.

Cryotherapy involves freezing the endometrium to −90°C under ultrasound guidance to monitor the depth of ablation. This allows monitoring in real-time, but requires additional equipment, staff and an appropriate level of scanning ability. The low temperature is thought to provide anaesthesia, making the procedure well tolerated. ELITT utilises diffuse laser beam energy to provide uniform thermal treatment of the endometrium. In the UK, it is not currently in widespread use. Photodynamic therapy involves instilling a photosensitising chemical into the uterine cavity. A laser probe is then inserted to activate the chemical resulting in endometrial ablation. Minimal data have been published on this technique, and it is currently not widely used.

These devices are thought to carry less risk of serious complications (fluid overload, uterine perforation, cervical laceration, haematoma), although there is additional risk of equipment failure, and infrequent but serious complications such as bowel and bladder injury have been reported.[9]

Whichever technique is employed by individual surgeons, it is essential that they have had appropriate training and are familiar with the equipment and how to trouble-shoot problems.

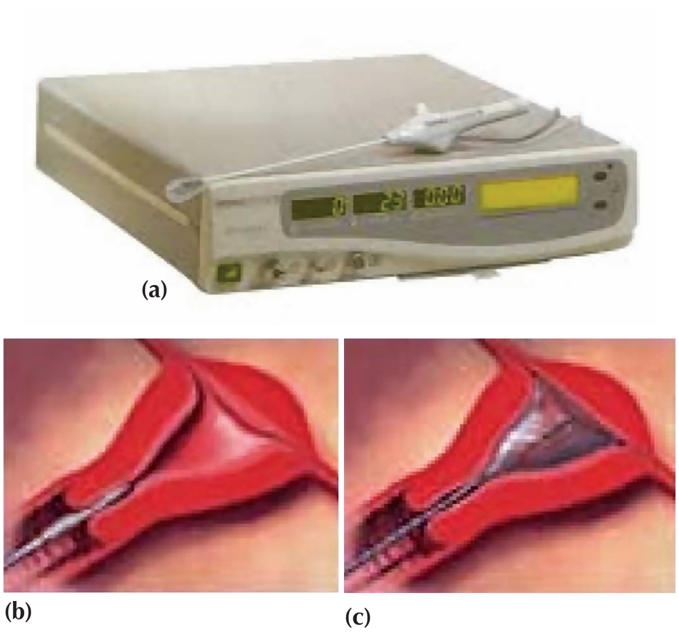


Fig. 9.12: The uterine balloon thermal ablation system (Gynecare, division of Ethicon). **(a)** The heat control unit. **(b)** Introduction of the catheter, and balloon. **(c)** The inflated balloon with heating element, which raises the temperature of the fluid within it to 87°C for 8 minutes.

Fig. 9.13: The Novasure® endometrial ablation system (Hologic, Inc., Bedford, MA).

Hysteroscopic Lysis of Adhesions and Septae

Intra-uterine adhesions most commonly develop after curettage, in the surgical management of products of conception (in the context of miscarriage, termination of pregnancy or post-partum), or following abdominal or hysteroscopic myomectomy. Infection is a rare cause of intra-uterine adhesions, except in the case of genital tuberculosis. Asherman's syndrome is the development of amenorrhoea following complete occlusion of the uterine cavity by iatrogenic adhesions. The presence of adhesions has been implicated as a cause of recurrent miscarriage, infertility and menstrual disorders.[13–15]

Diagnosis is by hysterosalpingogram (HSG) and hysteroscopy. If scarring is dense, hysteroscopy may be performed under ultrasound or laparoscopic guidance. Filmy adhesions can be broken down with the blunt end of a hysteroscope. More dense myofibrous bands of tissue can be divided mechanically using hysteroscopic scissors or biopsy forceps, or with electrosurgery or fibreoptic lasers. Following lysis, an intra-uterine stent can be inserted (e.g. a copper-containing intra-uterine contraceptive device) and hormonal therapy with oestrogen and progesterone used, in an effort to prevent reformation of adhesions and encourage endometrial proliferation. Recently developed adhesion barriers such as hyaluronic acid may also play a role in preventing recurrence. Following treatment, intra-uterine pregnancy rates range from 22% to 45%, and live births range from 28% to 32%. Subsequent pregnancy carries a risk of placenta accreta with the potential for massive blood loss, transfusion and peripartum hysterectomy.

The treatment of congenital uterine septae can be managed in an identical way (Figs. 9.14, 9.15). Prior to treatment, it is important to diagnose the nature of the malformation through imaging (including transvaginal ultrasound and pelvic MRI), and possibly HSG or diagnostic laparoscopy. Laparoscopic guidance may be necessary during septum division.[16]

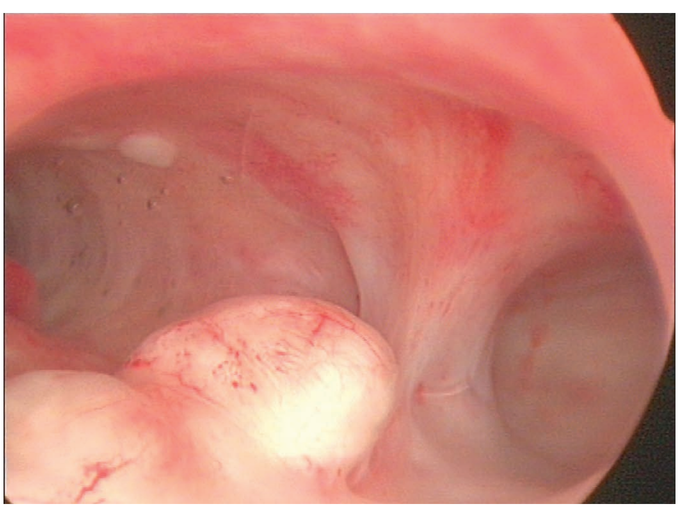


Fig. 9.14: Hysteroscopic view of small fibroid polyps and an intra-uterine septum.

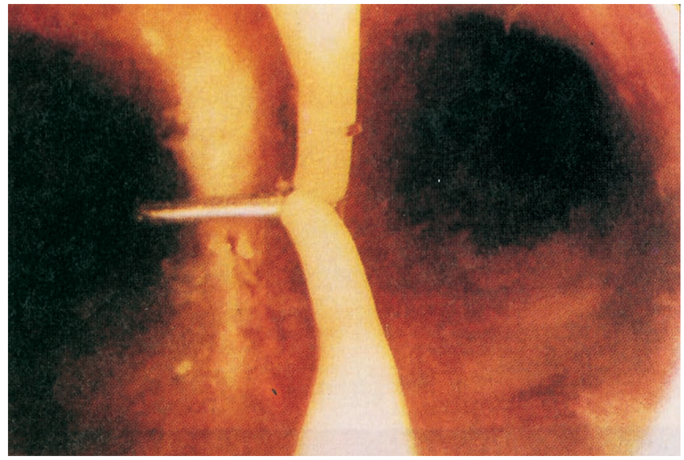


Fig. 9.15: Hysteroscopic resection of an intra-uterine septum using needle diathermy.

Hysteroscopic Sterilisation

Laparoscopic tubal ligation remains the gold standard for effective sterilisation but is an abdominal operation, is costly and carries small but serious risks of injury to major blood vessels, bowel or bladder, in addition to anaesthetic risks. Several attempts have been made to achieve effective sterilisation via a transcervical approach. Previous attempts include hysteroscopic tubal electrocautery and tubal occlusion using the Nd:YAG laser. Unfortunately, these procedures are associated with unacceptably poor occlusion rates.[17]

More recently, a hysteroscopic sterilisation technique, Essure® (Conceptus, Inc., Mountain View, CA), has been developed. It can be performed under local anaesthetic in an office setting. It involves placement of metallic micro-inserts into the interstitial portion of each Fallopian tube under hysteroscopic guidance. The inserts are designed to cause a local inflammatory reaction to achieve tubal occlusion through fibrosis. Follow-up data have shown its efficacy to be comparable with tubal ligation, with only 2.6 pregnancies per 1000 procedures after 5 years. Currently, the technique requires confirmation of tubal occlusion 12 weeks later with an HSG, but they appear to be relatively safe, and are likely to be cost-effective.

Complications of Hysteroscopic Surgery and Associated Procedures

The severity of complications at hysteroscopic surgery depends on the type of procedure, use of power source and type of distension medium. Clearly operative hysteroscopy may potentially be associated with both an increased frequency and severity of complication compared to diagnostic procedures.

Perforation of the non-pregnant uterus, especially with a blunt instrument such as a sound or a dilator, may go unnoticed by the operator and the patient. In the case of an intra-uterine contraceptive device, shortening or absence of the threads indicates likely perforation and requires appropriate investigation. Ultrasound will show a correctly placed coil within the uterine cavity. If this is not demonstrated, an abdominal radiograph will identify the location of the device, but give no indication to the involvement of other intra-abdominal structures. Perforation in the presence of sepsis or malignancy risks pathological dissemination and may require expert intervention with early laparoscopy or laparotomy. This is particularly the case if a radioactive source has been inserted through a false passage into the pouch of Douglas. A potential late complication of uterine perforation with any instrument is uterine rupture during subsequent pregnancy.

Significant haemorrhage is more likely during hysteroscopic resection of fibroids or endometrium. Second-generation endometrial ablation procedures, whilst less likely to cause significant bleeding, can be complicated by equipment failure. As with any surgery, careful patient positioning is crucial. Incorrect positioning can result in back injuries, soft tissue damage or neuropraxia. Prolonged pressure on the peroneal nerve from unpadded lithotomy stirrups can cause paraesthesia or foot-drop.

Minor complications include difficulty with dilatation and cervical lacerations. Where it has been anticipated that cervical dilatation may be difficult (e.g. following cone biopsy), pre-operative treatment with vaginal misoprostol (400 µg in the posterior fornix 1–3 hours before surgery) may be helpful. Cervical laceration is more likely to occur where dilatation is difficult. The risk may be reduced by grasping the anterior lip of the cervix with two instruments to spread the traction force applied. In principle ½ size graduated dilators should be available, and application of lubricating jelly may also be helpful. Where a tear does occur, superficial bleeding may stop with compression or the use of cautery. For more extensive tears, suturing is usually straightforward. Other minor postoperative sequelae include uterine cramping pain, urinary retention and nausea and vomiting.

It is essential that those performing uterine cavity surgery are familiar with the potential complications and how to recognise and manage them (Table 9.4). This is particularly important when using power sources such as electrosurgery.

It is worth remembering that thermal injury to viscera can occur without perforation, for example during prolonged application of energy to a single area of the uterine wall, especially in the region of the tubal ostia.

CO_2 is not advised for distension at operative hysteroscopy as any bleeding will cause bubbling and compromise the operative view. Its use during diagnostic procedures may be associated with the rare event of CO_2 embolus. Air embolism can also rarely occur in association with repeated introduction and removal of the operative hysteroscope, especially in the presence of cervical trauma or air in the fluid giving set.

The most important peri-operative complications and their management are summarised in Table 9.4.

Urinary tract infection can occur following any hysteroscopic procedure, but will clearly be more likely if urethral catheterisation has been necessary. Pelvic inflammatory disease is an important complication, which may be avoided by the appropriate use of prophylactic antibiotics at operative hysteroscopy. Where possible, it is good practice to screen for genital tract infections including *Chlamydia trachomatis* prior to surgery. Patients can be reassured that it is common to experience vaginal discharge, which is usually self-limiting, following ablative procedures or TCRF.

Intra-uterine adhesions can form after any operative hysteroscopy or curettage. In the case of adhesiolysis, resection of a septum or extensive resection of a fibroid, there is an increased risk of adhesion formation. Insertion of an intra-uterine device and administration of oestrogen and progestogen therapy may help prevent this. Endometrial ablation carries some specific longer-term risks. These are detailed in Table 9.5.

TERMINATION OF PREGNANCY

Legal Requirement

In the United Kingdom, termination of pregnancy is governed by the Abortion Act (1967) and its amendments. The indications for termination of pregnancy and the details of the criteria that must be satisfied are beyond the realms of this book. In essence, British law currently requires that two registered medical practitioners have certified in good faith before the operation that the procedure is indicated on at least one of five counts specified in the Act. The exception to this is when a practitioner is forced to act on his/her own for the purpose of saving life. The place where terminations are carried out is also subject to regulation, and there is a statutory obligation to notify the Chief Medical Officer of the Department of Health within seven days of carrying out the procedure.

Vacuum aspiration has replaced dilatation and curettage as the surgical method of choice since the early 1970s, and is extremely safe and effective. It is particularly indicated in the evacuation of a molar pregnancy where medical management is contraindicated. A significant proportion of women with molar pregnancy will require subsequent drug treatment (typically methotrexate or combination chemotherapy) due to persistently raised serum hCG. In principle, this is preferred to repeat evacuation as further surgery does not improve outcome.

Prior to 7 weeks gestation, there is a higher risk of failure due to the small size of the fetus. Surgical evacuation becomes increasingly hazardous after 12–13 weeks, and considerable skill is required to carry out safe fetal destruction and evacuation up to the 20th week. Medical options for the termination of pregnancy exist and, where permitted, they should be considered on an individual basis according to medical status and the duration of gestation. In the United Kingdom, the guidance over method selection may be summarised as follows:

Early First Trimester (5–9 Weeks)

Medical termination is a permitted and highly effective procedure at this stage of pregnancy. A single oral dose of 400 mg mifepristone, a progesterone receptor antagonist, is given followed 24–48 hours later by a 1-mg vaginal pessary of gemeprost. More recently, oral or vaginal misoprostol has also been introduced as a simpler and cheaper alternative. In over 95% of cases, complete abortion will follow in 4–8 hours with

9

Table 9.4: Major operative complications at hysteroscopic surgery[10,18]

Major operative complications	Recognition	Management
Uterine perforation • Uterine injury alone • Bowel injury • Vascular injury • Urinary tract injury	Sudden change in fluid balance Loss of distension Visualisation of bowel Vaginal bleeding Hypovolaemic shock	Blunt perforation with no evidence of bleeding - potentially manage conservatively (stop procedure, observation and antibiotics) Electrosurgical perforation (risk visceral burn injury or vascular trauma) - immediate laparotomy, although laparoscopy may be appropriate in some cases depending on patients condition and individual surgeon's experience Presumed vascular injury requires prompt midline laparotomy
Vaginal/uterine bleeding	Bleeding during resection	Exclude perforation Coagulate bleeding myometrial vessels using electrosurgery
	Immediate postoperative bleeding (in the operating theatre)	Re-scope to exclude perforation, coagulate vessels and remove residual resection chippings Uterine massage Tranexamic acid 1 g IV Intra-uterine balloon (e.g. a 30 ml balloon Foley catheter filled with up to 50 ml of fluid) for 24 hours with antibiotic cover Embolisation Hysterectomy
	Postoperative bleeding (outside the operating theatre)	Tranexamic acid Intra-uterine balloon Embolisation Hysterectomy
Fluid overload (pulmonary/cerebral oedema)	1–1.5 litres discrepancy between input and output Dyspnoea, hypoxia, chest pain Hyponatraemia Bradycardia and hypertension Then hypotension, nausea, vomiting, headache, visual symptoms, confusion, agitation, lethargy. Eventually, seizures, coma, cardiovascular collapse, death	Exercise caution at 1 litre positive fluid balance Stop surgery at 1.5 litre positive fluid balance, send serum sodium levels and treat immediately (before lab results) with IV diuretics (furosemide 20–40 mg) and fluid restriction If severe hyponatraemia/neurological symptoms, consider hypertonic saline perfusion (beware rapid correction causing central pontine myelinosis)
CO_2/air embolism	Sudden decrease in end-tidal CO_2 pressure Late signs • Hypotension • Tachycardia • Increased central venous pressure	Stop flow of distension medium Ventilate with 100% O_2 Central venous access to reach right atrium and aspirate gas bubble

Table 9.5: Late complications and longer term risks of endometrial ablation

Late complications	Long-term risks
• Pelvic inflammatory disease • Intra-uterine synechiae • Haematometra with cervical stenosis (cryptomenorrhoea) • Post-ablation tubal sterilisation syndrome (development of haematosalpinx) • Self-limiting vaginal discharge	• Occult endometrial carcinoma • Post-ablation pregnancy (risk placenta accreta/percreta, abruption, post-partum haemorrhage) • Need for additional therapies (including repeat ablation or hysterectomy)

Endometrial ablation carries some specific longer-term risks. These are detailed in Table 9.5.

either drug.[19] Adequate follow-up arrangements are essential to confirm success of the treatment and identify complications. In addition, contraception and sexual health should be addressed. Surgical evacuation is equally appropriate from 7 to 9 weeks.

Late First Trimester (9–14 Weeks)

Vacuum aspiration is the method of choice, using cervical pre-treatment in selected cases including women under 18, nulliparous women or those who have had previous surgical treatment of the cervix, and for pregnancies beyond 11–12 weeks' gestation. Pre-procedure cervical preparation may be achieved with oral or vaginal prostaglandins. Post procedure use of oxytocics is controversial due to the relative lack of relevant receptors at this gestation. It is particularly important to avoid the use of such drugs in cases of suspected molar pregnancy as this may increase the risk of dissemination of trophoblast to the lungs.

Mid-Trimester Termination

Although surgical evacuation is technically feasible after 18 or 20 weeks, many gynaecologists do not have the training and expertise necessary to carry out this procedure. The cervix must be dilated up to a diameter of 20 mm, and large crushing forceps must be used for fetal destruction before extraction under ultrasound control. There are increased risks of uterine perforation and damage to viscera or blood vessels with a surgical approach at these gestations. Unsurprisingly many would prefer medical termination with the use of oral mifepristone and 24–48 hours later a combination of oral and vaginal misoprostol. Depending on gestation, pre-procedure fetocide with intracardiac KCl may be indicated for medical termination of pregnancy.

Surgical Technique

Due to the risk of post surgical pelvic infection, all women should ideally be screened for Chlamydia or given antibiotic prophylaxis.

The patient is prepared in the usual way for a vaginal operation. Bimanual examination is then performed to establish the size and orientation of the uterus prior to instrumentation. The cervix is exposed with the Sims speculum and gently held with an appropriate pair of forceps. Some gynaecologists will insert a para-cervical block (see Chapter 7) at this stage, which may facilitate cervical dilatation. Dilatation is achieved with a series of graded metal dilators.

A plastic disposable curette and suction generator is typically used in the majority of procedures worldwide (see Fig. 9.16). Following careful systematic suction curettage, a blunt curette is introduced to explore the cavity. An empty uterus will reveal a typically "gritty" sensation.

Evacuation of a more advanced mid-trimester pregnancy will be made safer if carried out under transabdominal ultrasound control. It is particularly helpful for removal of the fetal head.

In later pregnancy, the evacuated products should be assessed so that missing fetal parts can be identified. This will clearly be more important where there is no facility for ultrasound assessment of the cavity during the procedure.

Aftercare

Whatever the method used for termination of pregnancy, the surgeon has certain specific responsibilities. The statutory obligation to notify the case in the United Kingdom has been mentioned. This applies even when hysterectomy has been employed.

If the woman is rhesus negative, the administration of anti-D Rh_0 immunoglobulin is required within 72 hours. This should be remembered in other relevant situations such as ectopic pregnancy or medical management of miscarriage. Contraceptive advice should be discussed during pre-operative counselling, and should be given before the patient leaves hospital. It may be appropriate to insert an IUCD at the time of operation in some first trimester cases.

If the termination is carried out on a short stay basis, it is prudent to give the patient appropriate advice on return to work, anticipated vaginal bleeding, contraception, resumption of coitus and action to be taken in the event of pain, fever or haemorrhage.


(a)
(b)

Fig. 9.16: **(a)** Suction generator. **(b)** Plastic disposable suction curette.

SURGICAL MANAGEMENT OF MISCARRIAGE

Missed or incomplete miscarriage can be managed expectantly, medically or surgically with exactly the same techniques described above for termination of pregnancy. The MIST trial studied the three alternative techniques and showed that the incidence of infection was equally low (2–3%) in each group. In comparison with the surgical group, however, the expectant and medical groups had a higher rate of unplanned hospital admissions and unplanned surgical curettage.[20]

Vacuum aspiration as described above is an effective treatment, and can be combined with pre-operative cervical preparation if required. If the fetal size is greater than 12–13 weeks gestation, medical management is usually employed using mifepristone and misoprostol in similar doses to those used for termination. Medical management can also be employed for missed miscarriages prior to 9 weeks gestation as an outpatient treatment. It is important to consider the sensitive disposal of products of conception after both termination and miscarriage. It is prudent, in the case of miscarriage, to perform histological examination to exclude trophoblastic disease where possible.

This is obviously logistically difficult in the case of outpatient expectant or medical management. Where tissue is obtained, written consent must be obtained from the patient, both for histological or cytological examination as well as the means of disposal, which should be in keeping with her religious and cultural beliefs.

CHRONIC INVERSION OF THE UTERUS

This condition is rare, and most gynaecologists are unlikely to come across a case in their practice at all. The incidence is higher in countries where maternity services are less well developed. Acute postpartum inversion is usually associated with either vaso-vagal or haemodynamic shock. In either situation, appropriate and prompt fluid resuscitation or transfusion is critical. Immediate uterine correction is ideal and obtained either by simple manual replacement or by the hydrostatic method. Detailed treatment of this acute obstetric complication is beyond the remit of this text.

Chronic inversion can be defined as an acute inversion that has been present for at least four weeks and which has resisted the standard methods for reposition. The patient is usually profoundly anaemic with a haemoglobin of 4–5 g/dl.[21]

Treatment

Three types of inversion have been described. Incomplete postpartum inversion, which has not responded to first-line options, will require abdominal surgery (Haultain's method). Chronic complete postpartum inversion is approached as a vaginal procedure. In some cases inversion is associated with a lesion (e.g. a pedunculated intracavity fibroid or rarely a malignant condition of the uterus), which can be treated either vaginally or by radical surgery depending on the pathology.

Classic Description of Haultain's Method

The abdomen is opened via a Pfannenstiel incision with the patient in the Trendelenburg position. The ring of tissue into which the Fallopian tubes and the ovarian ligaments pass is defined and drawn up with Littlewood's forceps. The posterior rim of this ring is then incised with a scalpel in the midline. It is necessary to retract the rectum in order to open the vagina. The surgeon now passes a finger into the vagina through the opening made in the posterior vaginal wall and attempts to push back the inverted fundus. This will fail unless the opening made into the vagina is sufficiently big and unless the incision made into the ring of tissue is sufficiently long and deep. If the incision is made through the whole wall of the uterus and cervix then replacement should be achievable. Help may be obtained from an assistant's finger passed through the vaginal orifice to push up the inverted fundus, and additional help is obtained by applying traction superiorly at the fundus with Littlewood's forceps. After reposition, the wounds in the uterus, cervix and posterior vaginal wall are repaired with interrupted sutures. Alternatively hysterectomy can be considered.[22]

Vaginal Technique

The method described by Kustner is relatively simple. The inverted fundus is grasped with a vulsellum and drawn forwards and upwards. A transverse incision is made in the posterior vaginal wall near the junction of the vagina and cervix. The pouch of Douglas is then opened and the incision made as long as possible to allow adequate access (Fig. 9.17). A finger can now be passed through the incision and introduced along the hollow of the inverted uterus. A full-length longitudinal incision through all the layers of the uterus is then performed (Fig. 9.18). The edges of the cut cervix are now drawn apart with Vulsellum forceps. The inverted uterus can then be reduced correcting the anatomy (Fig. 9.19). Subsequently, the incised posterior wall of the uterus is repaired with interrupted sutures, and lastly the wound in the posterior vaginal wall is closed.

Spinelli's operation is similar to this except that the uterovesical pouch is opened by an anterior colpotomy and the uterus is split along its anterior wall. Otherwise the technique is similar to Kustner's operation. The operation was performed by Samarrae on a small series of six patients. Five of the six patients subsequently conceived, one of them three times. Four were delivered normally and one by Caesarean section.[23]

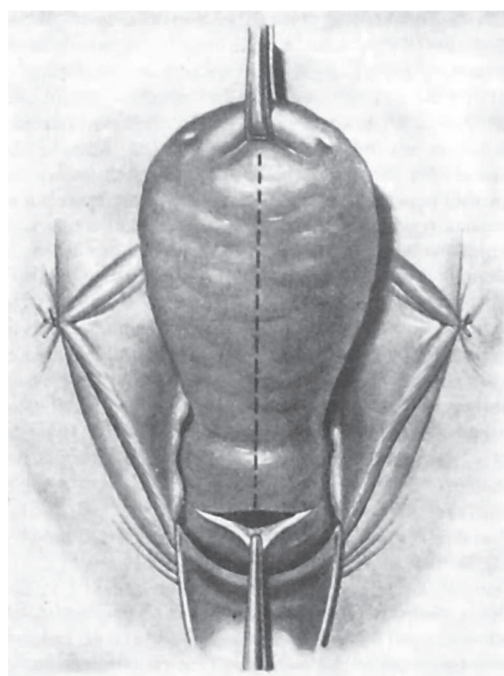


Fig. 9.17: Chronic uterine inversion: vaginal operation (Kustner's method). The inverted fundus is held upwards and forwards. The posterior vaginal wall is incised transversely to open the pouch of Douglas. The crucial part of the operation is to place this incision correctly. Subsequently, by means of a midline incision represented by the dotted line, the whole thickness of the cervix and body of the uterus is cut through.

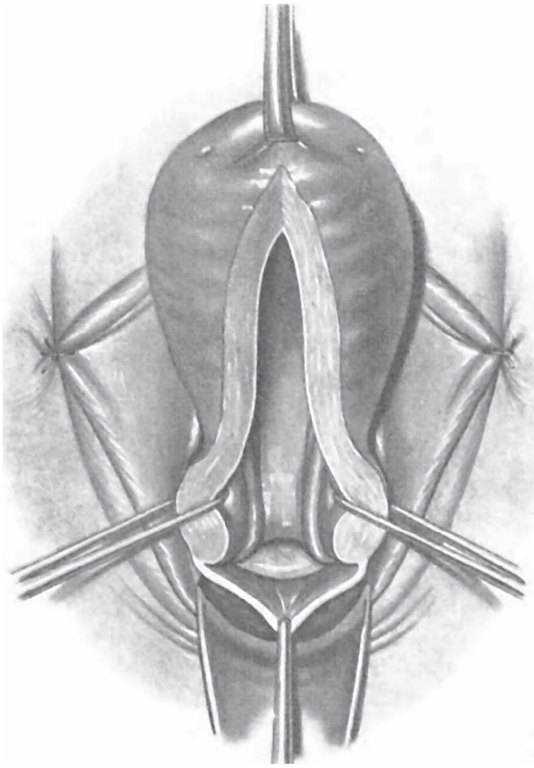


Fig. 9.18: Chronic uterine inversion: vaginal operation (Kustner's method). The wall of the uterus has been incised and the edges of the cervix are drawn apart. It is essential to achieve good mobilisation, as the next step is to push the fundus of the uterus downwards through the cervix.

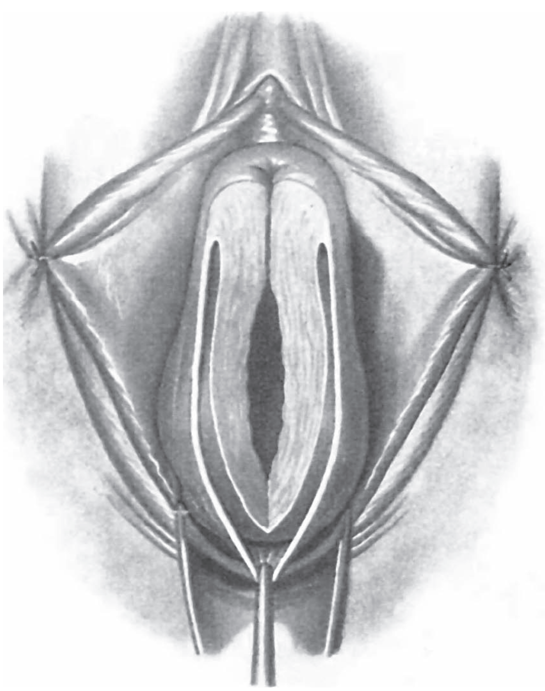


Fig. 9.19: Chronic uterine inversion: vaginal operation (Kustner's method). The inversion has been corrected. Notice how the incision in the posterior vaginal wall must be significantly stretched. The operation will be extremely difficult if the incision through the posterior vaginal wall is not wide enough.

COMPLICATIONS OF SURGERY TO THE UTERUS IN PREGNANCY

Perforation/Rupture of the Uterus

Uterine perforation can complicate any operative procedure carried out on the uterine cavity. It can occur during gynaecological surgery on a pregnant or non-pregnant uterus, and involve varying degrees of damage to the uterine wall and adjacent viscera.

The principles of management are to assess and control bleeding from the uterine defect, and repair it if necessary. In the case of perforation with a surgical instrument, there is additional hazard of injury to other organs. If perforation is anticipated, the potential need for hysterectomy may have been discussed with the patient pre-operatively, but there will be a premium on retaining reproductive capability if that is desired. In general, uterine defects can be repaired with deep interrupted sutures in one or two layers, either laparoscopically or at laparotomy. The chief problem arises with extensive haemorrhage from the base of the broad ligament, which will lead to a large haematoma. With continuing bleeding, the broad ligament needs to be opened and the haematoma evacuated. Actively bleeding vessels can then be identified and secured. In such cases, it may be extremely difficult to identify the ureter, although this is desirable and ureteric stenting may need to be considered. Where localised bleeding cannot be identified, it may be necessary to consider ligation of the anterior branch of the internal iliac artery. Alternatively where facilities exist and the patient is haemodynamically stable, radiological embolisation can be performed. Packing the space with topical haemostatic agents (e.g. Surgicel®, an absorbable oxidised cellulose polymer) is an important adjunct for low-volume generalised bleeding.

In some situations, formal packing of the broad ligament will become necessary. Typically, the patient would then require further surgery 24–48 hours later for removal of the pack. Passing the end of the pack through the perforation in the uterus and through the cervix and into the vagina has been described in the past and can be considered. This pack can then in principle be removed without need for a further procedure although clearly re-bleeding will not be visible.

The pregnant uterus is a highly vascular organ and can tolerate uterine artery ligation, should that be necessary.

Perforation of the pregnant uterus, even if only with a sound, should always be assessed by laparoscopy at least due to the likelihood of significant bleeding. Where bleeding from a perforation is not controlled by closing the defect, unilateral uterine artery ligation with or without ligation of the ovarian pedicle can be easily performed. The pregnant uterus has such a good blood supply that this is well tolerated. If vacuum aspiration has been used, laparotomy is required, unless the surgeon has sufficient laparoscopic experience to assess for intra-abdominal damage including a detailed assessment of the bowel and omentum. Laparotomy should be mandatory if any extra-uterine tissue is identified, including globules of fat from an appendix epiploicus, the Fallopian tube or even bowel contents. Even the ureter has been mistaken for umbilical cord!

Iatrogenic bowel injury must be suspected in any patient who develops symptoms of peritonitis or bowel perforation following suction curettage of the uterus. Imaging can be performed to exclude a pelvic abscess, which might be managed laparoscopically or even by ultrasound-guided percutaneous drainage. Following that, prompt exploratory laparotomy is indicated to assess for potential bowel trauma at an unrecognised uterine perforation. Large and small bowel must be examined from jejunum to rectum, and the mesentery must be examined for possible tears. Damaged bowel must obviously be repaired. If there is any doubt as to the viability of the damaged segment, resection and anastomosis should be performed. A temporary stoma may be required in this situation.

Infective Peritonitis and Sepsis

After dilatation of the cervix, this complication may rarely develop, even when the operation has been apparently uncomplicated. This occurs secondary to the introduction of cervical or vaginal pathogens into the upper genital tract. Symptoms and signs will not develop immediately. Once recognised, the first-line treatment is broad-spectrum intravenous antibiotics. If the patient's clinical condition does not improve or in fact deteriorates, laparoscopy or laparotomy may be life-saving. Severe sepsis is associated with profound circulatory collapse and often multi-organ failure and disseminated intravascular coagulation. Management will require a full multidisciplinary team.

In the past, clostridial infections were commonly seen after criminal abortion. Progression of *Clostridium perfringens* endomyometritis to uterine gas gangrene is now a rare but grave complication in obstetric and gynaecological patients, and should always be considered in cases of overwhelming sepsis following gynaecological surgery.

Septic Miscarriage

Retained products may become infected and cause significant sepsis. Depending on the patient's condition, infection should ideally be controlled with intravenous broad-spectrum antibiotics prior to surgical evacuation. Immediate surgery carries additional risks of bacteraemia and acute decompensation. Clearly if there is a poor response to antibiotics, it is inappropriate to continue delaying surgery.

Haemorrhage

Intra-operative haemorrhage can rapidly lead to hypovolaemic shock if not recognised and treated promptly. First-line treatment is bimanual compression of the uterus. This will arrest bleeding and allow the anaesthetist to fluid resuscitate the patient and request blood products. Subsequently, it is essential to ensure that the cavity is empty, and ultrasound where available is particularly useful. Clearly in early pregnancy, manual exploration of the cavity is not possible so careful re-curettage is advised. If the cavity is empty and bleeding continues, oxytocics and balloon-tamponade (typically a urinary catheter with a 30 ml balloon) will usually be extremely effective.

Persistent heavy bleeding where retained products or molar pregnancy has been excluded suggests trauma, although in addition the rare complication of cervical or caesarean section scar ectopic pregnancy needs to be considered. Ultimately laparotomy and hysterectomy may be necessary where other measures have failed.

Retained Products of Conception

Patients with retained products of conception can present after any gestation of pregnancy, and management has to be tailored accordingly. Sometimes the placenta is intact, while at other times placental tissue must be removed piecemeal. Occasionally, the majority of the placenta has been expelled spontaneously by the uterus and only small pieces of placental tissue remain adherent. In these patients, a simple dilatation, suction evacuation and curettage is warranted.

Placental tissue can be fixed firmly by fibrous tissue to the wall of the uterus, and a sharp curette may be required to remove it. Although in the past, gauze "curettage" and use of a hot saline (44–49°C) douche has been described, in modern practice these techniques would not normally be considered.

The location of the projecting placental tissue can usually be palpated with a curette without much difficulty and removed. Where placental tissue remains adherent despite curettage hysteroscopic resection under direct vision can be used.

Where a moderately large piece of placental tissue remains adherent, it may become organised and form a sessile projection, which is termed a 'placental polyp'. This situation is associated with an increased risk of major haemorrhage. Sharp curettage is usually essential to rapidly evacuate the uterus, and balloon tamponade or packing may be required.

Failure to Achieve Suction Termination of Pregnancy

This unfortunate outcome can occur if a false passage has been made and the uterine cavity not entered. Alternatively this may rarely be encountered in multiple pregnancy or congenital malformation of the uterus. Visual confirmation of products of conception in the suction device is therefore advisable.

Failure to Recognise an Ectopic Pregnancy

This most commonly occurs when a patient presents in early pregnancy with pain and bleeding and is found to have a thickened endometrium on ultrasound. A mistaken diagnosis of incomplete miscarriage may then be made. Following suction curettage, histology will show only decidualised endometrium but no chorionic villi. Undiagnosed ectopic pregnancy can also present following attempted termination of an early pregnancy. If there is any doubt, a diagnostic ultrasound in conjunction with serial quantitative beta-hCG measurements can help to confirm the diagnosis, before consideration of any surgical or medical intervention.

Long-Term Complications

Finally, longer-term iatrogenic complications include cervical stenosis and cervical incompetence. Subfertility can be caused by the development of intra-uterine adhesions (Asherman's syndrome), which can follow any surgery on the uterine cavity (particularly in the presence of infection). Upper genital tract infection, typically with *Chlamydia*, following uterine instrumentation can lead to tubal infertility. As described previously, uterine rupture can occur in late pregnancy or labour as a result of a previous uterine perforation.

Hysterectomy

Hysterectomy is defined as the surgical removal of the uterus. Reference to vaginal hysterectomy dates back to the time of Hippocrates in the 5th Century BC.[24] Abdominal hysterectomy is a comparatively new operation, first successfully performed by Ellis Burnham in Lowell, Massachusetts in 1853.[25] It can be adapted to involve removal of the ovaries, Fallopian tubes and the cervix, and has a wide range of indications in the treatment of benign and malignant gynaecological disease. The focus in this chapter is on the management of benign conditions.

The role of minimally invasive techniques for hysterectomy is expanding, with a variety of laparoscopic methods described. Satisfaction rates following hysterectomy are high, but surgery involves the risk of complications. Hysterectomy has been implicated in the aetiology of urinary, bowel and sexual problems as well as premature loss of ovarian function.

INDICATIONS

The vast majority of hysterectomies for benign gynaecological conditions are elective procedures. In the USA between 2000 and 2004, the most common indications for hysterectomy were symptomatic uterine leiomyomas (40.7%), endometriosis (17.7%) and prolapse (14.5%).[26] The variety of benign indications is outlined in Table 9.6.

Emergency hysterectomy may be indicated for the management of catastrophic uterine haemorrhage, which is usually puerperal (primary or secondary post-partum haemorrhage) or occasionally associated with a penetrating vesicular mole or vascular anomaly of the uterus, but there are less destructive options. Control of the blood supply to the uterine artery may be achieved either by arterial embolisation through retrograde femoral arterial catheterisation (see Chapter 4) or by ligation of the anterior division of the internal iliac artery.[27] Alternatives to emergency hysterectomy are also possible during the management of uterine rupture. Rupture occurs either as an obstetric accident or as the result of perforation with an instrument. In either of these situations, suturing of the defect may be feasible, averting the need for hysterectomy.

As previously discussed in this chapter, there are ever-increasing alternatives to hysterectomy. In the context of heavy menstrual bleeding, the UK's National Institute of Clinical Excellence (NICE) has developed recommendations on hysterectomy, taking into account evidence on complication rates, quality of life data and health economics. NICE recommends that hysterectomy should be reserved for cases where other treatment options for menorrhagia have either failed or been declined by the patient.[29]

As with any surgery, a detailed discussion of the implications of surgery is mandatory in order to educate the patient and ensure realistic expectations. This should include potential complications and their sequelae, psychological effects, impact on fertility, effect on bladder function, persistence of symptoms (e.g. pelvic pain), need for further treatment, sexual function and suitable alternative treatments. In all cases where hysterectomy is contemplated, such discussion enables truly informed consent to be obtained, and will undoubtedly improve patient satisfaction.

Table 9.6: Indications for hysterectomy[28]

- Uterine leiomyoma
- Dysfunctional uterine bleeding
- Genital prolapse
- Endometriosis and adenomyosis
- Chronic pelvic pain
- Pelvic inflammatory disease (PID)
- Endometrial hyperplasia
- Genital tract malignancy
- Obstetric indications

PRE-OPERATIVE CONSIDERATIONS

Route of Hysterectomy

Whilst increasing availability of medical treatments and ablative techniques have diminished the need for hysterectomy,[4,5] it remains a definitive solution and will remain an integral part of gynaecological surgery. Hysterectomy can be performed vaginally, abdominally or laparoscopically. It is commonly regarded that vaginal hysterectomy is the safest and most cost-effective route. Abdominal hysterectomy is clearly the most invasive option whilst debate continues as to what are appropriate indications for laparoscopic hysterectomy. These include situations where there is a need for the evaluation and management of adnexal masses, ablation or excision of symptomatic endometriosis, pelvic adhesiolysis and the treatment of early upper genital tract cancers in conjunction with lymph node sampling and staging. Laparoscopy enables magnification of the surgical field, precise dissection techniques and complete haemostasis compared to the alternative routes.

When deciding on the route of hysterectomy, important factors to consider include presence of other pathological conditions, uterine size, fibroids and their size and location, mobility and descent of the uterus, poor vaginal access (such as limited vaginal space or a narrow sub-pubic arch) and a history of previous surgery. All of these factors can provide relative indications for a laparoscopic or abdominal approach. Nevertheless, vaginal hysterectomy can be performed on larger uteri using simple debulking techniques such as bisection, coring, morcellation or myomectomy.[30] Successful vaginal hysterectomy has been shown to be possible in uteri weighing in excess of 1000 grams,[31] and in cases of suspected endometriosis, lack of prolapse, previous surgery, adnexal pathology and even malignancy.[32] In the presence of an experienced vaginal surgeon, the most important criteria are uterine mobility and vaginal access. With the advent of laparoscopic hysterectomy, an abdominal approach should only be necessary in a minority of patients. Indications for the abdominal route would include gross uterine enlargement, genital tract malignancy, and gross extrauterine disease not amenable to the laparoscope. In contrast, the VALUE study looked at 37,295 hysterectomies performed in the UK in 1994/5, and found that 67% of hysterectomies were performed abdominally, 30% vaginally and 3% as laparoscopic-assisted vaginal hysterectomies.[33] This suggests that individual surgeons' experience is influencing choice of route of hysterectomy.

Evidence justifying the choice of surgical route for hysterectomy is gradually accumulating (see Table 9.7). The VALUE study and the eVALuate trial collected data in the UK up to 1995 and 2000 respectively. In both trials, major complications were twice as high in the laparoscopic group when compared with abdominal hysterectomy. The laparoscopic route, however, was associated with less pain, shorter hospital stay, quicker recovery and improved quality of life.[33,34]

In a Cochrane review in 2009, vaginal hysterectomy, when compared with the abdominal route, was associated with a speedier return to normal activities, fewer febrile episodes and infections and a shorter hospital stay. Comparing laparoscopic with abdominal hysterectomy, patients endured less postoperative pain and were quicker to return to normal activities. They also had lower intra-operative blood loss, a shorter hospital stay and fewer wound infections. There were, however, more urinary tract injuries and operating time was longer, although in the hands of experienced laparoscopic surgeons this may not be true. There was no evidence of benefit of laparoscopic over vaginal hysterectomy, and the operating time and chance of substantial bleeding were increased.[35] More recent studies have associated the laparoscopic route with more favourable quality of life scores than the abdominal route, and indeed complication rates for the different routes of hysterectomy have recently been demonstrated to be similar.[36] In addition to being time consuming, laparoscopic management of the uterine artery may be technically difficult, and carries the risk of haemorrhage and ureteric injury. Some surgeons may prefer to convert to a vaginal procedure as early as possible, for example once the uterovesical fold has been opened. Indeed it has been suggested that laparoscopic-assisted vaginal hysterectomy (LAVH), when compared with the total laparoscopic route, is associated with a shorter operating time and fewer postoperative infections.[37,38]

Table 9.7: Comparative advantages of different routes of hysterectomy[35,36]

Vaginal vs. abdominal	Vaginal vs. laparoscopic	Laparoscopic vs. abdominal
• Shorter hospital stay • Faster return to normal activity • Fewer febrile episodes or unspecified infections	• Shorter operating time	• Improved quality of life scores postoperatively • Shorter hospital stay • Faster return to normal activity • Smaller drop in haemoglobin • Lower intra-operative blood loss • Fewer wound infections • Longer operating time • Higher rate of lower urinary tract injuries (bladder/ureter)

It has also been argued that there is a significant learning curve with laparoscopic hysterectomy. The procedure is still in its relative infancy, having first been described by Reich in 1989.[39] This could explain the higher operative complication rates, including urinary tract injuries, seen in earlier studies, which compared hysterectomy performed by surgeons with comparatively greater experience in abdominal than laparoscopic hysterectomy.

Naturally, cost is an important factor. Operative costs at laparoscopic hysterectomy have been shown to be higher than at abdominal surgery.[40] This difference can be explained by increased theatre time and equipment expenses, particularly if disposables or stapling devices are used. Sculpher argued that vaginal hysterectomy was the most cost-effective route, and that the laparoscopic and abdominal routes were similar.[41] Surgical costs, however, can be offset against the reduced hospital stay and complication profile. Taking this into account, Bijen showed that the lower postoperative cost of laparoscopic hysterectomy outweighs the higher intra-operative cost when compared with abdominal hysterectomy in the case of early stage endometrial cancer.[42] It therefore seems justified to consider the laparoscopic route as cost effective compared to abdominal hysterectomy.

Whilst it may be feasible for the specialist endoscopic surgeon to extend the indications for laparoscopic hysterectomy, for the general gynaecologist with average endoscopic skills, contraindications and personal readiness to convert to an abdominal procedure are of great importance. Depending on experience levels, relative contraindications could include severe obesity, uterine size greater than the equivalent of a 12–14 week pregnancy, very extensive adhesions involving bowel, particularly if there has been previous bowel surgery, and the finding of unexpected adnexal pathology where the diagnosis is uncertain.

In some cases, the choice of route of hysterectomy is clear (e.g. abdominal approach for massive uterine fibroids). The concensus view in the UK and the USA is that the vaginal route should be the first line, in view of its well-documented advantages and lower complication rates. The abdominal approach should ideally be reserved for patients in whom vaginal hysterectomy is not indicated or feasible. Laparoscopic hysterectomy has a clear role as an alternative to open abdominal hysterectomy in the hands of an appropriately trained gynaecologist. Ultimately, however, many factors determine the route of hysterectomy, not least personal preference and surgical ability and experience. Whilst each method of hysterectomy will have its pros and cons, its supporters and protagonists, the decision on surgical route inevitably comes down to patient choice and the surgeon's specific confidence and abilities.

Total or Subtotal Hysterectomy

The subtotal (or supracervical) procedure was the universal approach to hysterectomy prior to 1940, with the associated reduction in risk of ureteric injury, haemorrhage, and postoperative sepsis.[25] The introduction of antibiotics, however, led to a fall in febrile morbidity and mortality, and the establishment of total hysterectomy.[32] Since then, a formidable literature has developed over the controversy of total versus subtotal hysterectomy.[43]

Whilst residual stump cancer of the cervix may occur, it is rare with an incidence of 0.3% and not usually a concern where there are well-established cervical cytology screening programmes in place.[44] Where screening is not available or cytology has been abnormal in the past, it may be safer to consider total hysterectomy. Clearly all women who have a subtotal procedure should have follow-up with routine smear tests.[45]

In a difficult hysterectomy, the subtotal operation carries less risk of urinary tract morbidity, and so is recommended for the less experienced operator in the presence of abnormal anatomy. The ureter, bladder and to a lesser extent the rectum are all anatomically related to the cervix, and may be injured during dissection. It has also been suggested that retention of the cervix at hysterectomy may confer some benefits. The pelvic plexus supplies innervation to the pelvic organs, and intra-operative damage could theoretically lead to symptoms. This has led to the belief that a subtotal approach may protect against urinary and bowel dysfunction.[46] The effect on sexual function has been particularly controversial following the original publications by Kilkku in Finland, which suggested a detrimental effect following removal of the cervix.[47] Subsequent studies have been less clear and a recent Cochrane review, which included a number of randomised studies, concluded that there is no evidence of difference in outcome for sexual, urinary (also supported by objective urodynamic and urethral sphincter pressure studies) or bowel function between subtotal and total hysterectomy.[48–51] Postoperative sexual satisfaction is however related to pre-operative sexual function, relationship status and expectations so this should be considered prior to surgery.[48,51]

A proportion of women will continue to have cyclical bleeding from a retained cervix due to residual endocervical endometrium. Whilst this may be desirable for a minority of patients, many women will find this unacceptable. Persistent discharge, dyspareunia or pain from the cervical stump can also occur secondary to chronic cervicitis, endometriosis and adenomyosis. As a result, a significant number of women will present subsequent to subtotal hysterectomy for excision of the cervical stump. Conversely after total hysterectomy, chronic stitch line infection and granulations, some of which may be related to a choice of suture material, can be painful.[52] Incidence of vault haematoma is reduced after subtotal hysterectomy, and Fallopian tube or small bowel prolapse is impossible.

The incidence of vault prolapse has not been shown to significantly differ between subtotal and total hysterectomy groups, although there is a paucity of long-term follow-up data.[43]

Table 9.8: Potential advantages and disadvantages of subtotal hysterectomy over total hysterectomy

Potential advantages of subtotal hysterectomy	Potential disadvantages of subtotal hysterectomy	Inconclusive evidence
• Reduced risk of urinary tract injury (bladder/ureter) • Reduced risk of operative haemorrhage • Reduced risk of vault haematoma • Eliminates risk of small bowel prolapse or granulation tissue at vaginal vault	• Risk of cervical stump carcinoma • Need for ongoing cervical smears • Risk of cyclical menstrual spotting • Risk of ongoing pain/dyspareunia from cervical pathology	• Sexual enjoyment/libido • Urinary symptoms • Difficulties with defaecation • Subsequent risk of vault prolapse

In conclusion, pre-operative counselling about the potential risks and benefits is crucial, and it is wise to listen to the patient's views prior to hysterectomy. Where subtotal is preferred, one must ensure that the patient is committed to continued cervical surveillance. The pros and cons of subtotal and total hysterectomy are listed comparatively in Table 9.8.

Concurrent Salpingo-Oophorectomy

As with the cervix, the ovaries carry a malignant potential. Unlike cervical cancer, there is no satisfactory screening strategy for ovarian malignancy, and extra-ovarian spread is present in 75% of cases at the time of presentation, carrying a 5-year survival rate of only 15%. It has been suggested that elective oophorectomy at the time of hysterectomy could prevent 10% of ovarian cancers,[53,54] although interestingly, hysterectomy alone appears to reduce the risk of subsequent ovarian malignancy.[55–57] This may be a result of opportunistic screening at the time of surgery, with removal of abnormal or suspicious-looking ovaries. Additionally, ovarian function might be affected by surgical interruption to the uterine blood supply. Indeed, hysterectomy with ovarian conservation has been associated with premature ovarian failure.[58] It is therefore appropriate to discuss the potential role of hormone replacement therapy pre-operatively.

As well as the risk of subsequent ovarian malignancy, conserving ovarian tissue can be associated with ongoing morbidity. Residual ovary syndrome is a cause of pelvic pain and dyspareunia, and results in further surgery in 1–2% of cases following hysterectomy.[59] This figure is higher in women having hysterectomy to treat endometriosis, with a relative risk of re-operation of 8.1 compared with those who had oophorectomy at their initial surgery.[60]

Pre-menopausal elective oophorectomy (other than for genital malignant disease) may be indicated in high-risk groups such as women with a strong family history of ovarian malignancy, certain types of hormone-sensitive breast cancer or a history of prolonged ovulation induction. The cumulative ovar-

Table 9.9: Pros and cons of ovarian conservation at hysterectomy

Advantages of ovarian conservation	Disadvantages of ovarian conservation
Endocrine advantages • Cardiovascular • Prevents early onset of bone thinning • Avoids accelerated vasomotor/ menopausal symptoms • Maintains libido Psychological advantages Avoidance of side-effects of HRT	No risk reduction for ovarian malignancy Incomplete treatment of pathology or recurrence of symptoms (e.g. endometriosis) Residual ovary syndrome Risk of subsequent surgery

ian cancer risk up to the age of 70 years is 40% for BRCA1 carriers and 18% for BRCA2 carriers. Risk-reducing salpingo-oophorectomy is the most effective preventative measure for ovarian or tubal cancer in high-risk women, although a 4.3% risk of primary peritoneal cancer persists in BRCA1/2 carriers.[61,62] Valid indications also include, in certain selected cases, severe premenstrual tension or other hormone dependent pathology. In cases of prolapse, oophorectomy can be achieved quite easily by the vaginal route. In other cases of vaginal hysterectomy, where access is restricted, laparoscopic assistance may be used or endoscopic instrumentation through the open vaginal vault.[63–65]

There are, however, strong arguments in favour of ovarian conservation[66] (Table 9.9).

The standard historical practice of elective oophorectomy at abdominal hysterectomy in women over the age of 45 is no longer acceptable, not only in view of the proven benefits of functioning ovarian tissue in the majority of women, but also the availability of laparoscopic surgery means most subsequent benign ovarian conditions can be treated without major abdominal surgery. The patient's wishes for ovarian conservation must be carefully discussed in advance of surgery and recorded; this is of the utmost importance both for the wellbeing of the patient and the prevention of medico-legal claims.

1. Endocrine

Following bilateral oophorectomy, oestrogen lack may cause severe and serious health problems:

- *Cardiovascular:* Low oestrogen levels result in changes in lipid and carbohydrate metabolism, and insulin sensitivity, which may predispose to cardiovascular disease.
- *Osteoporosis:* After the menopause, there is an increase in bone loss with as much as 5% of trabecular and 1.5% of cortical bone being lost annually for up to 7 years.[67] Age-related bone loss persists with a long-term increase in the risk of bone fracture.
- *Vasomotor:* The symptoms of the climacteric such as hot flushes and night sweats are said to be more severe after a surgical menopause.
- *Libido*: Reduction in circulating androgens may be responsible for a loss of libido.

2. Psychological

Many women quite rightly regard the ovary as the gland that chiefly determines their femininity. Regardless of age and menopausal status, some women may give consent to hysterectomy only with the proviso that their ovaries can be retained. In recent years, there have been lawsuits, and even prosecution for criminal assault, against surgeons who have removed the ovaries without the specific consent of the patient.

In view of the above, certain guiding principles should be followed:

- Before the menopause up to the age of 50, healthy ovaries should normally be conserved.
- Conversely, it is reasonable to offer the option of prophylactic bilateral oophorectomy to women over 40 undergoing hysterectomy, especially if any risk factors for ovarian cancer have been identified.[53]
- If a patient undergoing hysterectomy specifically requests ovarian conservation, irrespective of age, the surgeon must obtain explicit consent to deviate from this plan, should unforeseen complications arise or unexpected pathology be found.

Pre-operative GnRH Analogues

There is an established role for pre-treatment of a fibroid uterus with GnRH analogues prior to hysterectomy. The evidence for pre-treatment in the case of dysfunctional uterine bleeding or endometriosis is less clear. GnRH therapy leads to a 40–60% reduction in uterine volume. Maximal effect occurs within 12 weeks of treatment.[68] Pre-operative treatment can be employed to allow borderline cases to be treated by the vaginal or laparoscopic rather than the abdominal route. In the case of a massive fibroid uterus extending above the umbilicus, it may also allow for sufficient shrinkage to achieve hysterectomy through a Pfannenstiel rather than a midline abdominal incision. Such pre-treatment can therefore promote a shorter hospital stay.

An additional benefit of GnRH analogue use is that transient amenorrhoea or reduction in menstrual blood loss will allow for easier correction of pre-existing anaemia.[68] The need for peri-operative transfusion can thus be reduced.

Prophylactic Antibiotics

The advent of antibiotic use in the management of postoperative sepsis after hysterectomy significantly reduced morbidity and mortality rates. Antibiotic prophylaxis is believed to reduce postoperative infections by reducing the number of contaminant organisms and rendering tissue fluid less suitable as a culture medium. A variety of regimens have been shown to be beneficial in reducing pelvic infection and febrile morbidity at vaginal hysterectomy. This has not been demonstrated as clearly for abdominal hysterectomy.[69] Nevertheless, in the UK, it is common practice to administer a single dose of prophylactic antibiotics at the onset of hysterectomy by any route. This is also the case in the USA, where the American College of Obstetricians and Gynecologists recommend a single dose of penicillin or a cephalosporin as antibiotic prophylaxis prior to both abdominal and vaginal hysterectomy.[70]

SURGICAL TECHNIQUES FOR ABDOMINAL HYSTERECTOMY

The operation is described for cases when the uterus is not greatly enlarged and when there are no adhesions to surrounding structures. For the purposes of this text we describe conventional dissection and ligation of pedicles using absorbable suture material (e.g. polyglycolic acid). There are now a variety of electrosurgical instruments and staple devices that have been developed for open surgery, which are capable of sealing large vessels effectively. These can be used as alternative methods for effective control of major pedicles. Cutting diathermy is also often used for dissection to further reduce blood loss.

Good exposure is vital, and can be facilitated by self-retaining retractors. A longer incision may be required if the patient is obese. The Trendelenburg position is helpful, though not always essential, and the anaesthetist must ensure adequate muscle relaxation to prevent increased intra-abdominal pressure that will force the intestines into the operative field.

1. The Ovarian and Round Ligament Pedicles: The abdomen is opened in the usual way with the patient lying in the Trendelenburg position. Self-retaining retractors are introduced and the intestines packed off if they protrude into the operation area. The uterus is drawn out of the abdominal wound and over to the left side of the patient so that the right tube and ovary come into view (Fig. 9.20).

Particular attention must be paid to obtaining complete haemostasis in the region of ovaries. A pair of long straight forceps (e.g. Spencer Wells) is placed over the right ovarian ligament and the right Fallopian tube, and a second is placed on the right round ligament. Spencer Wells forceps are also applied on the uterine side of both of these clamps and the intervening tissues cut through with scissors (Fig. 9.21). If the clamps have been correctly placed, there will be no bleeding from the cut tissues, but occasionally a tortuous terminal branch of the uterine artery may escape the medial clamp and have to be caught up by an extra pair of artery forceps. The clamp placed over the ovarian ligament and the Fallopian tube should be placed as near to the uterus as possible because when the tissues enclosed by the clamp are tied, the ligature material may cut through the tissue of the ovarian ligament and lead to troublesome bleeding. Furthermore, secondary haemorrhage after the operation is frequently due to vessels that retract away from the ligatures placed around the tissues enclosed by this clamp. For this reason, a second suture is recommended to ligate this important pedicle.

In some cases, it is only necessary to use a single clamp to include the round ligament, the Fallopian tube, the ovarian ligament and the tissues that lie between these structures, but it is better on anatomical grounds to clamp the round ligament separately from the Fallopian tube and ovarian ligament.

Sometimes, despite appropriate traction, the uterus does not pull up very easily, particularly when there is pelvic endometriosis or old fibrosis of the parametrium. In such cases, little can be done to mobilise the uterus until the endometriotic disease has been excised or parametrial tissues have been divided.

2. Dividing the Anterior Leaf of the Broad Ligament: The uterus is firmly pulled to the left side of the patient by the assistant, and the above procedure repeated. Then, with dissecting forceps and scissors, starting from the cut round ligament, the surgeon divides the peritoneum, which forms the anterior leaf of the broad ligament, downwards and inwards towards the uterovesical pouch. If the round ligament is now drawn laterally by an assistant, a thin sheet of endopelvic fascia will be seen passing downwards from the round ligament towards the lateral border of the uterus (Fig. 9.22). This sheet of fascia, though thin, is always present, and it reaches the uterus anterior to the uterine vessels as they pass along its side. It is the practice of the authors always to cut through this fascial layer downwards and forwards

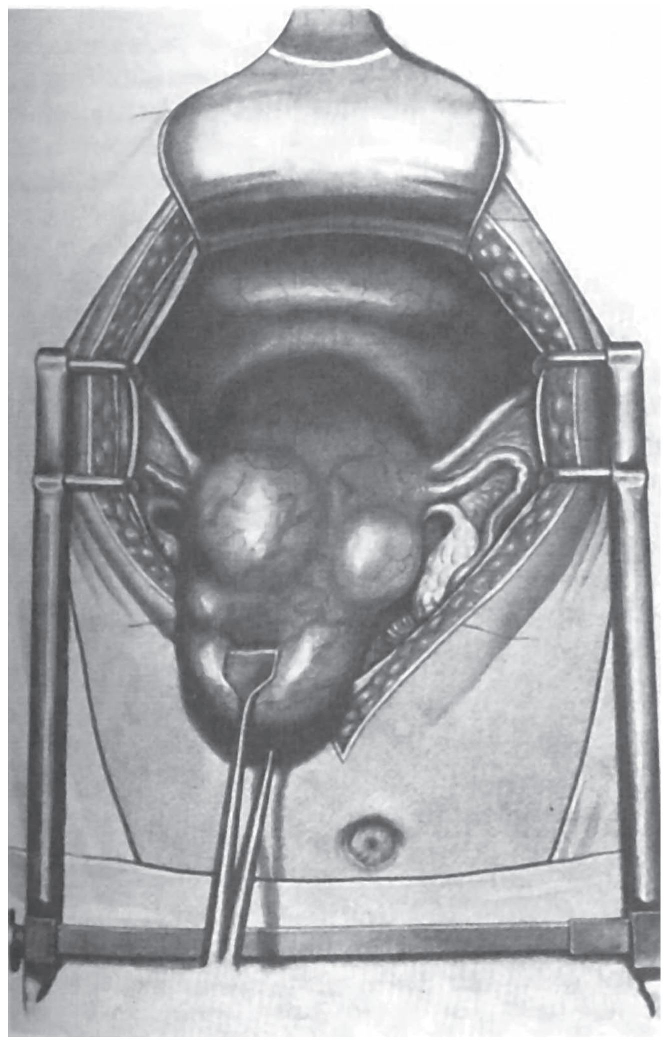


Fig. 9.20: Abdominal hysterectomy: The abdomen has been opened and retractors have been inserted. A gauze pack holds back the intestines. The fundus of the uterus is being held with forceps and pulled upwards. Alternatively, the uterus can be manipulated by Spencer Wells forceps placed at each cornu. In front, the upper limit of the bladder can be identified, while on the anterior surface of the uterus is a V-shaped fossa. Above this the peritoneum is fixed firmly to the uterus. The uterus contains multiple fibroids.

until it reaches the cervical fascia. In this way the uterine vessels are cleanly exposed, or skeletonised, and in a sub-total hysterectomy they can be clamped with a curved clamp low down near the junction of the body with the cervix.

In a total hysterectomy, the clamping and division of the uterine pedicle should be postponed until the bladder has been freed from the cervix and dislocated downwards, as described in the next steps of the operation.

3. Reflecting the Bladder Inferiorly: To achieve bladder reflection, the peritoneum of the uterovesical pouch must first be divided. Certain anatomical features may be emphasised at this stage. If the correct surgical plane is not found, injury to the bladder can occur. This surgical plane can be less apparent if there has been previous dissection of the uterovesical space (e.g. at lower segment Caesarean section).

In the normal uterus, the peritoneum is reflected onto the anterior surface of the uterus from the bladder approximately at the level of the internal os. If the anterior peritoneal surface of the uterus is examined, a small fossa can always be identified just above the level of the internal os, and quite frequently a small ridge can be identified on each side of the uterus, which passes from the lower edge of this fossa in the midline upwards and laterally. The peritoneum is adherent to the uterus over this fossa, but immediately below it can easily be separated from the underlying structures. If the bladder is empty and the uterus pulled upwards in the midline, at least 1–2 cm of loose free peritoneum will be found between the lower edge of the fossa and the point where the peritoneum becomes adherent to the muscle wall of the bladder. It follows that the peritoneum of the uterovesical pouch must be divided transversely below the fossa and well away from the attachment of the peritoneum to the top of the bladder.

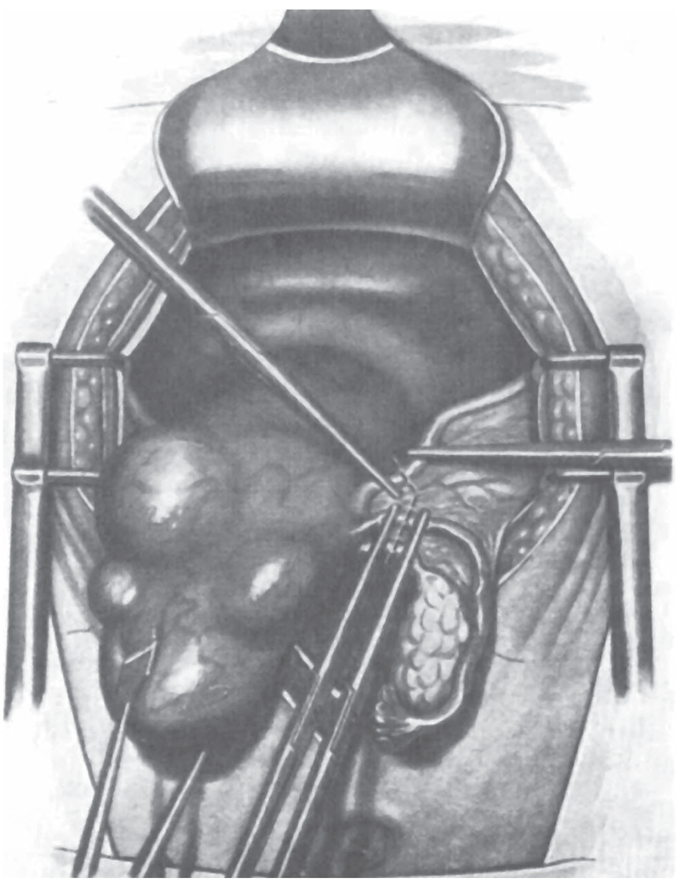


Fig. 9.21: Abdominal hysterectomy: The uterus is drawn over to one side and rotated so that its anterior surface is slightly turned towards the left side. Clamps are placed over the ovarian ligament and the Fallopian tube and the tissues between the clamps divided. A similar procedure is carried out with the round ligament. If the uterus is small, instead of four clamps, only two clamps need be used to enclose the ovarian ligament, the Fallopian tube and the round ligament.

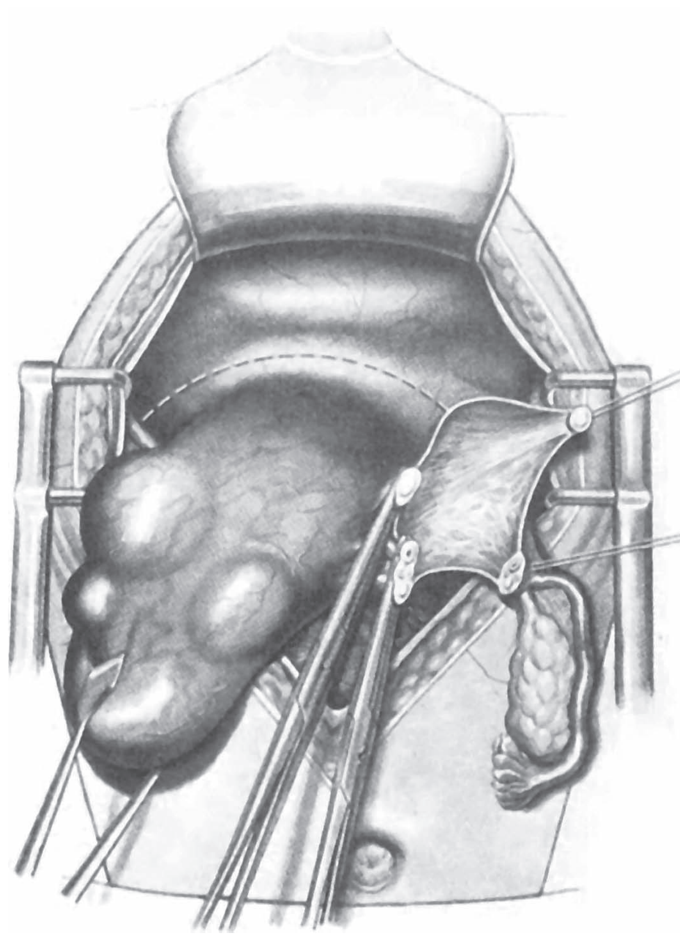


Fig. 9.22: Abdominal hysterectomy: If not already done, the pedicles are now sutured. If necessary the ligatures can be left long and used as retractors to open up the broad ligament. The dotted line shows the position of the incision made through the peritoneum of the uterovesical pouch. It lies below the V-shaped fossa, well above the limit of the bladder. It will also be noticed that there is a connective tissue mesentery passing from the round ligament downwards and inwards to reach the uterus, anterior to the uterine vessels. This mesentery becomes adherent to the front of the uterus and below becomes continuous with the bladder pillar.

For the peritoneum to be incised safely, the bladder itself should be picked up with non-toothed forceps. This puts the loose peritoneum of the uterovesical pouch on the stretch so that it can easily be divided with scissors; it also facilitates the division of the vesico-uterine "ligament" (Fig. 9.23). The cervix is covered with its own layer of endopelvic fascia. On each side of the midline the upward prolongation of the bladder pillar passes upwards to be attached not only to the cervix but to fuse with the endopelvic fascia. The method used by the authors is to trace down the sheet of pelvic fascia, which passes from the round ligament, to detach this from the cervix, and in doing so the upward prolongation of the bladder pillar is separated from the cervix. It has already been pointed out that the vesico-uterine ligament is rarely well defined, but it must be divided before the vesicocervical space can be identified.

The next step is to separate the bladder and with it the ureters from the cervix and upper part of the vagina. The endopelvic fascia that lies on each side of the midline, and which can be regarded as an upward prolongation of the bladder pillar, is divided with scissors near its attachment to the uterus. This enables the bladder and ureter to be stripped away from the front of the cervix. The space between the bladder and vagina in the midline in the region of the vesicocervical space is blood-less, but lateral to the upward prolongation of the bladder pillar lie the lateral vaginal plexuses of veins together with the venous plexuses of the parametrium. The more the bladder and ureter are mobilised laterally, the more these venous plexuses will be opened up, yet unless the ureter is kept well out of the operation area it may be erroneously included by clamps placed over the lateral vaginal plexus of veins.

4. Ligating the Uterine Artery Pedicle: At this stage, the posterior leaf of the broad ligament should be divided to skeletonise the uterine vessels (Figs. 9.24, 9.25). This also helps to release the ureters laterally, away from the clamp that will be applied to the uterine vessels. The uterine vessels can then be clamped at the level of the internal os (Fig. 9.26). It is preferable to ligate the tissues enclosed in the clamps at this stage of the operation, to prevent excessive numbers of clamps hindering access to the surgical area in the pelvis, and to ensure adequate ligation of this vascular pedicle rather than risk accidental displacement of the hysterectomy clamp with subsequent bleeding.

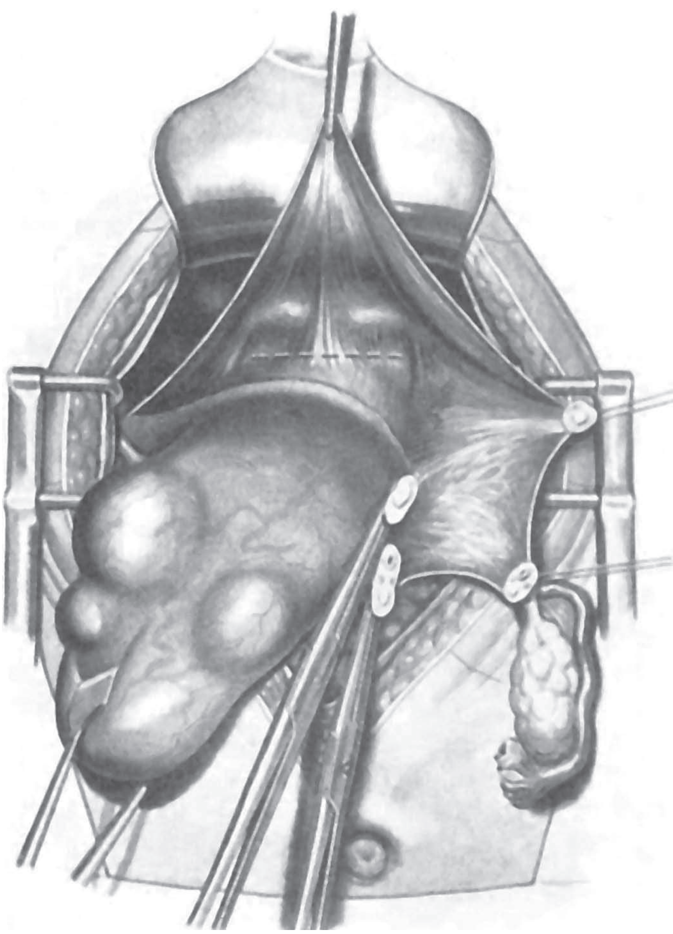


Fig. 9.23: Abdominal hysterectomy: The peritoneum over the bladder is drawn upwards. The diagram illustrates the position of the vesico-uterine ligament, which must be cut through transversely to open up the vesicocervical space. On each side, the pillar of the bladder can be seen attaching the bladder to the lateral part of the uterus and becoming continuous with the connective tissue mesentery of the round ligament.

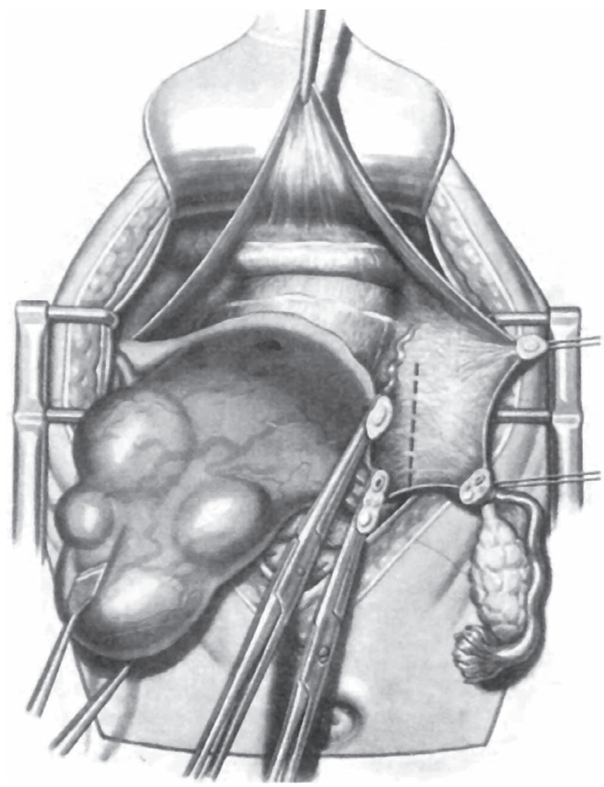


Fig. 9.24: Abdominal hysterectomy: The structures illustrated in the previous diagram have been cut through and the bladder has been mobilised and displaced downwards from the cervix and upper vagina. This manoeuvre carries the ureters downwards with the bladder and somewhat safeguards them from the uterine pedicle clamps. The uterine vessels are skeletonised and well exposed. The next step is to cut through the peritoneum of the posterior leaf of the broad ligament, as illustrated by the dotted line.

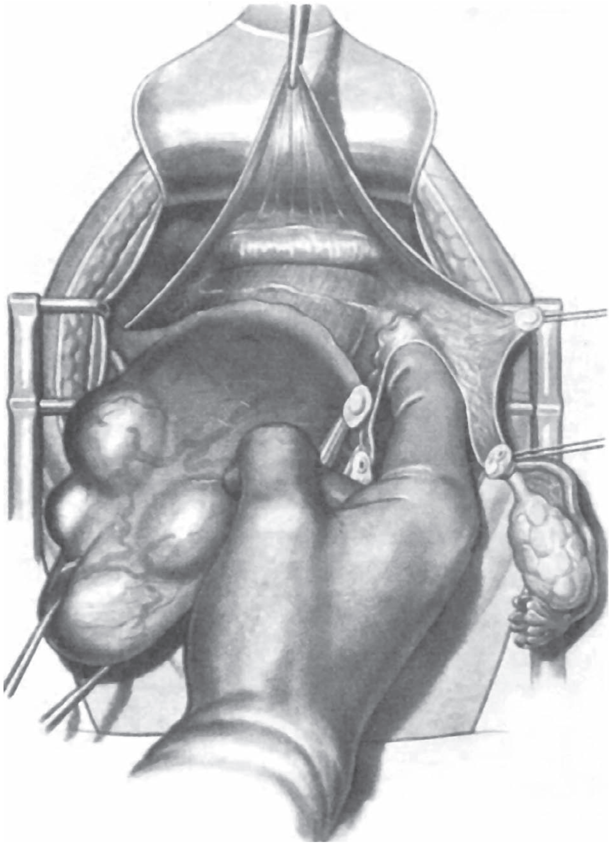


Fig. 9.25: Abdominal hysterectomy. The diagram illustrates how the uterine vessels can be still further exposed if a finger is placed behind the peritoneum of the broad ligament to push the uterine vessel anteriorly.

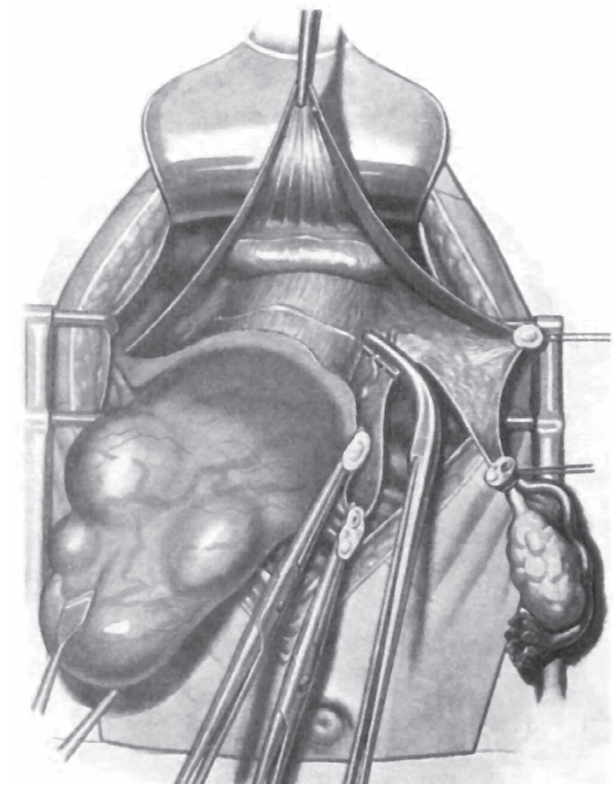


Fig. 9.26: Abdominal hysterectomy: A curved hysterectomy clamp is now placed over the uterine vessels and the tissues cut through above the clamp. A Spencer Wells forceps can be placed along the uterine portion of the pedicle to prevent 'back-bleeding'.

5. Concurrent Salpingo-Oophorectomy: Dividing the Infundibulopelvic Ligaments: Alternatively, as shown in Fig. 9.27, the ovaries and Fallopian tubes can be removed with the uterus. This involves opening and ligating the round ligaments as described above. Then, a window can be made in the avascular peritoneum of the posterior leaf of the broad ligament, between the infundibulo-pelvic ligament and the divided round ligament. This has the function of pedicalising the infundibulo-pelvic ligament, and allows easier identification of the ureter. The vascular ligament can then be clamped with a hysterectomy clamp, ligated and divided. In the case of large pedicles (e.g. with large dilated veins) the suture should be transfixed to prevent slippage, and then tied a second time proximally with a further length of suture material. It is important to be aware of the proximity to the ureter when dividing and ligating the ovarian blood supply. The subsequent steps are as for conventional hysterectomy described above and below.

6. Dividing the Parametrial Tissues: The next part of the operation consists of dividing the parametrium and the vascular cervical branches below the level at which the uterine artery reaches the lateral border of the uterus. The fundus of the uterus is drawn over to one side by the assistant and a long straight clamp or curved hysterectomy clamp is placed medial to and below the level of the pedicle containing the uterine vessels. The clamp is placed immediately lateral to the wall of the cervix, and medial to the ligated uterine artery pedicle. The tip of the clamp must be placed within direct vision, and with great care to avoid the bladder and ureter, which should be retracted away when necessary (Fig. 9.28). The serrations of the clamp must be longitudinal to prevent the tissues enclosed within slipping away from the clamp after the tissues which intervene between the cervix and the clamp have been divided. Sometimes the parametrial tissues slip out of the clamp and bleed, and additional clamps must be used to pick up the bleeding points. Accidental clamping of the ureter is possible at this stage, and clamps should be placed as close as possible to the lateral border of the cervix, well away from the position of the ureter and bladder. Some surgeons use a single straight clamp to include both uterine vessels and parametrium.

In this technique, the surgeon works not between the cervical fascia and the cervix but between the cervical fascia and the vesical fascia. For an intrafascial hysterectomy, the cervical fascia is incised transversely with a knife close to the level at which the uterine arteries have been divided, and the dissection proceeds closer to the vagina.

It is sensible at this stage to identify the ureter in the ureteric canal of the parametrium by palpation between the finger and thumb of the right hand. With experience, there is no other structure that feels like the ureter and it can be rolled between finger and

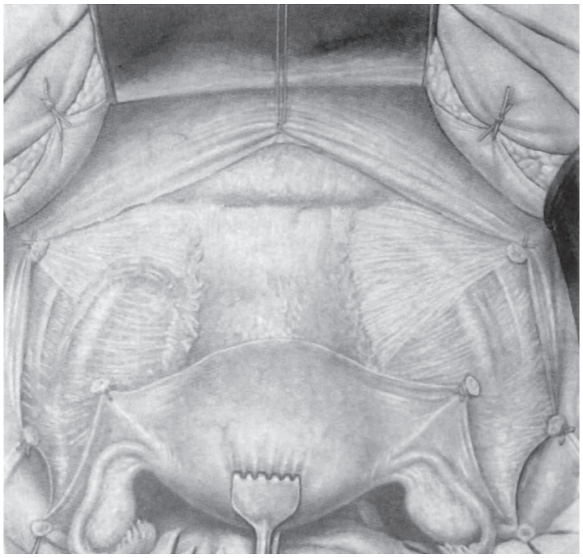


Fig. 9.27: Abdominal hysterectomy and bilateral salpingo-oophorectomy: This illustrates the early steps of an abdominal hysterectomy in which both adnexae are to be removed. The round ligaments have been ligated and cut, as have the infundibulopelivc ligaments. The uterus is being drawn upwards and the bladder pushed downwards. The vesicocervical ligament and the bladder pillars are shown, and the left uterine vessels can be seen crossing the left ureter. The posterior half of the broad ligament has not yet been divided down to the level of the uterine vessels. The round ligament mesentery has been divided on the left side to expose the uterine vessels; on the right it is intact.

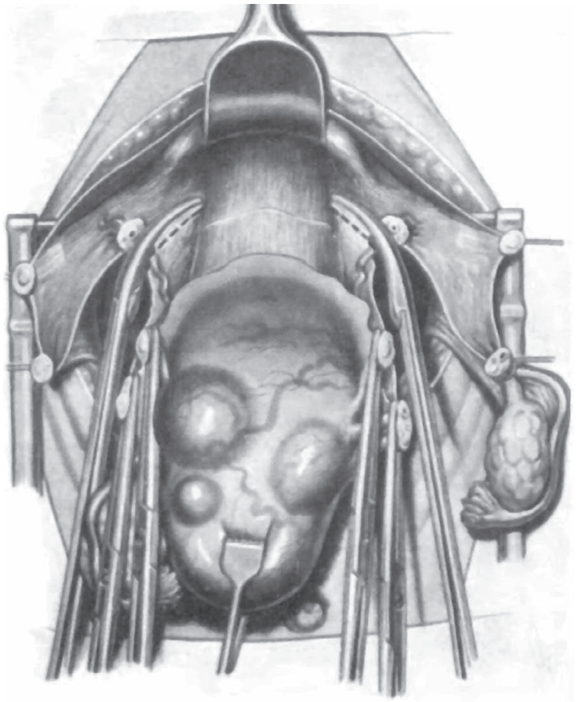


Fig. 9.28: Abdominal hysterectomy: The uterine arteries have been ligated. The diagram shows how clamps are placed over the parametrium. To apply the clamps, the uterus is drawn over to the opposite side and the assistant carefully retracts the bladder away. Note that the clamps are positioned medial to the ligated uterine artery pedicles.

thumb as a firm, thick, incompressible cord. As it escapes from the grip of the finger and thumb, it gives a palpable 'snap' or 'twang'. Ureteric injury is discussed in detail in Chapter 21. It is imperative that no pedicle should ever be clamped until the ureter has been precisely defined by inspection or palpation.

7. The Uterosacral Ligaments and the Vaginal Angles: The uterus is then drawn upwards and forwards by an assistant, and the uterosacral ligament of the opposite side exposed. A curved hysterectomy clamp is then placed on the vaginal angle, including the uterosacral ligament, and the tissues which lie between the uterus and the clamp cut through with scissors or a blade (Fig. 9.29). When both angles and uterosacral ligaments have been clamped and divided, upward traction of the uterus allows much greater elevation and better definition of the remaining structures that still require division before the uterus can be removed. The vaginal incision can then be continued either anteriorly or posteriorly (Fig. 9.30).

It has been emphasised already that the operation is hazardous unless the bladder and the distal ureters are accurately defined and mobilised. If necessary, the bladder can be retracted away from the vagina with a retractor (e.g. a Morris or Diva retractor). No attempt should ever be made to open the vagina until the bladder has been identified, mobilised and separated from the vagina. One of the main difficulties is to mobilise the termination of the ureter without opening up the venous plexuses that lie in the region of the lateral wall of the vagina. Only surgeons with a detailed knowledge of the endopelvic fascia will find the correct layer of separation and avoid damaging these vaginal vessels. If clamps are placed blindly on bleeding points,

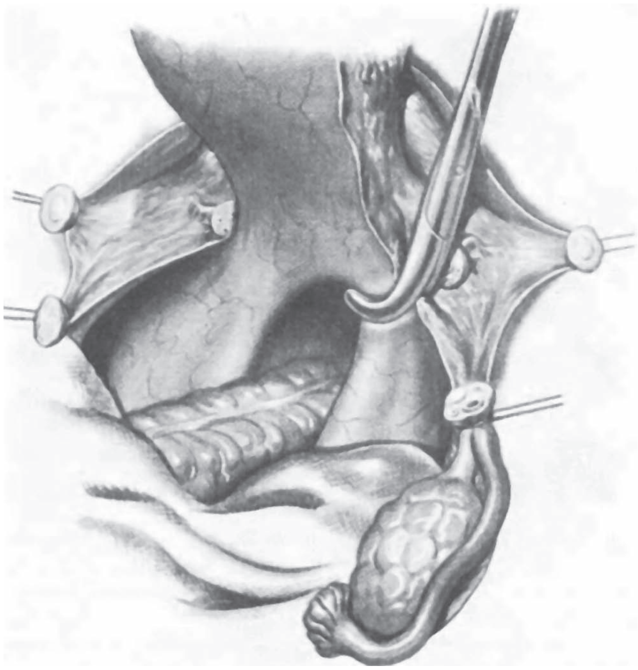


Fig. 9.29: Abdominal hysterectomy: The next step is to clamp and cut through the vaginal angle. This is an important step in the operation. The uterus must be drawn upwards and to the opposite side to expose the attachment of the cardinal ligament.

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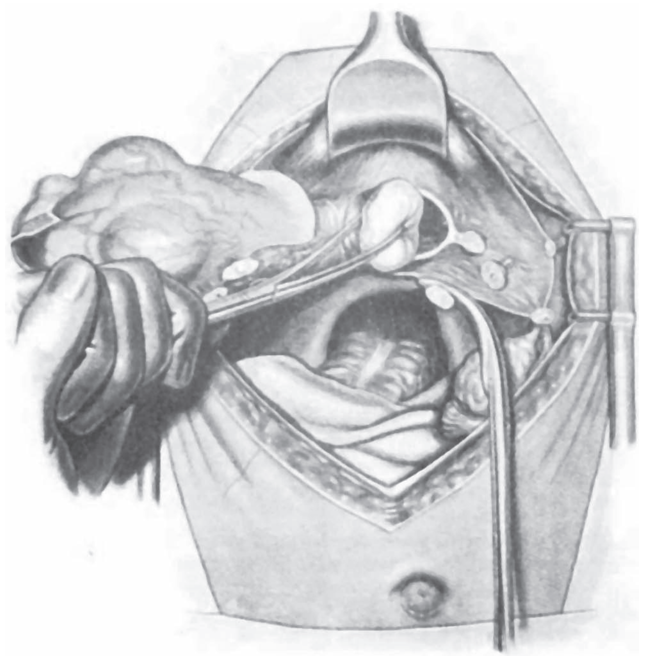

Fig. 9.30: Abdominal hysterectomy: The cervix is taken with Vulsellum forceps and drawn out of the vagina. The diagram shows the ligated right uterine artery together with the right parametrium ligature and an extra clamp lies in position attached to the uterosacral ligament. The vagina has been opened posterolaterally.

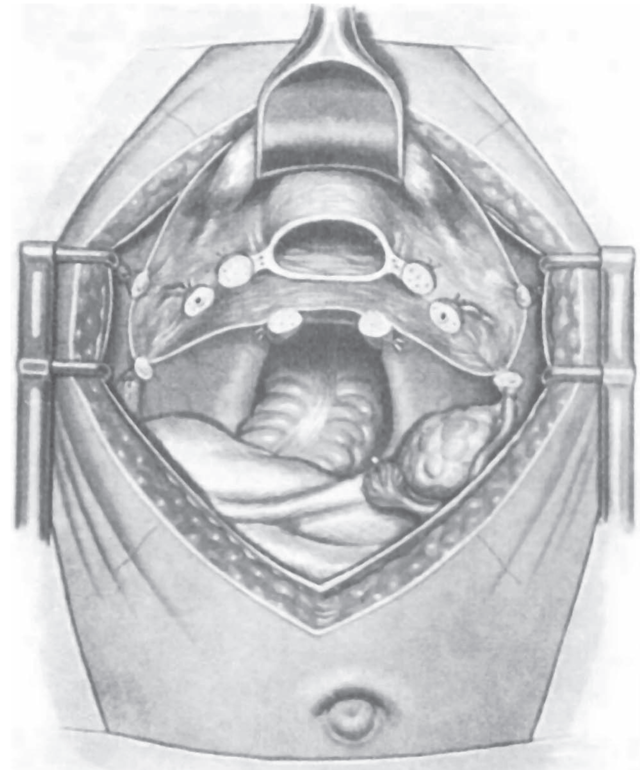

Fig. 9.31: Abdominal hysterectomy: The vagina has been cut through, and the ligated pedicles of the uterine vessels, the parametrium and the uterosacral ligament are shown on each side. Some unligated vessels of the vaginal angle are deliberately shown.

there is a high risk of damage to the ureter. The method of opening the vagina by cutting through the uterosacral ligaments (see below) may help to avoid ureteric injury.

A posterior vaginal incision has the advantage of being well away from the bladder and ureters, and there is no possibility of either of these structures being injured. Long straight forceps are attached to the cut edge of the vagina on each side. The vagina can then be drawn up and, if necessary, the bladder can be mobilised still further by snipping through the connecting tissues between the vagina and bladder with scissors. It is not always necessary to attach a Vulsellum forceps to the cervix, but in difficult cases, when the patient is obese or when the uterus cannot be drawn up satisfactorily, this technique is useful. The vagina is then gradually incised with scissors or a blade around the cervix. In benign surgery, the surgeon should keep as close as possible to the normal attachment between the vagina and the cervix. Not only does this reduce the incidence of damage to the bladder, but also prevents the vagina from being unnecessarily shortened. In endometriosis, the anterior wall of the sigmoid colon is often adherent to the peritoneum on the posterior surface of the vagina, and the sigmoid must be mobilised before the uterosacral ligament is divided. As a general rule, it is much simpler to separate the sigmoid colon from the posterior surface of the cervix than it is to separate the bladder and ureter from the anterior surface of the cervix and vagina.

It should be remembered that during a total hysterectomy, the tissues are drawn upwards and put on the stretch. Veins, and even arteries, can subsequently bleed to produce a reactionary haemorrhage when the tension is released (Fig. 9.31). Particular attention should be paid to the types of forceps used in the operation, as tissues tend to retract away from transversely grooved artery forceps. For this reason, a longitudinally grooved clamp is recommended. Most cases of reactionary haemorrhage after total hysterectomy result from either incomplete ligation of the vessels in the cut edges of the vagina or from parametrial tissues slipping away from ligatures. Most gynaecological surgeons will recall cases when the operation area was seemingly dry when the abdomen was closed yet developed reactionary haemorrhage within a few hours of the completion of surgery. Such complications are largely preventable if correct technique is employed.

8. Closing the Vaginal Vault: The next part of the operation is to ligate the tissues enclosed by the clamps. High polymer absorbable suture is used, and the tip of the pedicle can be transfixed with a needle held in a needle holder. If the uterosacral ligaments are thick or prominent, three clamps can be used for the parametrial tissues. One is placed over the parametrial tissues lateral to the cervix below the level of the uterine artery, one is placed onto the uterosacral ligament, while a third clamp encloses the cardinal ligament attachment (Fig. 9.29). If, however, the uterus can be drawn up without difficulty it might be possible to clamp all of these structures together.

The vagina should normally be closed. Spurting arteries are nearly always found in the cut edges of the vagina. As a general rule, these are picked up with the long straight forceps used to draw up the cut edges of the vagina. There are several alternative methods for closure of the vaginal vault. These include mattress or interrupted sutures, or a continuous suture with or without locking. An interrupted suture can be used at each end to enclose any part of the lateral vaginal plexus that was not included in the vaginal angle (Figs. 9.31, 9.32, 9.33).

9. Alternative Non-Closure of the Vaginal Vault: Some surgeons do not close the vagina completely in an attempt to allow any blood accumulating in the pelvis after the operation to drain out of the abdominal cavity into the vagina, and hence reduce the possibility of haematoma formation.

If the vagina is left open, the cut edge must be encircled by a continuous interlocking suture, similar to a blanket stitch

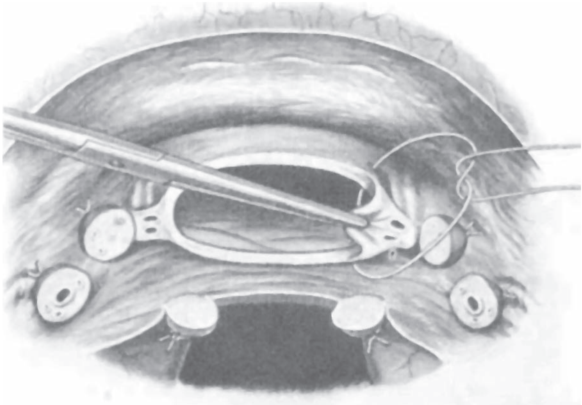

Fig. 9.32: Abdominal hysterectomy: The diagram illustrates the open technique of ligating the paravaginal plexus of vessels. This step in the operation is essential if the vaginal angle (cardinal ligament) clamp has not reached the vaginal lumen.

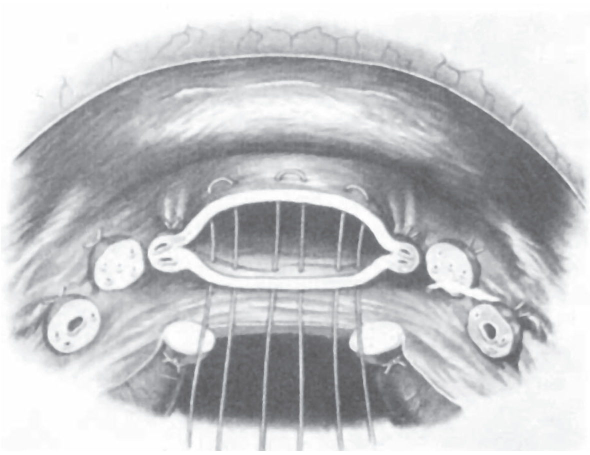

Fig. 9.33: Abdominal hysterectomy: The upper end of the vagina is closed with mattress or interrupted sutures to obtain the maximum degree of haemostasis. The vagina is closed completely only if absolute homeostasis has been obtained from the raw area in the pelvis.

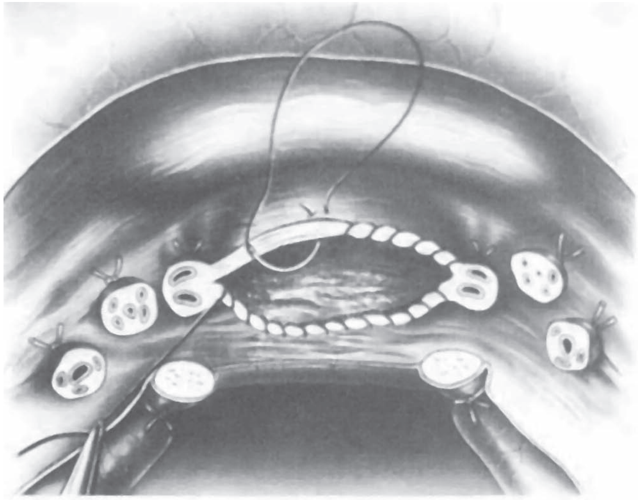

Fig. 9.34: Abdominal hysterectomy: Alternative management of the vaginal vault. Once the vaginal angles have been secured, the free cut edge of the vagina can be oversewn without closure to allow drainage from the retroperitoneal dead space. If this method is adopted, it is essential that adequate peritoneal closure is achieved to eliminate the risk of intestinal prolapse.

(Fig. 9.34). Haemostasis of the cut edge is as important when leaving the vagina open as it is when completely closing it. As a further alternative to the illustrated methods, some surgeons close the vaginal vault using a similar method to a Lembert suture, picking up the muscle only and avoiding the vaginal skin so that, when tied, no suture actually appears in the vagina.

10. Reperitonisation of the Pelvis: It is no longer considered necessary to surgically reperitonise the pelvis. Mesothelial healing occurs very rapidly, and adhesion formation may be more extensive where there is an inflammatory reaction to suture material. Two considerations apply however and the description of peritonisation is included for circumstances where it may be felt appropriate:

If the vaginal vault has been left open, the supravaginal space must be covered to prevent prolapse of either small bowel or Fallopian tube stump. Secondly there is an argument for peritonising the larger pedicles, although this is arguably an outdated method involving fixation of the ovaries close to the vaginal vault, with a subsequent risk of dyspareunia. The method involves combining a "purse-string" suture with fixation of the round ligament to the angle of the vaginal vault. In this technique, the vaginal angle ligature, still attached to a needle, is passed through the uterosacral ligament, then through the Fallopian tube lateral to the ligature, then through the round ligament, lateral to its ligature and afterwards through the cut edge of the peritoneum of the uterovesical pouch. When the ligature is tied, the adnexal tissues are fixed firmly to the lateral angle of the vagina and much of the raw surface is covered with peritoneum. The ovary itself is not immediately adjacent to the vagina, although there is still a risk of producing dyspareunia. The same procedure is used for the opposite side. Subsequently, one or two interrupted sutures draw the peritoneum of the uterovesical pouch over the raw surface of the cut edges of the vagina. The peritoneum is swabbed clear of blood and closed in the usual way (Figs. 9.35, 9.36).

During the process of separating the uterus from its vascular attachments, vessels (usually veins) may be torn. It is essential that these torn vessels are controlled and individually ligated at the time of injury. Uncontrolled bleeding can lead to the development of a dangerous haematoma, which can spread into the loose areolar tissue of the broad ligament. All the main pedicles (e.g. ovarian and uterine) must be firmly secured by double ligature to reduce the chance of any vessel escaping the ligated pedicle and forming a subsequent haematoma. Before closing the abdomen, the surgeon must meticulously check each pedicle and each cut surface, to ensure that the operation area is perfectly dry.

Special Surgical Conditions at Abdominal Hysterectomy

Some variation in surgical technique is necessary in certain situations.

Adhesions: Prior to commencing the hysterectomy, any adhesions between the uterus, tubes and ovaries and their surrounding structures should in principle be divided, either by sharp dissection or by electrocautery if there is no danger of lateral thermal tissue damage. This allows the surgeon to mobilise the pelvic structures and normalise the anatomy. Previous pelvic infection or inflammation, endometriosis and previous surgery are the likeliest causes of pelvic adhesions found at surgery. Adhesions in the pouch of Douglas can fix the posterior uterus and ovaries to the rectum or sigmoid colon, and prevent the uterus being drawn up into the abdominal incision. Alternatively, there may be dense adhesions from the small bowel onto the uterus (for example in the case of a previous myomectomy with adhesions onto the old suture line of the uterine visceral peritoneum). Blunt dissection and forcible traction of the bowel should be avoided in favour of accurate sharp dissection. Any bleeding vessels should be proximally and distally ligated or coagulated with diathermy. Injuries sustained to the serosal or muscularis layers of the bowel should be repaired by a surgeon with the appropriate experience.

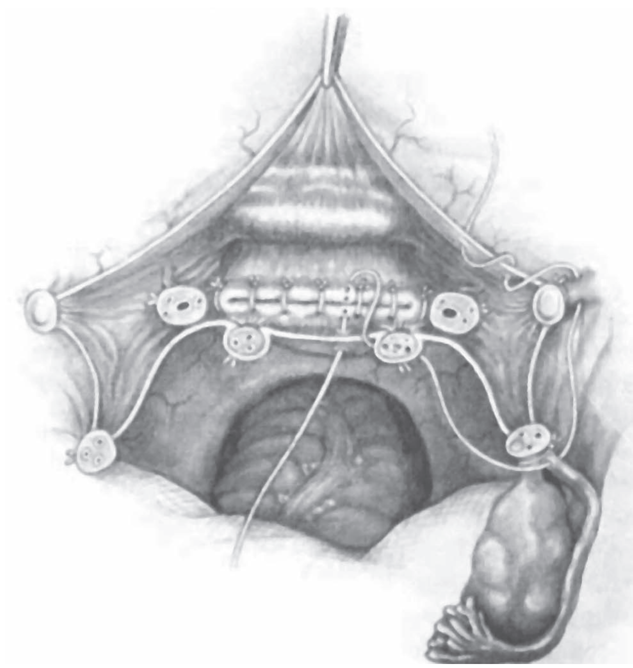

Fig. 9.35: Abdominal hysterectomy: Method of peritonisation of the pelvis after hysterectomy. The half-purse-string suture transfixes the peritoneum on the back of the vaginal vault, the vaginal vault itself, the uterosacral ligament, the broad ligament, the round ligament and the anterior leaf of the broad ligament where it becomes the uterovesical peritoneum. When tied, the uterosacral ligament and the round ligament are firmly attached to the lateral vaginal vault, providing additional support.

Very large fibroids: Large uterine fibroids can necessitate a larger abdominal incision, and possibly use of a midline incision from above the level of the umbilicus to the pubis, rather than a Pfannenstiel.

Following appropriate abdominal entry, a fibroid uterus may be fixed or impacted in the pelvis, leading to difficulty in drawing the uterus up and out of the pelvis and into the abdominal incision. This is more likely in the case of large cervical fibroids with a broad ligament or uterosacral component, or when large fibroids have developed from the back of the uterus and have become impacted below the sacral promontory. If there is difficulty in delivering the fibroid uterus out of the pelvis, a myoma screw (a special uterine holder, which is in fact a cork-screw with a large handle, see Fig. 9.37) can be inserted into the bed of the uppermost fibroid, as near to the fundus of the uterus as possible, to allow powerful and accurate traction. Except in the case of very large cervical fibroids and large extraperitoneal or retroperitoneal tumours (e.g. broad ligament or uterosacral

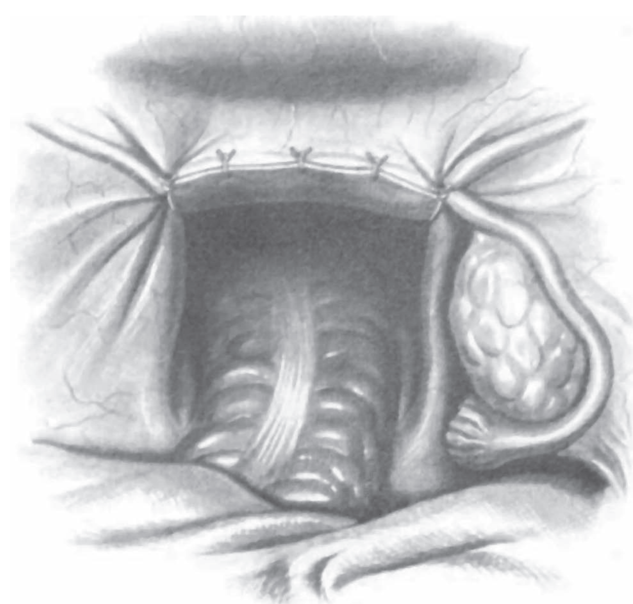

Fig. 9.36: Abdominal hysterectomy: The vaginal angles are fixed to the round and cardinal ligaments. The ovary is not tethered.

Fig. 9.37: Abdominal hysterectomy: A myoma screw for manipulation of large fibroids to facilitate hysterectomy.

fibroids), it is usually possible to draw up the uterus before commencing the hysterectomy.

Large tumours can cause significant distortion of normal anatomy. Fibroids growing on the anterior surface of the uterus may force the bladder so far anteriorly that the bladder can be injured during the abdominal incision. In addition, the bladder may be drawn up high onto the anterior surface of the uterus and be traumatised when the peritoneum in front of the uterus is being incised. As with all hysterectomies, every effort should be made to find the correct tissue plane in the uterovesical peritoneal fold. As described earlier, there is a small fossa in front of the uterus just above the reflection of peritoneum from the bladder onto the anterior surface of the uterus, which can aid in identifying the plane of dissection.

Broad ligament fibroids: The uterine vessels lie along the side of the body of the uterus. Fibroids expanding laterally into the broad ligament rarely displace these vessels. Therefore, if a fibroid grows out from the uterus into the broad ligament, it lies either anterior or posterior to the vessels. Fibroids posterior to the uterine vessels can extend to some degree along the uterosacral ligaments. Broad ligament fibroids are often large enough to almost completely fill the pelvis. If they arise from the lower part of the uterus, they tend to displace the ureter upwards and outwards. In these cases, it is essential to define the ureter before attempting to remove the uterus or before clamping the uterine vessels. The ureter is sometimes firmly connected to the capsule of the fibroid, and it must be dissected clear. The bladder is often displaced upwards and forwards with the result that the angle of the bladder together with the ureter lies at a much higher level than normally. It may be necessary in such cases to divide the uterine vessels relatively high up and to separate them on their medial side from the uterus before dissecting downwards into the pelvis to reach either the cervix or the vagina. Occasionally, the stretched ureter can resemble a hypertrophied uterine artery, and if in doubt, the ureter should be traced downwards from the point where it crosses the pelvic brim.

After the ureter has been identified and dissected clear, the fibroid can then be enucleated from the broad ligament. This is usually straight-forward provided that the correct layer of separation is found. For posterior broad ligament fibroids, it is usually necessary to divide the peritoneum, which covers its surface, as far down as the insertion of the uterosacral ligament into the cervix. A broad ligament fibroid extending into the uterosacral ligament can become calcified and firmly adherent to the ureter. It is imperative that the surgeon obeys the rule, "never to attempt to cut or divide any tissue in the vicinity of the ureter without first identifying the ureter itself".

Some broad ligament fibroids are associated with secondary polycythaemia believed to be due to the production of erythropoietin. The mechanism for this is unclear, but may be related to ureteric compression resulting in hydronephrosis and inappropriate renal erythropoietin production. In some cases, erythropoietin production has been isolated from the uterine fibroids themselves.[71,72] This effect is clinically significant as it increases the risk of thrombosis and possibly haemorrhage.

Cervical fibroids: Cervical fibroids can pose a significant surgical problem. The body of the uterus, usually only slightly enlarged, is found perched on top of a large fixed tumour, which is wedged in the pelvis. The Fallopian tubes and ovaries, together with the broad ligaments, are easily identified as their anatomical relations are not disturbed. The difficulties of the operation depend upon the mobility of the fibroid together with its relationship with the ureter. With large cervical tumours, the ureters are pushed high upwards so that they pass over the upper and lateral surface of the fibroid. Most cervical fibroids originate from the posterior part of the cervix, although they can occasionally lie anteriorly and adjacent to the bladder.

The operative principle is to mobilise the fibroid as much as possible. The initial steps of the hysterectomy should be performed as normal with the round ligament and adnexal pedicles, opening of the broad ligament and the reflection of the uterovesical peritoneum. Anteriorly, there is usually no difficulty in identifying the triangular fossa in the midline, and the peritoneum should be divided below this level. The broad ligament should then be further opened and the uterine vessels identified. It is important to divide the uterine vessels as high up as possible, which means that they must be divided at the level of the upper surface of the tumour. The ligated uterine vessels can then be dissected from the surface of the tumour and drawn laterally.

Next the ureter should be identified. This is usually found on the upper lateral surface of the cervical fibroid rather than being below it. Dissecting the bladder pillar from the uterus can be difficult, but the vesicocervical space is usually easier to find. The next step is to divide the posterior peritoneum, which is stretched over the posterior surface of the fibroid. The peritoneum should be divided transversely between the uterosacral folds of peritoneum. The peritoneum and the subperitoneal tissues are then stripped away from the posterior surface of the fibroid, which should now be mobilised sufficiently to allow the uterus and most of the tumour to be drawn up into the abdominal incision. A total hysterectomy is preferable, and the dissection must be continued deeply downwards until the vagina is reached. The bladder, the ureter and the uterine vessels are retracted laterally, and the parametrial tissues clamped and divided. A separate clamp is used for the uterosacral ligament. The vagina is opened, and the usual procedure for a total hysterectomy followed.

However complicated the case, the surgeon can work with confidence provided that the ureter is identified on both sides along with the upper part of the bladder.

Intra-operative myomectomy: In some cases with large uterine fibroids, it can be helpful to enucleate the fibroid from its capsule intra-operatively before attempting to perform a hysterectomy. This is simple to perform and can significantly reduce the volume of the uterus, allowing the surgeon greater freedom of movement and anatomical exposure in the depths of the pelvis (e.g. for access to the uterine artery pedicles), which more than justifies the additional short time spent on the additional myomectomy. In the case of a cervical fibroid, myomectomy may be achieved by sagittal hemisection of the smaller uterine body (see Figs. 9.99, 9.100). The obstructing tumour is shelled out in a matter of moments, and the capsule and bed can then be rendered relatively bloodless by the application of several vulsella to the bleeding surfaces. These haemostatic vulsella can be used as tractors applied to the uterus. An otherwise difficult hysterectomy immediately becomes simplified, often with the need for a smaller abdominal incision and with a reduction in subsequent operating time (Fig. 9.38).

Fig. 9.38: Abdominal hysterectomy - cervical fibroid. Distortion of the anatomy within the base of the uterus and broad ligaments due to a large cervical fibroid can make removal of the uterus hazardous. Surgical safety and operative time can be improved by preliminary enucleation of the fibroid.

Endometriosis: The management of endometriosis is discussed in detail in Chapter 11. The surgical aim is to remove all endometriotic and adenomyotic disease, in the hope of achieving resolution of symptoms. Removal of the ovaries, the cervix and any other endometriotic disease is therefore advocated at hysterectomy. The main surgical concern is loss of tissue planes and altered anatomy as a result of the disease process. This can make identification of the ureters difficult, and surgery may include dissection of small or more commonly large bowel that is morbidly adherent to the uterus, ovaries or cervix. In more severe cases of rectovaginal endometriosis, resection of a disc or even a segment of large bowel, with subsequent end-to-end re-anastomosis, may be warranted in order to clear the pelvis of endometriotic disease.

Congenital uterine abnormalities: These are discussed in more detail in Chapter 8. In the case of a unicornuate uterus, there is no broad ligament on one side, and it is not possible to develop a retroperitoneal space. It is important to know whether there is a concurrent urological anomaly such as a unilateral renal agenesis. In such cases, the cervix may have to be cored out by sharp dissection. Similar considerations apply bilaterally when the uterine body is completely bifid (uterus didelphys). There may be a urorectal septum between the two uterine bodies, which needs to be divided with great care as the boundary between bladder and rectum is not clearly demarcated.

SURGICAL TECHNIQUES FOR VAGINAL HYSTERECTOMY IN THE CONTEXT OF UTEROVAGINAL PROLAPSE

The technique for vaginal hysterectomy may differ slightly depending on the degree of uterine and vaginal prolapse. The pre-operative preparation of the patient is the same as that employed for other vaginal operations for prolapse. The patient is placed in the lithotomy position, the vagina and vulva disinfected and the surgical field surrounded with sterile drapes. A Sims' speculum is introduced to expose the cervix, which is then pulled downwards and backwards by an assistant using two vulsella forceps placed on the anterior and posterior lips of the cervix. The Sims' speculum can be discarded if the cervix can be pulled down through the vaginal orifice. If the prolapse is of a severe degree, it may not be necessary for the assistants to employ lateral vaginal retractors. Some surgeons advocate infiltration with either saline or bupivacaine (0.5%) with 1:200,000 adrenaline solution to aid haemostasis and identification of tissue planes.

1. Vaginal Incision and Demarcation of Lateral Vaginal Flaps: A midline or inverted V incision is made in the anterior vaginal wall in exactly the same way as if for an anterior colporrhaphy (Fig. 9.39). At the cervical end, the incision is then continued laterally at right angles to the original incision and continued around the cervix in order to complete the circumcision of the cervix. When there is also a hernia of the pouch of Douglas (enterocoele), the incision must include more redundant vaginal wall from the posterior fornix (Fig. 9.40).

The vaginal flaps are separated from the bladder in the vesicovaginal space, while near the urethra the flaps are dissected clear of the posturethral ligament with a scalpel.

2. Freeing the Bladder Upwards to Expose and Open the Uterovesical Pouch: The peritoneal cavity can be entered by either an anterior or posterior colpotomy. In the case of prolapse, an anterior colpotomy is usually advocated, although this is dependent on the operator. The vesicocervical ligament is incised with Mayo's scissors, and the bladder stripped back using careful sharp dissection until the uterovesical peritoneal fold can be seen (Fig. 9.41). The bladder is retracted upwards with a vaginal wall retractor; the uterovesical peritoneum is picked up with toothed forceps and divided with Mayo's scissors to expose the peritoneal cavity. The peritoneum is divided on each side as far laterally as is possible using a lateral stretching motion with both index fingers. Some surgeons place a stay suture on the peritoneal edge near the bladder.

3. Excision of Redundant Vaginal Flaps: The redundant lateral vaginal flaps can now be excised, removing both vaginal wall and vaginal fascia. Bleeding branches of the azygos vaginal artery can be underpinned and ligated. If there is a large cystocoele, a series of interrupted Lembert reefing sutures (see Chapter 14) can be introduced, although these sutures should be kept long and not tied until after the hysterectomy has been performed, to avoid reducing the surgical access into the vagina.

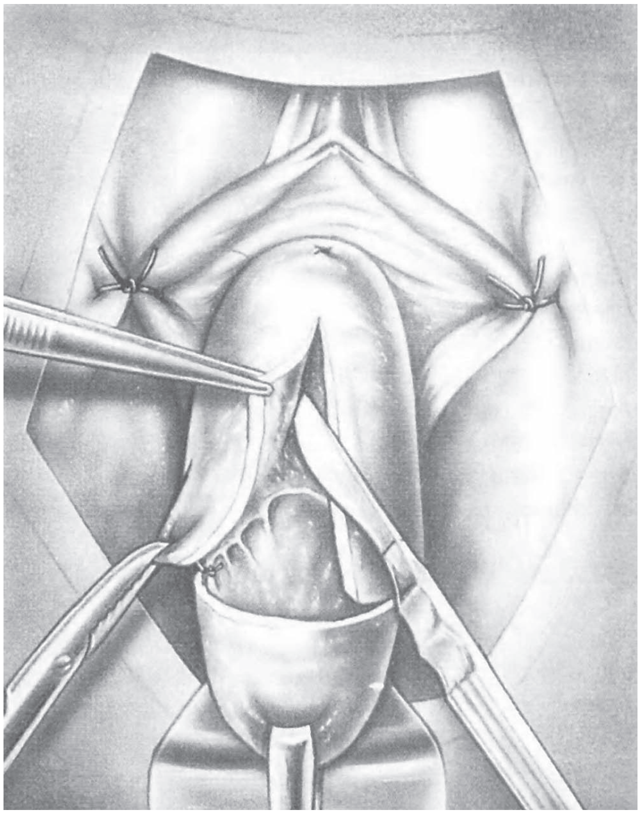

Fig. 9.39: Vaginal hysterectomy. A longitudinal incision has been made in the anterior vaginal wall together with a transverse incision. The incisions are made with a scalpel. The diagram shows the method of opening the vesicovaginal space by dissecting the vagina together with the vaginal fascia away from the bladder.

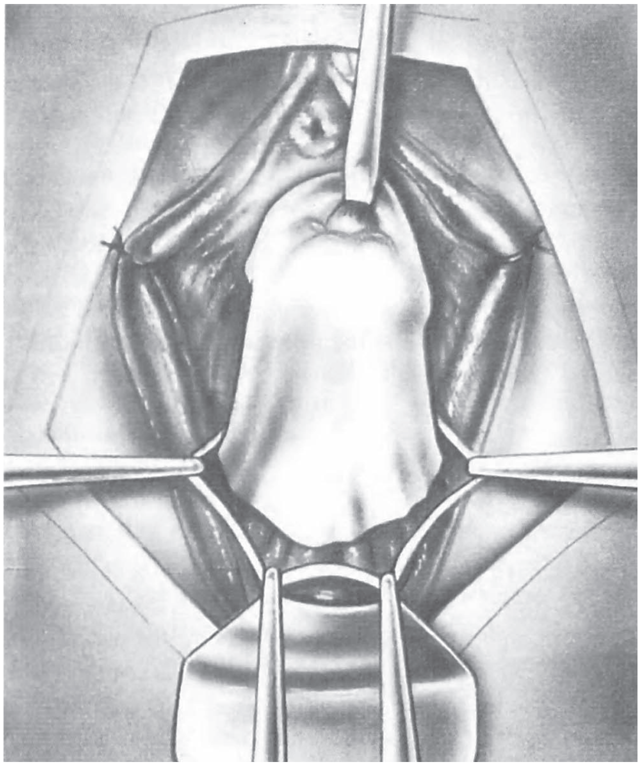

Fig. 9.40: Vaginal hysterectomy. The cervix is elevated to allow the incision to be completed across the posterior fornix. An inverted V may be used if there is redundant vaginal skin covering an enterocoele.

4. Opening the Pouch of Douglas: The assistant now pulls the cervix upwards and forwards, and the surgeon displays the pouch of Douglas by exerting traction on the vaginal flap of the posterior fornix in a downward direction.

The peritoneum of the pouch of Douglas is now opened and the incision extended laterally on both sides as far as the dense fibres of the uterosacral ligaments (Fig. 9.42). An assistant passes a retractor (Landon's or Sims') into the pouch and pulls the rectum backwards (posteriorly). If bowel presents, it can be replaced, and a wet gauze pack (attached to identification forceps) inserted.

The uterosacral ligaments are now identified by the surgeon's finger and secured from within the pouch of Douglas by a clamp. They are then cut and immediately doubly ligated by a heavy transfixion suture (e.g. a No. 1 polyglycolic acid suture). The second of these transfixion sutures is left long and secured without tension to the operation towels as a marker. This step will help to mobilise the uterus downwards.

5. Clamping and Dividing the Main Pedicles: The surgeon now proceeds from below (inferiorly) upwards along the tissues of the broad ligament by clamping, cutting and ligating each bite. If the cervix is elongated and the uterus large, several bites

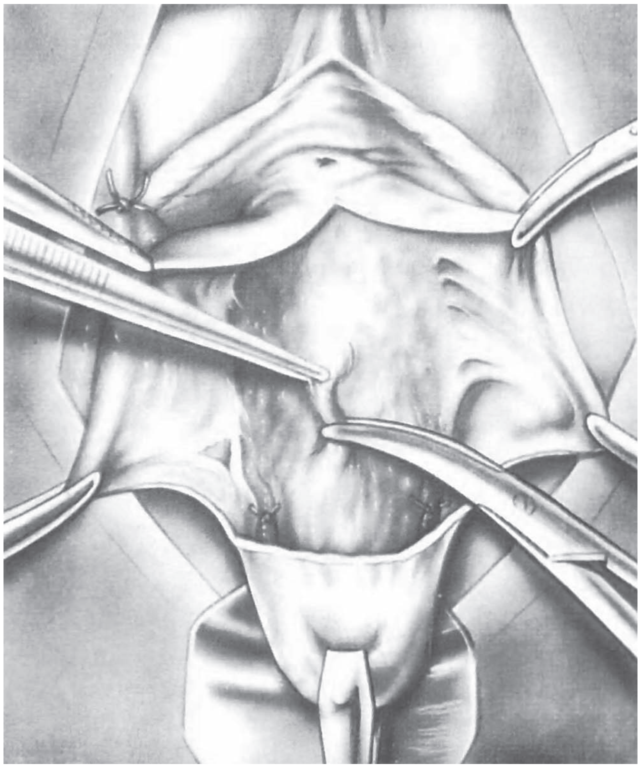

Fig. 9.41: Vaginal hysterectomy. The vesicocervical ligament is being cut through with curved scissors. The bladder pillars lie on each side.

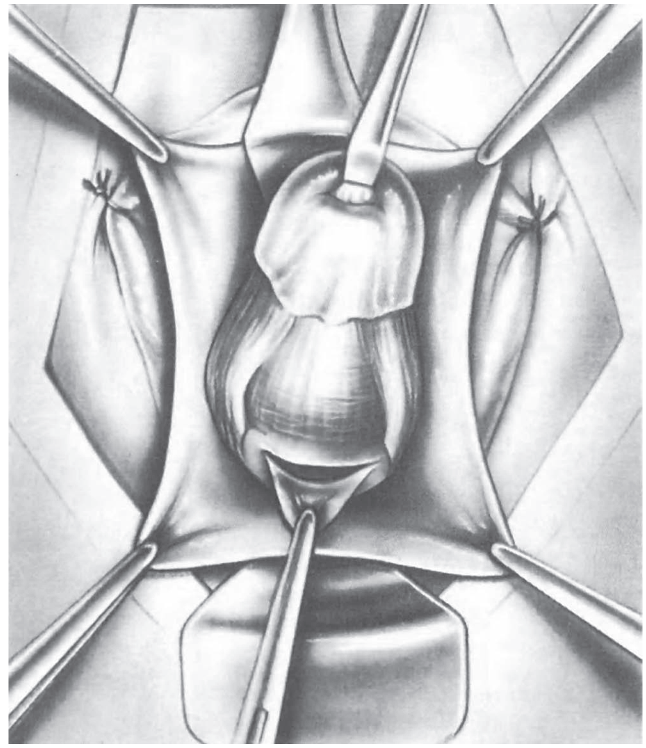

Fig. 9.42: Vaginal hysterectomy. The cervix is pulled upwards and forwards, placing the uterosacral ligaments on the stretch. The vaginal flaps that have been dissected from the cervix are drawn posterolaterally. The peritoneum of the pouch of Douglas has been opened.

may be needed before the final pedicle of the round ligament is reached. For instance, the cardinal ligament and the uterine pedicle may require three clamps and separate sutures for their safe and secure ligation. Each bite should have a double transfixation suture. As each is secured, the mobility of the uterus increases. First one side and then the other is dealt with so that the surgeon ligates both uterine vessels before proceeding higher. This increases the degree of uterine mobility simultaneously and to a greater degree than if one side is completely transected before the other is detached (Fig. 9.43). The tip of the clamp securing the uterine pedicle should include the peritoneum on the anterior and posterior surface of the broad ligament. This reduces the chances of a vascular tributary not being included in the ligature.

At this stage, if not yet done, the peritoneum of the uterovesical pouch should be opened by introducing a finger into it from the already opened pouch of Douglas. When only the ovarian ligament and round ligament are attached to the uterus on each side, the uterine fundus can usually be exteriorised by passing it posteriorly through the pouch of Douglas. Once the uterus is delivered, the ovarian pedicles and the round ligaments are clamped either together or separately and the uterus removed. The ovarian and round ligament pedicles are then doubly ligated and one ligature is left long as a marker (Figs. 9.44, 9.45).

If the uterus cannot easily be delivered through the pouch of Douglas, it can be delivered as an alternative through the uterovesical pouch after Wilfred Shaw's method. The ovarian pedicles are then secured similarly (see later).

6. The Peritoneal Sac and Closure of the Uterosacral Hiatus: Some surgeons close the peritoneum completely in order to extraperitonealise the location of the pedicles. Complete closure of the peritoneum is not necessary, however the process of extraperitonealising the pedicles has been described later (see Fig. 9.48). It is the authors' practice to keep a long ligature on only the uterosacral and cardinal ligaments, which are used to aid support of the vaginal vault and to close the posterior peritoneal sac of the pouch of Douglas.

Any redundant peritoneum of the pouch of Douglas should be excised to reduce the risk of enterocoele formation. The posterior cut edge of the peritoneum, adjacent to the initial vaginal incision in the posterior fornix, is picked up and the peritoneum carefully dissected by sharp and blunt dissection as far as the rectum. The remaining ligatures attached to the two uterosacral ligaments are then picked up and, using an empty needle, the ligatures are passed through the posterior peritoneum and tied together, approximating the uterosacrals and obliterating the potential hernial sac. The ligatures can then be passed out on an empty needle through the posterior vaginal tissue and left long, held on a clip (Fig. 9.46).

When there is a small cystocoele, the bladder is dissected from its lateral attachments to the vaginal fascia of the anterior

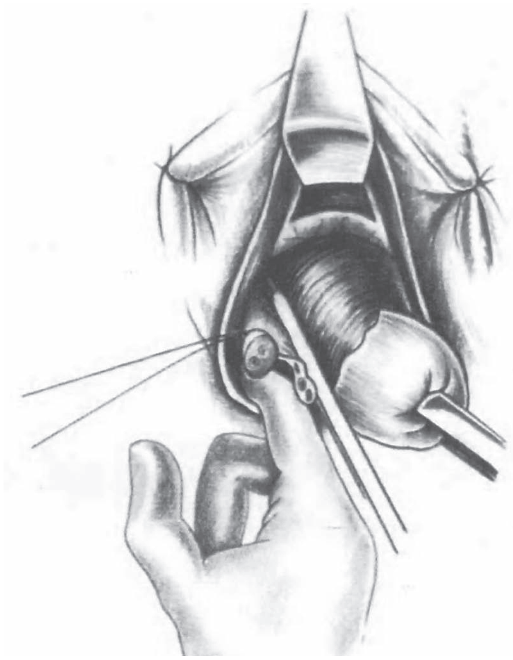

Fig. 9.43: Vaginal hysterectomy. The surgeon's right forefinger is raising the uterine pedicle on the patient's right side while the cervix is drawn downwards and to the patient's left. A clamp is being applied to the right uterine pedicle. The teeth of the clamp should engage the peritoneal edge. This will ensure that all tributaries of the uterine vessels are included. A long ligature is left on the uterosacral pedicle as a marker.

vaginal flaps until a firm pillar of pubovesical fascia is reached (see earlier). This pubovesical fascia is united in the midline by interrupted sutures from the urethral meatus to the peritoneum of the uterovesical pouch. This usually requires four or five sutures. The last of these sutures secures a good bite of pubovesical fascia laterally, and includes the peritoneum of the uterovesical pouch. When tied, it closes the anterior part of the hiatus through which the uterus has been removed (Fig. 9.47).

Some gynaecologists leave the second ligature of each remaining pedicle long in order to thread them through an empty needle and bring them through the adjacent vaginal wall. The long sutures from the previously united cardinal ligaments are fixed in the posterior fornix and those from the round ligament to each lateral fornix. The theory is to help obliterate dead space in which haematoma formation can occur and possibly as a prophylactic against subsequent vault prolapse and enterocoele (Fig. 9.48). This is not the practice of the authors however. It is important to avoid tying the round ligament sutures together. This can cause tenting of the vaginal vault and cause dyspareunia.

7. Additional Uterosacral Sutures if Needed: If there is a significant gap between the cut edges of the uterosacral ligaments, the posterior peritoneum and the posterior vaginal wall, extra-peritoneal uterosacral sutures can be employed to close this shelf (Fig. 9.49). If a severe degree of prolapse is present, the uterosacral ligaments and their downward prolongations may be ill-defined and identified with difficulty.[73]

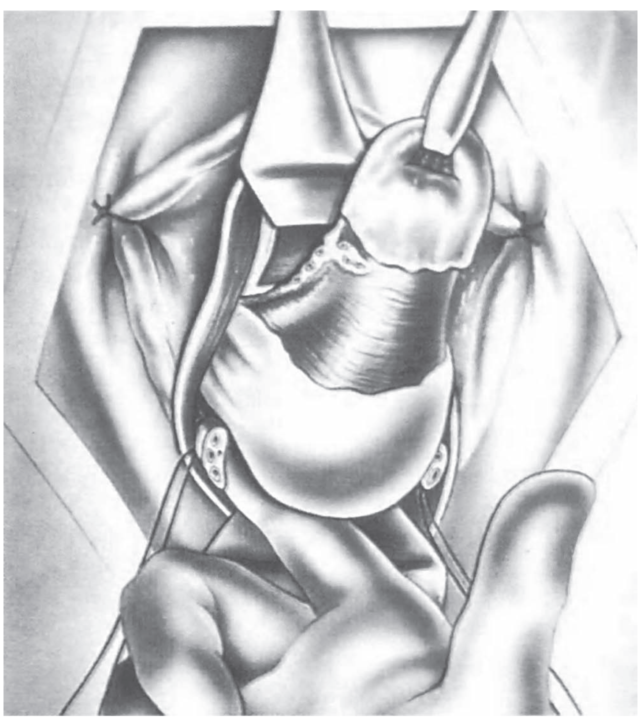

Fig. 9.44: Vaginal hysterectomy. The uterus is now free on the patient's right side except for the round and ovarian ligaments. The cervix is being drawn upwards and to the left while the surgeon hooks an index finger around the remaining pedicle before applying a clamp.

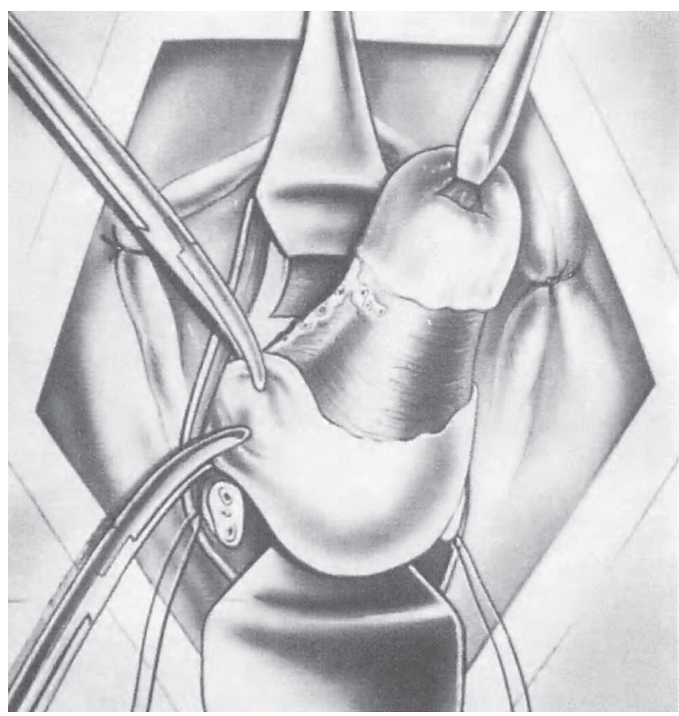

Fig. 9.45: Vaginal hysterectomy. The fundus of the uterus has been displaced posteriorly through the incision in the pouch of Douglas. Separate clamps have been applied to the round and the ovarian ligaments.

In such cases, a full posterior colpoperineorrhaphy is required (Fig. 9.50) (see Chapter 14), with prerectal fascial plication extending up to the site of the hiatal closure.

Once the excess vaginal tissue has been excised, the vault can be closed using a No. 1 polyglycolic acid suture. This closure can be performed either longitudinally or transversely, depending on the degree of prolapse and the direction of the vaginal incisions required at the start of the operation.

Alternative Procedure for Vaginal Hysterectomy with Prolapse

If there is major prolapse, Wilfred Shaw's own technique may be preferred. In this, the uterine fundus is delivered through the anterior (uterovesical) pouch (Figs. 9.51 and 9.52) before ligation and division of the vascular and ligamentous pedicles. These latter manoeuvres are then carried from above down the inverted uterus.

1. The Ovarian, Round Ligament and Uterine Pedicles: The uterus is grasped with uterus-holding forceps. Hysterectomy clamps, such as Zeppelin or Rogers, are now placed over the Fallopian tube, ovarian ligament and round ligament on the left

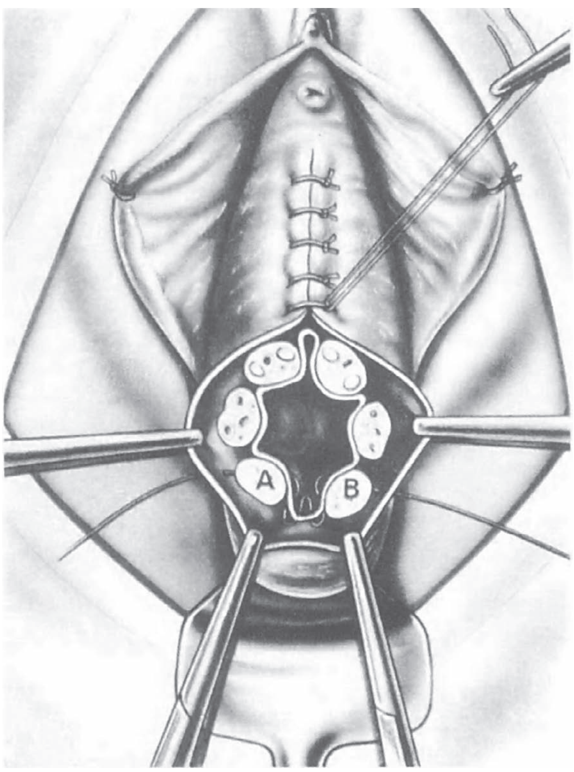

Fig. 9.46: Vaginal hysterectomy. The diagram shows the position after the uterus has been removed. The edge of the peritoneum is illustrated diagramatically; the two uterosacral ligaments A and B can be approximated and the sutures brought out through the posterior vaginal wall. Some gynaecologists approximate the sutures attached to the uterine pedicles. This practice is not advocated by the authors however, as it applies unnecessary tension to this important vascular pedicle, risking haemorrhage. The round ligament pedicles should also not be approximated to avoid tenting the vaginal vault.

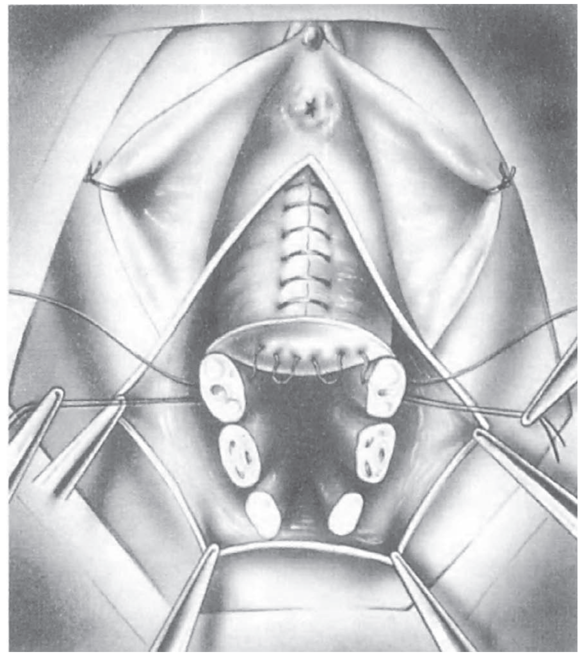

Fig. 9.47: Vaginal hysterectomy. The anterior peritoneal flap has been closed by a reefing suture that passes from one round ligament to the other. The sutures from the ovarian pedicles have been left long in this image, although they can be cut shorter when haemostasis has been confirmed prior to closure.

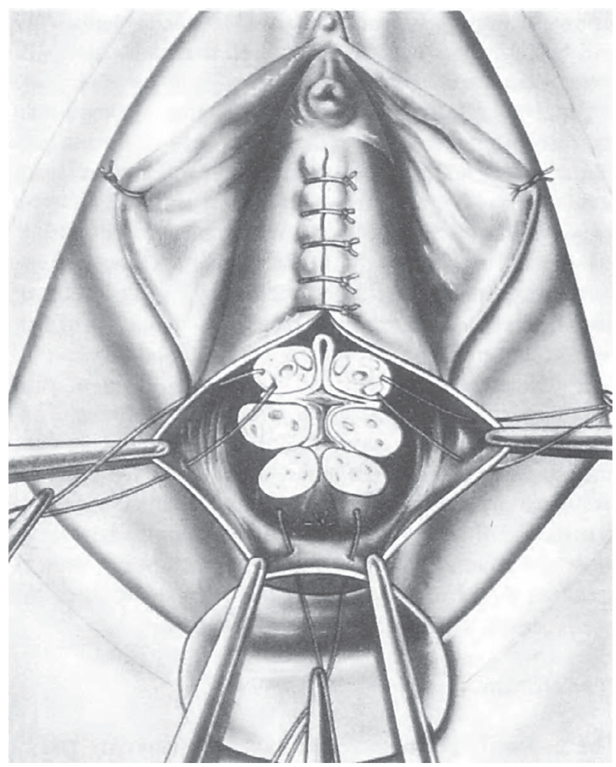

Fig. 9.48: Vaginal hysterectomy. Fixing all the pedicles in an extraperitoneal position. The round ligament and ovarian pedicle are attached to the vaginal angles. The authors' practice is to fix the uterosacral ligaments in the midline to obliterate the pouch of Douglas, and then fix them to the posterior vaginal wall, leaving the uterine pedicle and the ovarian and round ligament pedicles free.

side of the patient close to the uterus. The clamp should be closed firmly, after which the tissue intervening between the clamp and the uterus is cut through on the uterine side (Fig. 9.53). The uterus is now drawn downwards and towards

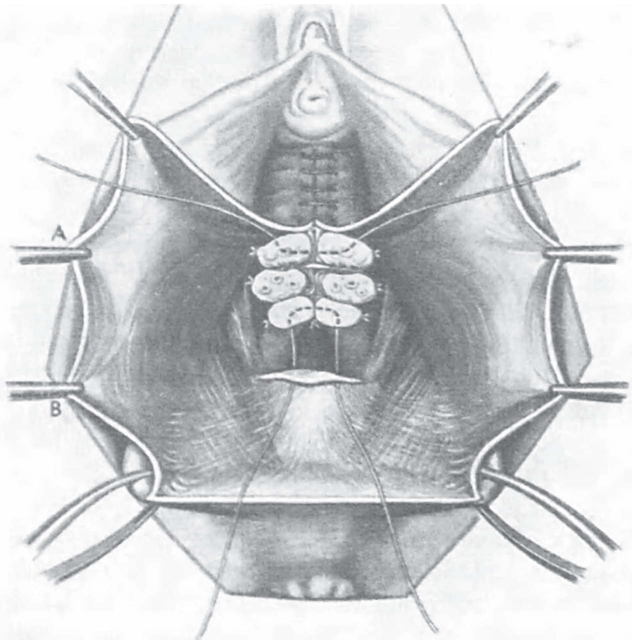

Fig. 9.49: Vaginal hysterectomy. Closure of the uterosacral hiatus. One suture is shown. One or more additional sutures may be required.

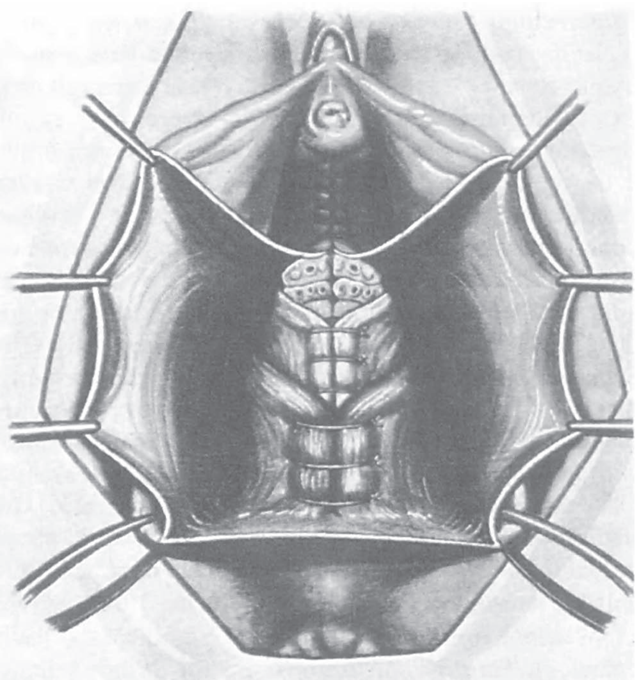

Fig. 9.50: Vaginal hysterectomy. The posterior repair is completed as in Chapter 14, if this proves to be necessary. Often no posterior repair is required.

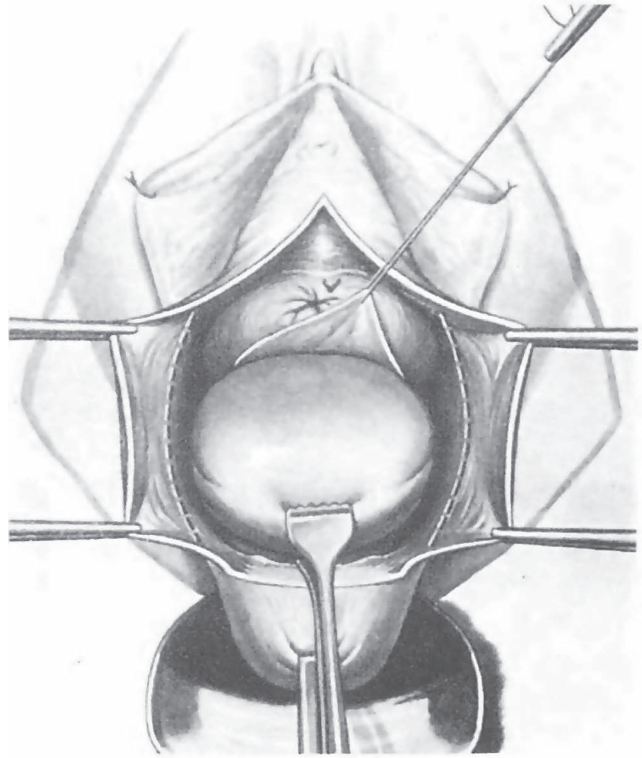

Fig. 9.51: Vaginal hysterectomy. Alternative method, where the fundus of the uterus is pulled down through the uterovesical pouch.

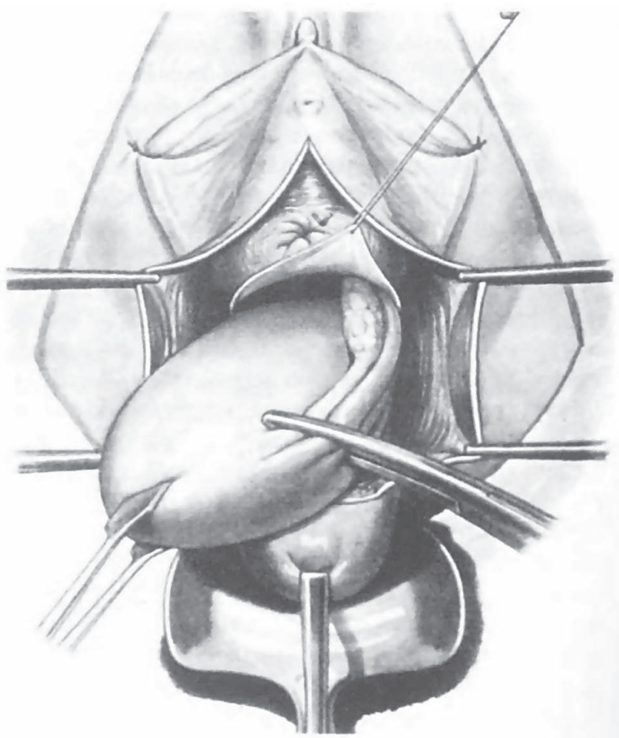

Fig. 9.52: Vaginal hysterectomy (alternative method). The fundus of the uterus is drawn over to one side and, with curved clamps, the ovarian ligament, Fallopian tube and the round ligament are clamped.

the right side of the patient, and the same process is carried out on the right side of the uterus.

The operation can be continued down towards the uterine vessels, which can be clamped, cut and ligated much like it were an abdominal hysterectomy.

2. Opening and Excising the Redundant Pouch of Douglas: At this stage of the operation, the fundus of the uterus should be pulled downwards and towards the surgeon. The pouch of Douglas is then exposed from within the peritoneal cavity, easily exposing any hernia of the pouch. The visualisation can be made easier by everting the pouch of Douglas with a finger placed in the posterior fornix (Fig. 9.54). If a hernia is present, the peritoneum on the posterior surface of the hernial sac is cut through transversely, and the hernial sac stripped away from its posterior attachments until the level of the rectum has been reached. The posterior leaf of peritoneum can be held by a stay suture or a pair of long forceps.

Following division, the uterosacral ligaments may be sutured together (McCall culdoplasty). As the two structures meet in the midline, they help to close off the pouch of Douglas and prevent enterocoele formation.

VAGINAL HYSTERECTOMY IN THE ABSENCE OF UTERINE DESCENT

Prior to commencing a vaginal hysterectomy in the absence of prolapse, as with all surgery, it is important to perform a careful examination of the patient. It is particularly important to assess the vaginal access and the size of the uterus. If there is any clinical doubt, an ultrasound scan can confirm the uterine size and exclude any tubal or ovarian pathology. Careful examination should then be repeated under anaesthetic. A uterine sound can be passed to help confirm the uterine size, and if additional pathology such as adhesions or endometriosis is suspected, a diagnostic laparoscopy carried out.

1. Circumcision of the Cervix: Using a scalpel, a circumferential incision is made around the cervix at the junction between the cervix and the vagina. At this stage, bleeding points can be ignored (Fig. 9.55).

2. Identification and Opening of Pouch of Douglas: In the absence of prolapse, the most straight-forward entry into the peritoneal cavity is often through a posterior colpotomy. Opening the pouch of Douglas at this stage in the operation enables the uterosacral ligaments to be secured. This step can be performed interchangeably, immediately before or after mobilisation of the bladder, at the surgeon's preference.

It is not always easy to identify the peritoneum of the pouch

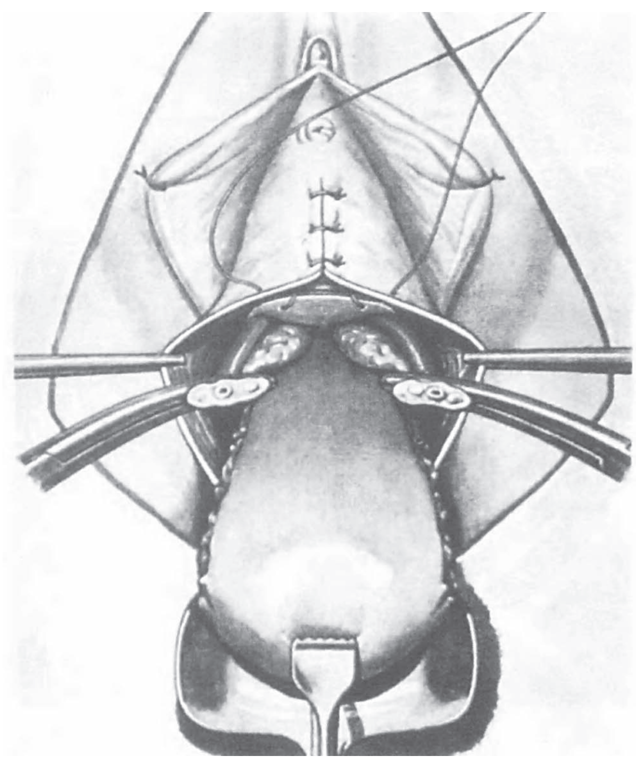

Fig. 9.53: Vaginal hysterectomy (alternative method). Some degree of repair of the anterior vaginal wall has already been carried out. This keeps the bladder back during the rest of the operation. The tissues contained in the clamps have been cut through on the uterine side of the clamps, and the uterus is drawn downwards.

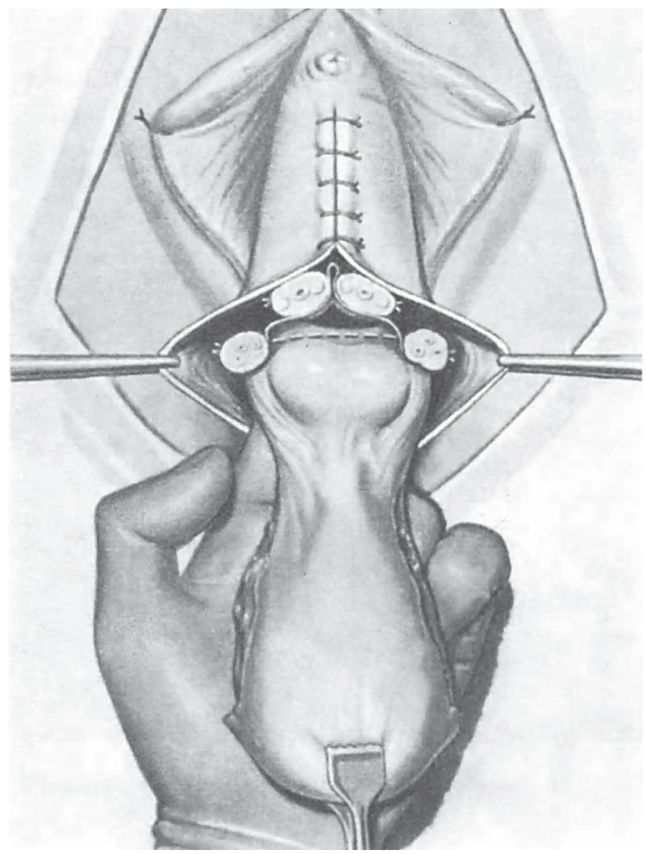

Fig. 9.54: Vaginal hysterectomy (alternative method). If the posterior fornix has not been opened, the fundus of the uterus is drawn downwards and backwards. Two fingers of the left hand can be placed posteriorly, in the posterior fornix and between the uterosacral ligaments, thus elevating the posterior peritoneum of the pouch of Douglas. The upper limit of the peritoneal sac is exposed and the peritoneum divided at the base of the sac along the dotted line. It may be easier to unite the uterosacral ligaments before this is done.

of Douglas. The posterior vaginal wall should be dissected away from the tissues lying on the back of the cervix, and in due course the peritoneum of the pouch of Douglas will be identified. Care must be taken to avoid separating the peritoneum from the back of the uterus. The position of the pouch of Douglas can often be identified by a shallow depression between the two uterosacral ligaments, which is accentuated when the cervix is drawn upwards and forwards. The apex of the peritoneum of the pouch is often further away from the cervix than expected, and the tendency is to make the initial scissor cut too high and miss the peritoneum altogether. It is then necessary to make progressively lower snips until the glistening peritoneal membrane is found. A small gush of free fluid is an additional reassuring proof that the peritoneal cavity has been entered. A stay suture can be inserted at the cut edge of peritoneum.

3. Mobilisation of the Bladder: The next stage is to divide the vesicocervical ligament and expose the vesicocervical space. This part of the operation is more hazardous when the cervix cannot be pulled downwards, as there is a greater risk of injury to the bladder. It may be easier to make a small midline incision in the anterior vaginal wall extending towards the urethral meatus for about 3 cm from the circular incision.

4. Identification of the Uterosacral Ligaments: The cervix is now pulled laterally and a little upwards to expose the side of the cervix. With Mayo's scissors and dissecting forceps, the vaginal wall is stripped away from the deeper structures both laterally and posteriorly. This exposes the downward prolongation of the cardinal ligament, together with the lower extremity of the uterosacral ligament. These structures are then divided, and at each step further descent of the uterus occurs. One helpful technique in the absence of prolapse is to use an aneurysm needle threaded with heavy suture material to ligate each structure in turn (Fig. 9.56). The tissues are then doubly ligated after clamping and separation from the uterus with scissors (Fig. 9.57). The cut edge of the divided tissues is inspected for haemorrhage, and if the haemorrhage has been completely controlled the ends of the ligatures are preserved for fixation to the vault. If possible, each succeeding second ligature should encircle the previous pedicle to eliminate bleeding from any vessel between the two.

5. The Uterine Pedicles: Prior to ligation and division of the uterine vessels, it is essential to ensure that the ureter is well away from the surgical field. If the bladder pillar has been correctly divided, both the bladder and the ureter can be pushed well away from the region of the uterine vessel. Again, a suture passed through an aneurysm needle can be used to ligate the parametrium and uterine vessels prior to clamping and division of the pedicle (Fig. 9.58). For the second ligature, a clamp should be used. It is vital to ensure that the tip of the clamp includes the peritoneum of the broad ligament at both the front and the back. The parametrium is divided close to the uterus medial to the clamp with either scissors or a scalpel. In cases with minimal descent, all the tissues are being stretched. Great care should therefore be taken when placing clamps and ligatures as there is a risk that the uterine vessels can retract upwards away from either the clamp or the ligature. This is less likely to happen if a small cuff of tissue is left distal to the clamp.

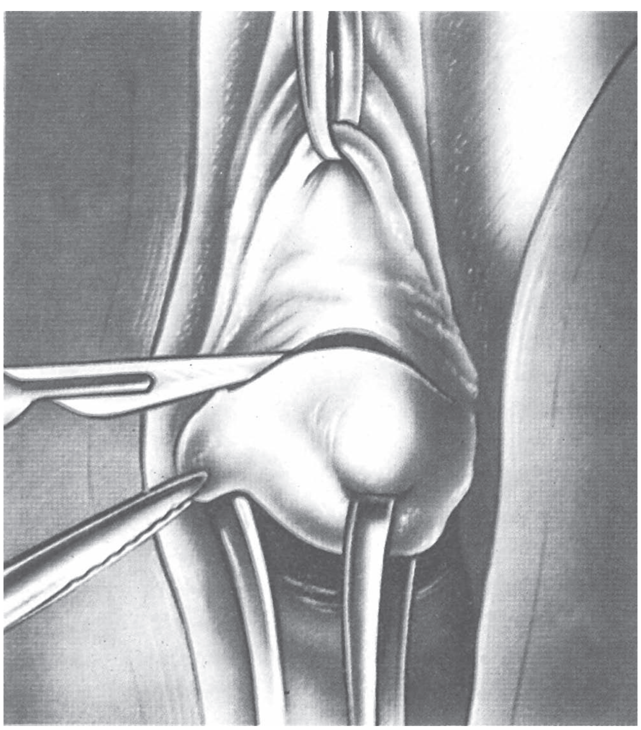

Fig. 9.55: Vaginal hysterectomy without prolapse. Circumcision (circumferential incision) of the cervix.

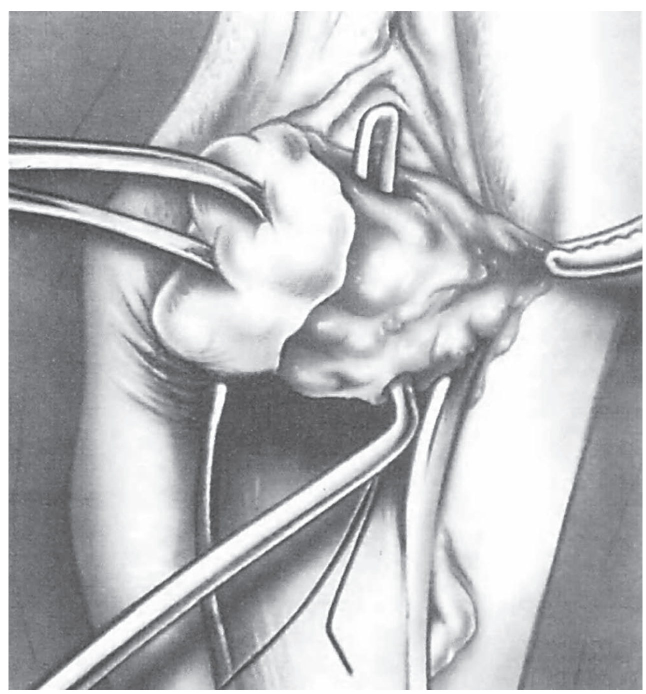

Fig. 9.56: Vaginal hysterectomy without prolapse. Ligature of the cardinal ligament using a modified aneurysm needle (after Gwillim).

6. Delivery of the Uterus: At this stage of the operation, the fundus of the uterus can often be drawn through the pouch of Douglas. The attachments of the round ligament, the Fallopian tube and the ovarian ligament to the uterus are now taken in a hysterectomy clamp and separated from the uterus after being doubly ligated with a heavy suture (e.g. No. 1 polyglycolic acid) (Fig. 9.59).

7. Closure of the Peritoneal Cavity and Vagina: The long sutures of the uterosacral ligaments can then be tied with an empty needle to the posterior peritoneum and the posterolateral vaginal walls or vaginal angles, and the anterior and posterior incised edges of the vault closed transversely with a continuous suture in a similar fashion to that described above. It is important to include the posterior peritoneal surface with the vaginal vault suture to minimise the risk of bleeding vessels between the two cut edges. Previously, the anterior uterovesical peritoneum was approximated to the posterior peritoneal edge and the vaginal vault, although this is now less common practice.

Oophorectomy at Vaginal Hysterectomy

Proponents of laparoscopic and abdominal surgery will often site the need for concurrent oophorectomy as a contraindication to the vaginal route for hysterectomy. It has been shown, however, that in the hands of experienced vaginal surgeons, vaginal oophorectomy is possible in more than 95% of cases.[64,65] Different techniques have been described, including the use of a laparoscopic endoloop to take the infundibulopelvic ligament. Oophorectomy is more easily achievable in the context of patients with uterine descent and an adequate introitus. In cases with limited vaginal access or no uterine descent, oophorectomy has been described using transvaginal endoscopic oophorectomy,[63] or by performing a laparoscopic-assisted vaginal hysterectomy, where the ovaries are taken first, prior to the vaginal component of the operation.

Using conventional vaginal surgical instruments, the authors' preferred technique is to divide the round ligament vaginally after the uterine artery pedicle. Then an angled clamp (e.g. Heaney forceps) is used to clamp the infundibulopelvic ligament as close to the ovary as possible. The Fallopian tube and ovary can then be removed and the pedicle double-tied with a No. 1 polyglactin suture. Care must be taken for the ureter,

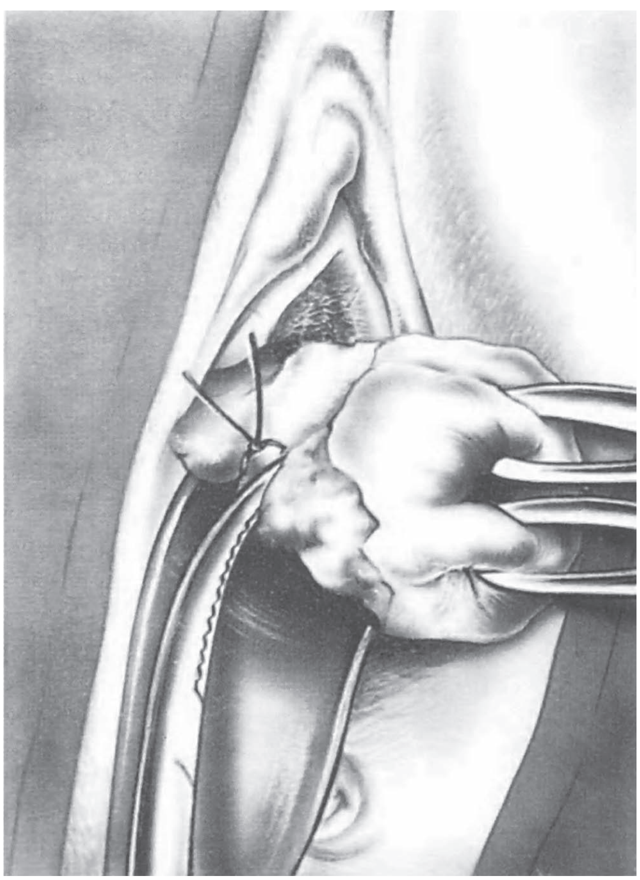

Fig. 9.57: Vaginal hysterectomy without prolapse. Application of clamp prior to incision and insertion of second ligature by suture.

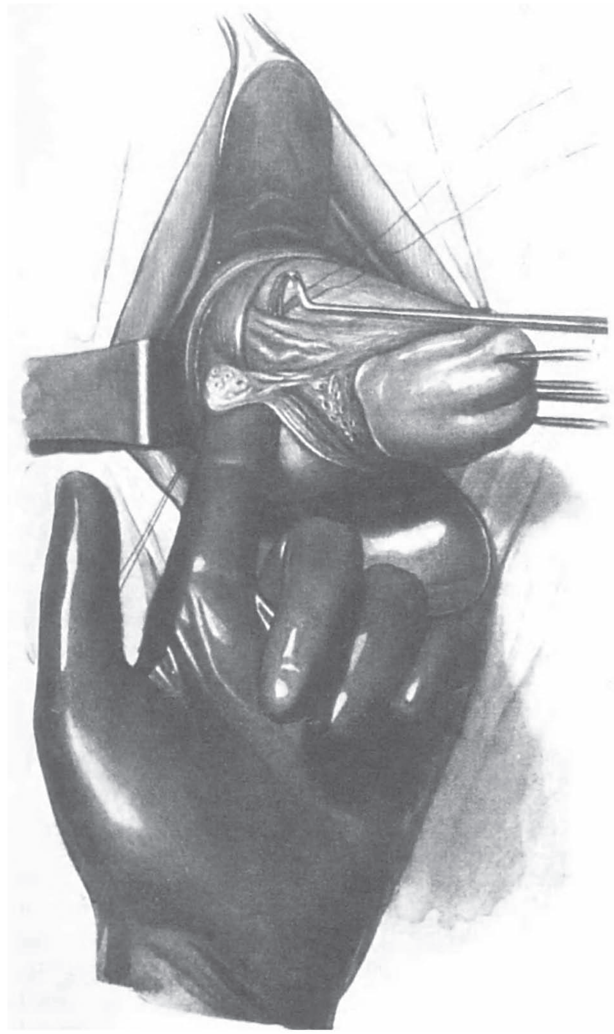

Fig. 9.58: Vaginal hysterectomy without prolapse. The uterine vessels are being encircled by a ligature introduced with an aneurysm needle. The divided uterosacral ligament, combined with the cardinal ligament, is being held up and exposed with the index finger of the surgeon's left hand.

which runs along the pelvic-sidewall posterior to the infundibulopelvic vessels. As described by Sheth, it may is beneficial to divide the round ligament and ovarian ligament on one side first, keeping a long tie on these pedicles, before taking the contralateral round ligament and then the infundibulopelvic ligament, using the vulsella on the uterus for traction to bring the pedicle towards the surgeon. This allows the uterus and one tube and ovary to be removed, and allows space to then proceed with taking the infundibulopelvic ligament of the remaining tube and ovary to complete the operation.[65]

The Larger Uterus at Vaginal Hysterectomy

Another common contraindication to the vaginal route of hysterectomy is a large uterus. Again, however, in experienced hands, this need not be the case. Using intra-operative techniques to morcellate the uterus, such as bisection, myomectomy and coring, larger uteri of up to at least 18–20 weeks size can be approached vaginally.[30,32,65] In fact, the literature reports successful vaginal hysterectomy for uteri weighing 1100 grams.[31] Each technique involves the use of Vulsellum forceps to provide downward traction, whilst the uterus is incised with a scalpel blade. Individual fibroids can be removed once their pseudocapsule has been incised. The fibroids can then be grasped with a Vulsellum forceps or Littlewoods forceps, and removed with sharp or blunt dissection and traction. Great care must be taken to protect adjacent structures, such as the vaginal walls, the bladder, the rectum and the small bowel. This is achieved with the help of lateral wall vaginal retractors, a Sims speculum and a small degree of head-down tilt.

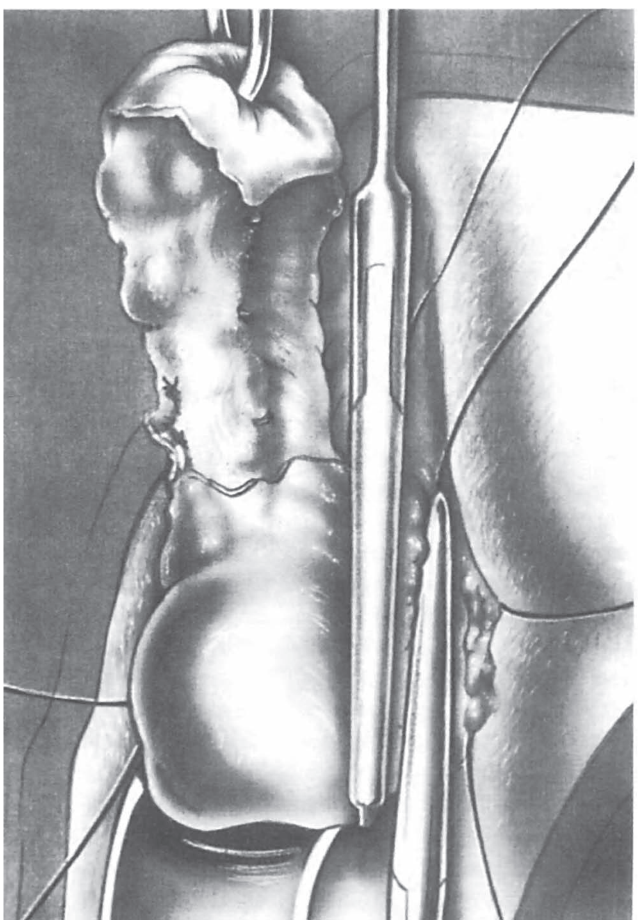

Fig. 9.59: Vaginal hysterectomy without prolapse. After delivery of the uterine fundus, the broad ligaments with Fallopian tubes and round ligaments are secured by double clamps prior to ligature.

SURGICAL TECHNIQUES FOR LAPAROSCOPIC HYSTERECTOMY

Laparoscopic hysterectomy was first described in 1989 by Reich.[39] Many modifications and developments to this technique have been described such that it is now necessary to classify the various procedures available. A simple classification is as follows:

1. Diagnostic laparoscopy with vaginal hysterectomy.[38] In this procedure, a diagnostic laparoscopy is carried out in order to ascertain that a vaginal hysterectomy is appropriate and feasible (e.g. to evaluate an ovarian cyst, the degree of adhesions and uterine fixity).
2. Laparoscopic assisted vaginal hysterectomy (LAVH) with or without bilateral oophorectomy.
3. Laparoscopic supracervical (sub-total) hysterectomy, with or without coring of the endocervical canal.[74,75]
4. Laparoscopic total hysterectomy, with or without bilateral oophorectomy.[76]

Equipment and Instrumentation

A good laparoscope, light source and video camera, along with modern CO_2 insufflator and diathermy electrosurgical units are essential pre-requisites. The choice of instrumentation available can be bewildering, and in the authors' view keeping the equipment simple and reproducible is important. The instruments necessary for straightforward laparoscopic hysterectomy will be described, but it is recognised that some units will have access to additional facilities. Disposable instruments have the advantage of requiring no maintenance, and of the assurance that scissors are sharp and forceps will grasp firmly, but their expense may prevent usage in some centres. Basic requirements include atraumatic grasping forceps, curved diathermy scissors, bipolar diathermy forceps and a suction irrigation device. Instruments should ideally have rotatable operating heads so that tissue can be handled in any plane. Sutures, clips, stapling devices, integrated vessel sealing and cutting instruments and ultrasonic scalpels have all been described to secure vascular pedicles, although none are essential for laparoscopic hysterectomy, but may be part of an individual surgeon's choice. Stapling devices allow for rapid surgical progress but they require 12 mm cannulae with higher port placement. In addition, they are expensive and may increase the risk of ureteric damage. Electrosurgery, whilst involving an initial capital outlay, is versatile, effective and does not necessitate the expense of disposable instruments. It is essential that both surgical and theatre staff are familiar with whichever instruments and equipment are to be used. A standard set of instruments for the vaginal aspect of the hysterectomy should be available.

Preparation

The patient is positioned in a modified lithotomy position, with minimal leg flexion at the hip. The operating table is horizontal initially. Vaginal preparations include indwelling catheterisation, sterilisation of the vagina with an aqueous antiseptic and insertion of a uterine manipulator. A standard laparoscopy is performed as described in Chapter 3. Typically two accessory ports are then inserted. The authors' preference is for two lateral ports, in the lower left and right abdomen. These are inserted under direct vision, at 90 degrees to the abdominal cavity, lateral to the inferior epigastric vessels (Fig. 9.60). If diathermy is the sole haemostatic modality being used, 5 mm ports are sufficient. If stapling devices are to be used, however, a 12 mm port will be required, and can be placed suprapubically. At this stage, the patient should be positioned in a steep Trendelenburg position (20–30 degrees). The pelvic organs are inspected, using the uterine manipulator to expose the adnexa and pouch of Douglas. It is important to assess any pathology of the pelvic organs, the presence or absence of adhesions, and mobility of the uterus. A brief inspection of the rest of the abdomen is made, including the appendix, liver, gall bladder and upper abdomen. Before proceeding to hysterectomy, adhesions should be divided to normalise the anatomy and optimise the view of the surgical field.

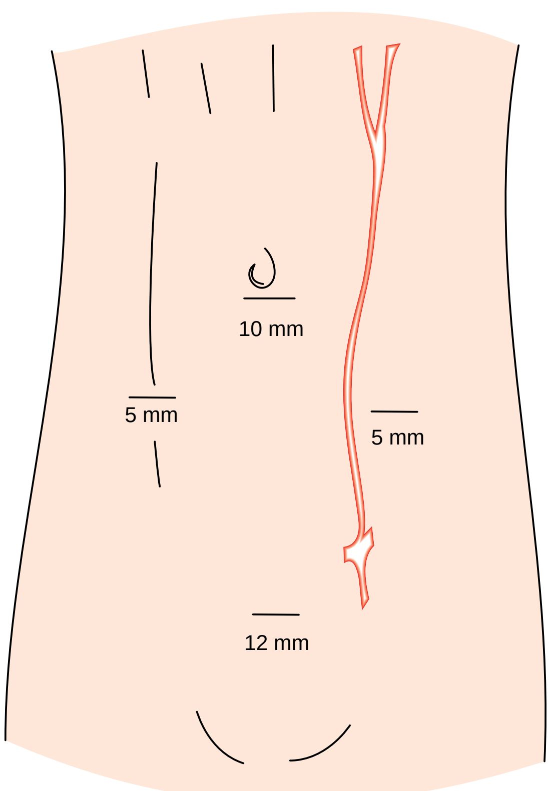

Fig. 9.60: The placement of trocars for laparoscopic hysterectomy. Note the relationship to the inferior epigastric vessels. The 12 mm suprapubic port is not essential, and is only recommended if larger instruments such as stapling devices are required.

Operative Technique

1. Dividing the Round Ligament and Ovarian Vessels: Having ascertained that the case is suitable for laparoscopic hysterectomy, the surgeon is now ready to proceed. Using the vaginally placed uterine manipulator, the assistant deviates the uterus to the right hand side to expose the left tube and ovary and the infundibulopelvic ligament. The round ligament is grasped with atraumatic forceps and coagulated with bipolar diathermy forceps before it is divided from the left hand port (Fig. 9.61). For ovarian conservation, the ovarian vessels are then coagulated with bipolar electrodes in at least two adjacent "bites", and the ovarian ligaments are divided using scissors or an ultrasonic scalpel to meet the divided round ligament (Figs. 9.62, 9.63). In the case of concurrent salpingo-oophorectomy, once the round ligaments are divided, the retroperitoneal space is then entered between the round ligament and the infundibulopelvic ligament using diathermy scissors or a harmonic scalpel, and the peritoneum opened sufficiently to identify the ovarian vascular pedicle and the ureter. Once the ovarian vessels have been adequately denuded of fat and peritoneum, they are grasped with bipolar forceps and thoroughly coagulated in at least two separate adjacent "bites" with bipolar electrodes. The ovarian vessels may then be divided, and the ovary and tube freed from their peritoneal attachments by extending the division of the peritoneum with the broad ligament down to the already divided round ligament (Figs. 9.64–9.67). The procedure is then repeated on the right side, starting with division of the right round ligament through the right lateral port (Fig. 9.68).

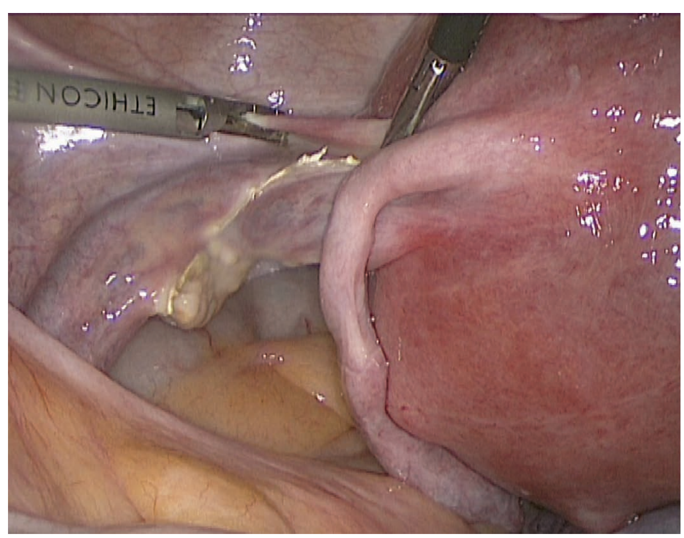

Fig. 9.61: Division of the left sided round ligament. In this image, the left tube has been separated from its mesosalpinx and will be removed with the uterus. The left sided ovarian vessels have not been divided yet.

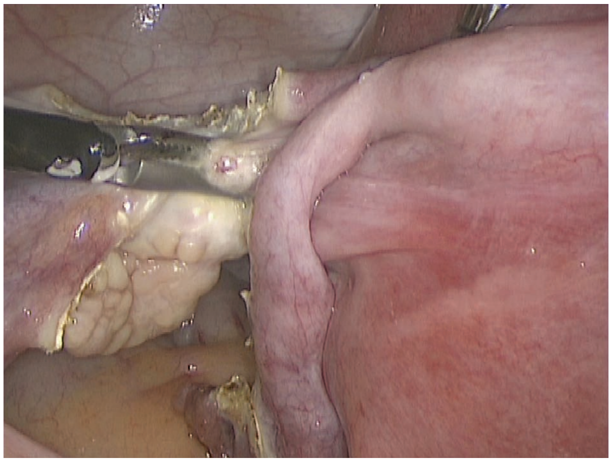

Fig. 9.62: Ovarian conservation. The round ligament has been divided. Bipolar forceps are being used to coagulate the vessels of the left ovarian ligament before it is divided.

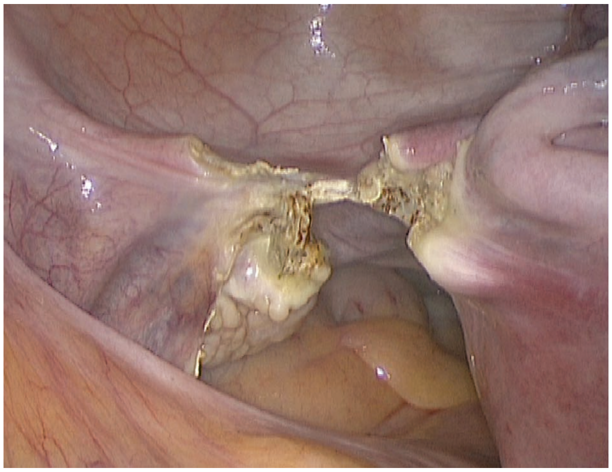

Fig. 9.63: Ovarian conservation. The left round ligament and ovarian ligament have both been divided. The left ovary has been conserved but the Fallopian tube has been removed from its attachments to the left ovary, and will be removed with the specimen. The tube, still attached to the uterine corpus, is being retracted medially from view. The broad ligament has been partially divided beyond the round ligament, inferomedially towards the uterovesical fold.

2. Reflecting the Bladder: The uterovesical peritoneum is then opened by extending the incision from the lower margin of the round ligament, downwards at first and then immediately towards the loose fold of uterovesical peritoneum, which should be picked up in the midline with grasping forceps placed through the opposite lower port. The grasping forceps will tent the peritoneum so that scissors can be placed to divide the peritoneum, just as in an abdominal hysterectomy (Figs. 9.69, 9.70). The same procedure with regard to the uterovesical peritoneum is carried out from the other side, and the bladder is then dissected from the anterior wall of the uterus and cervix, using a combination of diathermy and scissors (Fig. 9.71). Probe dissection with the flushing irrigation cannula can also

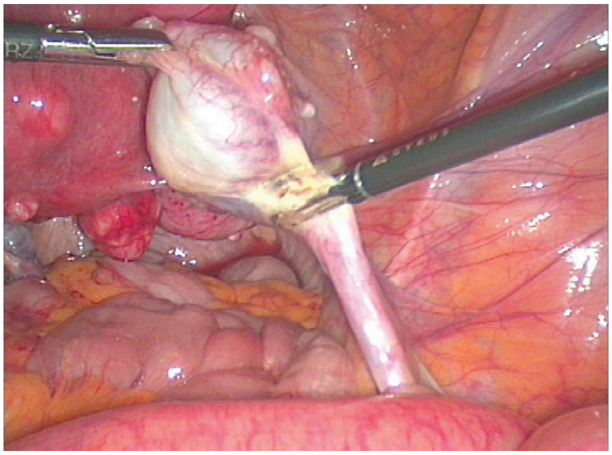

Fig. 9.64: Concurrent oophorectomy. The right infundibulopelvic ligament containing the right ovarian vessels is being coagulated with at least two adjacent applications of the bipolar electrode forceps before it can be safely divided.

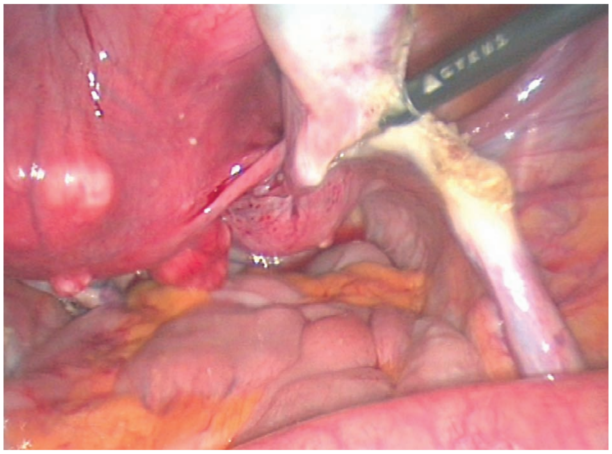

Fig. 9.65: Concurrent oophorectomy. The right ovarian vessels have been divided. The ovary and tube are being separated from their peritoneal attachments (the broad ligament).

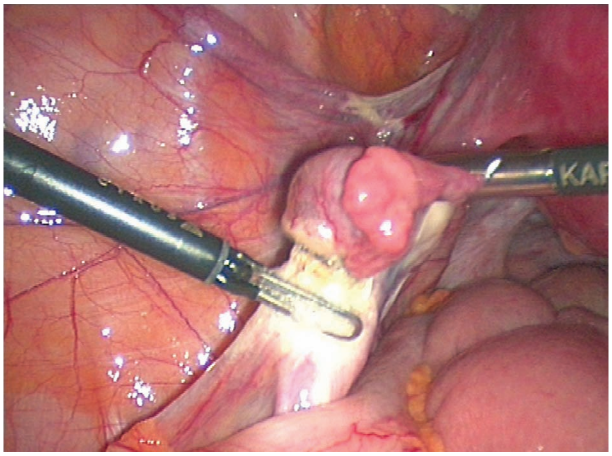

Fig. 9.66: Concurrent Oophorectomy. The left infundibulopelvic ligaments are being coagulated. Care should be taken to avoid lateral thermal damage to the sigmoid colon. The left ureter has already been identified.

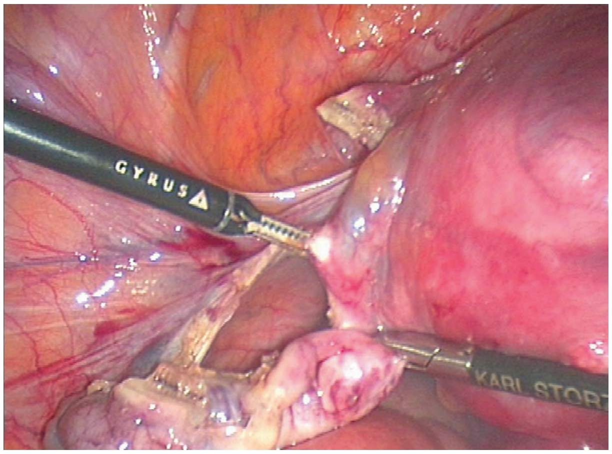

Fig. 9.67: Concurrent oophorectomy. The right ovarian vessels have been divided. The ovary and tube are being separated from their peritoneal attachments. The cut medial edge of the round ligament is visible.

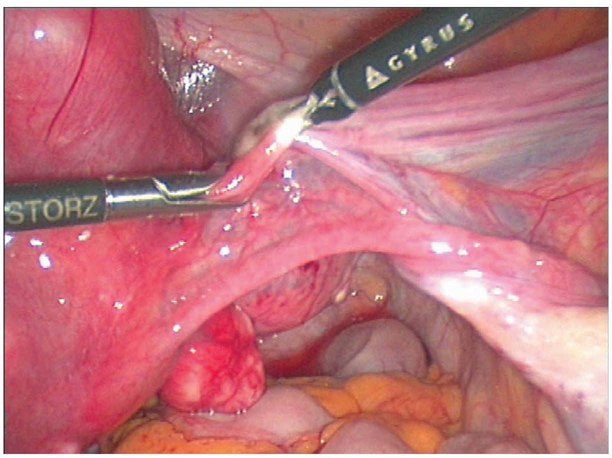

Fig. 9.68: Coagulation of the right round ligament with bipolar forceps. A single application with bipolar electrodes is usually sufficient prior to division of the relatively avascular round ligament.

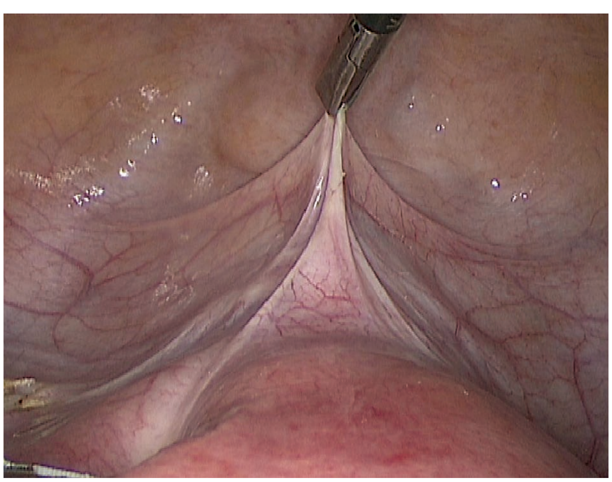

Fig. 9.69: Tenting the uterovesical peritoneal fold with grasping forceps.

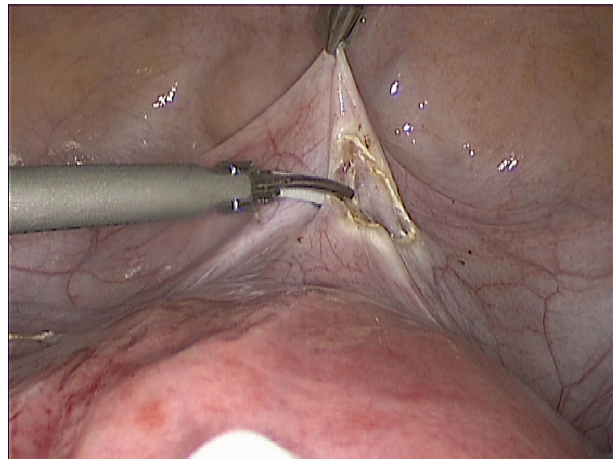

Fig. 9.70: Opening the uterovesical peritoneal fold to enable dissection of the bladder away from the uterus.

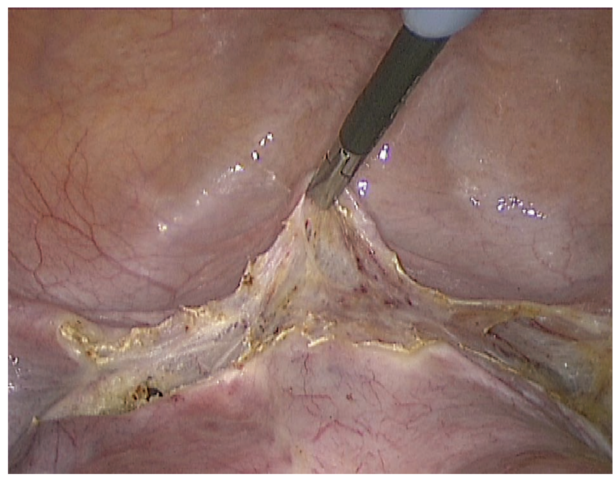

Fig. 9.71: The uterovesical peritoneum has been divided laterally to meet the division of the anterior leaf of the broad ligament. The cut edge of the left round ligament is clearly visible. The bladder must now be dissected further off the uterus and carefully reflected inferiorly, as in open abdominal hysterectomy.

be used in addition. The bladder is freed until the vaginal wall is identified.

3. The Uterine Vessels: Many surgeons will regard the laparoscopic part of the procedure as now complete, and will clamp the uterine vessels in the vaginal part of the operation. The uterine artery can be ligated laparoscopically, however, following inferior reflection of the bladder. By manipulating the uterus vaginally to expose the lateral border of the uterine corpus, the anterior and posterior leaves of the broad ligament can be carefully divided close to the body of the uterus with monopolar diathermy or scissors (Figs. 9.72, 9.73). A magnified view of the uterine vessels can then be obtained.

Once skeletonised, the uterine artery is seen as a tortuous vessel running medially towards the uterus, then superiorly against the lateral border of the uterine corpus. The uterine vessels can then be divided laparoscopically, close to the uterine corpus, medial to the ureter, after first using bipolar diathermy to coagulate the vessels in at least two different adjacent "bites" (Figs. 9.74–9.76). Alternatively, after the artery has been "skeletonised", it may be ligated with a suture and knot pusher, or clamped with a stapling device. If there is any bleeding evident at this stage, the pelvis should be washed out with the suction irrigation device, and attention given to any small bleeding vessels. In the case of LAVH, this is important to perform before the surgeon moves to the vaginal part of the operation. The pneumoperitoneum can then be released, but the laparoscopic operating ports left in place.

Vaginal Component of LAVH

A Sims speculum is inserted into the vagina, and the uterine manipulator removed. The procedure follows the technique for

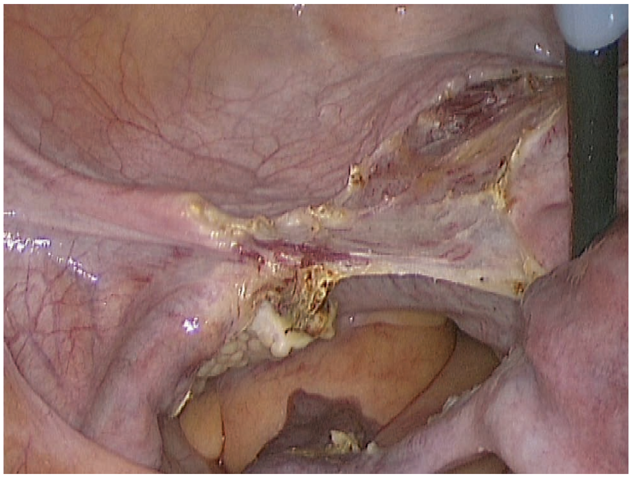

Fig. 9.72: The anterior leaf of the broad ligament has been divided and the bladder has been reflected inferiorly. The posterior leaf of the broad ligament must be carefully divided to skeletonise the uterine vessels. This is further demonstrated in Fig. 9.73, on the right side of the uterus.

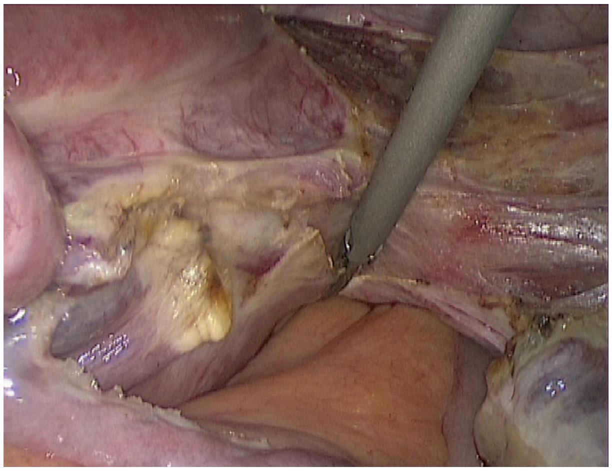

Fig. 9.73: Division of the posterior leaf of the broad ligament on the right side towards the uterosacral ligament.

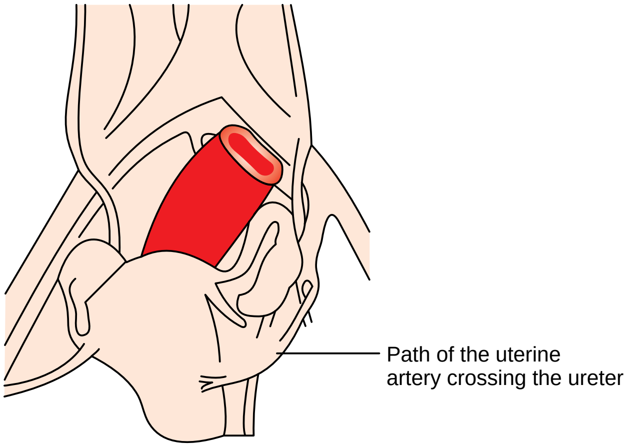

Fig. 9.74: Angulation and counter-traction on the uterus allows identification of the ureter and uterine vessels. As with open abdominal hysterectomy, ligation of the uterine vessels close to the uterus, medial to the ureter, is perfectly feasible provided the bladder has been pushed well down.

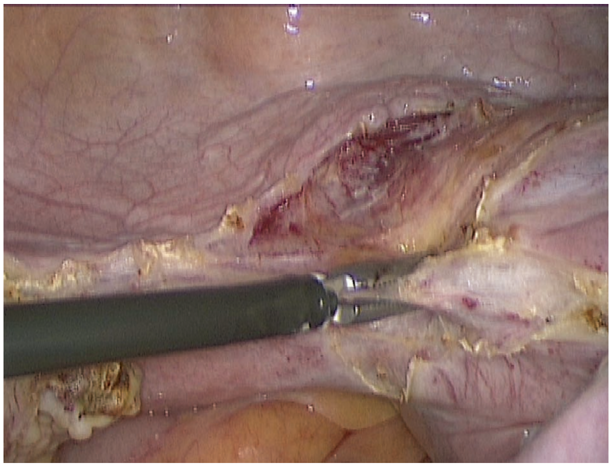

Fig. 9.75: Bipolar diathermy to coagulate the left sided uterine vessels.

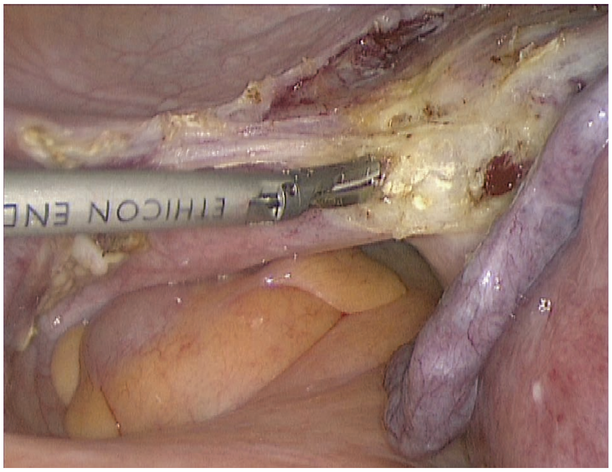

Fig. 9.76: Division of the left sided uterine vessels. A small amount of "back-bleeding" is visible from the uterine end of the vessels.

vaginal hysterectomy set out above. The uterine arteries can be ligated vaginally if not already divided laparoscopically. Commonly, a small area of charring may be seen on the uterus at the level of the tissue that has been successfully coagulated with electrocautery laparoscopically.

Eventually, the uterus and ovaries can be delivered vaginally. At closure, the uterosacral ligament pedicles may be tied together in the midline and fixed to the vaginal incision, which is then closed incorporating the peritoneal edge, using high polymer suture material. Once the vagina is closed, it is advisable to reinsufflate the abdomen and inspect the uterine bed to check for haemostasis again. Some surgeons insert a drain via one of the laparoscopic ports to be brought out either abdominally or vaginally, and this is certainly worthwhile if there is any appreciable blood loss. The laparoscopic ports are then removed and the incisions sutured. A catheter may be left in the bladder for 24 hours, but is not essential. Vaginal packing is not normally necessary.

Total Laparoscopic Hysterectomy

Following ligation of the uterine vessels, the remainder of the hysterectomy can be performed laparoscopically. This is arguably more challenging for the inexperienced laparoscopic surgeon, but has advantages over vaginal surgery in certain cases involving, for example, difficult vaginal access, poor uterine descent or a large uterus. Ultimately the type of laparoscopic hysterectomy performed will be governed by the surgeon's experience and technical feasibility.

Separating the cervix from the vagina laparoscopically can be difficult. Identification of the cervicovaginal junction requires inward pressure from a vaginally-placed uterine manipulator (e.g. a Spackman cannula or uterine sound or dilator). This helps to stretch the cervix and upper vagina away from the reflected bladder, and ensures that the vaginal fornices are stretched above the path of the ureter. Once the vagina is opened, however, the pneumoperitoneum, and hence the laparoscopic view, is lost. This problem can be overcome by the use of a wide-bore plastic tube such as the McCartney tube[77] (see Fig. 9.77). The firm, transparent polypropylene tube is electrically inert and is closed at the distal end to prevent loss of pneumoperitoneum once the vagina is opened. It can also be employed to enable exposure of the cervicovaginal junction and stretch the vaginal fornices.

The tube is inserted into the vagina, and pushed up towards the cervix. It may be necessary to mobilise the bladder further to improve the anterior vaginal exposure. Once the cervicovaginal junction is clearly in view, the anterior vagina can be opened laparoscopically with a monopolar diathermy hook or scissors, or ultrasonic scalpel device (Fig. 9.78). The tube can be used to stretch and manipulate the uterus and upper vagina, allowing protection for the bladder anteriorly, the ureters laterally and the rectum posteriorly, as the vagina is circumcised and the uterosacral ligaments divided (Figs. 9.79, 9.80). The rim of the tube provides an excellent anatomical marker for the cervicovaginal junction.

Once the uterus has been separated from the vagina, a laparoscopic grasper can be used to pass the cervix and after-coming uterus into the opening of the vaginal tube, allowing the tube and specimen to be removed vaginally (Fig. 9.81). Just prior to removing the tube, the pneumoperitoneum should be temporarily deflated through an abdominal port to prevent a sudden rush of gas and aerosolised fluid from the open vagina. Once the cervix is visible in the mid-vagina, it can be grasped with a Vulsellum forceps to enable removal. If the uterus is too large to be removed vaginally, a Sims speculum can be inserted into the vagina to protect the posterior vaginal wall, and the specimen can be morcellated carefully with a scalpel. Bisection of the uterus may be sufficient. Alternatively, in the case of a larger, fibroid uterus, the specimen can be carefully 'cored' with a scalpel, until its volume has been sufficiently reduced to allow for removal vaginally.

In order to close the vaginal vault laparoscopically and check for haemostasis, the abdomen must be re-insufflated. The tube

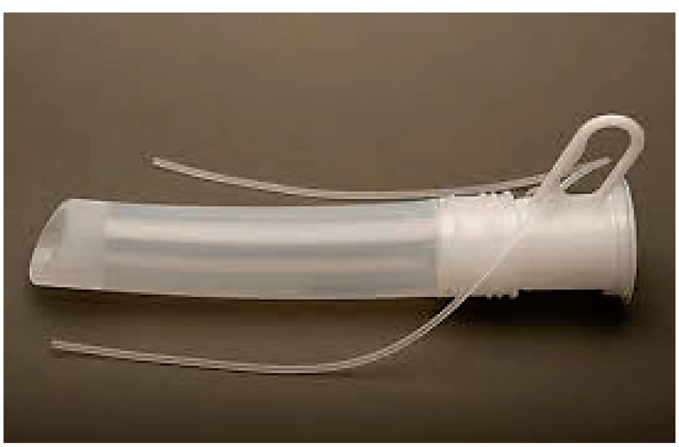

Fig. 9.77: The McCartney tube, Gynetech Pty Ltd, Australia.

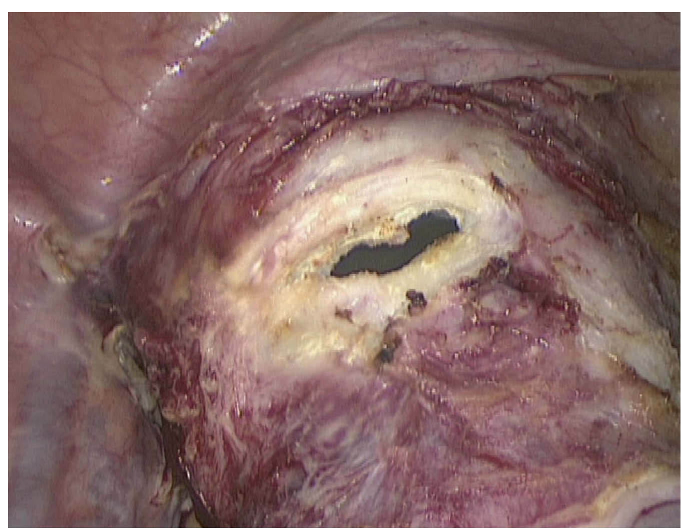

Fig. 9.78: The anterior vagina has been opened. The reflected bladder is seen anteriorly, well clear of the incision. The vaginal tube maintains the pneumoperitoneum and aids exposure of the cervicovaginal junction.

is re-inserted, allowing for an adequate pneumoperitoneum. The vaginal vault can then be sutured laparoscopically using intra- or extra-corporeal knots. Alternatively, using the technique described by McCartney and Johnson, a needle can be placed in the vaginal tube, with the suture trailing out of the tube and outside the vagina (Figs. 9.82–9.84).[77] The author prefers a No. 1 monofilament high polymer suture.

Alternative Technique

An alternative method employs the use of endo-GIA staples, but these are costly and need great care in application, with particular regard being paid to the course of the ureter. Phipps has advocated the use of illuminated ureteric splints to enable the course of the ureter to be identified at all times during the operation,[76] but this is again a costly and time consuming addition to the operation.

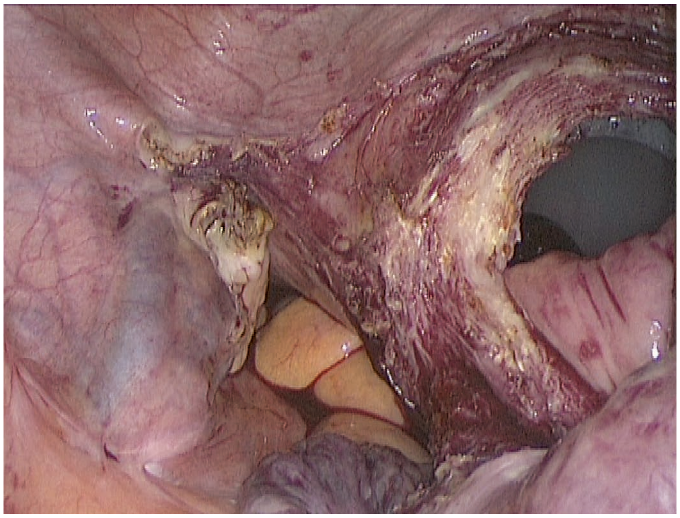

Fig. 9.79: Circumcision of the vagina at the cervicovaginal junction (1). A grasper is holding the cervix out of view under tension. The monopolar scissors or ultrasonic scalpel is used to divide the vaginal tissue overlying the McCartney tube. The tube can be used to push the vaginal fornices upwards, away from the bladder and ureters.

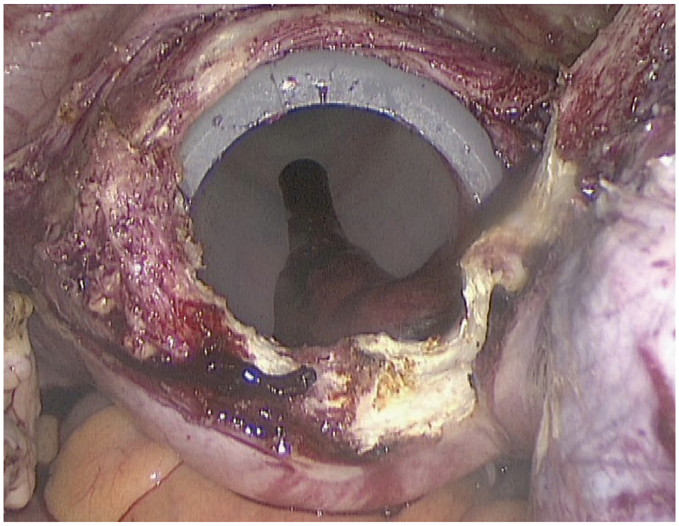

Fig. 9.80: Circumcision of the vagina at the cervicovaginal junction (2).

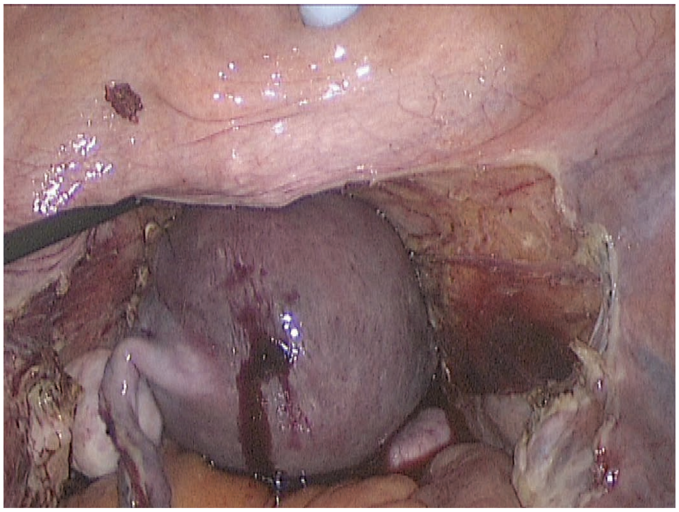

Fig. 9.81: The specimen is passed into the vaginal tube to allow removal vaginally. Note the dusky tissue colour of the devascularised uterus.

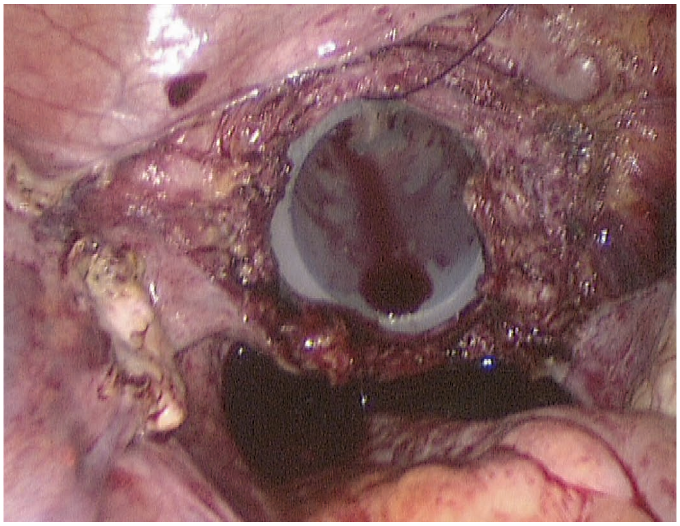

Fig. 9.82: A suture needle has been passed into the peritoneal cavity via the vaginal tube. The trailing end of the suture is lying between the tube and the vaginal mucosa, and is passing out of the vagina.

Operative Variations

Conservation of Ovaries

If the ovaries and tubes are to be conserved, the only modification to this technique is that the round ligament is grasped at its insertion to the uterus and pulled medially and then coagulated and divided some 2–3 cm from the uterine insertion. The Fallopian tube can be similarly coagulated and divided, or removed with the uterus despite ovarian conservation.

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Salpingectomy in such cases involves simply dividing the mesosalpinx to separate the tube from the ovary. Following this, the broad ligament is then opened, and the anterior and posterior leaves of the broad ligament are then dissected with care to avoid injuring the veins within the broad ligament. Identification of the uterine artery and dissection of the bladder proceeds as above. Many surgeons feel that there are few cases when laparoscopic assistance for vaginal hysterectomy with conservation of ovaries is necessary, and would prefer to carry out a straightforward vaginal hysterectomy.

Laparoscopic Subtotal Hysterectomy

Preservation of the cervix may be desirable in certain circumstances such as pelvic inflammatory disease with a cervix that has restricted mobility, or an obese patient with large fibroids. Previous Caesarean section with a bladder adherent to the lower uterine segment or cervix may be another relative indication for this procedure, and in addition the patient herself may have a preference for subtotal hysterectomy, in the hope that retention of the cervix might preserve better sexual function. Several techniques have been described for preserving the cervix, notably by Semm[74] and Lyons.[75] More recently, laparoscopic electrosurgical loop devices specific to supracervical hysterectomy have been introduced. The technique is similar to laparoscopic assisted vaginal hysterectomy, including dissection of the bladder from the lower uterine segment, although complete separation down to the vagina may not be necessary. After division of the uterine vessels, the cervix is divided at or below the endocervical os using a cutting diathermy hook or needle, and a coring technique to remove the upper end of the cervical canal. The stump of the cervix is inspected for bleeding vessels, which may be coagulated, and Lyons recommends approximation of the anterior and posterior peritoneum with an interrupted mattress suture of polyglactin. In the 'intrafascial' technique described by Semm, the cervical canal and lower uterus are "cored" out using a transcervical coring instrument prior to removal of the uterus.[74]

The major difficulty with laparoscopic subtotal hysterectomy is to remove the uterus through laparoscopic portholes. It will almost always be necessary to morcellate the uterus at least by hemisection. One simple technique is to transfer the laparoscope into one of the lower ports, remove the umbilical port and extend the umbilical incision to 2–3 cm, and extract the hemisected uterus with a strong pair of grasping forceps. Various electrical morcellating devices exist that are useful for larger uterus. They require up to 15 mm ports, and great care is needed with these potentially dangerous instruments. Their use can be time-consuming, and the degree of morcellation may make histological examination more difficult.

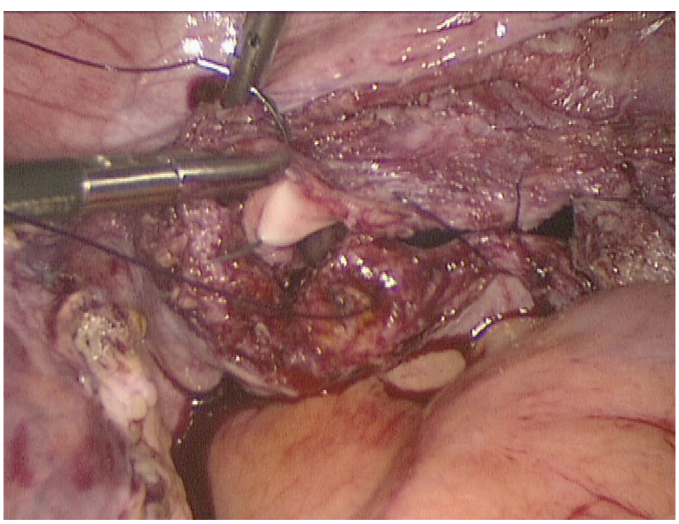

Fig. 9.83: The vault is being closed laparoscopically using a grasping forceps and a needle holder. Following approximation of the vault laparoscopically, the needle can be passed back through the vault, into the tube, and the tube and suture removed from the vagina. The two ends of the suture can then be tied extra-corporeally from the vaginal end. Once the vault is closed, haemostasis can be checked laparoscopically.

COMPLICATIONS OF HYSTERECTOMY

Mortality rates after hysterectomy have fallen dramatically with the advent of antibiotics and aseptic techniques.[70] Little over 100 years ago, hysterectomy mortality rates were as high as 70%.[24] The figure today is in the region of 10 to 20 per 10,000 cases (0.1–0.2%).[32] This rate is affected by patient age, with mortality rates ranging from 3–7/10 000 cases under the age of 55 years to 173/10,000 for 75 year olds and above. Correcting for age, mortality rates are also affected by the pathology. Pregnancy-related hysterectomy carries a mortality rate of around 29/10,000 and hysterectomy for malignancy around 38/10,000.[78]

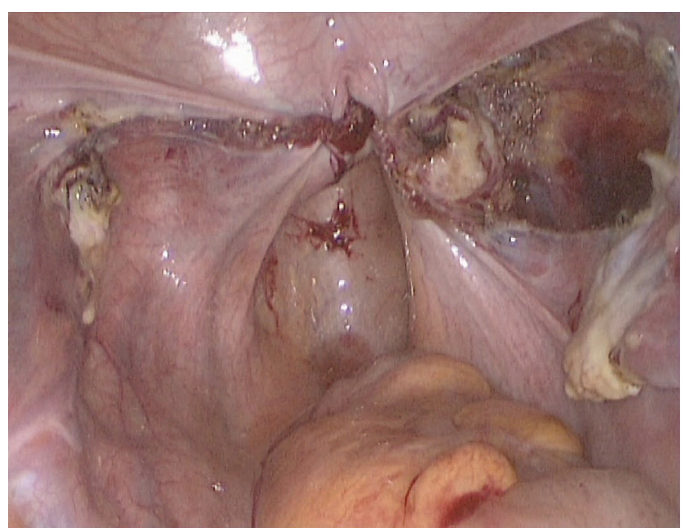

Fig. 9.84: Laparoscopic view of the closed vaginal vault. In this image, the cut edges of the anterior and posterior peritoneum have been approximated. Alternatively, the anterior vaginal edge can be approximated to the posterior vaginal edge and posterior peritoneum without including the anterior pelvic peritoneum.

Table 9.10: Predictors of major morbidity in the 30 days after major benign gynaecological surgery[83]

Predictor	Adjusted odds ratio (OR)
Ascites	6.6
Unintended weight loss >10% in past 6 months	4.2
Pre-operative systemic infection	2.6
Known bleeding disorder	2.5
Operative time (hours)	
< 1	1 (reference)
1–2	1.2
2–3	1.7
3–4	2.2
> 4	3.3
Morbid obesity (BMI >40 kg/m^2)	2.0
Age >80 years	1.9
Emergency procedure	1.8
Pre-operative functional status	1.8
Current smoker	1.5
Diabetes mellitus	1.5

Surgical complication rates are inherently difficult to quantify. Comparison is hampered by the variety of definitions and classification systems for complications reported in the literature. Many studies look retrospectively at nationally collected statistics. This allows for large datasets, but is likely to represent under-reported complications. Even large, multicentre, randomised controlled trials will undoubtedly be subject to a degree of either over- or under-reporting bias. When considering generic statistics, it is important to remember that complication rates will depend on a number of factors including the individual surgeon, experience level of theatre staff, anaesthetic factors, the patient's pathology, age and co-morbidities, and the standard of postoperative care. As with all surgery, careful pre-operative selection of patients is crucial to minimise complications.

Historically, two personal series of 1000 cases, together with data from a collaborative study provided the "bench mark" for the morbidity and mortality of hysterectomy for benign conditions.[79,80] Dicker produced further data on complication rates,[81,82] but since then many new studies have been undertaken. Indications for hysterectomy, surgical practices and available antibiotics are just a few of the many contributory factors affecting complication rates, which have changed dramatically in the last half century. It is therefore reasonable to consider the most up-to-date, robust published data when discussing surgical complication rates.

In the US, a recent analysis of 22,214 women undergoing major gynaecological procedures for both benign and malignant pathology quoted an overall 30 day postoperative major complication rate of 3.7%. Predictors of major postoperative morbidity after benign gynaecological surgery included increased operative time, medical comorbidities and pre-operative dependent functional status (see Table 9.10).[83] In contrast, NICE published data based on long-term cohort studies describing major operative complication rates at 3.1% for vaginal, 3.6% for abdominal and 6.1% for laparoscopic hysterectomy, with major postoperative complications of 1.2% for vaginal, 0.9% for abdominal and 1.7% for laparoscopic hysterectomy.[29]

Specific complications include vascular, bowel and urinary tract injury, and a need to convert from vaginal or laparoscopic to open surgery (see Table 9.11).[29] Increasingly, studies are showing similar complication profiles between abdominal and laparoscopic hysterectomy, which may reflect increasing experience in the laparoscopic procedure.[84,85] Outcome from visceral injury relies on intra-operative recognition and repair. Unrecognised bowel, ureter or bladder injury can result in sepsis or fistula formation, commonly entero-vaginal or vesico-vaginal. Ligation or transection of the ureter can result in unilateral loss of kidney function. It should be reiterated that the course of the ureter should be carefully assessed during surgery. Ureteric injury can occur at the level of the infundibulopelvic ligament, the uterine artery pedicle, the uterosacral ligament and the vaginal angle. Ureteric injury most commonly occurs in the distal 3 cm portion closest to the cervix. Complications specific to laparoscopic entry are discussed in Chapter 3 and 6.

Urinary outflow tract dysfunction can be a long-term complication of hysterectomy. The uterus is closely related to the bladder and the pelvic plexus, which provides autonomic innervation to the pelvis. The pelvic plexus is more at risk during total hysterectomy, either during division of the cardinal ligaments, dissection of the bladder from the uterus and cervix, paravaginal dissection or during removal of the cervix. Almost universally, radical hysterectomy involves neural bladder damage. In contrast, hysterectomy for benign conditions is associated with a spectrum of symptoms postoperatively, in keeping with inconsistent damage to the pelvic plexus. The evidence for postoperative bladder dysfunction after hysterectomy remains inconclusive, with both positive and negative effects being demonstrated. Urinary symptoms are prevalent in women undergoing hysterectomy, and it is likely that pre-operative status will go some way to governing postoperative symptoms. One advantage of observational studies over randomised controlled trials is the increased availability of long-term outcome data, which allows for urinary function outcomes to be assessed (see Table 9.12).

Lesser complications include postoperative urinary retention and urinary tract infection. In theory, reduced postoperative pain and early mobilisation should reduce the incidence of acute retention. Prophylactic antibiotics, scrupulous aseptic technique and shorter duration of catheterisation will all reduce the incidence of urinary tract infection. In addition to the more common complications already discussed, numerous immediate and delayed complications have been described (see Table 9.13).

OUTCOME MEASURES

All forms of hysterectomy should ideally result in complete amenorrhoea. Very occasionally, cyclical "staining" may occur

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Table 9.11: Complication rates for hysterectomy (as described by NICE Heavy Menstrual Bleeding Guideline[29] using data from randomised controlled trials in a Cochrane review[35])

Complication	Abdominal hysterectomy (%)	Vaginal hysterectomy (%)	Laparoscopic hysterectomy (%)
Blood transfusion	3.33	3.87	4.23
Bowel injury	0.67	0.00	0.20
Vascular injury	0.77	0.94	1.81
Pelvic haematoma	6.00	4.04	3.94
Vaginal cuff infection	2.06	1.93	4.15
Abdominal wound infection	7.38	0.00	1.92
Laparotomy	---	2.66	4.17
Urinary tract injury (bladder/ureter)	0.86	1.60	2.33
Bleeding	1.57	0.00	0.37
Urinary tract infection	4.87	1.60	4.77
Chest infection	4.55	6.67	0.56
Unspecified infection	13.15	7.73	10.01
Thromboembolism	0.00	0.00	0.59

from endometrium in the cervical stump. The outcome measures for comparison are not exhaustive, but include:

1. Immediate morbidity, length of hospitalisation and time to full recovery.
2. Major complication rate, haemorrhage, sepsis, visceral injury and other complications.
3. Impact upon coitus, micturition and defaecation; especially the occurrence of new symptoms following surgery.
4. The occurrence of post-hysterectomy genital prolapse.
5. Cost of procedure and hospital admission/follow-up.
6. Quality of life.

CONCLUSION

Hysterectomy where indicated is a safe and effective operation with high patient satisfaction rates. In principle, vaginal hysterectomy should be the first choice of route if it is clinically feasible. Laparoscopic hysterectomy has a relatively long learning curve, but more recent published data and the authors' experience suggest that in experienced hands, the laparoscopic approach is no longer associated with the higher complication rates published during its infancy.[33–37,84,85] Quicker recovery rates following the laparoscopic and vaginal approaches provide a clear advantage over the abdominal approach, but the surgeon's own experience and ability are of paramount importance when considering the appropriate type of hysterectomy.

Uterine Fibroids and Their Treatment

Uterine fibroids are benign smooth muscle tumours (leiomyomas). They are common, occurring in up to 1:4 women of reproductive age, but typically regress spontaneously after the menopause. Many fibroids are asymptomatic, often detected incidentally during routine examination or on imaging. In such cases, patients do not need treatment and should be reassured. It has been estimated that between 20% and 50% of women with fibroids will present with symptoms, which will depend on their number, size and position. Fibroids can occur in any part of the uterus and can be found in the cervix or in the broad ligament, or parasitised to other organs.[88–90]

Clinical manifestations of fibroids include heavy menstrual bleeding, pressure on the bladder or gastro-intestinal tract, increased abdominal girth, pain and subfertility (see Table 9.14). The role of fibroids in miscarriage and pre-term delivery is more controversial. Pain can be associated with fibroid degeneration (often in pregnancy), torsion of a pedunculated fibroid or extrusion of a submucous fibroid through the cervix. Surgery is indicated to control symptoms that are having a significant impact on quality of life, to relieve hydronephrosis due to ureteric compression or in suspected cases of uterine sarcoma where the 'fibroid' is growing rapidly. This diagnosis should be particularly considered in the presence of a rapidly growing painful fibroid and is more common in post-menopausal women (see Chapter 16).

THERAPEUTIC OPTIONS

GnRH Analogues

Gonadotrophin-releasing hormone analogues (GnRHa) cause hypo-oestrogenism, which leads to a 40–60% reduction in uterine volume and fibroid size, and transient amenorrhoea. The maximal effect occurs within 3 months of treatment, although it may be continued for a total of 6 months as a primary treatment of symptomatic myomas, or as an adjunct to surgical treatment. Associated transient menopausal symptoms

Table 9.12: Urinary symptoms reported by long-term cohort studies[29]

Complication		Abdominal hysterectomy	Vaginal hysterectomy	Laparoscopic hysterectomy
Urinary incontinence	Moderate (OR)	1.19 (1.00–1.41)	1.30 (1.15–1.46)	1.82 (1.28–2.59)
	Severe (OR)	1.52 (1.20–1.93)	1.59 (1.34–1.89)	2.02 (1.32–3.07)
Urinary frequency	Moderate (OR)	1.28 (1.08–1.52)	1.10 (0.97–1.23)	1.03 (0.74–1.43)
	Severe (OR)	1.51 (1.20–1.90)	1.15 (0.96–1.37)	1.33 (0.85–2.07)
Nocturia	Moderate (OR)	1.34 (1.06–1.69)	1.19 (1.01–1.39)	1.03 (0.68–1.57)
	Severe (OR)	1.33 (1.08–1.64)	1.17 (1.00–1.36)	0.90 (0.57–1.41)

Odds Ratios (ORs) calculated against general population. All ranges are 95% confidence intervals.

Table 9.13: Less frequent and longer term complications of hysterectomy[29,82,83,85–87]

Genital tract complications	Gastrointestinal complications
Vault prolapse Incisional hernia at vaginal apex Eversion of vagina Vaginal vault dehiscence Prolapsed Fallopian tube Foreign body granuloma Residual ovarian syndrome Ectopic pregnancy Adnexal abscess Consort glans laceration	Necrotising colitis Constipation Irritable bowel syndrome Bowel obstruction Colo-vaginal fistula Sigmoido-vesical fistula Perforation of duodenal ulcer
Urinary tract complications	**Other complications**
Ureteric fistula Salpingo-vesical fistula Hydronephrosis Chronic renal failure Wissler-Fanconi syndrome Incisional bladder hernia	Sexual difficulties Recurrent pneumoperitoneum Femoral neuropathy Premature ovarian failure Ischaemic heart disease Osteoporosis

can be alleviated with addback HRT, although this may also render the fibroid shrinkage less effective. Longer GnRHa treatment carries a significant risk of osteoporosis and is not recommended. Once therapy stops, fibroids soon return to their previous size over several months. Consequently primary treatment is rarely undertaken, and the role of GnRHa is limited to volume reduction and correction of anaemia prior to surgery. Rarely, medical treatment with GnRHa therapy may be considered in perimenopausal women in an attempt to avoid surgery until the menopause is reached, or for patients in whom other treatments have failed and surgery is contraindicated.[91]

Women who continue to have significant symptoms in spite of 3 months of medical therapy or whose fibroids show no sign of shrinkage should not normally be considered for conservative management. There is a remote risk of unrecognised leiomyosarcoma. Progress of medical therapy may be monitored by symptoms, examination or by ultrasound or in some cases MRI imaging.[92]

Table 9.14: Clinical manifestations of fibroids

Heavy/prolonged menstrual bleeding
Anaemia
Increased abdominal girth
Pelvic mass
Pressure symptoms
  Urinary frequency
  Urinary outflow obstruction
  Ureteric compression (hydronephrosis)
  Constipation
  Tenesmus
  Bowel obstruction (rare)
Pelvic or lower limb deep vein thrombosis
Recurrent pregnancy loss
	Pre-term labour
	Subfertility
	  Tubal obstruction or distortion
	  Distortion of endometrial cavity
	  Altered location of cervix/ uterine size
	Pelvic/abdominal pain
	  Fibroid degeneration
	  Torsion (pedunculated fibroids)
	  Cervical extrusion (submucous fibroids)
	Dysmenorrhoea
	Dyspareunia
	Malignant transformation (rare)
	Ascites or polycythaemia (rare)

Other Hormonal Therapies

Progestogens have been reported to reduce the growth of fibroids, and mifepristone (an antiprogesterone) has also been shown to reduce fibroid size. They are less beneficial than GnRHa however, and the authors rarely use either in clinical practice. A newer selective progesterone receptor modulator is now available, which has shown some promise as a medical therapy in achieving fibroid shrinkage. This appears to have advantages compared to GnRHa treatment in terms of side-effect profile, and early studies suggest persistence of fibroid shrinkage following cessation of treatment. Currently it is licensed in the UK for pre-operative treatment of fibroids only. In cases where the main symptom of the fibroids is heavy menstrual bleeding, progestogens can limit menstrual blood flow and hence preclude the need for treating the fibroids themselves.

Laparoscopic and MRI-Guided Myolysis

Myolysis involves the internal coagulation of targeted fibroids to destroy the stroma and the associated vascular supply resulting in degeneration and shrinkage. The method used may be laser, electrocoagulation or hypothermia (cryomyolysis).[93–95] There is a greater risk of uterine rupture in pregnancy following myolysis, due to devascularisation of adjacent myometrial tissue, and the procedure has been associated with dense adhesion formation in some cases. Consequently it is a less common method of treatment, and is not advisable for women wanting to conceive.[96]

Uterine Artery Embolisation (UAE)

This minimally invasive technique was originally devised to control bleeding in massive postpartum haemorrhage, but has since been employed to treat symptomatic uterine fibroids. Non-biodegradable particulate emboli (typically polyvinyl alcohol [PVA] or trisacryl gelatin spheres) are delivered to both uterine arteries via percutaneous catheterisation of one of the femoral arteries under angiographic guidance. The uterine vessels are occluded bilaterally, causing ischaemic necrosis of the uterine fibroids.[97] This causes a reduction in fibroid volume of 30–50%. It is usually a day-case or overnight-stay procedure. There is commonly significant post-procedure pain (comparable to "red degeneration" in pregnancy), and serious complications from uterine infarction followed by infection have been reported.[98–101] The risk of this is less than 1%, although severe sepsis may warrant hysterectomy, and fatalities have been reported.[102] Other risks include premature ovarian failure in 1–2% of patients and secondary amenorrhoea.[98,101]

Recent long-term follow-up data comparing UAE with surgery (hysterectomy or myomectomy) showed equally improved quality of life scores at 5 years in both groups; however, UAE carried a 32% re-intervention rate, which neutralised its initial cost benefit.[103]

Although normal uterine myometrium preferentially establishes a new collateral blood supply from vaginal and ovarian vessels, there are concerns about subsequent pregnancy following UAE. Miscarriage rates are higher and uterine rupture in labour has been described. The altered uterine blood supply could theoretically impact on placentation, causing intra-uterine growth restriction. Premature labour, postpartum haemorrhage, Caesarean section and malpresentation are all more common after UAE.[98,104,105] In essence, whilst UAE is an effective non-surgical treatment for symptomatic fibroids, it should be used with great caution in women who wish to conceive in the future.

MRI-Guided Focused Ultrasound

This is a non-invasive procedure, which involves the treatment of fibroids with a focused beam of high-frequency ultrasound under MRI guidance. Resulting localised thermal energy causes coagulative necrosis of individual fibroids and hence a reduction in fibroid volume. Patients are thought to experience less pain than with the ischaemic effects of UAE, and the procedure has an excellent safety profile. Potentially this therapy will have an application as a non-surgical treatment that preserves reproductive capacity. The treatment is not yet widely available, and long-term comparative data are awaited.

Herbal Remedies

In 2010, a Cochrane review researched the evidence for traditional herbal remedies in the treatment of fibroids. It concluded that current evidence does not support their use due to the limited number of trials and their insufficient methodological quality, and it called for large good quality studies.[106]

Myomectomy

Whilst the definitive surgical treatment for symptomatic fibroids is hysterectomy, many women desire relief of symptoms but wish to conserve their uterus, often to retain or improve their reproductive potential, or to adhere to their cultural or social views. For these women, myomectomy is an important option.

Hysterectomy

Hysterectomy is discussed in detail earlier in the chapter, and remains a surgical alternative to myomectomy if ongoing fertility is not desired. Advantages over myomectomy include amenorrhoea and preventing recurrence of fibroids. Hysterectomy would normally be preferred to myomectomy in women who have completed their family as it is widely accepted to be associated with lower peri-operative morbidity and is definitive. Myomectomy may cause adhesion formation between the uterus and the small or large bowel, which can render subsequent pelvic surgery (e.g. repeat myomectomy or hysterectomy) more complex.

Myomectomy

Myomectomy is defined as the enucleation of uterine fibroids with reconstruction and preservation of the uterus, in an effort to maintain its function. Successful abdominal myomectomy was first described in 1845 by Atlee, prior to the development of abdominal hysterectomy.[107] It is a less common surgical treatment than hysterectomy, with approximately 35,000 abdominal myomectomies performed each year in the USA, compared with 600,000 hysterectomies. It is widely accepted that myomectomy is associated with a higher rate of blood transfusion, postoperative anaemia, febrile morbidity, and possibly an increased risk of paralytic ileus and longer length of stay.[89] Recent literature suggests that with improved access to blood transfusion and the widespread use of prophylactic antibiotics, morbidity and length of hospital stay following abdominal myomectomy is comparable to abdominal hysterectomy.[108] Selection bias may govern procedure choice and hence outcomes of comparative studies however. Arguably, in cases where operative difficulty is anticipated (e.g. previous myomectomy or women with multiple fibroids), patients may have been preferentially advised towards hysterectomy. Further prospective studies are needed.

Fibroids can be surgically removed at laparotomy, laparoscopy, by vaginal myomectomy or, in the case of submucous fibroids, by hysteroscopic resection (see 'Transcervical Resection of Fibroids'). The major advances in laparoscopic equipment of recent years, together with refinements in technique, allow effective and efficient haemostasis, suturing and tissue removal. Consequently, the limits of laparoscopic myomectomy in relation to fibroid size, location and number are continuing to be challenged.

In women with abnormal bleeding, preliminary diagnostic hysteroscopy is generally indicated to exclude submucosal fibroids or an endometrial lesion.

REDUCING SURGICAL RISKS

Operative Blood Loss

A number of techniques have been described to overcome the problem of haemorrhage during open myomectomy.[109–112] Some techniques can also be applied to the laparoscopic approach, and indeed laparoscopic myomectomy itself is associated with only a 2% transfusion rate compared with 20% at abdominal myomectomy. This may reflect patient selection however.[113] Blood loss can occur intra- or postoperatively and be associated with formation of a haematoma. Myomectomy for huge fibroids can be associated with massive blood loss, which can warrant blood transfusion and intra-operative conversion from laparoscopic to open myomectomy, or conversion from open myomectomy to hysterectomy. Techniques to reduce blood loss can be broadly divided into four categories (see Table 9.15).

By causing amenorrhoea, pre-operative GnRHa treatment allows optimisation of haemoglobin levels in patients suffering

Table 9.15: Interventions to reduce blood loss at myometomy

Interventions on uterine blood supply	Uterotonics
• Laparoscopic uterine artery dissection • Intramyometrial vasopressin • Uterine artery +/- ovarian artery tourniquet or clamp • Intramyometrial bupivacaine with adrenaline • Pre-operative GnRH analogues • Pre-operative uterine artery embolisation	• Misoprostol **Dissection techniques** • Mesna (lytic agent facilitating enucleation) • Laparoscopic myomectomy • Cutting diathermy for uterine incisions **Antifibrinolytics** • Tranexamic acid

with menorrhagia. Pre-treatment also reduces operative blood loss due to its effect on uterine vascularisation. Fibroid shrinkage can allow massive fibroids to be approached via a Pfannenstiel rather than a midline incision, or even laparoscopically or vaginally. Operating time may be reduced at hysteroscopic resection but not at myomectomy. Some surgeons describe adherent, fibrotic tissue planes around myomas after GnRHa, although this has not been confirmed by clinical studies. Postoperative complication rates are not affected by GnRHa, although there is a small reduction in postoperative stay.[112]

There is no benefit from using oxytocin during myomectomy, which is consistent with the fact that there are few myometrial oxytocin receptors outside of pregnancy. Likewise myoma enucleation by morcellation has no effect on intra-operative blood loss. Other alternatives that have not been formally assessed by clinical trials include pre-operative UAE, ergometrine and the use of cutting diathermy to dissect out the myoma. The most effective intervention appears to be occlusion of the uterine and ovarian arteries, which in one small prospective study of 28 patients showed a significant reduction in mean blood loss compared with control, making it difficult to justify not using tourniquets. The study demonstrated a significant reduction in transfusion rate from 79% to 7%, with no apparent effects on uterine perfusion or ovarian function.[111]

It is common knowledge amongst gynaecologists that rarely, massive haemorrhage can complicate myomectomy. It is therefore important when considering myomectomy to discuss with the patient the rare but appreciable risk of resorting to hysterectomy intra-operatively in cases of uncontrollable, life-threatening bleeding.

Adhesion Prevention

Postoperative adhesions are common following myomectomy, affecting 59% of women 2 years after open myomectomy.[114] They are particularly important in the context of surgical treatment for subfertility. Small bowel adhesions onto the site of the uterine incision can be dense. Adhesions have been associated with small bowel obstruction, chronic abdominal pain, dyspareunia and subfertility[115,116] and can impact on the feasibility of subsequent pelvic surgery, including repeat myomectomy, hysterectomy or even Caesarean section. Posterior uterine wall incisions are associated with a higher rate of adnexal adhesion formation than fundal or anterior wall incisions, and second-look laparoscopy has been advocated by some surgeons in the past for secondary adhesiolysis.[117]

Adhesion formation has been shown to be less common following laparoscopic procedures compared to laparotomy.[118] Adhesion prevention may be due to factors such as meticulous haemostasis, evacuation of blood clot from the pelvis and less tissue handling and drying. These factors are all more readily achieved laparoscopically. There is no evidence that these factors apply to adhesion reduction in laparoscopic myomectomy, although comparative data with open myomectomy are limited.[113]

Whilst it is accepted that fertility outcome after myomectomy is improved,[119] it is logical to take any precautions available to reduce adhesion formation. Adhesion barriers have been explored for this reason. Omental or peritoneal grafts have been described. These have the advantage of being natural and cheap, although there is no evidence of benefit. They may interfere with ovulation or oocyte transfer, and need to be sutured into place, which increases operative time. This can be especially disadvantageous during laparoscopic procedures. Several synthetic adhesion barrier agents are available that are designed to provide an inert barrier between damaged serosal surfaces for at least 72 hours, in order to prevent unwanted mesothelial regeneration and fibrosis. Again evidence for their efficacy is limited and their cost must be considered, but they have the advantage of being safe and quick to apply.[116] It is the authors' preference to use synthetic adhesion barriers during laparoscopic and open myomectomy.

OPEN VERSUS LAPAROSCOPIC MYOMECTOMY

There has been little change to the technique of open myomectomy popularised by Bonney in the 1930s.[120,121] Surgical principles of myomectomy are to minimise intra-operative blood loss, reduce postoperative adhesion formation and achieve adequate myometrial repair and closure to allow the uterus to withstand pregnancy and possibly labour. Laparoscopic myomectomy requires meticulous repair of the myometrium, which can be technically difficult. It should only be attempted by experienced laparoscopic surgeons. With advances in laparoscopic instruments and experience in the techniques required to achieve safe removal of large fibroids including multilayer closure of large myometrial defects, evidence for the benefits of laparoscopic myomectomy is growing. Recent meta-analysis has shown that the laparoscopic approach is associated with a shorter hospital stay, faster recovery, less adhesions, less blood loss and fewer overall postoperative complications in the hands of skilled surgeons.[122] Mean operative time is comparable, and there is no difference

9

in the subsequent pregnancy rate, miscarriage rate, ectopic pregnancy rate, preterm delivery or Caesarean section rate between open and laparoscopic groups.[119,123] Meta-analysis has shown no evidence of benefit of pre-operative GnRHa and no difference in recurrence rates compared with open myomectomy. Indeed, whilst pre-operative GnRHa therapy results in a 40–60% reduction in uterine volume within 12 weeks of treatment, the effects on fibroid size and vascularity may paradoxically make dissection of the fibroid from its pseudocapsule more difficult. This could lead to increased operative time. With appropriate myometrial closure, the risk of uterine rupture is low and pregnancy outcomes have been good.[122,124] Appropriate patient selection is important: uterine size and mobility, fibroid size and location and previous surgery must all be considered when deciding on route of myomectomy.

The main limitation of laparoscopic surgery is the relatively long learning curve required to achieve complex surgery safely. Some surgeons rely on robotic-assisted laparoscopic surgery for this reason, and whilst robotic surgery carries the obvious limitations of increased abdominal port size, longer operating times and considerable cost, there is evidence to suggest that in terms of operative blood loss and length of hospital stay, robotic myomectomy is similar to conventional laparoscopic myomectomy. Both are associated with decreased surgical blood loss and reduced length of hospital stay when compared with open myomectomy.[125,126]

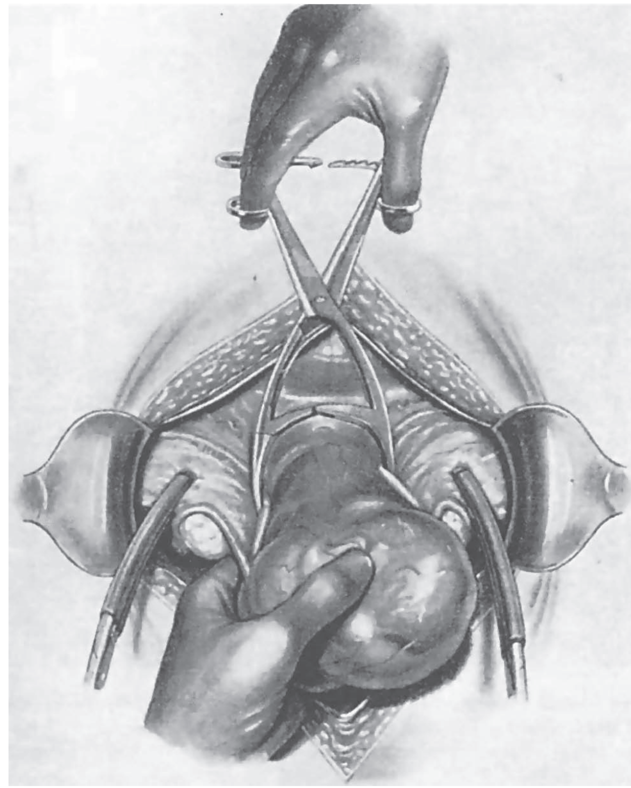

Fig. 9.85: Open myomectomy. Bonney's myomectomy clamp is being applied to the cervix in order to occlude the uterine vessels. A rubber-guarded bowel clamp has been applied to each infundibulopelvic ligament to control the ovarian vessels. This technique can result in an almost bloodless uterine incision.

OPERATIVE TECHNIQUES

Open Abdominal Myomectomy

A careful assessment of the size and mobility of the uterus should be made under anaesthetic prior to deciding between a midline or Pfannenstiel incision. After abdominal entry, a careful assessment of the location, size and number of the fibroids present is made. The tubes and ovaries are also inspected. In cases of significant anatomical distortion due to large or multiple fibroids, the Fallopian tubes and round ligaments provide useful uterine landmarks and act as a guide to locating the endometrial cavity and planning the incision, or incisions, on the uterus.

Temporary haemostasis of the surgical field may be obtained by the use of Bonney's myomectomy clamp (Fig. 9.85) applied to the uterine vessels and by guarded bowel clamps or loose ties to the infundibulopelvic ligaments. Alternatively, a rubber catheter may be tied as a haemostatic sling around the cervix (Fig. 9.86). As described earlier, injection of 20 ml of vasopressin (0.05 U/ml) over the site of the uterine incision has also been shown to reduce haemorrhage.

The uterus is delivered through the incision, and the fibroids are inspected to assess the best and safest incisional approach for enucleation without compromising the Fallopian tubes, the endometrial cavity or the ovarian or uterine vessels.

In the case of individual fibroids, a primary uterine incision should be made down to the tumour. As soon as the pseudocapsule of the fibroid is reached, the uterine incision opens up by retraction and it is usually possible to find a natural plane of cleavage between the tumour and normal myometrium. The actual enucleation can be carried out digitally or by blunt dissection (Fig. 9.87) with a slightly curved instrument such as a pair of curved Mayo scissors.

Often, the most useful incision in the uterus is on the anterior surface. This allows anterior fibroids to be removed first, hence debulking the uterus and improving access to other parts of it. It is possible to use an anterior incision to approach posterior fibroids through the uterine cavity, enucleating them from the posterior wall of the myometrium without making a separate incision on the posterior peritoneal surface of the uterus (Fig. 9.88). This is a so-called transcavity myomectomy.

One advantage of the transcavity approach is that it enables the surgeon to explore the endometrial cavity for submucous fibroids if desired. Where possible, posterior incisions are avoided due to the greater risk of bowel adhesions and a subsequent risk of obstruction. Bowel adhesions can also necessitate difficult dissection during future pelvic surgery. Entering the endometrial cavity carries the obvious risk of Asherman's syndrome however, and could theoretically lead to adenomyosis. It is therefore important to consider the patient's future fertility intentions and other abdominal or pelvic pathology when planning the uterine incision.

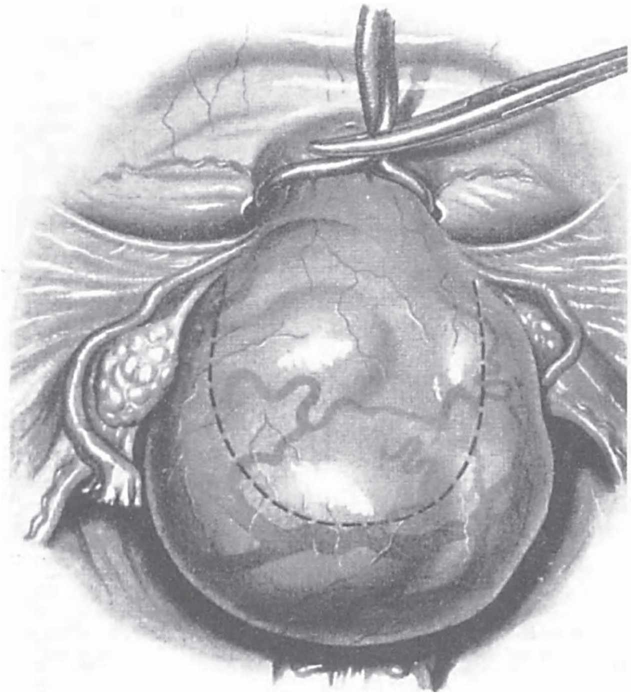

Fig. 9.86: Open myomectomy. This illustration shows the rubber tourniquet method (e.g. a urinary catheter) for controlling the uterine vessels. The ovarian vessels have to be compressed separately with intestinal clamps. The dotted line shows one method of making a peritoneal flap.

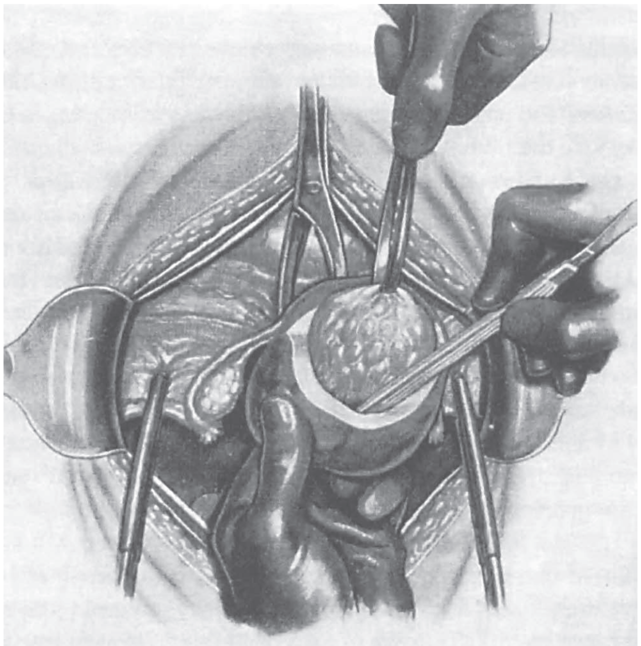

Fig. 9.87: Open myomectomy. The uterus has been incised and the fibroid grasped by a Vulsellum forceps. It is being enucleated from its pseudocapsule by the handle of a scalpel. This is an intramural, postero-fundal fibroid.

In certain cases (e.g. in case of a posterior pedunculated subserous fibroid), a posterior uterine incision is unavoidable (Fig. 9.89). In the past, some surgeons advocated tacking a small omental graft over the posterior uterine incision in order to prevent the small bowel from adhering to the uterus.

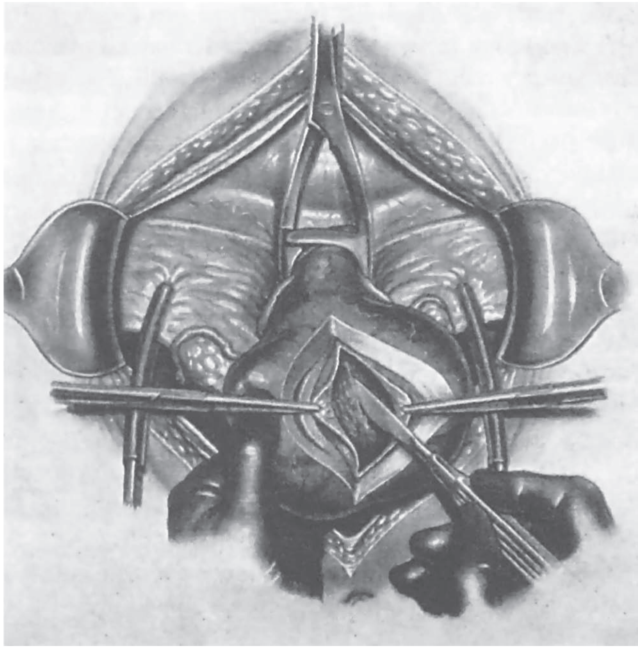

Fig. 9.88: Open transcavity myomectomy. The anterior uterine wall has been transected and the endometrial cavity entered. An incision is being made in the posterior uterine wall in order to enucleate any fibroids in the posterior wall.

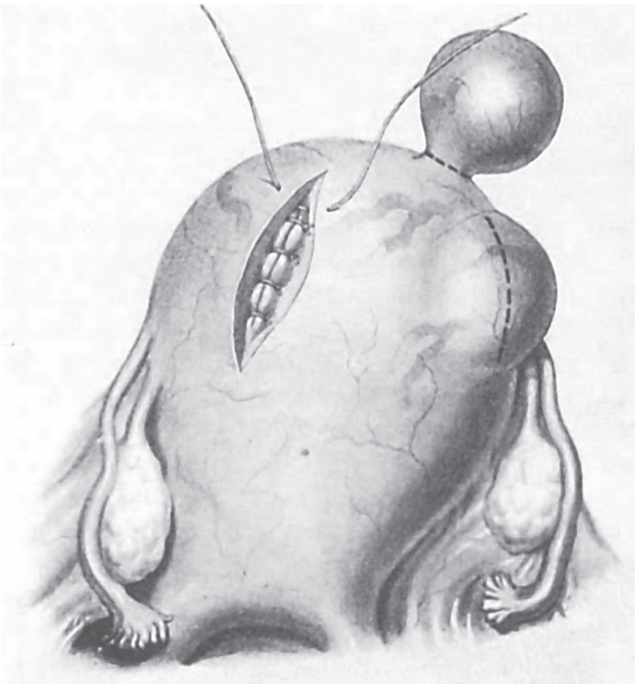

Fig. 9.89: Open myomectomy. Multiple uterine incisions to approach fibroids in different locations.

Alternative and more conventional approaches to reducing the risk of adhesions include careful, atraumatic surgical technique and suturing, minimising blood loss, preventing tissues from becoming dry during surgery, careful closure of the uterine serosa to ensure no myometrium is exposed, and as described later, artificial adhesion barriers such as "Interceed" (Ethicon), which can be placed over the uterine incisions to prevent adhesion formation.

In order to minimise the danger of bowel adhesion to the uterus and to ensure proper peritonisation, Bonney described the 'hood' operation.[120] In this method, a transverse incision is made across the capsule of the fibroid as low down and as anteriorly as possible. After enucleation of the fibroid, the capsule is trimmed of its redundant myometrium and sewn over the uterus so that the apex of its lower end lies in the uterovesical space (Figs. 9.90, 9.91). Another potentially useful manoeuvre to limit the size of the primary uterine incision is to morcellate the fibroid in vivo. This can be associated with more bleeding however.

If the uterus contains a large number of fibroids and individual enucleation is impractical, it is sometimes feasible to remove a block of the uterus containing the bulk of the fibroids en masse. Another useful technique is hemisection of the anterior or posterior myometrium, allowing access to centrally placed fibroids, and then enucleating any further fibroids remaining in each half by lateral tunnelling (Fig. 9.92). Finally, the uterus can be reconstructed by suturing the two halves together in the midline.

Fibroids may be encountered in a number of different locations, including anterior, posterior, fundal, cervical, broad ligament or submucosal sites. These types may occur alone or together as multiple masses, and each demands certain modifications of technique, with a view to normalising the uterine anatomy as much as possible.

In planning the primary incision on the uterus, transverse incisions may be preferable to vertical, because the arteries and

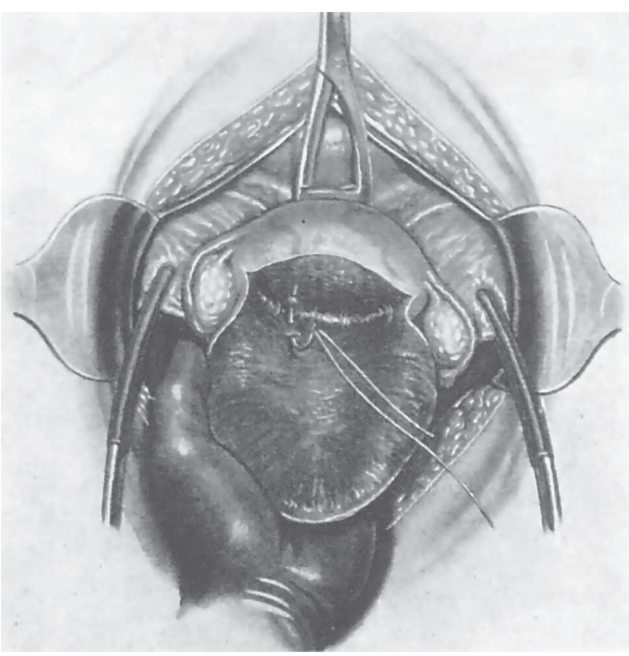

Fig. 9.90: Open myomectomy. Bonney's 'hood' operation. The fibroid has been enucleated and the resulting dead space is being obliterated with sutures.

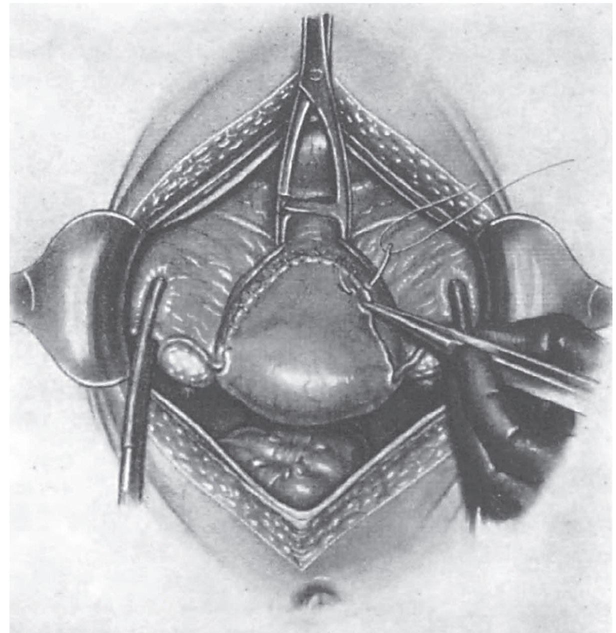

Fig. 9.91: Open myomectomy. Bonney's 'hood' operation. The peritoneum is being sewn over the anterior surface of the uterus.

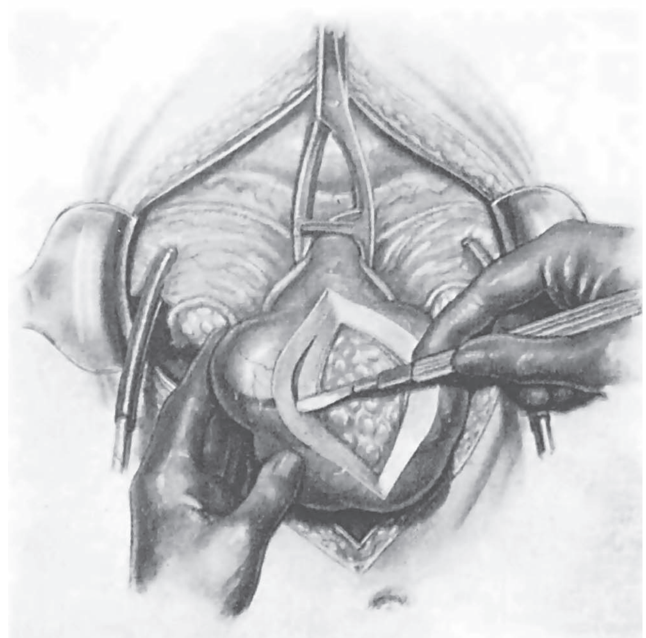

Fig. 9.92: Open myomectomy. The technique of lateral tunneling, by which the surgeon employs a primary incision in the anterior uterine wall and extends the dissection laterally to enucleate fibroids lying on either side of the primary incision.

arterioles of the myometrium run transversely.[127] The ideal position is one comparable to that used in lower segment Caesarean section because, when the myomectomy is complete, the loose peritoneum of the uterovesical pouch can be used to completely cover the uterine scar. It is, however, important not to fix the bladder too high up on the front of the uterus, as this could complicate reflection of the bladder in a subsequent Caesarean section or hysterectomy. The flap method illustrated in Figures 9.93 to 9.96 can also be useful. In the case illustrated, the base of the flap is situated at the fundus.

When all apparent fibroids have been removed, the myometrium is systematically palpated for residual fibroids prior to closure. The enucleated fibroid cavities must be carefully explored and thoroughly obliterated by absorbable, No. 1 polyglycolic acid sutures. These are passed through the full thickness of the myometrium on each side of the myometrial defect and tied so that no dead space remains (Fig. 9.97) and haemostasis is achieved. Approximating the tissues of the defect reduces the real chance of postoperative bleeding into the dead space, which can result in a significant haemoglobin drop, postoperative pyrexia and infection, and the risk of a postoperative haemoperitoneum or collection.

It is important that the endometrial cavity is carefully closed if it has been entered. Closure is achieved with a size 3-0 absorbable polyglycolic acid suture (Fig. 9.96). If there is any

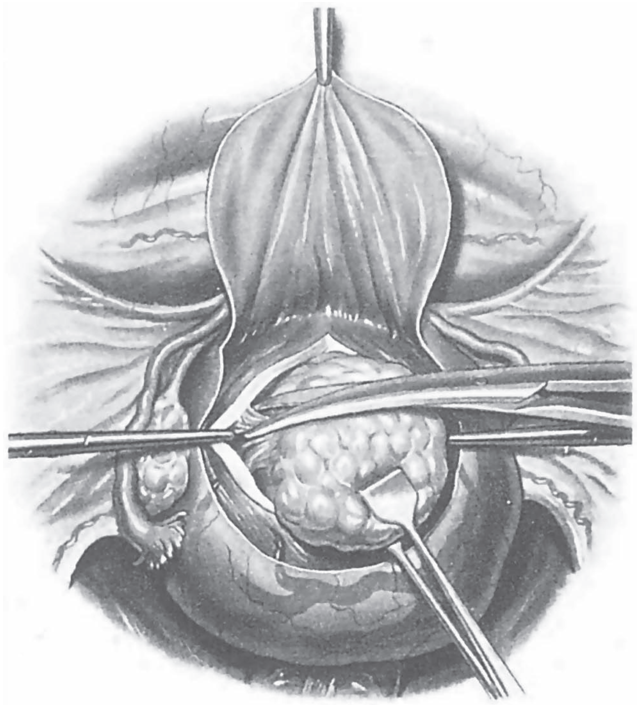

Fig. 9.94: Open myomectomy. Enucleation of the tumour from the uterus. The fibroid is drawn up with traction using a Vulsellum forceps, and its attachments to the myometrium of the pseudocapsule are divided by sharp dissection with Mayo's scissors.

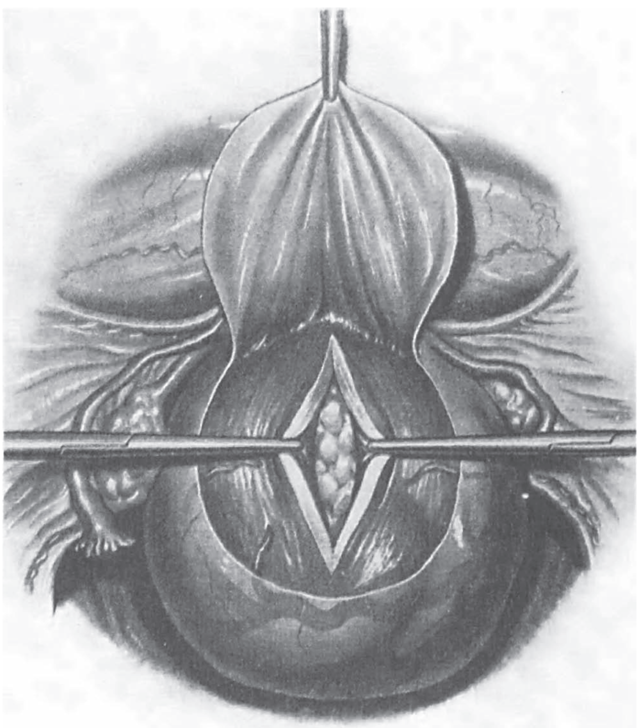

Fig. 9.93: Open myomectomy. The peritoneal flap has been drawn downwards. In this type of case, there may be great difficulty in stripping the peritoneum from the front of the uterus. The separation is easier if the fibroid lies immediately beneath the peritoneum. The myometrium beneath the flap has been incised longitudinally and the fibroid exposed.

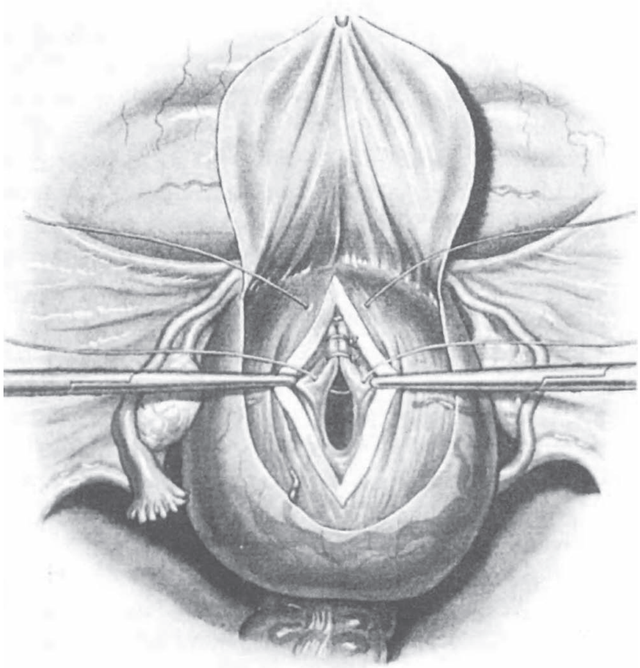

Fig. 9.95: Open myomectomy. In this case, the endometrial cavity has been opened and the endometrial layer is being closed carefully with a fine absorbable suture.

doubt as to whether the endometrial cavity has been entered, methylene blue dye can be injected vaginally into the cavity through a Spackman cannula. If the cavity has been breached, the Spackman cannula itself may be directly visible.

The myometrium is often closed in two or three layers using either interrupted or continuous sutures. It is important to avoid placing sutures that might interfere with the entry of the Fallopian tube at the uterine cornu. For uterine closure, the authors prefer a continuous transverse stitch to bring together the most superficial layer of myometrium (similar to a subcuticular stitch on the skin) in order to closely approximate the uterine serosa and allow it to be closed under less tension. The uterine serosal layer is traditionally closed with a continuous non-absorbable monofilament suture (e.g. polypropylene). This is theoretically less likely to cause adhesions to surrounding structures such as small bowel. Alternatively, absorbable monofilament sutures (e.g. polydioxanone) can also be utilised. The purpose of this layer is to closely approximate the visceral peritoneum of the uterus, which in turn will promote uterine healing and reduce the chance of adhesion formation.

The haemostatic clamps or tourniquets are now removed and any secondary bleeding controlled with further haemostatic sutures. Once the surgeon is satisfied that the operation area is dry, the abdomen is closed.

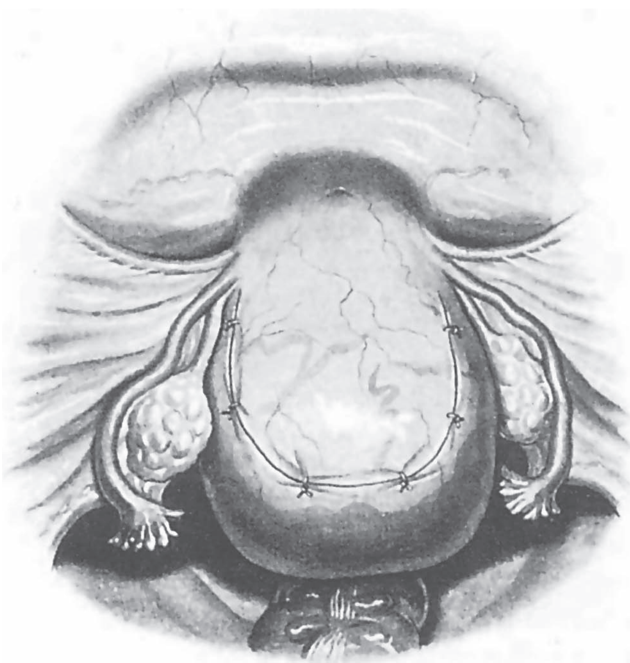

Fig. 9.96: Open myomectomy. The peritoneal flap has been sutured back into position.

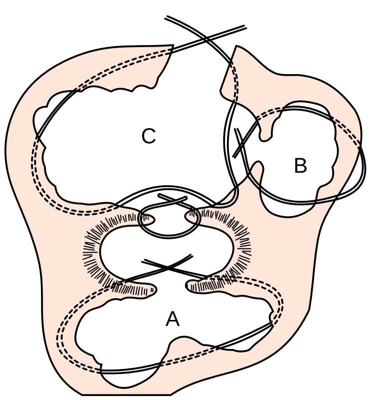

Fig. 9.97: Obliteration of dead spaces. A, B and C illustrate the cavities from which fibroids have been enucleated. The central cavity represents the endometrial cavity. Various types of suture designed to obliterate dead spaces are shown.

Cervical Fibroids

About 5% of fibroids are situated in the cervix, and these pose a particular surgical problem in turns of accessing the mass. If the cervical fibroid lies anteriorly, it can be approached by a transverse division of the uterovesical peritoneum. In these cases, it is impossible to apply Bonney's myomectomy clamp until the myoma has been removed. The clamp should be applied as soon as this has been done. Haemostasis can then be secured and the fibroid's cavity can be closed in the normal fashion (Fig. 9.98).

In some cases, a cervical fibroid can be located centrally and uniformly expands the cervix around it, and the uterus sits on top of the expanded cervix. To approach these fibroids, the uterovesical peritoneum is divided transversely as before. It may be helpful to also divide the round ligament. To reach the fibroid, it is necessary to bisect the uterus from above to provide

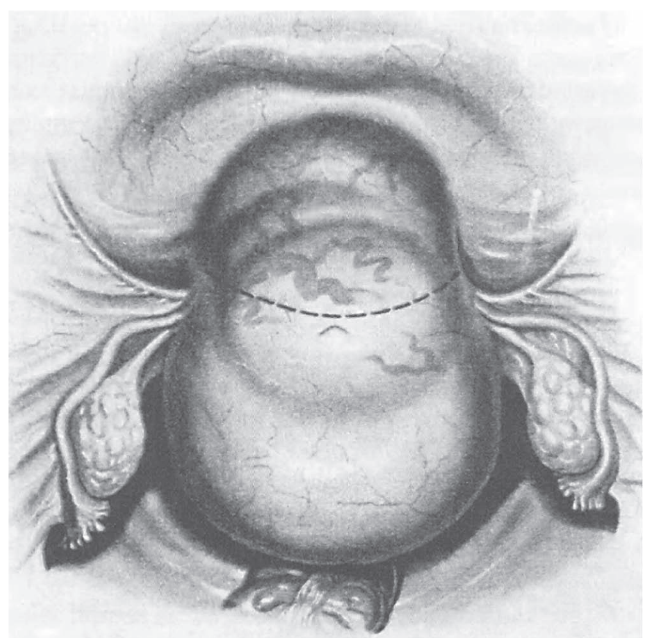

Fig. 9.98: Cervical myomectomy. In this case, the V-shaped depression has been displaced upwards. There is a large space between the depression and the bladder. The peritoneum is loosely attached to the uterus below the V-shaped depression, and the peritoneal flap can be separated easily.

access to the bed of the tumour, which can now be enucleated. Following enucleation, the myomectomy clamp can be applied immediately, allowing reconstruction of the uterus without excessive blood loss (Figs. 9.99, 9.100, 9.101). Diagnostic hysteroscopy using the hydrodilatation technique may be useful

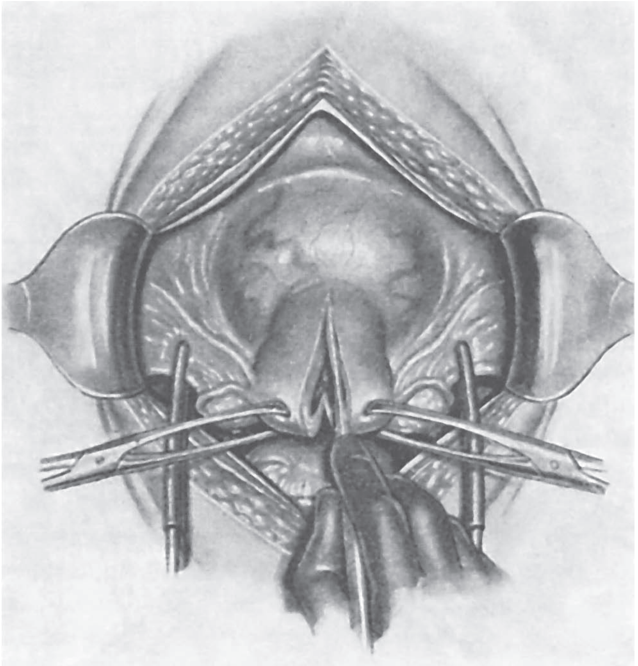

Fig. 9.99: Cervical myomectomy. The surgical approach to a cervical fibroid by bisection of the uterus.

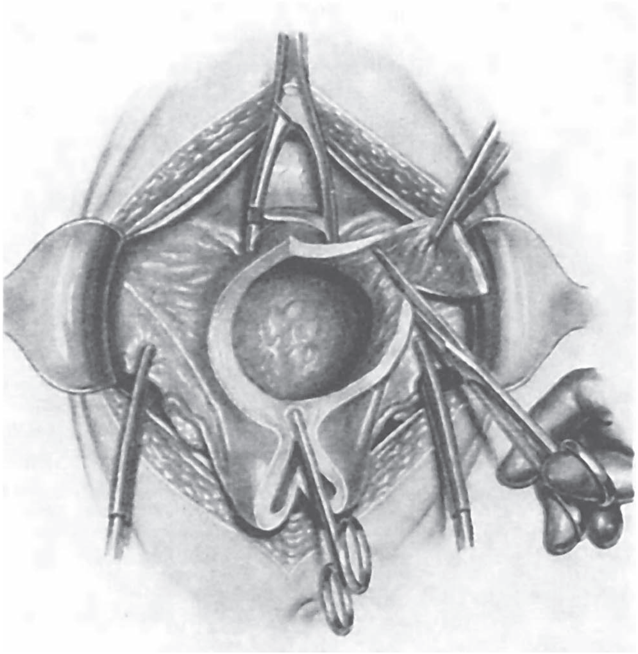

Fig. 9.100: Cervical myomectomy. Enucleation of a cervical fibroid by bisection of the uterus. A forcep has been passed down the cervical canal to identify its direction, while the cervical tumour is enucleated.

as part of an assessment of the exact location of a cervical fibroid in relation to the cervical canal, prior to performing an incision on the uterus.

If the fibroid lies posteriorly in the cervix, it will have to be enucleated by a low posterior incision in the back of the uterus in the pouch of Douglas. This may be vertical or transverse depending on the exact position of the fibroid, access to the pelvis and the individual surgeon's preference.

Such an incision, of course, leaves a posterior scar, which is unavoidable.

Broad Ligament Fibroids

Fibroids that grow laterally into the broad ligament are relatively easy to deal with (Fig. 9.102). There is usually a clear dissection plane between the fibroid and the loose areolar tissue of the broad ligament, and closure is relatively straight-forward as there is usually plenty of peritoneum available to cover the incision. Three important points must be stressed in these cases:

(1) Broad ligament fibroids can be associated with a secondary polycythaemia, which in turn can lead to impaired haemostasis[72] or thrombosis.
(2) Careful closure of the tumour bed is imperative to prevent haematoma formation, which may complicate the postoperative course with febrile morbidity or even sepsis. Care must also be taken to avoid the uterine artery and vein during dissection of the fibroid.
(3) There is a risk of damage to the ureter, which may be displaced from its normal position and be vulnerable to surgical injury. When incising the capsule for removal of a broad ligament fibroid, the ureter should always be identified to prevent iatrogenic injury (Fig. 9.101).

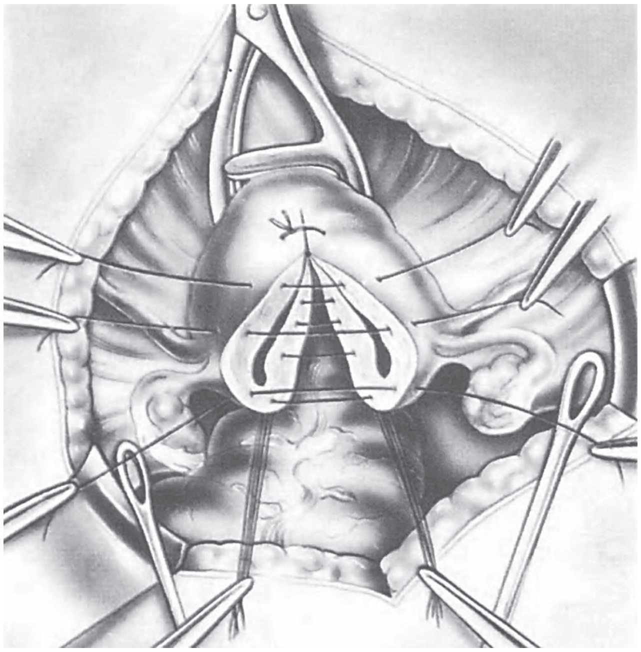

Fig. 9.101: Cervical myomectomy. The bisected uterus may be reconstructed with two layers of interrupted sutures.

9

Submucosal Fibroids

Large submucosal fibroids are best dealt with hysteroscopically (see earlier in chapter), sometimes after a course of GnRHa injections. Particularly large submucous fibroids, unsuitable for hysteroscopic resection, may be approached by open myomectomy via an anterior uterine incision and a transcavity approach.

"Seedling" Fibroids

In some cases, the myometrium contains multiple small "seedling" fibroids, and the surgeon needs to decide intra-operatively at what point it is not worth pursuing such small lesions. In general, it is probably best to limit myomectomy to those lesions that are greater than 1 cm. Logically, where multiple lesions exist the risk of symptomatic fibroid recurrence is higher, and it may be prudent to advise planning conception earlier rather than later if appropriate for the patient. If pregnancy is not desired in the near future, medical management may be a more suitable approach, but clearly the management will need to be tailored to an individual's symptoms and wishes.

Vaginal Myomectomy

This is a less common approach to myomectomy, but has its obvious advantages in relation to postoperative recovery and return to normal activities. Vaginal myomectomy for fibroids a large as 250 g has been described via a posterior colpotomy, using a combination of morcellation and bisection following 3–4 months of GnRH analogue therapy.[128] Some pedunculated submucosal fibroids can be removed after performing a hysterotomy by a vaginal approach (see Figs. 9.8, 9.9 earlier in this chapter).

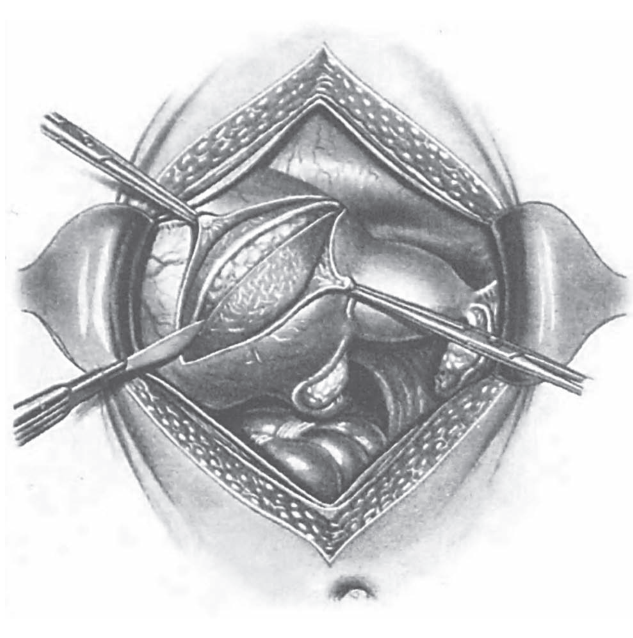

Fig. 9.102: Broad ligament myomectomy. A left broad ligament fibroid being enucleated by incision of the capsule. The location and path of the ureter must be identified before the incision is made.

Laparoscopic Myomectomy

Potential laparoscopic myomectomy cases should fulfill the necessary selection criteria to confirm feasibility of the operative approach. Pre-operative investigations should include a pelvic ultrasound to determine the size, location and number of fibroids. Any intracavitary fibroids can be identified on ultrasound scan as being amenable to hysteroscopic resection. Technical problems include haemostasis, uterine closure and tissue removal. These issues have prompted several proponents to impose limits on the number and size of fibroids amenable to laparoscopic surgery. Dubuisson, for example, suggests that the open approach should be favoured if a single fibroid measures more than 8 cm in diameter, or if there are more than two fibroids to be removed.[129,130] In the 20 years since Dubuisson's preliminary reports on laparoscopic myomectomy,[131] the limits to what is achievable by the laparoscopic approach are increasingly being re-evaluated, and will invariably depend on operator experience. Fibroids of more than 15 cm in diameter, weighing in excess of 1400 g have subsequently been reported at laparoscopic myomectomy.[132] In the authors' experience, size of an individual fibroid is rarely a contraindication.

The positioning for laparoscopic myomectomy is similar to laparoscopic hysterectomy with the legs abducted, hips straight and the knees flexed to 90º. An indwelling urinary catheter is sited and a bimanual examination is performed to assess the size and mobility of the uterus and the location of the fibroids. This, along with the pre-operative ultrasound findings, will help to confirm the suitability of the case for a laparoscopic approach. A diagnostic hysteroscopy should be performed at this point if it has not recently been done to assess for submucous fibroids, which might be treatable by hysteroscopic resection. A uterine manipulator is inserted through the cervical os to the upper limit of the endometrial cavity. Routine umbilical laparoscopic entry is then performed (see Chapter 3), unless the fibroid uterus extends to the level of the umbilicus or above, in which case entry at Palmer's point may be necessary. At least two lateral 5 mm accessory ports are inserted at a level high enough to allow unobstructed passage of the lateral instruments over the fundus of the uterus. The authors use a further 5 mm midline suprapubic port to assist in dissection and enucleation of the fibroids.

Following careful laparoscopic inspection of the peritoneal surfaces, the location of the fibroids is ascertained in relation to the round ligaments, ovaries and Fallopian tubes (Fig. 9.103). These serve as useful guides of the relationship of the fibroids to the endometrial cavity. It is the authors' practice to then inject a solution of 20 iu of vasopressin diluted in 20 ml of 0.9% normal saline into the myometrium at the base of each fibroid, in order to induce vasoconstriction and reduce intra-operative blood loss. Care must be taken to avoid inadvertent intravenous administration of vasopressin, as serious cardiopulmonary side-effects have been described.[132]

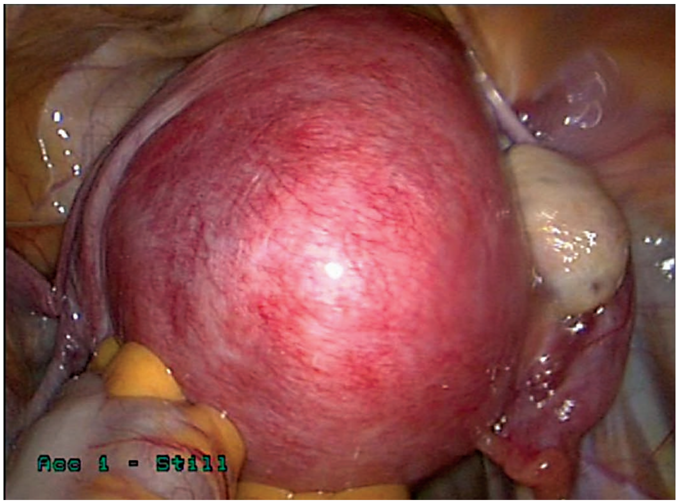

Fig. 9.103: Laparoscopic myomectomy. There is a large postero-fundal subserosal fibroid. The round ligaments and Fallopian tube insertions are anterior to the mass.

Subserosal and Intramyometrial Fibroids

The technique will depend upon the fibroid location. In the case of pedunculated subserosal fibroids, the pedicle can simply be treated with bipolar diathermy forceps close to the normal uterine myometrium, before division with laparoscopic scissors. In the case of intramyometrial or subserosal fibroids, the uterus must be incised. This can be achieved with a variety of instruments and energy sources, such as a monopolar diathermy hook or an ultrasonic scalpel. The incision is made directly over the fibroid, either transversely or obliquely in order to facilitate suturing of the defect after enucleation. The incision is made to the depth of the pseudocapsule where the plane of cleavage is identified (Fig. 9.104). The fibroid is then placed under tension with a grasping forceps or a myoma screw, to provide traction out of the uterine incision and facilitate enucleation (Figs. 9.105, 9.106).

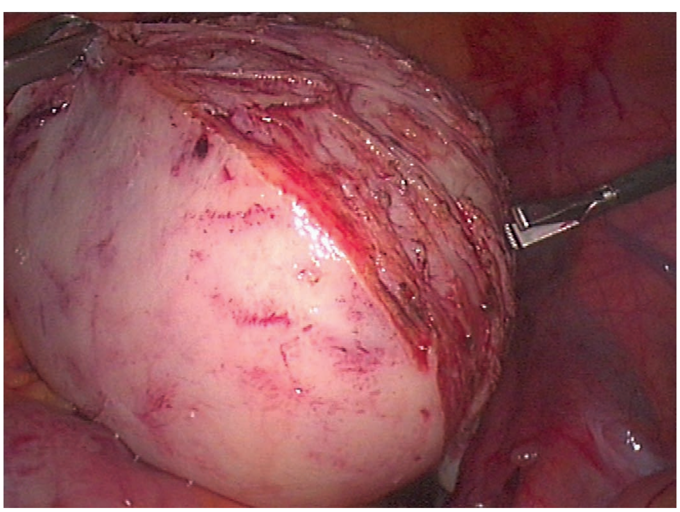

Fig. 9.104: Laparoscopic myomectomy. A transverse/oblique incision has been made. The psudocapsule has been identified and grasped before the fibroid can be dissected out.

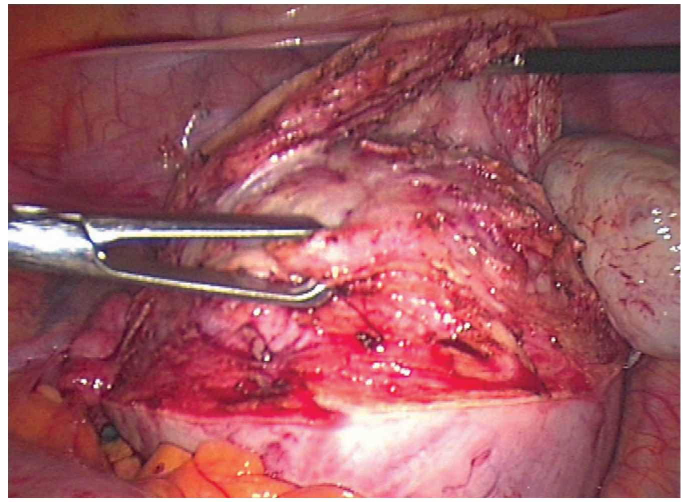

Fig. 9.105: Laparoscopic myomectomy. The fibroid is grasped with a 10 mm claw forceps through the left lateral port. Normal myometrial tissue anterior to the fibroid has been dissected away.

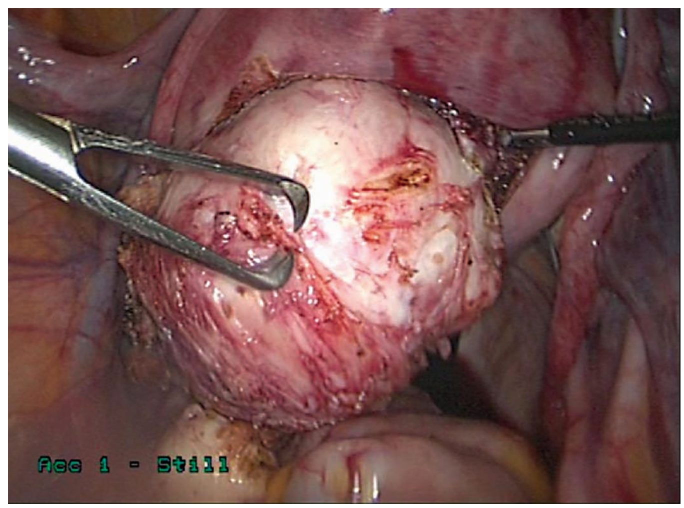

Fig. 9.106: Laparoscopic myomectomy. In this image, the fibroid has been successfully dissected out and away from the uterus.

During the enucleation process, small vessels can be coagulated with bipolar forceps. Dissection with an energy source rather than cold scissors helps achieve haemostasis. This is important not only to reduce blood loss but to ensure a clear surgical view through the laparoscope. Commonly larger blood vessels are located near the base of the fibroid, and again these should be treated with bipolar diathermy. Once the fibroid is removed, any additional bleeding vessels in the fibroid's cavity can be inspected and coagulated.

The myometrial defect must then be closed, except in the case of very superficial, pedunculated fibroids. There are various suturing options for closure of the defect in the myometrium and serosa. A continuous or interrupted suture can be used. Deeper defects will need to be closed in layers, just as in the case of open myomectomy. The authors prefer an interrupted No. 1

polyglactin suture for myometrial closure, tied with extracorporeal knots (Figs. 9.107–9.109). The uterine serosa is then closed. The authors' choice for this final layer is closure with an absorbable, unidirectional barbed suture that does not require a knot at either end; however, other suture material and methods of suturing are equally acceptable (Figs. 9.110–9.112).

9

Broad Ligament Fibroids

For a broad ligament fibroid, the incision is made through the avascular anterior leaf of the broad ligament. The round ligament can also be divided if further space is required for dissection. It is important to identify the uterine vessels and the ureter, after which dissection is usually relatively straightforward. The uterine defect can then be closed, along with either the anterior or posterior leaf of the broad ligament (to prevent small bowel herniation through the peritoneal defect) (Figs. 9.113–9.115).

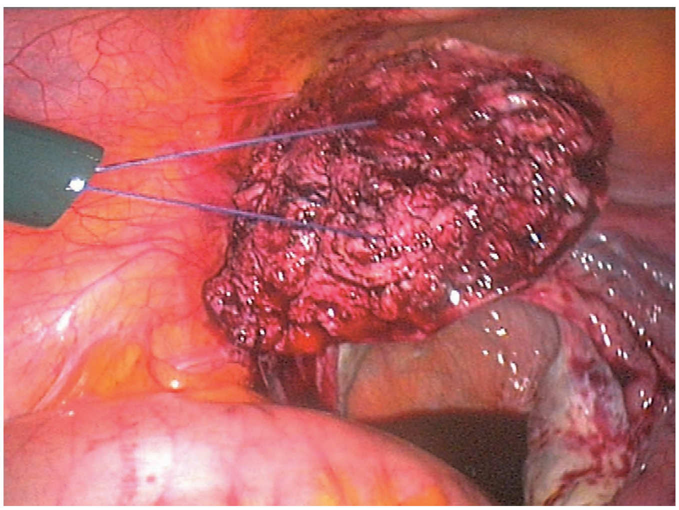

Fig. 9.107: Laparoscopic myomectomy. A large raw myometrial defect remains where the fibroid has been dissected out. A No. 1 polyglactin suture has been placed at the base of the defect and an extracorporeal knot is about to be tied.

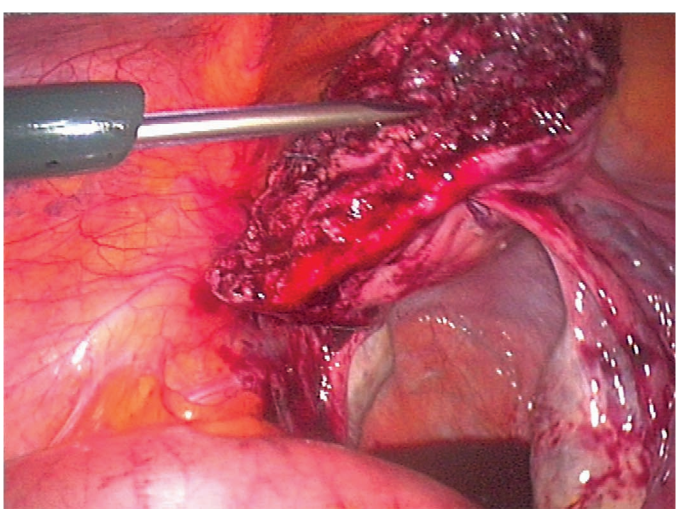

Fig 9.108: Laparoscopic myomectomy. A knot pusher is being used to tighten an extracorporeally tied knot.

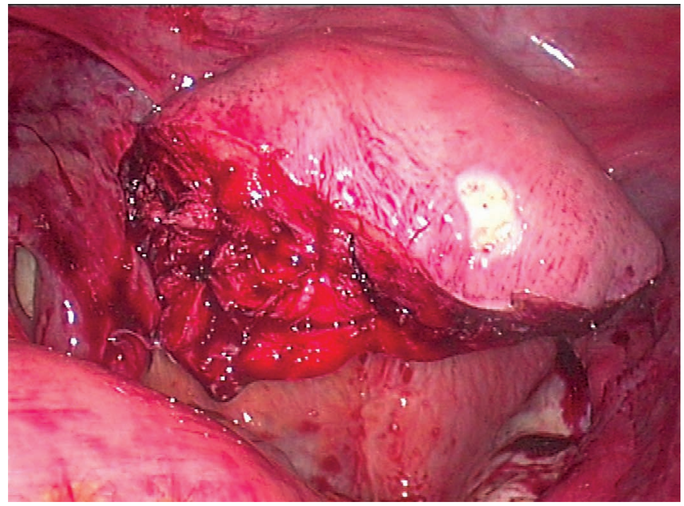

Fig 9.109: Laparoscopic myomectomy. The right hand side of the myometrial defect is now closed. The uterine serosa has not been sutured yet.

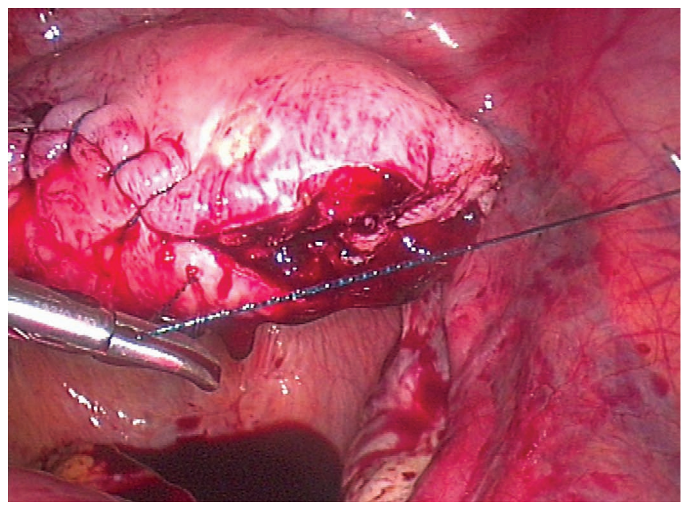

Fig. 9.110: Laparoscopic myomectomy. Following closure of the myometrial defect, the uterine serosa is being closed. In this image, a barbed, unidirectional, absorbable suture is being used to close the serosa. This confers the advantage of not needing to be tied for security.

Specimen Retrieval

Once the uterine defects have been closed and haemostasis confirmed, the fibroids must be removed from the peritoneal cavity. Small fibroids can be mechanically morcellated and removed piecemeal either through the ancillary ports or by extension of the skin incision. For larger fibroids, a mini-laparotomy incision can be performed to either remove them intact or to allow access with conventional instruments for

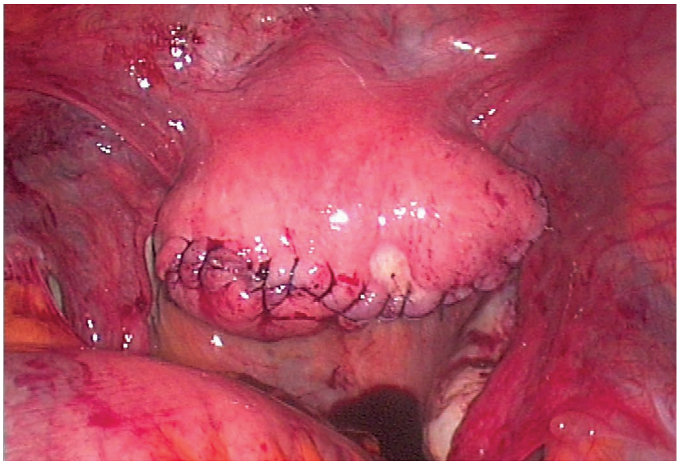

Fig. 9.111: Laparoscopic myomectomy. The uterine serosa has now been completely closed and the uterine anatomy has been restored to normal.

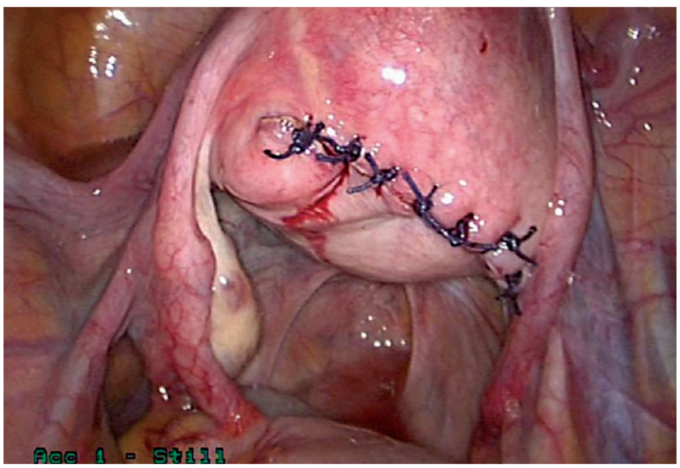

Fig. 9.112: Laparoscopic myomectomy. Alternative uterine serosal closure with interrupted No. 1 polyglactin sutures.

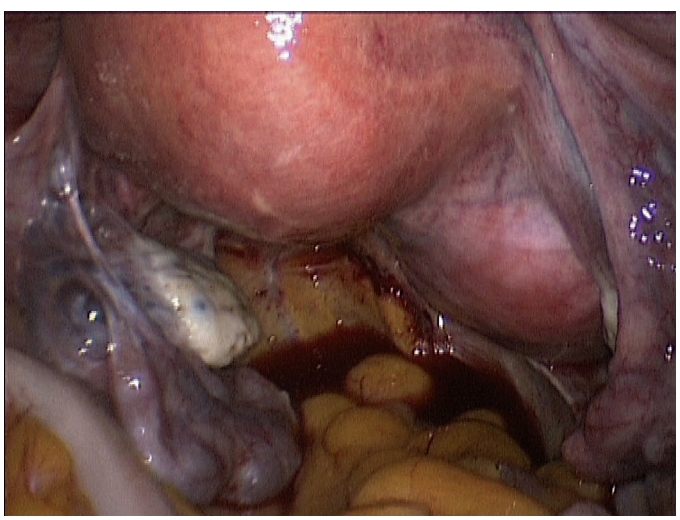

Fig. 9.113: Laparoscopic myomectomy. A right sided broad ligament fibroid.

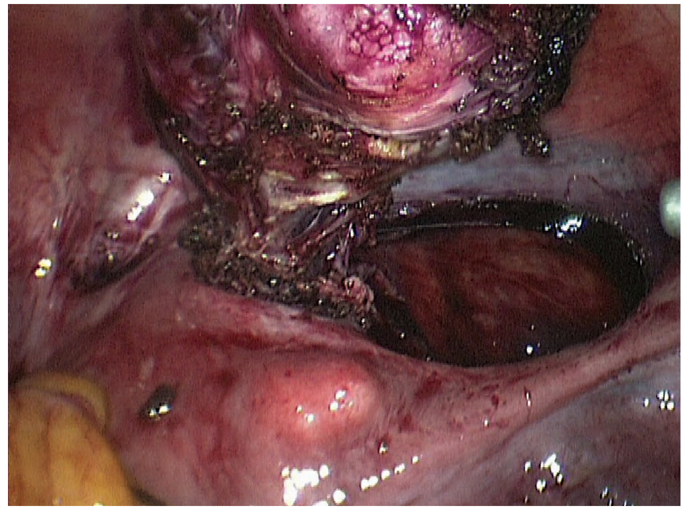

Fig. 9.114: Laparoscopic myomectomy. The broad ligament fibroid has been dissected out after careful identification of the right ureter and uterine vessels.

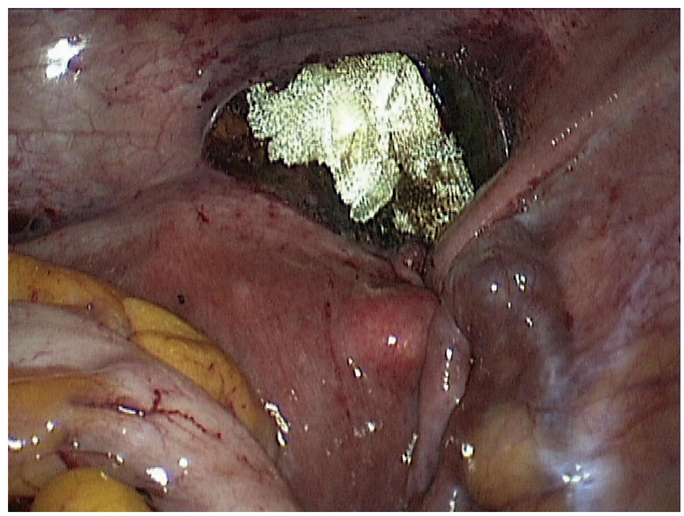

Fig. 9.115: Laparoscopic myomectomy. An oxidised cellulose polymer has been placed in the broad ligament defect to act as a haemostatic agent.

mechanical morcellation. However, this technique negates one of the main advantages of laparoscopic surgery, namely the rapid recovery rate, reduced analgesia requirement and shorter hospital stay afforded by small endoscopic incisions. One elegant alternative is to place the fibroids in an endoscopic bag and then perform a posterior colpotomy, either laparoscopically or vaginally, to allow removal of the specimens through the vagina. The fibroids can be morcellated in the vagina if needed to facilitate extraction.

Electrical morcellators have also been developed.[133] They are introduced into the pelvis through a 10–20 mm port. Tissue morcellation can still be a relatively lengthy procedure for large fibroids (Fig. 9.116). Electric tissue morcellators are potentially dangerous instruments, and they should only be used by

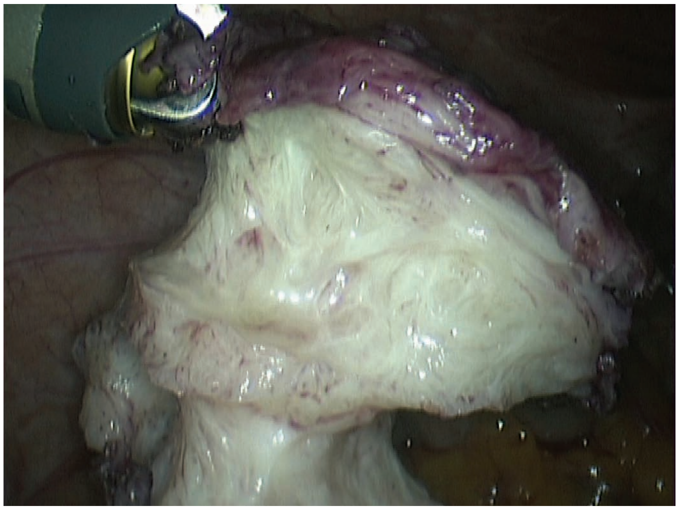

Fig. 9.116: Laparoscopic myomectomy. The fibroid is being morcellated with an electrical morcellator. An external motor drives a circular blade, through which the fibroid is passed. Cylindrical strips of morcellated fibroid are removed through the associated port and sent for histology.

experienced laparoscopic surgeons who have received the necessary training. It is imperative that the fibroid being morcellated is kept well clear of the bowel and adjacent blood vessels such as the internal and external iliac vessels. Tissue morcellation is not appropriate if there is concern regarding possible malignancy, as it risks peritoneal or port-site tumour seeding and only allows histological assessment of piecemeal tumour rather than an entire, untouched specimen.

Prior to closure, a synthetic adhesion barrier can be applied to the surgical site in the uterus. If an electrical morcellator has been used through a port of 10 mm or larger, the incised rectus sheath at the port site should be closed to prevent a postoperative hernia.

Parasitic Myomas

Occasionally, pedunculated subserosal fibroids develop a new blood supply separate from the uterine myometrium (e.g. vaginal, peritoneal or mesenteric fibroids), termed parasitic myomas. There is evidence that parasitic myomas are more common after surgery using morcellation techniques, prompting awareness that these can have an iatrogenic aetiology. With the increasing popularity of laparoscopic myomectomy, surgeons must take precautions to minimise parasitic fibroid occurrence, by ensuring meticulous removal of fibroid chippings from the peritoneal cavity following morcellation.[90]

POSTOPERATIVE COMPLICATIONS

Myomectomy can result in both short- and long-term complications (see Table 9.16). In addition, laparoscopic myomectomy carries the usual risks of laparoscopic surgery including trocar insertion accidents, excessive intra-operative bleeding and the need to convert to laparotomy in as much as 10% of cases.[134] The use of morcellation techniques is also thought to increase the risk of parasitic myoma formation, and electrical morcellators carry an obvious inherent risk of serious intra-abdominal trauma. Some research suggests that compared with open myomectomy, the laparoscopic approach may be associated with a higher risk of uterine rupture in subsequent pregnancy,[130,135] although evidence for this is limited. Hysteroscopic myomectomy and its complications are discussed earlier in this chapter.

Table 9.16: Complications of myomectomy

Haemorrhage (intraperitoneal or intramyometrial)
Hysterectomy
Post-myomectomy pyrexia
Paralytic ileus
Postoperative adhesions
Small bowel obstruction
Bladder/ureteric injury
Subfertility (tubal damage or adhesions)
Endometriosis/adenomyosis
Fibroid recurrence
Uterine rupture in pregnancy

Slight oozing from the uterine incision is inevitable, but myomectomy is notoriously associated with postoperative bleeding, which can either cause a significant myometrial haematoma or intraperitoneal haemorrhage. The use of intramyometrial vasopressin or intra-operative uterine tourniquets run the risk of re-perfusion bleeding after the operation is complete. It is wise to employ meticulous haemostasis by atraumatic suture techniques and to have a low threshold for inserting a drain in the pelvis. The abdomen should never be closed until the surgeon is satisfied with uterine haemostasis. Transfusion rates have been reported to be as high as 20% following abdominal myomectomy.[136] The conversion rate from myomectomy to hysterectomy, due to massive intra-operative bleeding, has been quoted as 2%.[137]

Postoperative fever has been reported to occur in as many as 36% of patients.[109] The cause is thought to be due to the release of fever-inducing factors during dissection of the fibroid, or possibly due to haematomas forming in the dead space left by the enucleated fibroids. A low threshold for postoperative antibiotic cover is recommended.

Open myomectomy is commonly associated with gaseous distension of the bowel and in some cases with paralytic ileus. This is usually a manifestation of intraperitoneal oozing of blood. Peritonitis is fortunately a rare complication, but a pelvic haematoma can become infected and form a pelvic abscess. Adhesions have already been discussed earlier in the chapter, and are a particular risk with posterior uterine incisions. Accidental trauma to surrounding structures is of course possible. Injury to the bladder or ureter is particularly likely when dealing with cervical and broad ligament fibroids. Interstitial Fallopian tube damage, either by incision or suture, must be most carefully avoided when dealing with fibroids near the uterine cornu.

Viable endometrium may implant in the dead space from which a fibroid has been removed. This produces an adenomyoma, a painful swelling in the uterus, and is particularly likely to occur if the uterine cavity has been opened. The incidence of postoperative fibroid recurrence was quoted in a follow-up of 379 patients by Bonney at under 4%.[120] It may be that more realistic estimates are available today with the help of ultrasound and magnetic resonance imaging. More recently fibroid recurrence has been quoted to be as high as 46% at one year post-myomectomy.[138]

The risk of uterine rupture in subsequent pregnancy or vaginal delivery is between 0% and 1%.[110] There is debate regarding how long a couple should wait to conceive following a myomectomy. A longer duration after myomectomy may allow for better uterine healing, although there is also a risk of recurrence of fibroids with time. Most surgeons advise a 3–6 month recovery interval before conceiving. There is also debate as to the best advice on mode of delivery after myomectomy, with very little evidence to rely on. Indications for Caesarean section are relative and may depend on various obstetric factors. Although normal delivery may be possible following myomectomy, rupture of the uterus is a well-recognised risk.[139,140] This appears to be more likely in the presence of a vertical incision in the body of the uterus or if the cavity has been entered, signifying a full thickness myometrial wound. In these cases, it is preferable to advise elective Caesarean section. There is also an increased risk of postpartum haemorrhage and possibly abnormal placental adherence to the myomectomy scar secondary to localised placenta accreta. It is the authors' practice to advise elective Caesarean in women who have had more than 50% of the myometrial thickness incised to remove a fibroid, in cases of multiple large fibroids with multiple uterine incisions, or as described above, in the case of a vertical upper segment uterine myomectomy scar that mimics a classical Caesarean section incision.

In Bonney's famous and unique series of 806 operations, the mortality was 1.1%.[120] Of the nine fatal cases, two were from pulmonary embolism, three from intestinal obstruction, one from secondary haemorrhage, and one from necrosis of the uterine wall caused by the over-use of mattress sutures. Two patients died of haemorrhagic shock, both of whom were pregnant. It should be stressed that myomectomy in pregnancy is to be avoided at all costs, including at Caesarean section. The greatest number of tumours removed at one operation was 225; in another case 40 tumours were removed, with a combined weight of 21 lb (9.5 kg). In one case, the tumour proved to be a sarcoma.

OUTCOME

Satisfactory reduction in menstrual loss occurs in 90–95% of cases, and whilst robust prospective data is lacking, retrospective studies of subfertility patients describe pregnancy rates between 39% and 75%.[2,141,142] In a comparison of leiomyoma therapies, myomectomy, hysterectomy and uterine artery embolisation all resulted in substantial symptom relief to near normal levels 12 months after treatment. Unsurprisingly, the greatest improvement was with hysterectomy.[143] In any patient undergoing myomectomy, it is prudent to consider postoperative contraception in the short term. It is the authors' preference to advise delaying conception for 3 months after surgery to allow sufficient time for maximal uterine muscular integrity. Unless other forms of contraception are contraindicated, it is sensible to avoid use of an intra-uterine device during this initial postoperative recovery.

Current medical, surgical, radiological and anaesthetic practice has contributed to safe and effective treatment of fibroids with uterine conservation in almost all cases, whilst progress in endoscopic surgery has benefited patients by radically reducing postoperative pain, length of hospital stay and recovery time, reducing adhesion formation and improving their reproductive potential.

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10 The Ovaries

Jane Borley, Alan Farthing

Benign Ovarian Cysts

DEFINITIONS AND SYMPTOMS

Ovarian cysts or masses arise from a physiological or a neoplastic process. The World Health Organisation classifies ovarian tumours depending on their precursor origin (Table 10.1). This can be broadly divided into epithelial tumours, sex-cord stroma tumours and germ-cell tumours; all of which can either be benign or malignant or borderline in the case of epithelial cell. (For ovarian malignancy please refer to Chapter 17). Ovarian cysts may be asymptomatic and found incidentally clinically or by ultrasound scan. Alternatively they may cause pain or discomfort, or present with bladder or bowel disturbance if they are large and exert pressure on surrounding viscera. Ovarian cyst accidents or torsion may present acutely with severe abdominal pain, which may radiate to the thigh, and are often associated with nausea and vomiting.

Functional cysts: The physiological process of ovulation can lead to the development of ovarian functional cysts but these are not pathological. Functional cysts arise from a Graafian follicle (the dominant follicle in the menstrual cycle) or a corpus luteum. Approximately 80–90% of simple cysts are found to resolve spontaneously after 6–12 weeks.[1,2] There is no recognised maximum size of a functional cyst, and they can occasionally be extremely large. There are reports of functional cysts being >30 cm in diameter,[3] and if they are causing symptoms then surgical removal may be necessary. However, because of their tendency to regress the management of a simple cyst in an asymptomatic patient should be conservative with ultrasound follow-up.

Table 10.1: Classification of benign ovarian tumours with some examples

Epithelial	Serous	Cystadenoma, adenofibroma and cystadenofibroma
	Mucinous	
	Endometrioid	
	Clear cell	
	Transitional cell	Brenner tumour
	Mixed epithelial	
Sex cord-stromal	Thecoma-fibroma	Meigs syndrome is an eponym that describes a benign fibroma of the ovary associated with ascites and a pleural effusion
	Granulosa-stromal cell	May secrete androgens, oestrogens and progestogens
	Steroid cell tumours	
	Sertoli-stromal cell	
Germ-cell	Mature teratoma	Dermoid cyst
	Thyroid tumour	Struma ovarii

Iatrogenic cysts will be present after ovulation induction therapy and can reach a significant size in ovarian hyperstimulation syndrome (see Chapter 12). Although this condition is common in assisted fertility techniques (33% of IVF cycles causing mild disease and a further 3–8% causing moderate to severe disease[4]), surgical input is rare and in fact should be avoided. Surgical intervention is only required for serious complications, namely rupture and haemorrhage or torsion.

Polycystic ovary syndrome (PCOS) is a complex syndrome with long-term health consequences including type 2 diabetes mellitus, sleep apnoea, increased rates of subfertility, endometrial hyperplasia and possible endometrial carcinoma.[5] For diagnosis of PCOS two of the three Rotterdam criteria[6] have to be present: (*i*) appearances of polycystic ovaries on ultrasound—either 12 or more peripheral follicles or an increased ovarian volume (>10 cm^3), (*ii*) oligo- or amenorrhoea, (*iii*) clinical and/or biochemical signs of hyperandrogenism. Surgery is rarely indicated except in the case of clomiphene ovulation–induction resistance where ovarian drilling has been shown to be as effective as gonadotrophin treatment without the risk of multiple pregnancy.[7]

DIAGNOSIS

A large ovarian cyst should be palpable abdominally arising from the pelvis. Smaller cysts will be palpable on bimanual examination by the presence of fullness in either adnexa. Positive examination findings will be easily missed if the patient is overweight or there is patient discomfort during the examination. Pelvic ultrasound scan will detect pathology in the majority of cases. Both transabdominal and a transvaginal approach should be used whenever possible. A transvaginal approach has been shown to improve sensitivity when compared

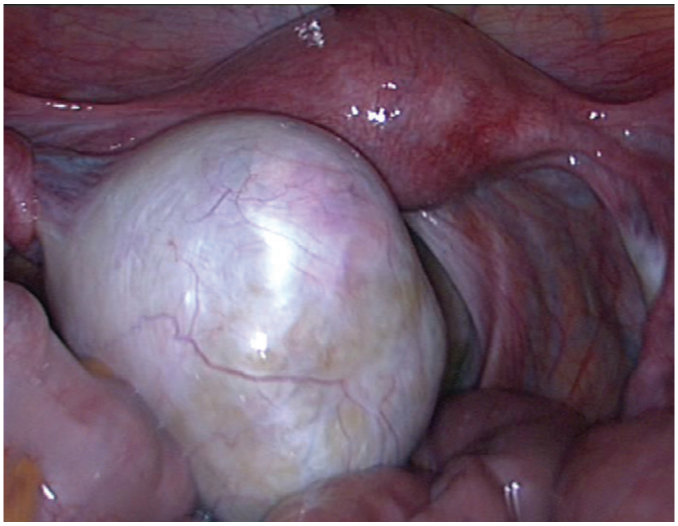

Fig. 10.1: Left ovarian cyst.

to a transabdominal approach for smaller cysts,[8] whereas transabdominal scanning will pick up very large cysts, which may be otherwise missed. Magnetic resonance imaging (MRI) of the pelvis and abdominal computed tomography (CT) may be used if there is concern of malignancy or originating site of the pathology. (See Chapter 4).

Diagnostic laparoscopy may be useful for further evaluation of a suspected cyst on occasion, and laparoscopy for pelvic pain or infertility may result in the finding of a previously unsuspected ovarian cyst (see Fig. 10.1).

MANAGEMENT

The most important question on assessment of ovarian cysts is whether there are features suspicious of malignancy. It is recommended that *a risk of malignancy index* be calculated to select women who are at high risk of having a malignant tumour and thus be referred and managed by the appropriate team.[9] Low-risk women can be operated upon by a general gynaecologist, moderate risk at a cancer unit and high risk at a cancer centre (Table 10.2). If an ovarian tumour is removed and subsequently found to be malignant, it may be necessary to subject the patient to a further abdominal operation for correct treatment and staging. This includes removal of the contralateral ovary, hysterectomy and omentectomy.

Risk of malignancy can be calculated by the patient's age, ultrasound findings and CA125 level.

$$RMI = U \times M \times CA125$$

U = ultrasound score with 1 point being given for each suspicious features on ultrasound, e.g. a multi-loculated cyst, evidence of solid areas or papillary projections, bilateral disease, presence of ascites or metastasis. $U = 0$ (for ultrasound score of 0); $U = 1$ (for ultrasound score of 1); $U = 3$ (for ultrasound score of 2–5). $M = 1$ for pre-menopausal, $M = 3$ for post-menopausal women. *CA125* is serum CA125 measurement in u/mL.

Table 10.2: An example of RMI scores and the subsequent percentage risk of cancer[9,11]

Risk of malignancy	RMI score	Women (%)	Risk of cancer (%)
Low	<25	40	<3
Moderate	25–250	30	20
High	>250	30	75

Although a CA125 level is useful, it is important to remember that overall 20% of women with ovarian cancer and 50% of women with stage 1 ovarian cancer have a normal CA125 level. CA125 may also be elevated in benign disease, such as endometriosis, fibroids and pelvic inflammatory disease, pregnancy or peritonitis.[10]

Carcinoembryonic antigen (CEA) and CA19-9 are markers for colorectal carcinoma, upper gastrointestinal and pancreatic cancer and may also be useful when investigating the nature of a pelvic mass. A recent development is the use of human epididymal protein 4 (HE4) as a tumour marker for ovarian carcinoma. It has been shown to improve specificity to 95% when combined with CA125 levels in a prospective review of patients diagnosed with a pelvic mass and may be used for reassuring women with a mildly raised CA125, if the HE4 is normal.[12]

SURGERY

Surgery for benign ovarian cysts should be performed laparoscopically whenever feasible. The benefits have been well demonstrated including increased patient satisfaction, shorter hospital stay and recovery, quicker return to work and decreased intra-abdominal adhesion formation. The objectives and surgical techniques are broadly similar to the open approach, and much will depend on the level of expertise of the laparoscopic surgeon. Aspiration of the cyst is generally discouraged, especially in post-menopausal women due to the poor sensitivity of cyst fluid cytology[9] and increased risk of cyst recurrence. If the cyst appears benign and the patient is pre-menopausal, it is usually important that healthy ovarian tissue be conserved.

Ovarian Cystectomy

An incision is made through the ovarian cortex around the base until the plane of cleavage is found, after which the cyst is shelled out. A little traction is usually necessary and any connective tissue passing from the substance of the ovary into the capsule of the cyst can be divided by sharp dissection. The aim is to remove the cyst with the capsule intact although this may be technically difficult especially if the cyst is thin-walled. If rupture of the cyst occurs the lining of the cyst should be gently avulsed from its bed. It is important to remove, if necessarily piecemeal, all the cyst lining in order to avoid a recurrence. The cyst is then placed in a laparoscopic bag, where it may be aspirated if necessary before removal through one of the ports. Repair of the ovary can be performed with fine non-absorbable sutures, which causes minimal inflammatory response. With the emergence of laparoscopic treatment we have discovered that repair is not necessary for future function. (see Figs. 10.2–10.6).

Strategies for Removal of Large Cysts Laparoscopically

- **Entry:** For large cysts, which extend above the umbilicus, Palmers Point (see Chapter 3) entry can be used (3 cm below the left costal margin in the mid-clavicular line).
- **Visualisation of pedicle and other ovary:** Visualisation may be obscured by a large cyst, and to optimise conditions attention should be paid to the accessory port sites. Visualisation can be improved by the manipulation of the uterus and the use of Trendelenburg tilt. Increasing the intra-abdominal pressure will allow further optimisation, although the pressure should not be so high that it compromises ventilation or venous return.

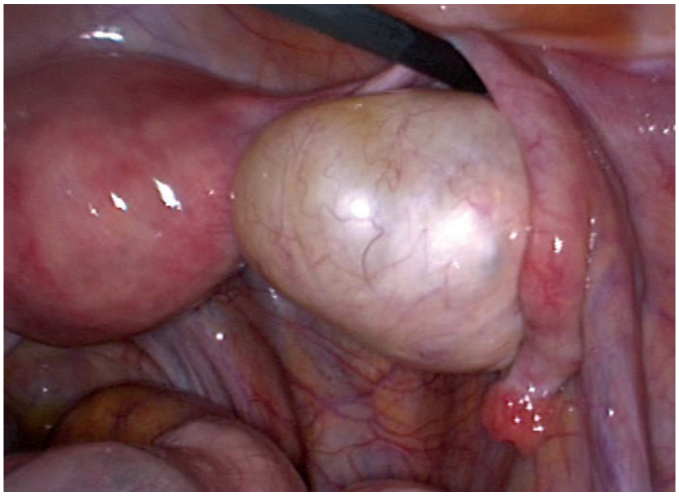

Fig. 10.2: Right dermoid cyst.

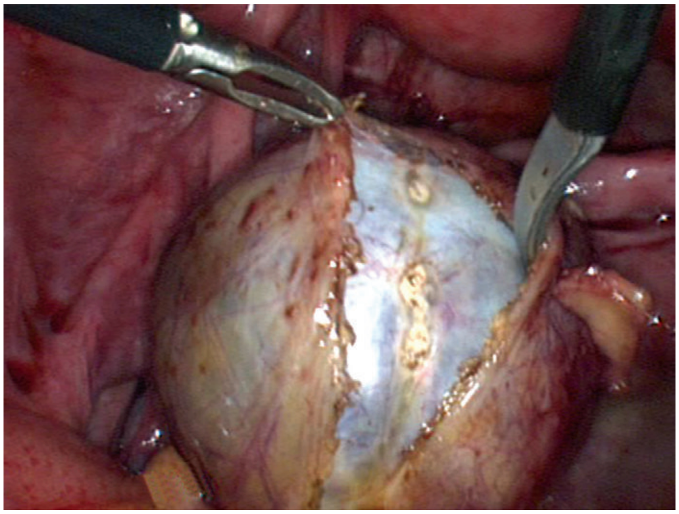

Fig. 10.3: Incision through the capsule to enucleate cyst.

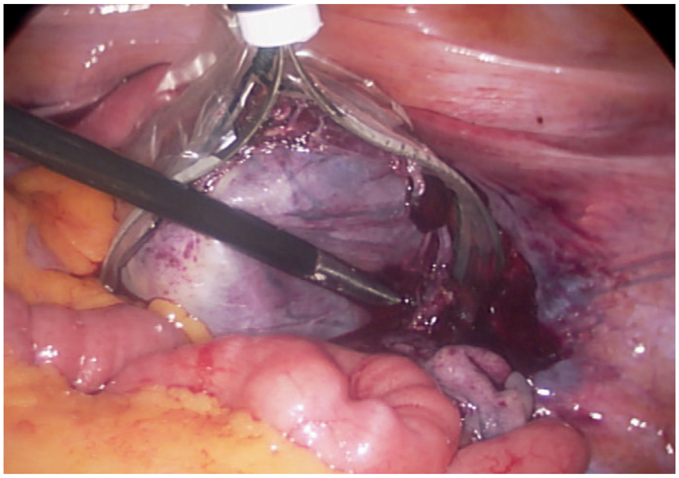

Fig. 10.4: Ovarian cyst within self-opening retrieval bag.

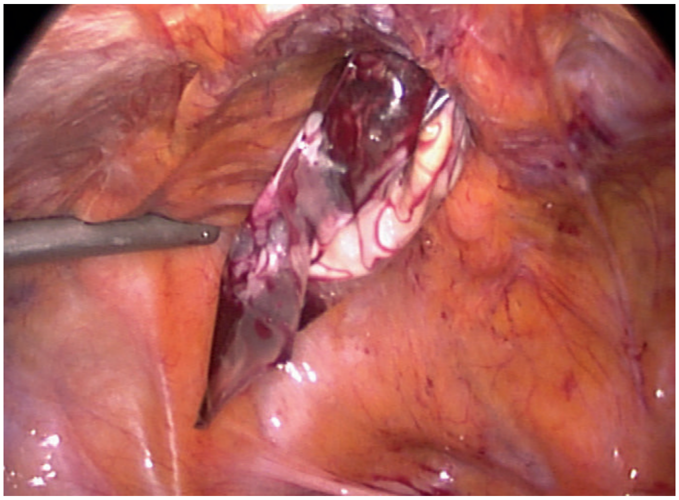

Fig. 10.5: Ovarian cyst within retrieval bag being removed through anterior abdominal wall.

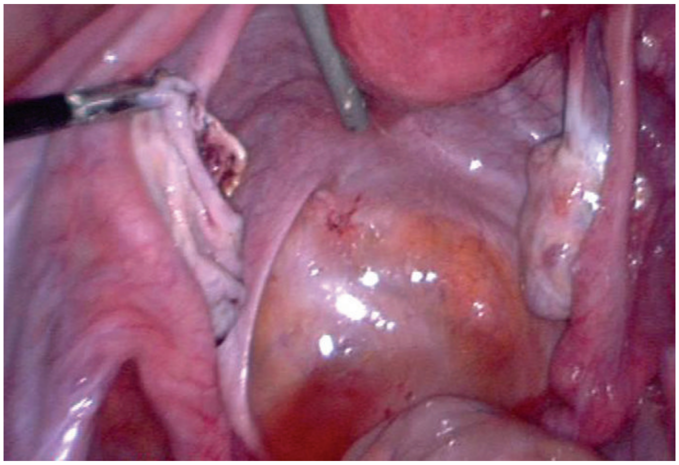

Fig. 10.6: Left ovary following ovarian cystectomy.

- **Removal of specimen:** When aiming to keep the ovarian cyst intact several techniques can be applied for removal. Laparoscopic bags can be obtained in a variety of sizes, once the cyst has been placed in the bag it can be drawn up to the abdominal wall and the cyst punctured within the bag. An extension of the port site is sometimes required if solid components are within the cyst. For larger cysts an alternative exit may be made by use of posterior colpotomy. The colpotomy incision should be made under direct visualisation, with the use of instruments such as Kochers forceps or the McCartney tube introduced vaginally into the posterior fornix. The cyst may be placed in an 'Aldon' intestinal bag, which can be closed by a drawstring, and then removed through the posterior fornix. The posterior fornix is then closed.
- **Deliberate puncture:** Ovarian cysts may be punctured and drained to allow easier excision and removal. Efforts should be made to minimise spillage of cyst contents into the abdomen. A purse-string can be sutured to the surface of the cyst and tightened around the suction tube once the cyst is perforated. Spillage of contents is contraindicated in malignancy and can cause chemical peritonitis in dermoid cysts unless the peritoneum is thoroughly washed out.

Oophorectomy

The ovary has two blood supplies: the ovarian ligament on the uterine side and the ovarian artery that arises from the aorta and runs in the infundibulopelvic ligament. Usually these are easily identified separately. Division of the two sides of the broad ligament enables the pedicles to be skeletalised, and they can then in turn be identified, divided and clamped.

Possible problems: Care should be taken if there is presence of adhesions from fibrosis, endometriosis or previous surgery. Division and exploration of the broad ligament should ensure the ureter is not included in the division of the infundibulopelvic ligament. Following previous hysterectomy, the inferior base of the ovary may become adherent to the bladder by adhesions. This can be easily damaged during division and care should be taken. Following adnexal torsion, the ovarian ligament and infundibulopelvic ligament may be twisted together. Efforts should always be made to untwist the pedicles and divide them separately to ensure optimal haemostasis.

Oophoropexy and Transposition

Oophoropexy refers to securing the ovary in a fixed anatomical location. This may be indicated in cases of recurrent ovarian torsion, dyspareunia (if pendulous ovaries hanging in the pouch of Douglas) or in infertility surgery to improve egg collection for assisted reproduction techniques.

Ovarian transposition is the process of dividing the ovarian ligament and dissecting the infundibulopelvic ligament to bring the ovaries out of the pelvis and fix them on the abdominal side wall. This may be indicated to protect ovarian function in certain cases of pelvic radiotherapy, particularly for lymphoma or cervical carcinoma. Unfortunately, ovarian function continues to fail in 40–50% of cases. This is probably due to the effect on ovarian blood supply when the ovarian ligament is divided and the sensitivity of the ovaries to radiation scatter, especially if they are only transposed short distances from the radiotherapy field.

Ovarian Cysts in Pregnancy

Due to the routine use of obstetric ultrasound in pregnancy, ovarian cysts presenting in pregnancy is relatively common, the majority of which are benign and asymptomatic. They are commonly functional in origin, which will naturally regress after the first trimester.[13] Management depends on the nature and size of the cyst, symptoms and gestation. The risk of ovarian torsion is thought to be increased in the first trimester and then decreases after 16 weeks gestation as the uterus fills the pelvis and reduces space in the adnexa.[14] Surgery during pregnancy increases the risk of miscarriage, pre-term labour and intra-uterine death therefore conservative management is advocated if there are no suspicious features or signs of cyst accident or torsion.[15] If surgery is thought to be necessary, the best timing is thought to be between 16 and 23 weeks to allow time for spontaneous resolution and in an aim to minimise risk of surgery to the fetus.[15] There is minimal data concerning the safety of laparoscopic management of ovarian cysts in pregnancy. The pelvic organs are more hyperaemic and therefore haemostasis may be more difficult to achieve, blood in the pelvis will also be a possible focus for irritation to the uterus with subsequent risk of miscarriage. It is more difficult to manipulate the uterus as instrumentation is contraindicated and the uterus is larger and softer. One could argue that laparoscopic management is rarely indicated as surgery for benign cysts should be postponed until after pregnancy and those with suspicious features of malignancy are more appropriately managed by an open approach. At term very large ovarian cysts may obstruct descent of the fetal head into the pelvis and therefore there may be an indication for Caesarean section with ovarian cystectomy.

Ovarian Cysts in Post-Menopausal Women

Guidelines from the Royal College of Obstetricians and Gynaecologists recommend that simple, unilateral, unilocular ovarian cysts that are less than 5 cm in diameter with a normal CA125 should be managed conservatively as the risk of malignancy is less than 1%.[9] Follow-up is recommended with repeat TVUSS and CA125 every 4 months. If there is resolution or no change in size of the cyst after 1 year no further follow-up is required. Outside of these criteria surgical removal is recommended by bilateral oophorectomy.

Ovarian Torsion and Cyst Accidents

Adnexal torsion or other cyst accidents usually present with acute pelvic pain. It can be defined as 'the twisting by at least one complete turn of the adnexa, ovary or more rarely tube alone, around a centre line consisting of the infundibulopelvic and tubo-ovarian ligaments'.[16] Between 2.5% and 7.4% of patients undergoing emergency surgery for acute pelvic pain are found to have proven ovarian torsion at laparoscopy.[17] Diagnosis may often be difficult especially if there is no preceding history of known adnexal cysts. History and examination are often non-specific and other surgical causes of an acute abdomen should be excluded. The right side is more frequently affected than the left side. Factors that increase the risk of torsion include benign ovarian cysts, ovarian hyperstimulation and the first trimester of pregnancy. Adnexectomy was traditionally the treatment of choice because of the theoretical risk of thromboembolism. It was believed that blood clot that formed within the ovarian vessels, due to stasis of blood flow could embolise to distant sites once the pedicle was untwisted. This has now been refuted in the literature. The aim of surgery is thus to recover viable ovarian tissue by urgently untwisting the pedicle and restoring blood flow to the area plus excision of any contributing ovarian cyst possibly as a second procedure. If the ovary has become necrotic and is unsalvageable then oophorectomy will need to be performed. There have been reports of ovarian function being restored even in ovaries that appear macroscopically necrotic [18,19]; however, further studies need to be performed before this practice is routinely recommended and currently assessment of whether the ovary can recover is somewhat subjective.

Ovarian cysts may also rupture and spill their contents into the abdominal cavity, or cause intra-abdominal bleeding from the serosal edge. This may cause acute pain, chemical peritonitis or even hypovolaemic collapse if bleeding is significant. Depending on the contents of the cyst and amount of bleeding, management will range from conservative to urgent resuscitation and surgery.

Para-Ovarian Cysts

Para-ovarian cysts can be simply defined as a cyst that arises next to the ovary but is not part of the ovary (see Fig. 10.7). This definition would include fimbrial cysts, broad ligament cysts and pseudocysts. Most are asymptomatic and can be managed conservatively. Occasionally, an ovarian cyst may appear para-ovarian by its nature of burrowing into the broad ligament. If excision is required, the ureter must be identified to avoid injury to it.

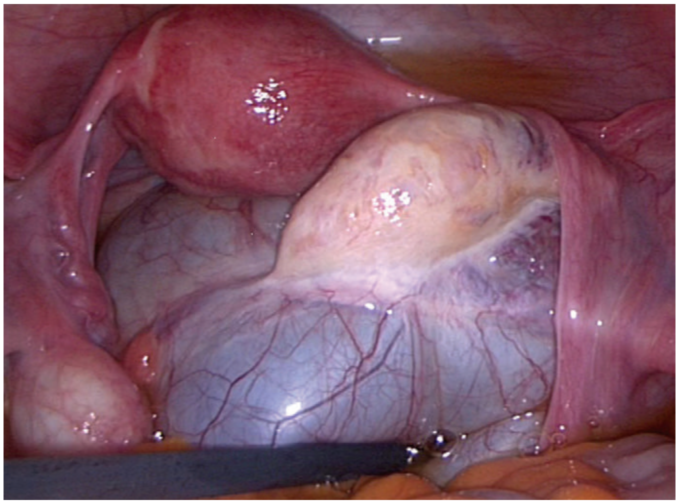

Fig. 10.7: Para-ovarian cyst.

Summary

Ovarian cysts are very common and many functional cysts will resolve spontaneously. Benign tumours of the ovary usually require surgical removal in order to relieve symptoms, regain ovarian function or prevent further growth or torsion of the ovary. The majority of benign ovarian cysts can and will be removed laparoscopically with preservation of ovarian tissue. However, a risk assessment and discussion with the patient is necessary in each case so that the appropriate weight is given to each risk factor in order to determine the optimal management.

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11

Endometriosis

Alan Farthing, Jane Borley

Introduction

SYMPTOMS

Endometriosis is the presence of ectopic endometrium which creates a micro-neovasculature around itself. In each menstrual cycle the area of ectopic endometrium bleeds. Depending on where the endometriosis is, this bleeding can either cause (*i*) local irritation and pain or (*ii*) can collect as a cyst or endometrioma or (*iii*) it can cause the development of fibrotic scar tissue that itself can become painful. Therefore superficial endometriotic spots tend to cause dysmenorrhoea alone, whereas deep infiltrating endometriosis—which causes adhesions, endometriomas and so-called rectovaginal septum disease with infiltration of the large bowel—can cause dyspareunia, backache, dyschezia, tenesmus and cyclical changes in bowel habit as well as dysmenorrhoea. There is a wide range of severity of disease and a wide range of severity of symptoms, and the two do not necessarily correlate very closely.

The scarring secondary to endometriosis has a detrimental effect on fertility, and a relatively asymptomatic patient may not discover the diagnosis until they seek help in conceiving.

PHYSICAL SIGNS

Pelvic examination may be unremarkable in superficial or mild endometriosis. It may be possible to detect enlarged ovaries on clinical examination or there may be tender areas in the pelvis particularly when the uterosacral ligaments are stretched. In severe disease, the uterus is usually retroverted with nodular thickening in the pouch of Douglas and uterosacral ligaments and on occasions dark purple nodules may be seen in the posterior fornix where the endometriosis has invaded into the vaginal epithelium. This nodular thickening of the uterosacral ligaments can usually be palpated best with a bi-digital examination using an examination index finger in the vagina and the rectum simultaneously. This is often too painful to give an accurate assessment in the outpatient clinic but can be very useful at examination under anaesthetic.

DIAGNOSIS

Transvaginal ultrasound scans can detect endometriomas with characteristic features of the blood-filled cysts; however, superficial endometriosis cannot be clearly identified. Deep infiltrating disease can also be seen with ultrasound but is particularly operator dependant. Involvement of the bowel serosa and mucosa is best assessed with MRI scans, especially if using a technique to distend the rectum during the scan. Multidisciplinary feedback of operative and scan findings is essential in helping to interpret the subtle signs that are seen on MRI in these patients.

Sigmoidoscopy or colonoscopy is not a particularly useful investigation even if there is cyclical rectal bleeding as there is rarely macroscopic breaching of the rectal mucosa.

For a definitive diagnosis of endometriosis, visual inspection of the pelvis at laparoscopy is the gold standard investigation.[1] A negative laparoscopy misses histologically proven endometriosis in around 0.7% of cases,[2] although many of us believe that this is only the case if the laparoscopy is accurately performed by an experienced operator. Typical lesions are described as ‘powder burns’ or ‘gunshot’ in appearance on the serosal surface of pelvis. They can be black or dark brown, and there is often puckering of the surrounding peritoneum. Less commonly, the lesions can be red or like petechial haemorrhages and serous or clear vesicles. The endometriomas contain thick ‘chocolate-like’ fluid and the fibrotic tissue can be extremely thickened and hard. The fibrosis can cause ureteric constriction, kinking or obstruction, and the rectum is often drawn up to become firmly adherent to the posterior surface of the uterus (see Figures 11.1–11.6 demonstrating endometriosis of differing severity).

There are a number of classification systems to score the severity of the disease. Each system has its advantages and disadvantages and no perfect system has yet been devised that correlates accurately with the severity of symptoms. The commonest used is that suggested by the American Fertility Society[3] (see Table 11.1).

ADENOMYOSIS

Endometriosis in the myometrium is known as adenomyosis. It is often associated with endometriosis elsewhere and can cause dysmenorrhoea, menorrhagia, a mass within the myometrium, and infertility in severe cases. The uterus can be bulky and tender on examination and imaging with ultrasound or MRI often demonstrates areas of haemorrhage within the myometrium which can be focal or widely distributed.

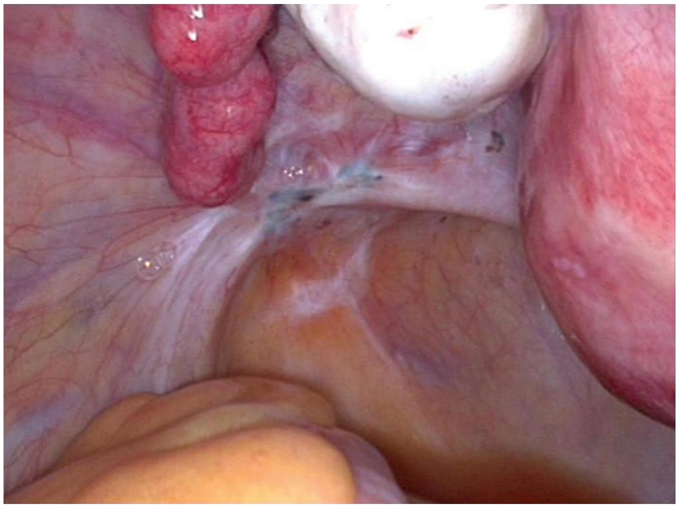

Fig. 11.1: Superficial endometriosis on left pelvic side wall. Powder burn and white lesions.

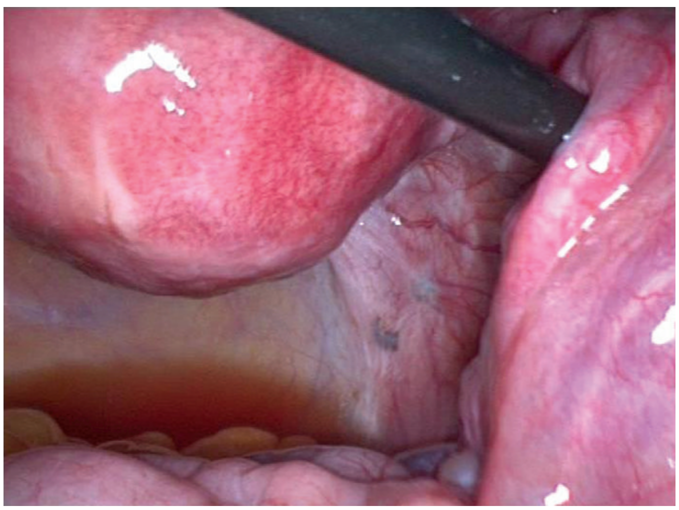

Fig. 11.2: Superficial endometriosis. Powder burn lesions overlying right uterosacral ligament.

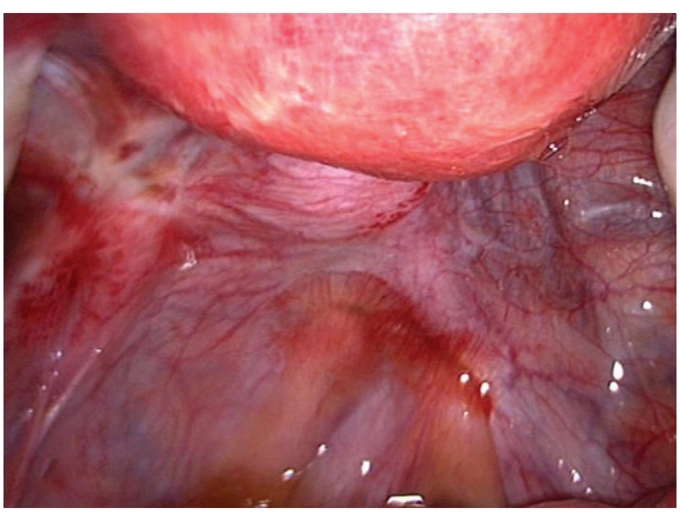

Fig. 11.3: Deeper endometriosis on left uterosacral ligament distorting anatomy with the early signs of tethering of the rectum.

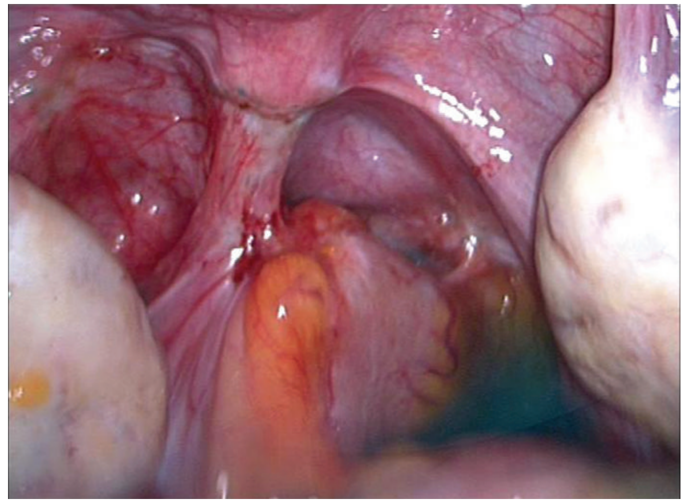

Fig. 11.4: Distinctly thickened left uterosacral ligament with tethering of rectum.

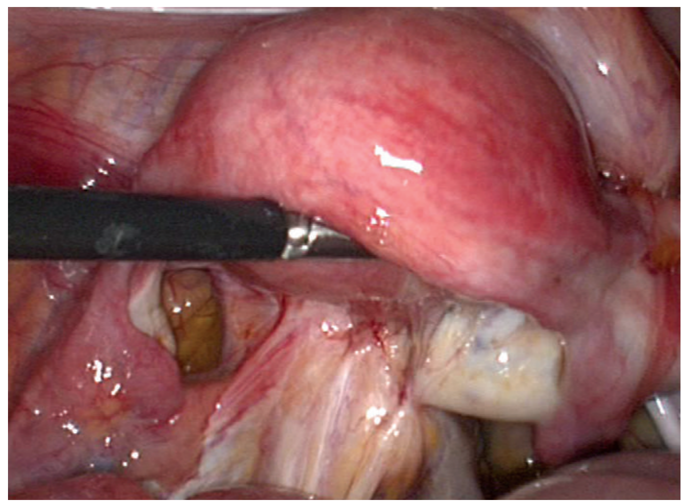

Fig. 11.5: Rectum firmly adherent to posterior surface of uterus obliterating the Pouch of Douglas.

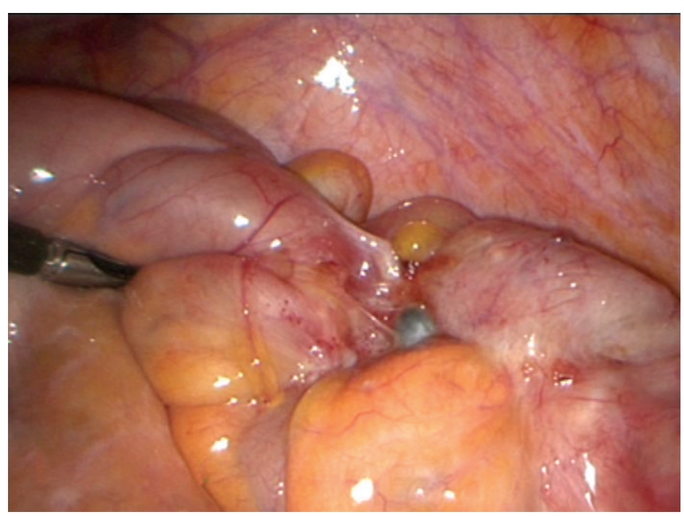

Fig. 11.6: Endometriosis of the ileocaecal junction causing cyclical bowel obstruction.

Table 11.1 The American Society of Reproductive Medicine revised classification of endometriosis

Stage I (Minimal) – 1–5
Stage II (Mild) – 6–15
Stage III (Moderate) – 16–40
Stage IV (Severe) – >40
Total ____________________

	Endometriosis	<1 cm	1–3 cm	>3 cm
Peritoneum	Superficial	1	2	4
	Deep	2	4	6
Ovary	R Superficial	1	2	4
	Deep	4	16	20
	L Superficial	1	2	4
	Deep	4	16	20
	Posterior cul de sac obliteration	**Partial**	**Complete**	
		4	**40**	
	Adhesions	<1/3 Enclosure	1/3–2/3 Enclosure	>2/3 Enclosure
Ovary	R Filmy	1	2	4
	Dense	4	8	16
	L Filmy	1	2	4
	Dense	4	8	16
Tube	R Filmy	1	2	4
	Dense	4	8*	16
	L Filmy	1	2	4
	Dense	4*	8*	16

*If the fimbriated end of the Fallopian tube is completely enclosed, change the point assignment to 16.

DISTANT ENDOMETRIOSIS

Endometriosis has been described in virtually every part of the body. Case reports of cyclical haemoptysis or cyclical pneumothorax because of lung endometriosis are described and it is not uncommon to find endometriosis seeding in a scar especially in the umbilicus after laparoscopy or in the abdominal wound after Caesarian section.

Treatment

It is fundamentally important that each patient is treated according to their symptoms and their aspirations. For example, infertility does not need to be addressed unless a patient wishes to conceive, and deep infiltrating disease does not need to be excised if it is not causing any problems. For these reasons, the first principle of endometriosis treatment is to take a full and detailed history, and plan treatment on the basis of symptoms.

Since endometriosis is a condition dependent upon the physiological functions of the ovary, preventing the ovaries from functioning with medication or their removal will logically control or alleviate the symptoms. The acute inflammation associated with deep infiltrating endometriosis will resolve but the fibrotic scar tissue and the original lesion may not and when medication is stopped the symptoms will return. If the fibrosis is the cause of the symptoms or they have been present for so long that they have caused neuropathic pain then medication is unlikely to work in isolation.

DYSMENORRHOEA

The most successful treatment of this symptom will be the establishment of amenorrhoea. Medically this can only be achieved with hormonal manipulation and a number of options are available. The combined oral contraceptive, progesterone only pill, oral progestogens such as medroxyprogesterone acetate, the levonorgestrel intra-uterine system (IUS), danazol, gestrinone and GnRH analogues can all be useful but have differing side effect profiles. Some, such as danazol and gestrinone, have permanent side effects and are used less frequently these days, whilst others such as GnRH analogues are only licensed for limited use as they cause osteoporosis and may require 'addback' hormone replacement therapy (HRT).

As a principle, medical treatment can be used for symptoms whilst the treatment continues but does not cause long-term relief. Various studies have shown that symptoms return within months of cessation of the treatment.[4]

Surgical removal of mild to moderate endometriosis causes significant relief of pain whether it is excised or ablated.[5,6] In the longer term, this pain relief is sustained and therefore if laparoscopy is being used to diagnose the disease it is sensible, if not compulsory, to have the facilities and ability to surgically treat the disease at the same time.

Dysmenorrhoea caused by deep infiltrating disease can be significantly improved by excision, although the complications of this type of treatment require careful pre-operative counselling and this is not something to attempt at the diagnostic laparoscopy. Ultimately removal of the ovaries will induce amenorrhoea and relieve symptoms. Sadly many women over many years have undergone hysterectomy with ovarian conservation for their endometriosis. This is the only type of treatment that induces amenorrhoea but still leaves cyclical pain. There is no reason to suspect hysterectomy with ovarian conservation could improve the symptoms caused by pelvic endometriosis unless it also removes the endometriosis itself.

NON-CYCLICAL PAIN

Non-cyclical pain due to endometriosis is caused by the fibrotic scar tissue secondary to repeated episodes of acute inflammation over months or years. This fibrotic tissue does atrophy postmenopausally and if a patient has been able to tolerate the symptoms until menopause she can be reassured that without further hormonal stimulation she can expect symptoms due to the fibrotic disease to gradually ease. However most patients with this deep infiltrating fibrotic disease are pre-menopausal and many will have debilitating pain.

Fibrotic disease is classically found originating in the uterosacral ligaments and involving the vaginal posterior fornix. This type of disease causes deep dyspareunia. As the scarring gets more severe, the rectum can get drawn up into the uterosacral ligaments causing obliteration of the Pouch of Douglas (see Fig. 11.5). In addition to deep dyspareunia, these patients get dyschezia or change in bowel habit, which is often worse at menstruation. Various medical treatments may help to alleviate some of the symptoms suffered by these patients and that may be sufficient to get on with normal life; however, relief of all the symptoms can only occur by excising the fibrotic tissue.

INFERTILITY

Endometriosis can cause infertility. Obviously if the Fallopian tubes are occluded from scar tissue or if ovulation is not occurring because of large cysts these need to be addressed but mild to moderate endometriosis is also associated with a decreased fertility rate.

There is no evidence that hormonal suppression improves the fertility rate in endometriosis-associated infertility.[7]

Ablation of mild lesions and adhesiolysis does appear to improve fertility rates.[8]

Ovarian cystectomy as opposed to drainage or ablation does improve the fertility rates whether spontaneous or assisted conception is required. In patients undergoing IVF, there is concern that an ovary containing an endometrioma larger than 3–4 cm might not respond to stimulation and may make egg retrieval more difficult and increase the risk of infection at egg retrieval. For these reasons most IVF teams will recommend surgical removal prior to IVF treatment.

Fig. 11.7: Uterine adenomyosis. Sometimes an adenomyoma forms a localised swelling, which may be distinguished from a fibroid by the absence of a place of cleavage when enucleation is attempted.

Adenomyosis

In this condition, islands of endometrium, both glands and stroma, are found in the myometrium which, as a result, undergoes considerable hyperplasia so that the uterus is symmetrically enlarged if the process is diffuse (Fig. 11.7). Adenomyosis can be localised in which case an asymmetrical enlargement occurs.

Adenomyosis is often present in widespread endometriosis and is probably the cause of treatment failure when excisional treatment does not relieve dysmenorrhoea. Inducing amenorrhoea or hysterectomy are the only treatments that will relieve the symptoms of adenomyosis.

Surgical Techniques

PELVIC ENDOMETRIOSIS

Superficial endometriosis can be ablated or excised. Techniques involving lasers and other ablative technology are detailed elsewhere. Ablation is easy to perform and frequently relieves symptoms but with deeper endometriosis the depth of destruction required can be underestimated. On occasions, the endometriosis can be overlying important structures (such as the ureter); in this situation, the surgeon needs to be able to excise the lesion with identification of the underlying structure if complications are to be minimised whilst complete treatment is achieved. This is illustrated in Fig. 11.8a and b. A gynaecologist who cannot safely identify the ureter and excise the pelvic peritoneum in this way should not treat this type of endometriosis.

EXTRA-GENITAL ENDOMETRIOSIS

Isolated deposits require local excision, such as the lesion shown in Fig. 11.6. In this case, the patient presented with cyclical pain. On closer questioning she noted that she became very bloated and constipated at the time of her periods, and more recently, she had been vomiting with each menses. Laparoscopy revealed superficial endometriosis in the pelvis with some secondary scarring of the fimbrial end of the right Fallopian tube but no other deep infiltrating disease until the rest of the abdominal cavity was inspected. This revealed deep infiltrating disease in isolation at the ileocaecal junction which had caused stenosis. The acute inflammation at menses then caused cyclical bowel obstruction. All her symptoms were relieved by a right hemicolectomy.

Endometriosis in abdominal scars is reported, particularly after Caesarian section or laparoscopy where the endometrium can implant as the wound is healing. Figure 11.9 shows endometriosis at the vaginal vault following hysterectomy. The ovaries were preserved and the uterus was removed vaginally with morcellation and presumably endometrium had implanted in the vault as it healed. She represented with cyclical bleeding

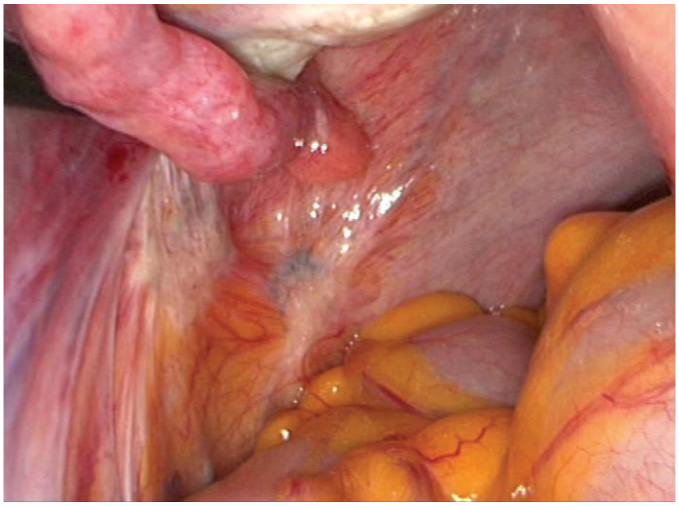

Fig. 11.8a: Endometriosis overlying the ureter on the left pelvic side wall.

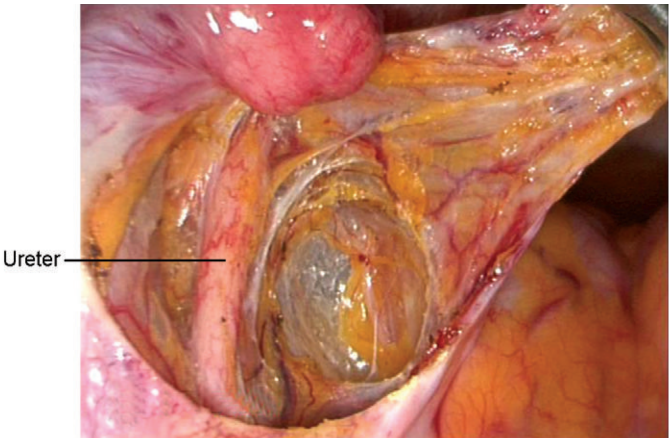

Fig. 11.8b: Careful excision of the endometriosis overlying the left ureter.

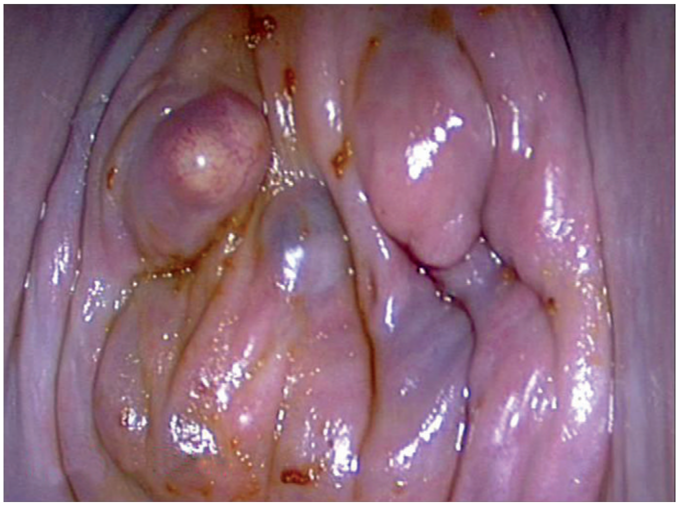

Fig. 11.9: Endometriosis at the vaginal vault where ovaries were retained at hysterectomy.

6 months after the hysterectomy and was cured by further local excision.

Some sites, such as lung, are only really amenable to medical treatment. These sites can cause significant problems with case reports of patients getting cyclical pneumothorax for example.

RADICAL FERTILITY-SPARING SURGERY AND EXCISIONAL SURGERY FOR RECTOVAGINAL SEPTUM ENDOMETRIOSIS

There appears to be little doubt that surgical removal of all areas of endometriosis provides significant symptoms relief with mild to moderate disease. For many years the surgical treatment of severe infiltrating endometriosis has been hysterectomy. Innumerable patients underwent hysterectomy because of their painful periods at an age when it was considered desirable to keep their ovaries. If the dysmenorrhoea was caused by endometriosis and surgical removal was incomplete, then inevitably ovarian conservation perpetuated these patients' symptoms. Hysterectomy remains the most successful treatment of complex infiltrating endometriosis but only if the ovaries are removed at the same time.

With the advent of laparoscopic surgery, greater effort has been put into radical excisional treatment that preserves fertility in the increasingly large group of patients with deep infiltrating disease. Laparoscopic surgery has enabled improved visualisation of the area requiring excision and provides greater clarity when identifying individual structures that are fused together by fibrotic disease. In addition, the angle at which the surgeon is working laparoscopically allows direct visualisation down the side of the rectum, into the Pouch of Douglas, and deeper into the rectovaginal septum. A surgeon looking directly through a laparotomy incision has to peer around the uterus which is usually fixed to the adhesions, and the view of the area requiring excision is poor.

Radical fertility-sparing excisional treatment does significantly improve symptoms for these patients,[9] but there is some debate about how extensive the surgery should be. The principle is to excise all areas of disease but resections are being done where the disease infiltrates entirely out to the pelvic side wall and even down the sciatic nerve where disease will inevitably be left behind. Those patients with adenomyosis may end up with significant resections whilst retaining the organ containing the endometriosis that is causing all the symptoms. Great care is required when counselling patients with significant adenomyosis to warn them of the possible consequences of conserving the uterus. It may be possible to excise all the disease by shaving it off the serosal surface of the rectum with excellent results.[10] If the disease is not fully excised by shaving it off the rectum, then a disc resection of a small portion of rectum can be performed or if this is not possible a segmental resection can be undertaken. Figure 11.10 shows the excised rectum of a patient who presented with severe pain and dyschezia. On rectal examination, there was a tight stenosis approximately 7 cm from the anal verge. The photo shows the extent of thickening caused by the endometriosis and this clearly required resection in order to relieve her symptoms.

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Fig. 11.10: Endometriosis infiltrating through the entire serosa and muscularis of the rectum causing stenosis requiring a segmental resection.

This kind of extensive surgery is not without complications and these can be devastating for young women suffering from a benign condition. The largest case series of bowel resection to date[11] showed a rectovaginal fistula rate of 3.2%, anastomotic stenosis rate of 3.7% and ileostomy incidence of 14% in 436 cases.

In UK, the British Society of Gynaecological Endoscopy has set up a database for recognition of centres of excellence for this difficult surgery. In order to be a recognised centre, surgery has to be performed on a minimum of 12 patients per annum where the rectovaginal septum is opened and all results have to be entered onto a database. In different units, this surgery is being performed primarily by a gynaecologist or a colorectal surgeon depending on their surgical expertise. Wherever it is performed it requires careful pre-operative evaluation, clear aims for the patient and the surgeon, a full discussion of complications and a multidisciplinary approach. Over the next few years we hope to learn which patients will benefit the most from this type of surgery.

LAPAROSCOPIC OR OPEN SURGERY

Previous editions of this text have referred to laparoscopic treatment as being a possible way of treating endometriosis and had a brief section at the end of the chapter. Surgical practice has changed so much in recent years that virtually all surgery for endometriosis is possible laparoscopically and laparotomy is only required for a small minority. As detailed above, the views obtained are significantly magnified, and with modern instruments for haemostasis, which have minimal thermal spread, the tissues can be clearly identified leading to more precise surgery. Patients clearly recover more quickly with smaller incisions. However, there is a place for laparotomy in the treatment of endometriosis, when the surgeon is not sufficiently trained in laparoscopic techniques and particularly where multiple previous surgical procedures have been undertaken. In this situation a midline incision will be required to be able to perform all the necessary dissection.

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The Fallopian Tube

12

Colin Davis, Christine Deguara

Pelvic Inflammatory Disease

Pelvic inflammatory disease (PID) usually results from ascending ectocervical infection[1] and is a common cause of morbidity in women under 45 years of age.[2] Signs and symptoms are varied and non-specific ranging from bilateral lower abdominal pain, abnormal vaginal discharge, a fever greater than 38°C, inter-menstrual, post-coital, or breakthrough bleeding, deep dyspareunia, cervical motion tenderness and/or adnexal tenderness on bimanual vaginal examination.[1] Differential diagnosis ranges between ectopic pregnancy, appendicitis, irritable bowel syndrome, urinary tract infection, endometriosis, cystic rupture or torsion and functional pain (of unknown physical origin).[1] Delay in treatment of a few days can substantially increase the risks of future infertility, ectopic gestations and chronic pelvic pain.[3] Diagnostic methods vary, all of which are non-specific. Computed tomography (CT),[4] magnetic resonance imaging (MRI)[5] and transvaginal ultrasound, in conjunction with Doppler[6,7] have all been employed to assist in diagnosis. There is limited evidence supporting their routine usage as diagnostic tools. Biopsy of the endometrium as a routine diagnostic test is currently not supported by sufficient evidence.[8] Acute genital infection in the female can vary from an asymptomatic carrier state to a fulminating genital infection with acute salpingo-oophoritis and endometritis leading to life-threatening septicaemia or to abscess formation (pyosalpinx and tubo-ovarian abscess), pelvic abscess, localised gangrene, peritonitis and septic thrombophlebitis. In the early stages, adnexal inflammation is acute catarrhal, which very soon becomes purulent salpingitis. Medical treatment in the early acute phase with appropriate antibiotics may prevent permanent damage to the Fallopian tubes. Even tubes that seem normal to the naked eye may have had their ciliary function so disturbed as to interfere with normal ovum transport (inducing infertility or the risk of ectopic pregnancy).[9] There should be a low threshold for diagnosing and treating PID in the under 25 years age group where the incidence is high and potential impact on future fertility is substantial.[1] Women who are HIV positive, present with worse clinical symptoms of PID when compared to non-infected patients. They do, however, respond well to the same treatment regimens and should be managed in conjunction with an HIV physician who can monitor possible drug interactions with their anti-retroviral medications.[1]

Chronic PID is a considerable problem in parts of the world where puerperal sepsis and genital infection may have received no treatment. The uterus is tethered, often in retroversion, with bilateral fixed tender adnexal masses, the chief distinguishing feature from pelvic endometriosis being the lack of uterosacral nodularity. In such cases, an inspissated pyosalpinx or tubo-ovarian abscess may be found, or, where the infection has completely resolved but fimbrial occlusion has occurred, a significant hydrosalpinx may have formed. Although a hydrosalpinx is often tethered in the pelvis as a 'retort'-shaped swelling, it may be mobile and stretch out towards the infundibulopelvic fold (Fig. 12.1).

AETIOLOGY

Puerperal and Post-Abortal Sepsis

Although *Chlamydia trachomatis* is now recognised to be one of the most common aetiological factors for post-pregnancy sepsis, particularly post-abortal, a range of non-specific

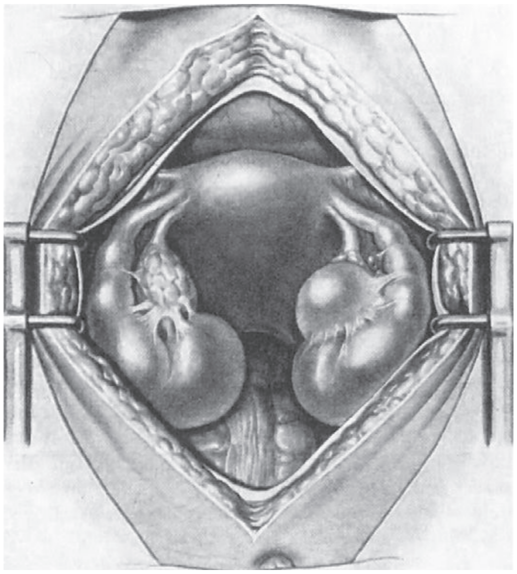


Fig. 12.1: The appendages are bound by adhesion to the back of the uterus, to the peritoneum of the pouch of Douglas and quite often to the intestine and the omentum. On the left side is a hydrosalpinx; on the right in addition a simple ovarian cyst, probably due to follicular entrapment by surface adhesions.

organisms may be found, often mixed aerobic and anaerobic. Of the latter, the most dangerous is *Clostridium perfringens*, which gives rise to gas gangrene.[10] This organism produces an exotoxin, which is haemolytic and may lead to acute renal failure and to severe hyperkalaemia with cardiotoxicity. Other forms of anaerobic infection can give rise to septic thrombophlebitis of the ovarian vein.[11]

Sexually Transmitted Infection (STIs)

Enhanced microbiological techniques have identified *C. trachomatis* as the commonest cause of salpingo-oophoritis hitherto classified as non-specific. *Neisseria gonorrhoeae*, however, remains an important source of pelvic inflammatory disease and additional STIs such as *Mycoplasma genitalium* may be implicated.[12–16] Positive testing for these infections increases the chance of PID being present, but their absence does not rule it out.[13,17] Most organisms can produce peritonitis of which a late sequel may be peri-hepatic adhesions (Fitz-Hughes Curtis), and gonorrhoea can produce metastatic conditions such as arthritis.[18,19] When sexually transmitted infections have been the cause of PID, sexual partner tracing within a 6 month period of symptom onset is advised.[1,20,21]

Actinomycosis

This relatively uncommon infection of the ileocaecal region has assumed importance in gynaecology as a source of complex pelvic inflammatory disease. It was thought to be associated with IUCD (intra-uterine contraceptive device) usage[22] but the association is far from clear; 30% of plastic IUCD wearers have actinomyces in their cervical smear. The rate is much lower with copper devices and varies with duration of use.[23,24] Most of these patients are asymptomatic and have no evidence of pelvic infection. There is limited evidence regarding whether or not to advocate the removal of an IUCD in women with PID.[25,26] This is particularly the case when symptoms have not resolved within 72 hours despite treatment.[1] Its removal, when considered may be associated with improved clinical outcomes but balance against the risk of pregnancy needs to be considered. If unprotected sexual intercourse has occurred within the preceding 7 days, hormonal emergency contraception should be considered.[1]

Genital Tuberculosis

Tuberculosis is one of the commonest causes of infertility and secondary amenorrhoea in underdeveloped countries.[27] It is accepted that genital tuberculosis is the local manifestation of a tuberculous infection elsewhere and a careful search will generally reveal the primary focus.[28] The lungs are the commonest situation of the primary focus. Miliary tuberculosis of the pelvic peritoneum may be present with an appearance closely mimicking carcinomatosis peritonei (Fig. 12.2). Frozen section of a nodule is diagnostic. The employment of special diagnostic techniques has disclosed an incidence of 0.56% of all gynaecological patients.[29] It is to be suspected in the infertile patient who may also give a history of pulmonary disease or pleurisy in adolescence and in whom pelvic examination discloses a fixed mass in the pouch of Douglas.[30] It is usually unilateral and physical signs may be entirely normal. The resurgence of this disease has been strongly linked to the increasing incidence of HIV infections.[31] It is exceptionally rare before puberty, favours the third and fourth decade, and is again rare in the post-menopausal patient.

The principal site is usually the Fallopian tube,[32] and both tubes are involved; spread to the endometrium occurs from this principal site and recurs with each menstrual cycle; only rarely is the myometrium involved. Tuberculous pyosalpinx may assume very large dimensions and may be in itself relatively mobile and easily freed surgically by blunt dissection. The tube may show signs of interstitial salpingitis with thickening and nodular enlargement; such nodules, when sectioned, show obvious caseation. In this last type, the abdominal ostium is sometimes open and even everted and pouting.

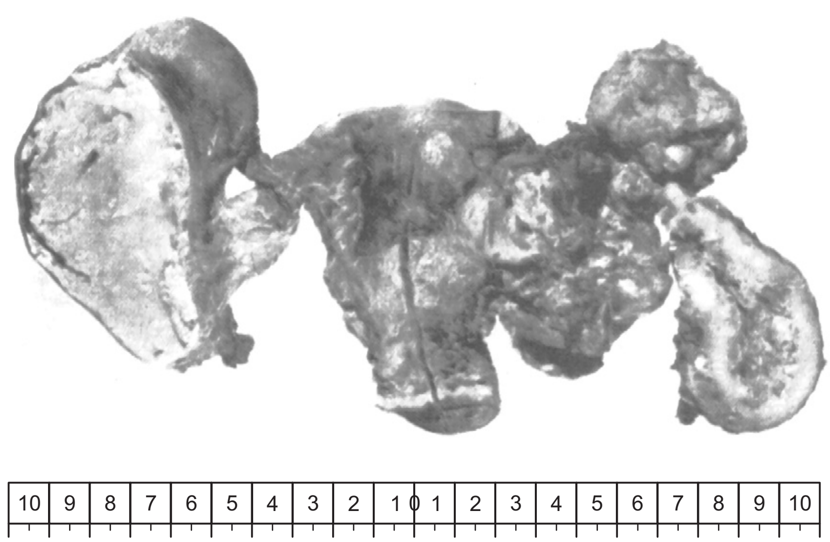


Fig. 12.2: Genital tuberculosis. Both appendages are completely disorganised by tuberculous caseation. Note the thick-walled tuberculous pyosalpinx on the right and the dense adhesions involving this tube and ovary.

The cervix may be involved and clinical distinction from carcinoma may be well-nigh impossible (see Chapter 7). Tuberculous lesions also occur on the vulva, and chronic vulval elephantiasis may be secondary to tuberculous inguinal lymphadenitis (see Chapter 15). If tuberculous caseation has occurred, the pelvic organs are densely adherent in a solid and seemingly inextricable mass. This abscess may result in development of a complicated intestinal fistula. In all these varieties the ovary is likely to be involved, especially on the surface, though a casual inspection without full histological examination may seem to exonerate this organ. If however, the ovary is conserved, it may become the seat of subsequent infection and later demand removal.

Uterine Tuberculosis

While it is now generally agreed that the tubes are the most frequently involved organs in genital tuberculosis[33] and figures of over 90% are given for tuberculous salpingitis, the endometrium is a close second with an involvement figure of probably 50%. Even this is likely to be an understatement and will increase with more exact methods of diagnosis. The extent of the endometrial infection, as in the tube, varies greatly. On the one hand, it needs microscopy and special culture to diagnose its presence, while in the extreme example the endometrium is converted into a mass of tuberculous granulation tissue that resembles an extensive and invasive cancer. The myometrium may then be destroyed as far as the serous surface of the uterus. The disturbance of menstruation and age of incidence shows ethnic variation.[34] There is an uncommon but persistent incidence of the disease in post-menopausal patients.

Salpingography, if performed, may show absolute occlusion in the interstitial part of the tube, occlusion at the ampulla with small or large dilatations, straight ‘gas-pipe’ tubes, calcification, jagged or roughened tubal outline, beading of the contrast medium and coiling of the tube. Though not absolutely diagnostic, these features are strongly suggestive if several are present.

Treatment of Patients with Chronic Specific Infections

Both actinomycosis and tuberculosis require expert microbiological advice and the assistance of a physician specialising in infectious diseases is strongly recommended. Prolonged treatment with the appropriate antibiotic (often penicillin) for actinomycosis, or combination chemotherapy for tuberculosis is required. Prior to the availability of appropriate antibiotics, any surgery for such conditions tended to be radical, as fistula formation was particularly likely after conservative surgery, especially if drainage had been used (Jedburgh 1950). At present, the indications for surgery are persistent (and resistant) residual disease with a pelvic mass and fistula formation. Hysterectomy is indicated for postmenopausal tuberculosis.

PID TREATMENT REGIMENS

Medical Treatment

As soon as diagnosis is suspected, mild or moderate disease (in the absence of tubo-ovarian abscess) can be treated in an out-patient setting with no benefits to hospitalisation. Care must be taken in young women who are on hormonal contraception as treatment regimens may minimise contraceptive effectiveness.[35] The choice of drug regimens varies according to microbial sensitivity, epidemiology, cost and the woman’s preference. It is of note that there is little evidence regarding the antibiotic prevention of long-term PID effects.

Royal College of Obstetricians and Gynaecologists advises the following antibiotic guidelines:

1. **Recommended outpatient antibiotic treatment regimens:**
   - Oral ofloxacin 400 mg twice daily plus oral metronidazole 400 mg twice daily for 14 days.[36–39] Levofloxacin, the L isomer of ofloxacin,[40] has the advantage of once daily dosing (500 mg OD for 14 days) and may be used as a more convenient alternative to ofloxacin.[41] Moxifloxacin has been advised as an alternate to ofloxacin in cases where it is considered inappropriate to use other recommended antibiotic agents or where these have failed. Its side effects include increased risks of liver reactions and cardiac QT interval prolongation, so it must be used with care.[42]
   - Intramuscular ceftriaxone* 250 mg single dose followed by oral doxycycline 100 mg twice daily and metronidazole 400 mg twice daily for 14 days.[36,37,43–45]

     To avoid increasing quinolone resistance in the UK, ofloxacin has been suggested to be avoided in women at high risk of gonococcal PID. In women with PID who are unable to tolerate metronidazole, it may be discontinued as it provides uncertain additional efficacy in this group.[1] An alternative regimen is available for use. This regimen is however supported by reduced strength clinical evidence[1] when compared to previous regimens.
   - Intramuscular ceftriaxone 250 mg immediately followed by azithromycin 1 g/week for 2 weeks.[46,47]

     Review is advisable within 72 hours[48] in the outpatient setting followed by 4–6 weeks review.[42] Admission to hospital is advised in clinically severe disease, tubo-ovarian abscess, PID in pregnancy, where surgical emergency cannot be excluded and lack of response or intolerance to oral therapy.[1] Once admitted, intravenous antibiotic therapy should be commenced and continued till clinical improvement is seen and then followed by oral treatment.
2. **Recommended inpatient antibiotic regimens:**
   - Ceftriaxone 2 g by intravenous infusion daily plus intravenous doxycycline 100 mg twice daily,† followed by oral doxycycline 100 mg twice daily plus oral metronidazole 400 mg twice daily for a total of 14 days.[36,37,44,45,49]

*Cefoxitin has a better evidence base for the treatment of PID than ceftriaxone but is not easily available in the UK. Ceftriaxone is therefore recommended.
†Oral doxycycline may be used, if tolerated.

- Intravenous clindamycin 900 mg three times daily plus intravenous gentamicin,‡ followed by either oral clindamycin 450 mg four times daily to complete 14 days. Or oral doxycycline 100 mg twice daily plus oral metronidazole 400 mg twice daily to complete 14 days.[36,37,44,45,49]
- Intravenous ofloxacin 400 mg twice daily plus intravenous metronidazole 500 mg three times daily for 14 days.[36,37,50]

  Cefoxitin has a better evidence base for the treatment of PID than ceftriaxone but is not easily available in the UK. Ceftriaxone is therefore recommended.[42]

In pregnancy, PID itself is rare unless in association with a septic abortion. Cervicitis may occur and guidelines advise a combination of cefotaxime, azithromycin and metronidazole for 14 days.[42] Teratogenic drugs such as tetracyclines should be avoided. In the paediatric setting, ofloxacin should be avoided where possible in young women where bone development is still occurring. There is no reported adverse events in human studies and the British National Formulary (BNF) recommends its usage where other options are limited.[42] Pregnancy tests should be performed in all suspected cases of PID to rule out an ectopic gestation. If the patient is at high probability of being pregnant, it is advisable that the pregnancy test is repeated 21 days after last unprotected sexual intercourse.[42] It is of note that the medical regimens discussed above can precede or run concomitantly or alongside any necessary surgical management.

Surgical Treatment

Observer diagnosis and reproducibility of PID is regarded as low, and is higher in junior staff.[51] Surgical intervention is advisable in severe cases of PID or where a pelvic abscess exists. It is advisable in those patients presenting with recurrent clinical symptoms and laboratory signs of PID[52] and is useful in providing specimens directly from the Fallopian tubes and pouch of Douglas providing information on how severe the disease is.[53] Many operations on the appendages can be performed laparoscopically, and in suitable cases this is the preferred method. The objectives and surgical techniques are broadly similar, and much will depend on the level of expertise of the endoscopic operator. Laparoscopy is today regarded as the definitive diagnostic method for PID[17] with an overall accuracy of 78% and specificity of 92%[51]; nevertheless 15–30% of suspected cases (even those having organisms identified from the Fallopian tubes) may have no laparoscopic evidence of acute infection.[13] Laparoscopy helps in the division and drainage of pelvic adhesions and abscess enabling early disease resolution.[54] If it is considered desirable that an adnexal swelling should be removed intact because there is a small element of doubt about its nature, or where there is fixity from dense adhesions, or the adnexal mass is large, an open approach may be preferred. Aspiration, morcellation and 'bagging' may not be appropriate in some cases. In cases where surgery might not be advocated, ultrasound or CT guided aspirations of pelvic collections may be equally effective with reduced invasiveness.[55,56]

Laparoscopy for Acute Pelvic Inflammatory Disease

Accurate diagnosis of acute salpingitis is extremely important because the sequels of inadequately treated salpingitis are so disastrous to the woman's future fertility. A systematic examination of the abdomen should include inspection of the liver for exudates or adhesions (Fitz–Hugh–Curtis syndrome) and the appendix as well as the pelvic organs and pouch of Douglas. Bacteriological samples from the ends of the Fallopian tubes and from the pouch of Douglas should be taken, and if abscesses are present, these may be aspirated and irrigated.[57] Swabs or purulent samples should be put in appropriate transport medium for gonococcus and *Chlamydia*, as well as for ordinary aerobic and anaerobic organisms. If the pus has all been aspirated, it is not necessary to leave drains in the pelvis.

Sometimes, with an acute abdomen, appendicitis cannot be excluded and laparotomy is required. On occasion, adnexal inflammation is secondary to an appendix abscess or inflammatory bowel disease such as Crohn's disease or diverticulitis. Laparotomy may also be required if acute pelvic inflammatory disease is not responding to antibiotics or if laparoscopy has been difficult or inconclusive.

Laparotomy for Acute-On-Chronic Pelvic Inflammatory Disease

Such a patient may well have already had a full course of antibiotics and it is possible that the causative organisms have become resistant. At this stage the tubal inflammation will have passed into the sub-acute stage and a pyosalpinx formed. The decision to operate on such a patient will only be made after all conservative measures have been exhausted and when the surgeon is convinced that the general condition is about to deteriorate unless the focus of infection is removed. Sometimes, however, the decision to perform laparotomy is precipitated by spontaneous perforation of the pyosalpinx.

Technique of Laparotomy for Acute Adnexal Infections

The patient is prepared for an abdominal operation, anaesthetised and placed in the Trendelenburg position. A vertical incision is made above the pubic symphysis. In all septic conditions it is better to use a vertical rather than a transverse incision, as the risk of wound infection is less. Free fluid and pus must be evacuated with a sucker. The omentum, small intestine and large intestine will be found adherent to the uterus and appendages. These adhesions are delicate and can be broken down quite easily with the gloved fingers, and the flexion of the fingers should always be directed away from the intestines. Collections of pus that are

‡Gentamicin should be given as a 2 mg/kg loading dose followed by 1.5 mg/kg three times daily [or a single daily dose of 7 mg/kg may be substituted].

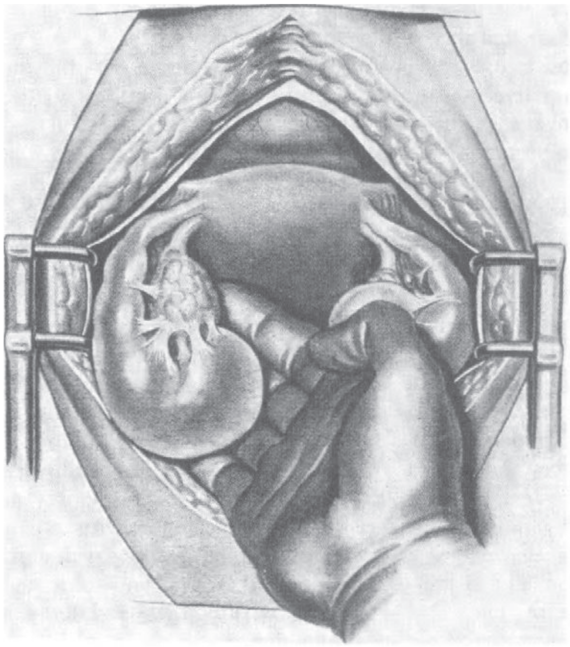


Fig. 12.3: Pelvic inflammatory disease. The illustration represents the method of mobilising the tube and ovary from the surrounding structures. The fingers are placed below and behind the adnexa and the separation proceeds from below upwards.

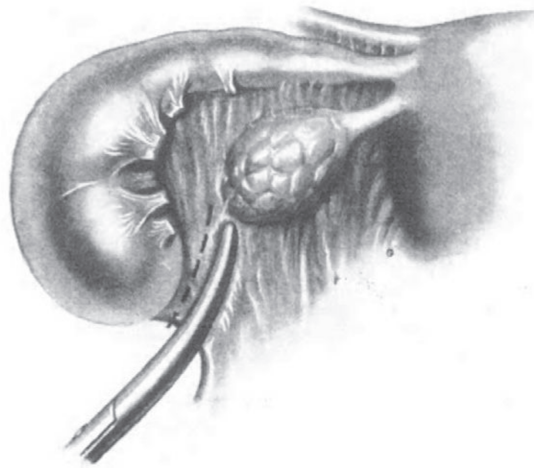


Fig. 12.4: Pelvic inflammatory disease. The tube and ovary have been mobilised and a clamp has been placed over the infundibulopelvic fold. The tissues lying distal to the clamp are cut through.

opened up should be evacuated with a sucker. It is necessary to free intestines and omentum away from the back of the uterus and from the posterior surface of the inflamed appendages. The separation must be continued downwards until the lower pole of the swollen Fallopian tube is reached. The tube should then be stripped away from its adhesion to the uterus by drawing it upwards and outwards. The ovary will accompany the tube, and this must be detached from the back of the uterus. The simplest and safest method of mobilising chronically inflamed tubes is by detaching the lower pole of the swollen tube and working from below upwards (Fig. 12.3).

If the wall of the pyosalpinx is thick there is little risk of its rupture, but if thin it will burst, however carefully it is detached from the back of the uterus and the discharged pus must be aspirated with a sucker. The mobilisation should be such that the infundibulopelvic fold can be identified by sight. In most cases the inflamed appendages can be drawn outside the abdominal incision. Clamps are now placed upon the infundibulopelvic fold and the fold divided with scissors between the clamps. If the ovary is relatively healthy it should be retained if the patient is young; the clamp is then placed on the fold distal to the ovarian vessels (Fig. 12.4). If it is severely diseased it may be necessary to remove the ovary as well as the Fallopian tube, but in young women the removal of the whole of both ovaries is to be avoided. Some healthy or relatively healthy ovarian tissue should be left. If the ovary is to be left behind, a second clamp is placed along the mesosalpinx, above the level of the mesovarium, and the tube separated from the clamp with scissors (Fig. 12.5). A third clamp is placed over the uterine end of the tube that is removed. Sometimes with a large pyosalpinx it may be necessary to use four clamps. If the ovary is to be removed, after the infundibulopelvic fold has been clamped and divided, a second clamp should be placed below the ovary to include the broad ligament and a third clamp placed to include the uterine end of the Fallopian tube, together with the ovarian ligament. In acute inflammatory disease the tissues enclosed in the clamp are oedematous, so that care must be taken to prevent ligatures cutting through the friable tissue, with risk of haemorrhage. Two clamps can be placed over each pedicle to prevent this possibility, and both time and care must be spent to ensure that satisfactory haemostasis has been obtained (Figs. 12.6 and 12.7). A similar procedure is followed on the opposite side. In these patients the question of removing the uterus does not usually arise. The purpose of the operation

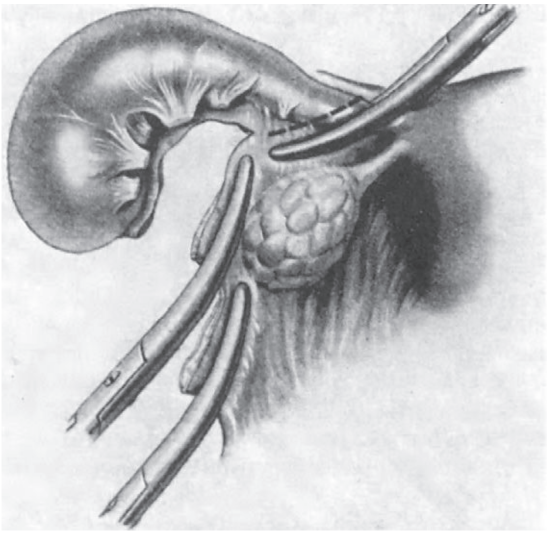


Fig. 12.5: Pelvic inflammatory disease. Two other clamps have been placed in position. The one that lies above and to the right encloses the Fallopian tube, while the other encloses the tissues of the broad ligament.

is to remove the infected appendages and thereby to remove the focus of sepsis. The less severe the operation the better will it be for the patient.

It is not customary to employ elaborate methods to cover the pedicles. The surrounding peritoneum is usually thick with oedema and difficult to mobilise. On the left side the pedicles can be covered with the sigmoid colon; on the right side, wherever possible, the omentum should be utilised.

Fig. 12.6: Salpingo-oophorectomy. A clamp has been placed on the infundibulopelvic fold and the tissues distal to the clamp are cut through along the dotted line.

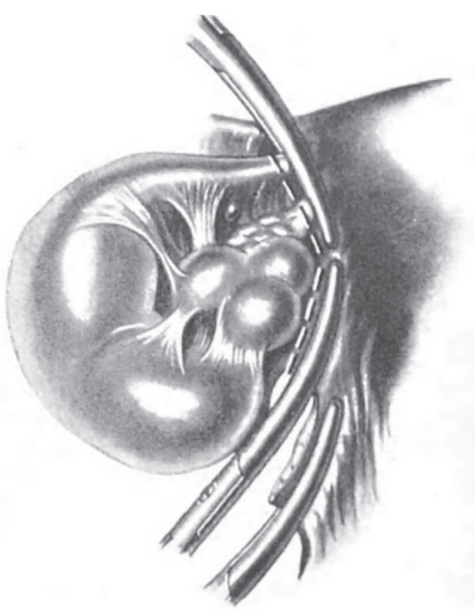


Fig. 12.7: Salpingo-oophorectomy. Further clamps have been placed in position. The upper one encloses the Fallopian tube together with the ovarian ligament, while the middle clamp encloses the tissues of the broad ligament.

Surgery for Chronic Pelvic Inflammatory Disease

Similar considerations to the above may apply. A combination of chronic pelvic inflammatory disease and large fibroids is quite frequently encountered in developing countries providing very testing surgery. Menorrhagia and dysmenorrhoea may be significant presenting features so that hysterectomy is required. The technique described as radical oophorectomy may be of assistance in such cases (see Chapter 17). It is important to identify specific aetiology (i.e. tuberculosis or actinomycosis), even at laparotomy and to defer any further procedure until antibiotic therapy has been effectively instigated.

Vaginal Drainage of Pelvic Abscess

A pelvic abscess that is localised and pointing into the posterior fornix can be treated by posterior colpotomy. The posterior vaginal wall is incised in the posterior fornix and the pus that has collected in the pouch of Douglas evacuated by this route (Figs 12.8, and 12.9). Although the theoretical basis for the operation is clearly correct, certain conditions must be satisfied before it is undertaken. First, the infection must be strictly localised to the pelvis. Second, there must be no doubt that the swelling in the pouch of Douglas is an abscess. The physical signs of a pouch of Douglas swelling, which pushes the uterus forward, must be combined with an area of softening in the lowest part of the swelling, together with induration around the area of softening. Diagnostic ultrasound can be very helpful in this situation. A rectal examination must always be made, as most pelvic abscesses if left untreated discharge into the rectum; if this has already happened, there is no point in performing the operation of posterior colpotomy. Sometimes there is difficulty in distinguishing between a haematocoele of the pouch of

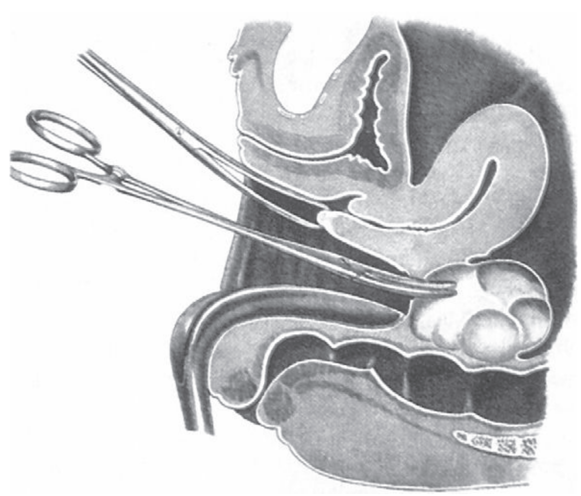


Fig. 12.8: Posterior colpotomy. Evacuation of a pelvic abscess through the posterior vaginal wall. The patient is placed in the lithotomy position, the posterior vaginal wall retracted away with a retractor and the posterior lip of the cervix pulled down. A small incision is first made through the vaginal wall and the pus evacuated with forceps.

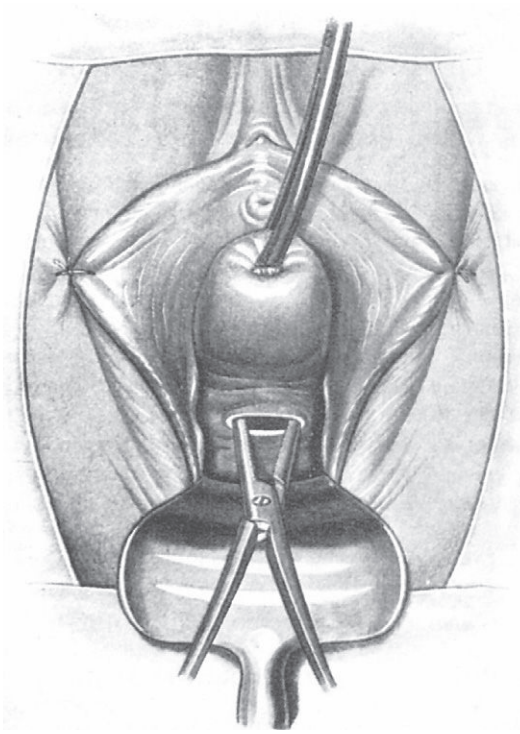


Fig. 12.9: Posterior colpotomy. Separating the blades of the forceps will allow the pus to be discharged freely.

Douglas and a pelvic abscess. While a pelvic abscess can be adequately treated by simple drainage, a pelvic haematocoele is best dealt with by laparotomy. The differential diagnosis of these two conditions is not easy. Aspiration under ultrasound control is the preferred option.

Tubal Disease and Infertility

Several factors have led to the management of infertility becoming more scientifically based over the last 20 years. These include a greater understanding of the endocrinology of the reproductive cycle and the process of fertilisation, the development and availability of relatively rapid hormone assays, and more accurate means of investigation of the anatomical aspects of the reproductive organs. Advances in treatment have stemmed from the introduction of a range of hormonal therapies, improvements in surgical technique, and from the numerous variations of assisted conception that followed on from Edwards et al. (1980) original successful 'in vitro' fertilisation treatment. Many of the older crude and inaccurate infertility tests have now been abandoned, as have some of the empirical and non-scientifically based therapeutic measures. These major developments do not detract from the importance of a thorough history and clinical examination, which should be carried out on both partners. The menstrual history should be carefully noted, and the frequency and timing of coitus recorded. Specific enquiry should also be made about congestive dysmenorrhoea and dyspareunia. The history may disclose that the patient has suffered from appendicitis with peritonitis, tuberculosis, pelvic inflammatory disease or endometriosis. With such a history, it is reasonable to assume that tubal occlusion may have occurred. Although either the history or the physical examination may lead to the suspicion that female factors are the cause, it is essential to confirm the husband's fertility is not a major contributing factor before undertaking operative treatment.

The following statistics give an overview of infertility aetiology within a UK district[58]: These figures are in keeping with reports from current tertiary fertility centres within UK and include couples with more than one cause of infertility, therefore, the total exceeds 100%.

12

Cause	Percentage (%)
Male factor	30
Unexplained	28
Ovulatory	21
Tubal	14
Endometriosis	6
Cervical mucous defect	3
Uterine	1

A trend for couples to delay pregnancy until later in their careers, and awareness of the opportunities afforded by infertility treatment, has resulted in a considerable rise in the number of couples seeking investigation of treatment of infertility.

INVESTIGATIONS

Male Factor

Sperm function is found to be the primary cause of infertility in approximately 30% of cases and present with other factors in approximately 50%. Unless, therefore, he can produce a seminal specimen showing at least 20 million sperms per millilitre with over 50% motility and over 15–30% normal morphology, most gynaecologists would hesitate to advise any but the most minor of operative procedures on the female partner. Semen analysis is often carried out in parallel with tests to confirm that the patient is ovulating.[59] The World Health Organisation (WHO) semen analysis reference ranges have recently been updated as follows:

	Former WHO values	New WHO values
Volume	2 ml	1.5 ml
Concentration	20 million/ml	15 million/ml
Motility	50%	32%
Strict morphology	14%	4%
TRM/TRL interpreted normal ranges		
Volume	2 ml	
Concentration	13.5 million/ml	
Motility	32%	
Strict morphology	9%	

TRM, Tennessee Reproductive Medicine and *TRL*, Tennessee Reproductive Laboratories

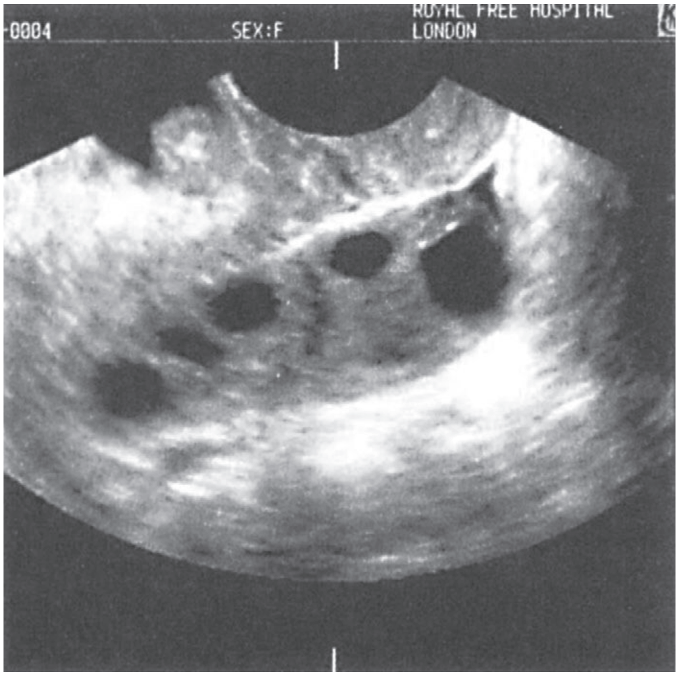


Fig. 12.10: Transvaginal scan showing multiple follicular development after stimulation with gonadotrophins (Courtesy of Mr. D. Economides and Mr. G. Michailidis).

Ovulation Tests

The traditional tests of ovulation such as temperature charts, endometrial biopsy and vaginal cytology have now been superceded by the use of luteal phase progesterone estimations, home ovulation LH (luteinising hormone) surge tests and ultrasound follicular scanning (Fig. 12.10). Pre-menstrual curettage for tuberculosis is now rarely indicated in the western world, but is still relevant in other parts of the world.

Tubal Factors

Tubal pathology is one of the most frequent causes of subfertility accounting for 14% of female infertility.[60] Assuming that the husband's semen analysis has been found to be normal and that the woman has been shown to be ovulating, the next step is to establish the functional behaviour and anatomical patency of the Fallopian tubes. The principal techniques employed for this are hysterosalpingography and laparoscopy with dye pertubation of the tubes. Before undertaking these investigations, it is imperative to exclude or eliminate active inflammatory conditions of the vagina, cervix or appendages in order to avoid the risk of causing an ascending infection. Any discharge, if present, must therefore be first cleared up by local or general medication. Screening for *Chlamydia trachomatis* before uterine examination or an offer of prophylactic antibiotics should be performed. (NICE guideline 2004 – Fertility assessment and treatment for people with fertility problems). Tubal insufflation is no longer used in modern infertility investigation.

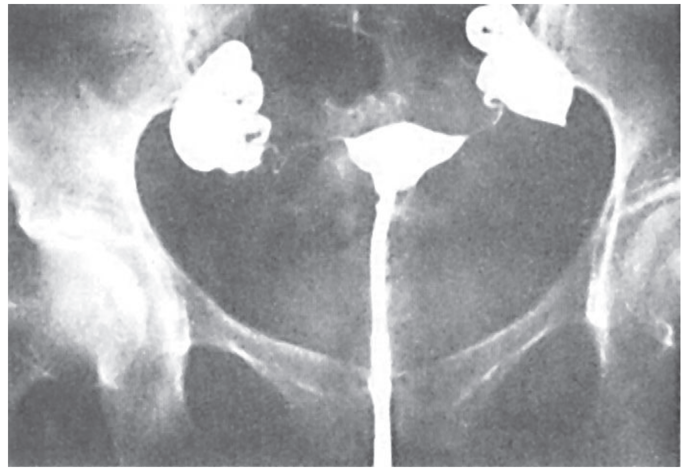


Fig. 12.11: Hysterosalpingogram. Bilateral terminal hydrosalpinges (by courtesy of Mr. HE Reiss).

Hysterosalpingography

Hysterosalpingography remains an essential part of the investigation of tubal function and is best performed in the radiology department with screening fluoroscopy. The patient may be given a mild sedative or analgesic prior to performing the test and general anaesthesia is rarely necessary. Having ascertained the direction of the uterus, the cervix is grasped with a tenaculum forceps and an intra-uterine cannula (such as Spackmans or Leech-Wilkinson) is inserted into the uterine cavity and a radio-opaque dye slowly injected.

The diagnosis of hydrosalpinx by this method is very reliable (Fig. 12.11). Careful technique also allows visualisation of abnormalities of the endosalpinx, such as tubal diverticulum, irregularities of the tubal lumen and loss of mucosal pattern in the ampulla. Study of the distribution of spilled contrast medium may help in the diagnosis of peritubal adhesions. Hysterosalpingography also is applicable to mid-tubal block such as is found after sterilisation operations. An appearance suggesting cornual block is more difficult to interpret and frequently misleading. It is important to realise that very much higher pressure is required to force contrast medium through the uterotubal junction immediately before and after menstruation than at mid-cycle.

Laparoscopy

The investigation of infertility provides one of the most important uses of diagnostic laparoscopy. The technique has been described in Chapter 3. Its importance lies in the provision of vital information complementary to that obtainable by hysterosalpingography. Only in this way can peritubal adhesions be diagnosed and the state of the tubes distal to the site of occlusion be ascertained. In cases of apparent cornual block, instillation of a less viscous, coloured dye such as methylene blue may yet demonstrate patency or an accessory ostium. Even when hysterosalpingography shows apparently normal tubes, some 50% of patients with otherwise unexplained infertility are found to have endometriosis, significant adhesions or other tubal disorders such as fimbrial stenosis. At the same time the ovaries can be examined and positive evidence of ovulation may be obtained by visualisation of a recent corpus luteum. Fine adhesions may be divided by diathermy or laser.[61] It is advisable to combine laparoscopy with hysteroscopy for a thorough diagnosis of female infertility, especially where the patient has a history of pelvic infections.[62]

Other Investigations

A post-coital test may be useful in certain circumstances, but less importance is attached to this investigation today. Similarly, in vitro sperm/mucus contact tests and anti-sperm antibody testing are only relevant in special cases because the treatment of many of the so-called hostile cervical mucus conditions is now one or other form of assisted conception.

More specialised endocrinological tests are relevant when anovulation has been demonstrated, but are not within the scope of this book.

Tubal patency may also be demonstrated with sonohysterography, whereby saline is injected transcervically and its passage through the Fallopian tubes is observed using transvaginal ultrasound. It is a useful screening test for tubal patency, but not sufficiently precise to diagnose the site of obstruction and make a decision to employ tubal surgery. The place of falloposcopy and salpingoscopy are of limited value in clinical practice. Hysteroscopy may not be obligatory in the investigation of all cases of infertility, but is useful to diagnose uterine malformations, intra-uterine adhesions and the presence of fibroids or endometrial polyps, which may be associated with implantation failure.

CHOICE OF TREATMENT

The form of treatment recommended for infertility will depend upon the cause, but it must be remembered that some 30% of cases of infertility are of unexplained origin. Anovulatory infertility requires treatment with ovulation induction, and details of this treatment are not appropriate here. Suffice it to say that commonly used drugs include clomiphene citrate, gonadotrophin therapy, and the use of GnRH agonists and analogues, whilst bromocriptine is used for hyperprolactinaemic anovulation. It is important to recognise the complication of ovarian hyperstimulation syndrome where there is gross ovarian enlargement due to the development of very large numbers of follicles, accompanied by abdominal distension and ascites, and even pleural effusions. Considerable electrolyte and haematological disturbances occur, which may lead to thrombo-embolic disorders in addition to the problems of electrolyte disturbance. Surgical intervention, apart from paracentesis if the ascites is gross, or laparotomy for haemorrhage or torsion, is not indicated and the principles of treatment are correction of the haematological and biochemical disturbances, and anti-coagulation may also be required in some cases.

Surgical induction of ovulation may be carried out in cases of polycystic ovary syndrome. The old operation of wedge resection of the ovaries[63] is not carried out any longer, but the procedure of laparoscopic ovarian puncture has produced good results in patients who have not responded readily to hormonal methods of ovulation induction. It is now recommended by NICE and RCOG guidelines that in women with polycystic ovary syndrome who have not responded to clomiphene citrate, laparoscopic ovarian drilling should be offered as it is as effective as gonadotrophin treatment and is not associated with an increased risk of multiple pregnancy. Using diathermy or laser three to four punctures per ovary are recommended with three punctures seeming to represent the plateau dose for effect.[64] Care must be taken not to allow the punctures to go too deeply into the hilum of the ovary or permanent damage may be done to the blood supply resulting in premature ovarian failure. Application of seven or more punctures is noted to cause excessive ovarian destruction without result benefit.

Male infertility was formerly only treatable by donor insemination, or rarely procedures to open the vas deferens, but assisted conception, particularly with the technique of intracytoplasmic sperm injection is now relevant to this category of infertility.

Endometriosis may be treated surgically or hormonally to enhance fertility, and treatments of this condition are described in Chapter 11.

Treatment of tubal infertility has traditionally been by tubal surgery and many sophisticated and time-consuming techniques for this have been developed, some using the operating microscope, and more recently the laparoscope. However, they are relatively unsuccessful and many patients will now be treated by assisted conception methods, without prior resort to surgery. If assisted conception is available, only the milder cases of tubal infertility will be treated surgically. Reversal of sterilisation, however, carries a good prognosis provided a reasonable length of Fallopian tube is intact. During 1970s and 1980s, the results of tubal surgery improved somewhat as a result of meticulous surgical technique and the use of the operating microscope. The same meticulous techniques and in particular lack of handling of the tissues, may be obtained by carrying out tubal surgery laparoscopically and there is a growing trend for this form of surgery to replace time-consuming tubal microsurgery with the advantage for the patient that a laparotomy is avoided. The choice of treatment for tubal infertility will depend upon the resources available, and the skills of the gynaecologist, as well as the wishes of the couple.

SELECTION OF CASES

Tubal patency is only one of the requirements for proper tubal function. In addition the fimbrial end must be able to 'pickup' the ovum; tubal peristalsis and ciliary action must be able to transport the ovum and the uterotubal junction must be able first to retain and then to deliver the fertilised ovum to the uterus at the right time for implantation to be possible.

Only by the most painstaking investigation can suitable patients for tubal reconstruction be selected. The poor results of haphazard selection and crude surgery do not justify the inherent risk of laparotomy. More will depend on the state of the tubes than the operative technique. Hence re-anastomosis of healthy tubes divided at sterilisation operations, or salpingolysis, will give the best results. The careful surgeon will avoid operating on chronically inflamed, grossly thickened tubes. Poor results must be expected when operating on tubes that are occluded at both the cornual and fimbrial ends or that display gross tubal diverticular formation. Similar disappointment follows procedures that markedly shorten the tubes or sacrifice the intramural portions. Where such conditions are found, it is better to refer the patient directly for 'in vitro' fertilisation, possibly after removal of grossly damaged tubes.

SURGICAL TREATMENT VERSUS IN VITRO FERTILIZATION

In couples faced with tubal factor sub-fertility, their options range between IVF or surgical tubal repair and reconstruction. Surgery can be undertaken laparoscopically or via laparotomy depending on the patient history and surgical expertise. Debates have arisen after certain studies indicated a higher risk of miscarriage and lower implantation rates in patients undergoing IVF who concomitantly had tubal disease.[65–67] There was also a direct relation between tubal disease severity and IVF outcomes.[68,69] Hydrosalpinx is regarded to be the most severe manifestation of tubal disease. In vitro fertilization pregnancy rates are reduced in the presence of bilateral Hydrosalpinges,[70] and in their presence, surgical removal or closure with clips is indicated in women considering IVF[70] prior to fertility treatment. A Cochrane database review of various trials involving 646 women has found that both laparoscopic salpingectomy and tubal occlusion prior to IVF increase pregnancy rates. Salpingectomy has the advantage of removal of chronically infected tissue, reducing the risk of abscess formation and increasing ovarian accessibility for oocyte retrieval in IVF.[71] Disadvantages in surgical intervention may include deterioration in ovarian function due to interference with the ovarian blood flow,[72,73] though this is by no means a definite relation.[74] Other disadvantages can involve interstitial[75] or ovarian pregnancies,[76] formation of Cornual fistulae[76] and corneal rupture.[77] Salpingectomy also carries a psychological impact on women as it completely removes the hope of spontaneous conception. Salpingostomy or tubal occlusion are regarded as easier to perform in cases of severe adhesions,[78] with reduced side effects and quicker patient recovery times.[79]

Because of the wide availability and improved success rates of assisted conception, tubal surgery is now rarely performed except for reversal of sterilisation. Most tubal surgery is now carried out laparoscopically, but the principles are similar to conventional open surgery. Hence some descriptions of open surgery have been retained here, but in less detail than in former editions.

SURGICAL TREATMENT

After full investigation on the above lines, detailed discussion with the patient and her partner is required. The relatively low success rate of tubal surgery and the risk of subsequent ectopic pregnancy must be explained. Operation is best performed in the immediate post-menstrual phase of the cycle. Adequate operating time is essential for unhurried and meticulous surgery.

Lysis of Adhesions (Salpingolysis)

Adhesion formation is quoted as the commonest form of failure of operation to promote fertility. Every additional procedure tends to compound the situation. The cause and nature of adhesion formation in an individual case must be a matter for speculation. It is logical to conclude that failure of haemostasis and trauma to peritoneal surfaces must play an important part. However, the regenerative powers of the peritoneum are considerable and those who have occasion to reopen the abdomen after a major operation in which the pelvic peritoneum has largely been denuded will be amazed to find how a glistening surface has regenerated over what was formerly a bare area and though there will be adhesions they are not usually as extensive as one might otherwise suspect. Relatively minor procedures in other individuals, however, appear to be followed by massive adhesion formation. In such patients, when surgical procedures are undertaken for infertility every possible measure to reduce the subsequent reformation of these must be taken.

Adhesions binding down the uterine tube or ovary must be put on the stretch and divided individually and in a painstaking manner with the microdiathermy electrode. Surface adhesions over the ovary are very likely to interfere with release of the oocyte at ovulation and indeed in some patients this phenomenon presents as recurrent ovarian cyst formation. Consideration should be given to the use of intraperitoneal anti-adhesion substances.

Fimbrial Occlusion and Hydrosalpinx

The term 'fimbrial phimosis' is usually applied to fimbrial conglutination that may result from pelvic peritonitis extrinsic to the oviduct. Genuine hydrosalpinx formation is more likely to be due to an intrinsic inflammatory condition of the oviduct and often implies a greater degree of damage to the physiology of the tube than is apparent with the naked eye. Unilateral disease may be better treated by salpingo-oophorectomy.[80]

Salpingostomy

Salpingostomy is the treatment to be considered when a club-shaped hydrosalpinx with apparent total fimbrial absence has been displayed. In this instance the transfundal injection of saline not only confirms cornual patency but also, by distending the hydrosalpinx, displays a scarred, dimpled area caused by fimbrial invagination. This area is then carefully incised with a fine diathermy point and the opening is slowly and carefully enlarged by incising along avascular planes from within outwards to display the buried fimbrial remnants (Fig. 12.12). Once the tubal ostium has been opened, sometimes the fimbriae may be found to be in remarkably good condition, and only a few sutures of 8/0 monofilament prolene on a small, round-bodied atraumatic needle are needed to tack the ends of the fimbriae to the tubal serosa. Often, however they remain conglutinated, and a large number of sutures are needed to evert the fimbriae (fimbriolysis), (Fig. 12.13), care being taken to assure good apposition to the ovary.

Cuff Salpingostomy

Cuff salpingostomy (Fig. 12.14) is only employed if there has been total fimbrial destruction. In this technique the opened mucosal layer of the tube is everted and rolled back, even further than with fimbriolysis, over the serosa to which it is secured by fine sutures. The pregnancy rate after this latter operation is very disappointing, and there is an enhanced risk of ectopic pregnancy. Some patients prefer to have this slim chance rather than no chance at all.

Tubal Anastomosis

Results from this procedure to reverse previous sterilisation are very much better, as the surgeon is operating on essentially healthy tubes, undamaged by previous inflammation unless extensive diathermy has been used (Figs 12.15 and 12.16a,b).

Originally this operation was carried out by open laparotomy, the surgeon often using loupes to give some magnification. Microsurgery was found to increase the success rate, but laparoscopic reversal has been found to be quicker, result in shorter hospital stay and achieve similar pregnancy rates as the former. Success is dependent upon the length of the tube following anastomosis, and if this is less than 4.0 cm the pregnancy rate is considerably reduced. Ectopic pregnancy remains a risk from sterilisation reversal.

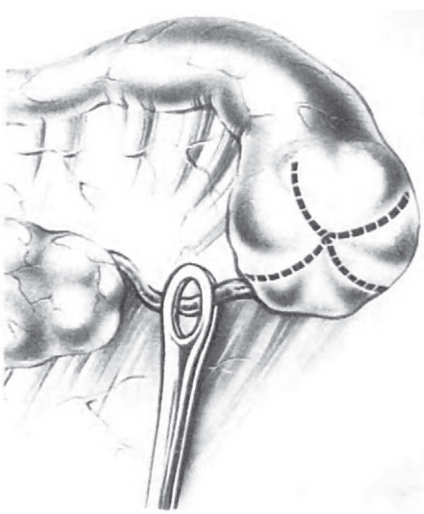


Fig.12.12: Salpingostomy. Cruciate incision to open the hydrosalpinx.

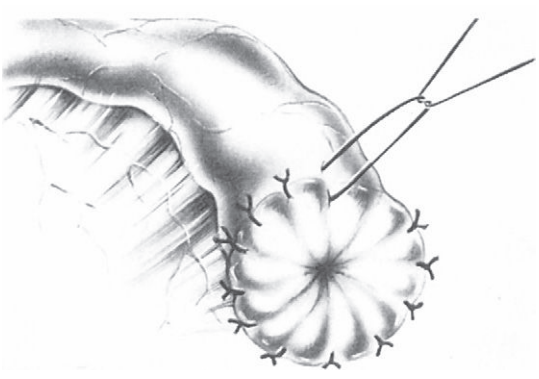


Fig. 12.13: Fimbriolysis. The conglutinated fimbriae are stitched back to the tubal serosa by fine everting sutures.

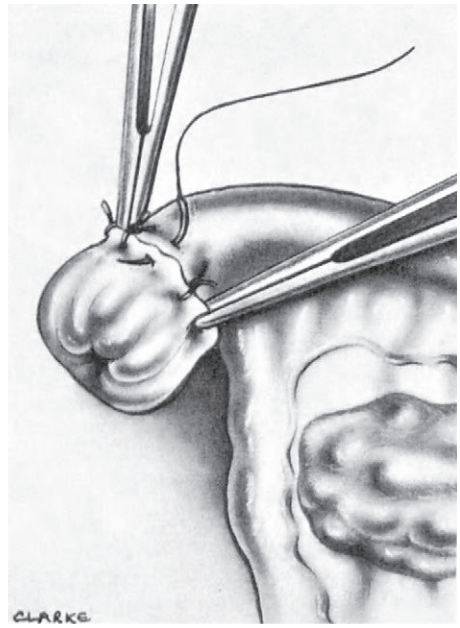


Fig. 12.14: Salpingostomy. Salpingostomy may be employed at the ampulla if the fimbrial end been destroyed. A cuff of distal tube is turned back and sutured so that the external ostium is permanently exerted.

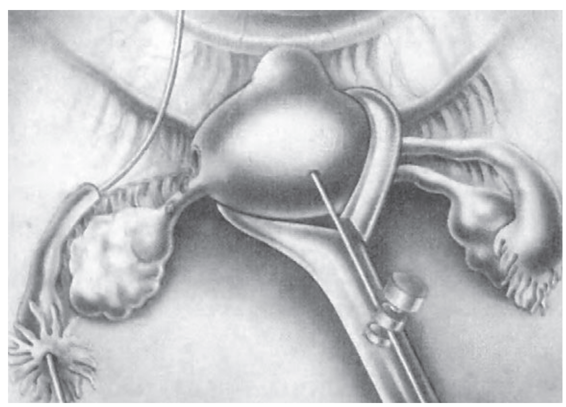


Fig. 12.15: Tubal anastomosis. An injection of coloured fluid through the fundus will demonstrate patency of the proximal tubal stump if the cervix is occluded. Alternatively transcervical hydrotubation may be used.

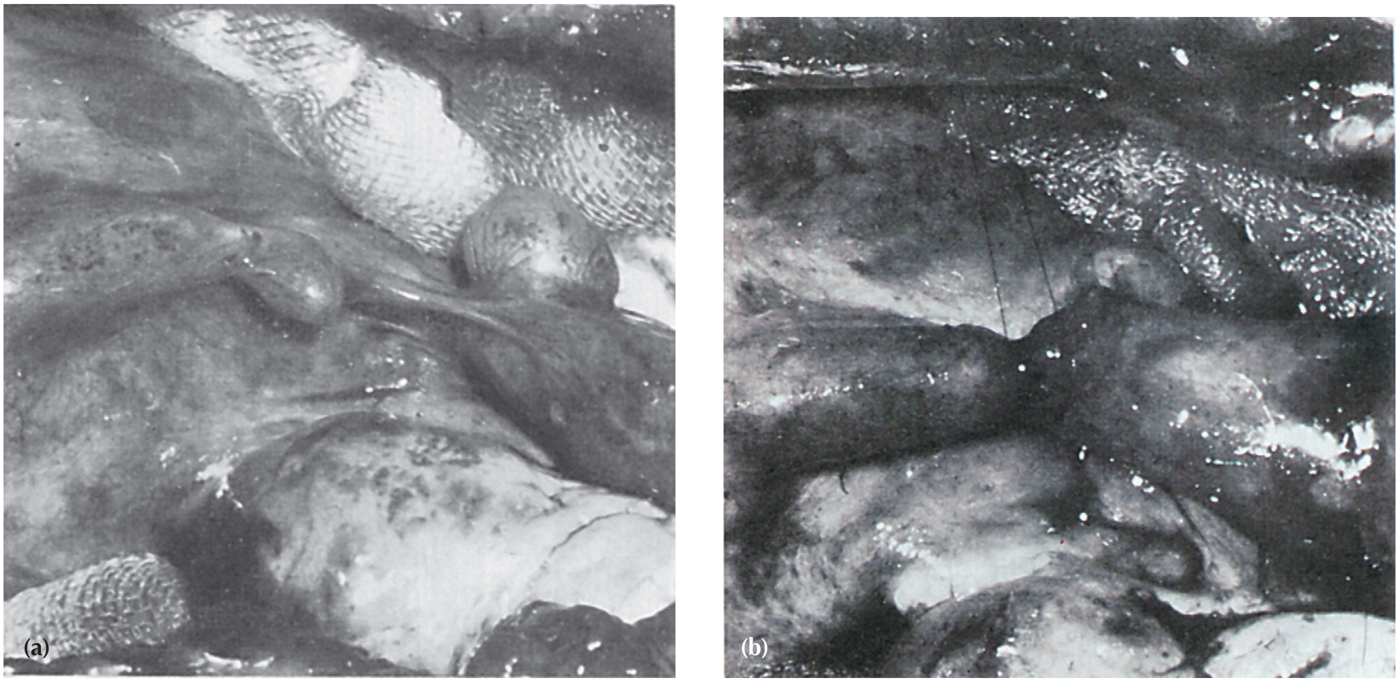


Fig. 12.16a,b: Reversal of sterilisation. **(a)** The situation prior to the reversal procedure. **(b)** Tubal anastomosis following excision of the scarred and damaged tubal segment. A temporary splint has been inserted and the first suture placed.

The vast majority of sterilisation operations are now carried out using clips or rings, with minimal loss of tubal length, and there is no place for ampullary-isthmic anastomosis.

OPERATIVE TECHNIQUE

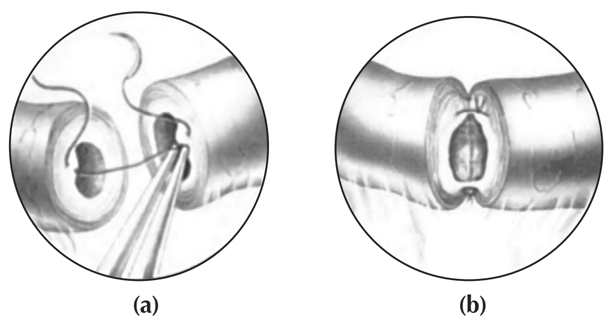
Having assessed that the remaining portion of the tubes and the ovaries are normal, the portion which has necrosed, including the clip or ring if they are still attached, is excised until fresh healthy tube with a patent lumen is clearly identified at both ends. Some surgeons pass a stent of firm nylon through the tube (see Fig 12.15, left side) to act as a splint. The two ends of the tube are then brought together along with the mesosalpinx and a series of very fine non-absorbable sutures used to approximate the ends (Fig. 12.17).

There are two special problems, namely disparity in size and the gap. The latter does not usually present major difficulty but adequate mobilisation is essential to avoid tension and before the tubal anastomosis is carried out a suture approximating the mesosalpinx should be placed, which will eliminate inadvertent and inappropriate tension being applied to the tubal sutures during their placement (Fig. 12.17b).

Disparity in Size

Two techniques are available:

1. Isthmic bevel: A technique precisely similar to that used in intestinal anastomosis between loops of disparate size, may be effective. A small slit is made in the anti-mesenteric border of the isthmic portion of the uterine tube. The flanges are folded outward and the pointed areas excised. If



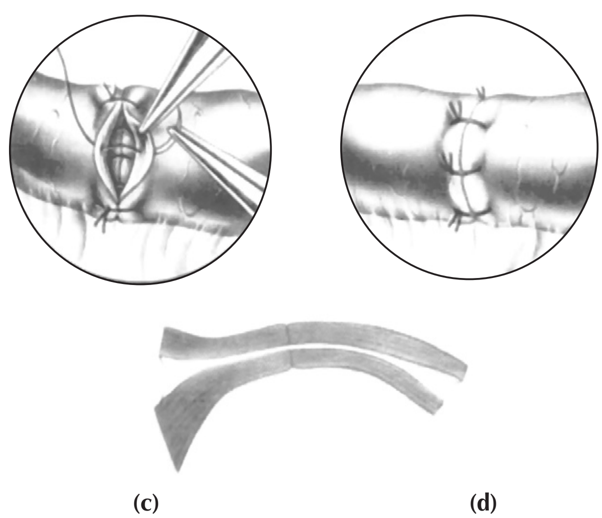


Fig. 12.17: Tubo-tubal anastomosis. **(a)** Interrupted muscular sutures avoiding the endosalpinx. **(b)** Approximation of the tubal ends. **(c)** and **(d)** Closure of the serosal layer with interrupted sutures.

the muscle walls are of unequal thickness, the bite of suture taken should be the same in both segments of tube but in the thicker segment not all the myosalpinx should be included but only that portion nearest to the lumen so that the anastomosis ends up with symmetrical distance of suture bite between the lumen of either segment.

2. When the distal remnant of oviduct has a smooth healthy proximal tip it is only necessary to make a small 'ostium' by incising over the tip of a probe inserted through the fimbriated aperture so that the two apertures for anastomosis are approximately the same size. If, however, the proximal part of the ampullary segment is fibrosed or diseased, then this requires serial section until healthy tube is exposed. It is this situation which leads to the disparity in lumen for which the management outlined above is indicated.

CORNUAL OCCLUSION

Inflammation of the uterus, often puerperal or post-abortal, may lead to proximal tubal occlusion. Sterilisation procedures, particularly diathermy, which have been carried out on the isthmic portion of the oviduct may produce the same result. In either instance the most proximal part of the interstitial oviduct may have escaped the occlusive effect of trauma or inflammation. The presence of such a small patent segment may only be determined by preliminary hysterosalpingography or possibly hysteroscopy.

The operation of uterotubal implantation has now been abandoned, as results were so poor, and it has been replaced by microsurgical tubo-cornual anastomosis.

Technique

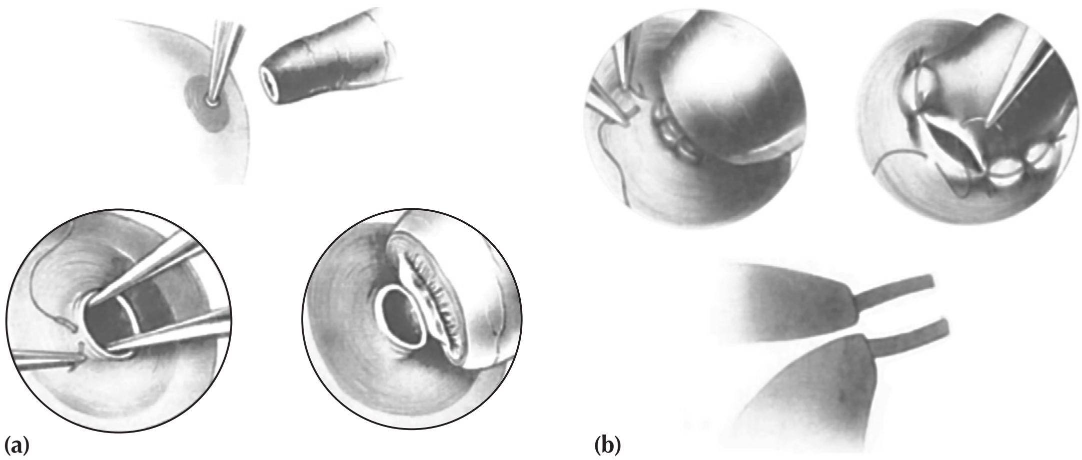
After the usual preliminary steps the proximal ostium must be created. Retrograde dye pertubation with either a very dilute methylene blue solution or clear normal saline is used. Some surgeons prefer to reduce the myometrial oozing by injection of a solution containing 10 units of oxytocin and 1 mL of vasopressin into the myometrium. The occluded cornu is then sliced as a thin disc (approximately 1 mm thickness) until such time as the pent-up fluid within the uterus spurts forth from the severed end of the patent intramural tube. All further scar tissue must be carefully trimmed under high magnification and haemostasis achieved with bipolar diathermy.

The next stage is to thread a number one nylon suture or the equivalent carefully and gently into the cornual ostium. It is usually possible to negotiate the small bend into the uterine cavity. The hollow ended probe is used to thread the other end of this temporary splint through the distal segment of tube for anastomosis.

The anastomosis commences with sub-mucosal muscular sutures usually 8/9 gauge, with the knots tied externally. The first such suture should be placed on the side of the anastomosis furthest from the operator. It may, however, be an advantage to place a suture in the mesosalpinx in order to bring the two segments for anastomosis into apposition. Very gentle stretching of the lumen of the tube to be attached using fine jewellers forceps may make the edge more readily defined for the accurate placement of sutures. The remaining steps of the procedure are not materially different from previously described tubo-tubal anastomosis. The splint is removed at the end of the procedure and a further injection may confirm that a waterproof patent anastomosis has been achieved (Fig. 12.18).

POSTOPERATIVE MANAGEMENT

With a careful technique as described, the postoperative course of these patients should be very smooth. Infection can completely vitiate any benefits from such surgery and peri-operative antibiotic therapy is recommended. The concurrent use of steroids may make this point of even greater importance.



(a) (b)

Fig. 12.18: Tubo-cornual anastomosis. **(a)** The problem of disparity of luminal sizes is illustrated. **(b)** The correct placement of symmetrical sutures may overcome this. A reefing effect on the serosa is produced, which absorbs the discrepancy (after Gomel).

SUBSEQUENT FOLLOW-UP AND ADVICE

1. **Coitus:** After straightforward tubal anastomosis, unprotected intercourse may be permitted in the cycle after the first menstrual period following operation.
2. **Pregnancy:** It is safest to suspect ectopic pregnancy whenever gestation occurs following tubal restorative surgery. Diagnostic ultrasound may be invaluable in such cases.
3. **Subsequent viable pregnancy:** Vaginal delivery should be ordinarily entirely satisfactory for all cases except those in which the myometrium has been transgressed. There is a small but real risk of herniation of a cornual anastomosis.
4. **Subsequent persistent infertility:** If pregnancy has not ensued after 12 months, it is reasonable to perform a hysterosalpingogram to assess the operative result.

LAPAROSCOPIC OPERATIONS

For laparoscopic tubal surgery, good video camera systems are essential and instrumentation must include atraumatic grasping forceps, fine scissors, bipolar diathermy forceps, as well as a mono-polar needle electrode and a good suction irrigation system. The surgeon needs to be thoroughly trained and experienced, and a good assistant is essential.

The principles of laparoscopic surgery for tubal infertility are similar to those for tubal microsurgery and almost all the operations described above may be done laparoscopically provided adhesions are not too dense.

The patient is placed in the standard laparoscopic surgery position and a cannula is inserted through the cervix into the uterine cavity. An exploratory laparoscopy is first carried out to assess the extent of adhesions and severity of tubal disease. Three suprapubic trocars will be required in most cases and methylene blue dye is injected into the uterine cannula to check whether there is any tubal filling and/or patency. Once a thorough inspection has been carried out, the surgeon assesses whether it will be feasible to proceed with the operation, and which of the techniques of tubal surgery will be required. Often there will be a mix of the procedures described.

Laparoscopic Adhesiolysis

It will often be necessary to carry out adhesiolysis before the tubes and ovaries can be inspected. Adhesions may be divided with laparoscopic scissors, diathermy hook or needle electrode, or with laser.

The division of adhesions should commence with those in the midline, gradually working laterally. Adhesions should be put on the stretch, by using grasping forceps and the line of division should be as close to the affected organ as possible, and particular care should be taken with adhesions involving small or large intestine, to avoid electrical injury to the bowel wall. Frequent irrigation with Hartmann's solution or similar is used, and meticulous haemostasis should be obtained. Once the pelvic anatomy has been restored, it may be found that the Fallopian tubes are patent and that the ovary and tube are now in better apposition and no further surgery will be required. If, however, there is partial or complete occlusion of the Fallopian tube, leading to a degree of hydrosalpinx, either fimbrioplasty or salpingostomy will be required.

Fimbrioplasty

This operation is required when there is fimbrial conglutination, resulting in phimosis of the distal end of the tube, but usually there is some degree of patency. Once all the adhesions are divided and the tube is as free as possible, it is grasped with atraumatic forceps to expose the distal end. A pair of alligator-tipped forceps is introduced into the small tubal ostium and opened and closed gently to break down adhesions and widen the ostium. The same procedure is then carried out with the instrument at right angles, and the tube will fall open and remain open without the need for suturing. Any small bleeding points are diathermised.

Salpingostomy

If the fimbrial end is completely occluded, it is likely that the tube will be distended as a hydrosalpinx. The size of this may be exaggerated by the methylene blue dye which has been instilled. If the tubal wall is very thickened, it is likely that the epithelium is so badly damaged that the operative results will be poor. Similarly, a very large thin walled tense hydrosalpinx is likely to have such poor tubal epithelium that success in terms of pregnancy is unlikely. In very severe cases, provided there has been prior discussion with the patient, it may be best to remove a large hydrosalpinx, leaving the pelvis in an appropriate situation for in vitro fertilisation.

If, however, the surgeon considers that the degree of dilatation of the tube is not too gross, the distal end is grasped and a small incision made into the dimple at the apex of the tube. This may be made with a diathermy needle, or with scissors, and two or three more incisions are made over avascular lines, each incision being 1–2 cm in length. Eversion of the new opening is maintained by touching the serosal surface of the tube just proximal to the new opening with either bipolar coagulation or with a diathermy probe. The serosa blanches and retracts, holding the ostium open. Laparoscopic sutures are rarely appropriate in this situation.

Tubal Anastomosis

This procedure is usually performed for reversal of sterilisation. The procedure followed is very similar to its laparotomy counterpart, with the occluded part of the tube being excised using fine scissors until a fresh vascular tubal lumen is identified on each side of the occluded portion. The ends of the tube are now anastomosed, using fine absorbable sutures such as 6/0 polyglactin. The first suture is inserted at 6 o'clock to include the muscularis and epithelium. It is not usually necessary to insert more than four sutures in all but the operating time is considerable in using such fine sutures with intracorporeal knot tying. Some surgeons will only anastomose one tube because of the length of operating time.

Results of Tubal Surgery

By far and away the best results are obtained from tubal anastomosis for sterilisation reversal because essentially healthy tubal tissue is being repaired. Using microsurgical techniques, Margara has reported a 60% overall pregnancy rate,[81] but in optimal cases where good tubal length was available, rates as high as 80–90% have been claimed. Laparoscopic reversal of sterilisation has not yet achieved these high pregnancy rates.

Salpingostomy is much less successful and overall pregnancy rates from unselected salpingostomies done in a large number of non-specialist centres in the UK have shown pregnancy rates not exceeding 10%. However, in specialised centres, figures of 25% are quoted provided the hydrosalpinx was not thick walled and excessively dilated. In the latter cases, Boer-Meisel et al.[82] report only a 3% pregnancy rate. Although numbers are not large, several studies of laparoscopic salpingostomy demonstrate a pregnancy rate of 30% and above, and similar good results have been claimed for laparoscopic fimbrioplasty. However, it must not be forgotten that there is also a considerable incidence of ectopic pregnancy following all of these surgical methods.

ASSISTED REPRODUCTION TECHNIQUES

Although in vitro fertilisation was originally developed in the late 1970s for the treatment of tubal occlusion, it rapidly became accepted as a more effective treatment for many other categories of infertility such as endometriosis, cervical mucus hostility, male factor and unexplained infertility. Variants of in vitro fertilisation were developed over the next few years such as gamete intra-Fallopian transfer, ovum donation, intracytoplasmic sperm injection and intra-uterine insemination. Other modifications include use of donor sperm where there is a male factor problem in addition, and various surgical procedures where sperm or spermatocytes are obtained from the testicles. All of these techniques are now grouped under the heading of assisted reproduction treatment and detailed description is not appropriate in a surgical operative book.

Complications

Although IVF is relatively safe, there are some important complications including ovarian hyper-stimulation syndrome (OHSS) when gonadotrophin therapy is used for anovulation. It is wiser to cryopreserve all embryos and use them in a subsequent cycle rather than replacing embryos immediately, if OHSS is recognised prior to oocyte collection.

Rarely, puncture of a large vein adjacent to the ovary on the pelvic side wall has occurred, resulting in the development of a large retroperitoneal haematoma. Several cases have also been reported of infection, resulting in ovarian abscess formation.

Concern has been raised that follicular stimulation may increase the incidence of ovarian cancer. Whittemore et al.[83] reported an increased incidence in a case controlled study, but Franceschi et al.[84] were unable to demonstrate any association. Nevertheless, the concern remains until further epidemiological studies have been completed, and some units are recommending that patients who have had ovarian stimulation should have ultrasound ovarian cancer screening subsequently. Current reviews are still inconclusive and more studies with the appropriate statistical power and elimination of confounding factors are required.[85]

Perhaps of greater importance than the complications are the enormous ethical dilemmas that have been raised by these new techniques. The use of embryos for research, the potential for genetic manipulation and the fate of unused frozen embryos are some of the major issues. In addition, there are social ethical issues around the use of donated ova to post-menopausal women, the application of these techniques to single women, and the request for frozen embryos to be re-implanted after the death of one or other of the parents. In most countries, there are statutory licensing bodies that monitor the activities of assisted reproduction units and impose codes of practice that are variably regulated by law. Many centres find it useful to have an Ethics Committee, with wide representation from different religious, cultural and professional backgrounds to advise on both research and clinical practice.

Sterilisation

Sterilisation as a deliberate operation is always a serious decision, and never one to be taken without considerable time for explanation, and opportunity for the patient to reflect and change her mind before embarking on the operation. Worldwide it remains a very important and frequently used method of contraception.[86] There are no absolute contraindications to the procedure provided that the woman (or man), requests it of their own free will, after suitable deliberation, and without coercion. Any surgeon who performs this operation is advised to observe precautions similar to those taken when terminating a pregnancy and similar indications frequently exist and the same principles and safeguards should be adopted.

Indications for sterilisation include a patient who for personal or social reasons decides to make a permanent and irreversible decision to never subsequently conceive any child of their own.[87] There may be medical indications for sterilisation, but these are very rarely absolute. It is a woman's right to determine whether to become pregnant or to continue with a pregnancy, in spite of an extra hazard to her personal health.

Sterilisation is perceived by the public at large as being a procedure of low risk and high efficacy and expectations are high, if not, at times, unrealistic.

CONSENT

The issue of informed consent is discussed in detail in Chapter 23. It is essential to correctly witness and record in the notes details of matters discussed prior to signing of the consent form. Any issues regarding intellectual disability or mental illness affecting the patient's capacity to consent for a procedure that will render them sterile should be referred to courts for judgment.[88] There are numerous medico-legal ramifications associated with failure of such procedures and care must be exercised at all stages to minimise risk of such unwelcome events.[89] To perform any sort of genital ablation or interruption that would remove a woman's reproductive capability without her knowledge and consent would be to invite not only civil action, but serious professional censure.[90]

Many institutions have a specially devised consent form for both male and female sterilisation with the option for a spouses' counter signature, an option that may be virtually mandatory in some cultures. The specific issues for consideration in such a consent form are:

1. The existence of alternatives, including other long-term reversible contraceptive methods, their advantages, disadvantages and failure rates (including male partner sterilisation).
2. The awareness that for all intents and purposes sterilisation is intended to be permanent and may not be reversible.
3. The risks are those of any abdominal surgery and are slightly increased if a laparoscopic method is used. There is a risk of failure for any method of sterilisation.
4. The potential for unrecognised coincidental pregnancy and the responsibility for any consequences.
5. There is no method without a small late failure rate.

RISK COUNSELLING

The risk of death during laparoscopy is estimated at 1 in 12,000.[91,92] Women who have increased risks for surgical complications (obese or previous abdominal surgical procedures) need to be fully informed of risks involved including morbidity, mortality and laparotomy. Counselling should be carried out by trained personnel who preferably provide written impartial documentation noting failure and complication rates.[93,94] It is advisable to provide women with written information about their procedure (translated if possible) at least 1 week before their surgery.

Complications can be major or minor in nature. The most serious morbidity and procedure-related fatality arises from vascular injury and sepsis (often related to bowel injury but can involve bladder and major vessel injury). Risks for laparotomy have been quoted at 1.4–3.1/1000 cases.[92,95]

Another aspect of risk to be discussed in advance is the risk of failure, which is method related. The consensus is that the long-term subsequent pregnancy rate is of the order of 0.2–0.3%. It is important to mention, however, that these pregnancies may well be ectopic, particularly if cautery has been used as the sterilising method.[96] No procedure is 100% certain: even hysterectomy has its recorded failures with subsequent ectopic pregnancy.[97]

ADDITIONAL COUNSELLING

Post-sterilisation regret is a real phenomenon and has been directly related to the following patient groups.[87]

- Young patients (less than 30).
- Women not currently in a relationship or in a relationship in crisis.
- Psychological and psychosexual issues.
- Coercion by partner or medical professional.
- Timing relating to abortion or childbirth.
- Lack of information provided (including the procedure, its effectiveness and failure rates and long-acting reversible contraceptive alternatives)

The importance of maintaining contraception and avoiding pre-clinical pregnancy at the time of surgery should be emphasised and the inclusion of dilatation and curettage as an option in the procedure. (Even this cannot guarantee removal of a very early conception).

It was previously thought that sterilisation in the aftermath of pregnancy (puerperal or post-abortal) carried a higher failure rate and increased regret rate. Whereas it is possible that the tubal hypertrophy of pregnancy may make mechanical occlusion less secure, studies have shown that there is no increased failure rate in puerperal or post-abortal sterilisations.[98] If sterilisation is to be considered at Caesarean section it is advisable that counselling and agreement should be obtained as early as possible in the pregnancy. A modified Pomeroy procedure rather than Filshie clip technique may lead to lower failure rates in post-partum sterilisations.

ADDITIONAL HAZARDS

Relevant aspects of the woman's health status need to be considered and under some circumstances may be a reason for the surgeon to decline to perform an abdominal procedure for social indications. Examples might be extreme obesity, pre-disposing conditions to thromboembolism and prior major intra-abdominal surgery, particularly the presence of an abdominal wall stoma.

METHODS OF STERILISATION

The laparoscopic approach (where trained staff and necessary equipment are available) is the commonest in general use for interval sterilisation. Tubal occlusion by Filshie clips or rings is now much preferred to diathermy. A small (mini-) laparotomy is an alternative, which is preferred in certain circumstances,

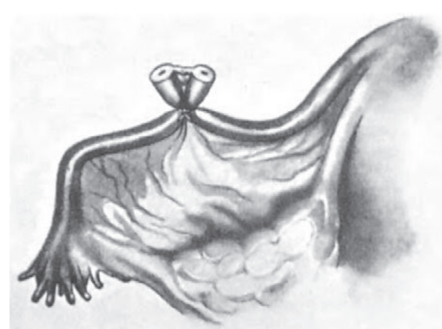


Fig. 12.19: Sterilisation: Partial salpingectomy (Pomeroy method). A loop of oviduct is picked up with forceps, a single ligature of catgut is tied around the base and the end of the loop is then excised. It is important that absorbable suture material be used so that after dissolution of the ligature the ends of the oviduct will separate.

namely in the aftermath of pregnancy and after significant prior abdominal surgery. The laparoscopic approach carries a lower risk of minor morbidity compared with mini-laparotomy. The vaginal route is technically feasible in many parous women, but no longer widely used. If the uterus is retroverted, access is reasonable through the pouch of Douglas; otherwise access through the anterior fornix with hooking down the fundus may be preferred.[99] Hysteroscopic methods of sterilisation look promising but are still under evaluation.[100]

STERILISATION TECHNIQUES

Pomeroy Operation

This remains a popular operation in spite of a slightly elevated failure rate compared with other methods. A loop of the isthmic portion of the tube is pulled up and ligated with a single catgut ligature (Fig. 12.19) after preliminary crushing. The loop is excised and examined to make certain that there is not a bridge of tissue between the two ends of the Fallopian tube in their common ligature. Provided that an absorbable suture is used, the two ends should separate once the suture has been absorbed.

Parkland Operation (Partial Salpingectomy)

For abdominal sterilisation on its own a small Pfannenstiel incision is ideal. This may be restricted to 3 cm length by the use of a suitable speculum. A miniature standard procedure is adopted until the peritoneum is opened. This should then be tacked to the skin edge with a few temporary stay sutures. This enables a Cusco speculum to be passed into the abdomen. Instruments may be passed through the slit at the side. The procedure is facilitated by elevating the uterus on a Spackman cannula inserted through cervix (Fig. 12.20).

The Fallopian tube is drawn up from the pelvis through the abdominal incision. It is held up so that a bloodless area of the mesosalpinx can be found. This usually lies about halfway along the length of the Fallopian tube. Small curved artery clamps are placed over the Fallopian tube at a distance of about 2 cm apart and so arranged that their points come into contact on the mesosalpinx. The segment of Fallopian tube is now held up with dissecting forceps and excised together with the mesentery which lies between the Fallopian tube and the clamps. A polyglycan ligature is then tied around the Fallopian tube enclosed in the clamp and the clamp removed, the same procedure being followed with the second clamp. The operation is bloodless and can be quickly performed. No effort is made to invaginate the cut ends of the tube or to cover them with peritoneum. The same operation is performed on the Fallopian tube of the opposite side.

'Burying' Variations

In the Usheda method, one end of the divided tube is buried in the mesosalpinx. The Irving technique involves burying the proximal stump into the muscular layer of the uterus using the round ligament as an intervening structure.

Diathermy Coagulation

Unipolar diathermy should be regarded as obsolete and even the use of bipolar diathermy has declined rapidly. In this, the electric current passes between the two jaws of the coagulation forceps and is not dispersed through the tissues to an indifferent electrode. This virtually eliminates the risk of misdirection of the electric current. It reduces, but does not eliminate, the risk of thermal injury, particularly to structures outside the field of vision or which may fall against an over-heated tube. Diathermy is also not advisable as a primary method of tubal occlusion as it increases the risk of subsequent ectopic pregnancy and is more difficult to reverse.[87]

Fallope Ring[101]

This silastic rubber ring is placed over the isthmic portion of the tube in a manner similar to the Pomeroy operation, except that the loop is not excised (Fig. 12.21). If there is difficulty in drawing a loop through because it is too thick or because it is too close to the uterus, there is a risk of tearing the mesentery or transecting the tube, which can lead to haemorrhage as well as likely failure. The operation causes significant postoperative pain and direct application of local anaesthetic to the tubes may be indicated.

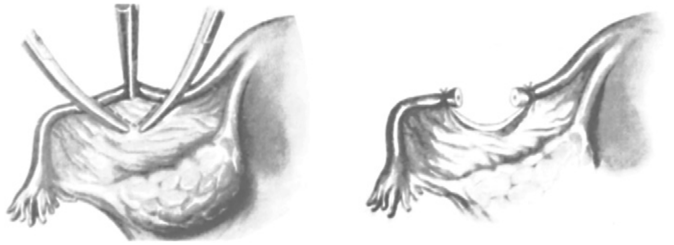


Fig. 12.20: Sterilisation (partial salpingectomy) by wedge excision. The Fallopian tube is drawn up with dissecting forceps in a position where the mesosalpinx is relatively bloodless and curved clamps are paced in position on each side. The tissue enclosed by the two clamps is then excised with a scalpel. Subsequently the tissues enclosed in the clamps are ligated. No effort is made to bury the cut ends of the Fallopian tube.

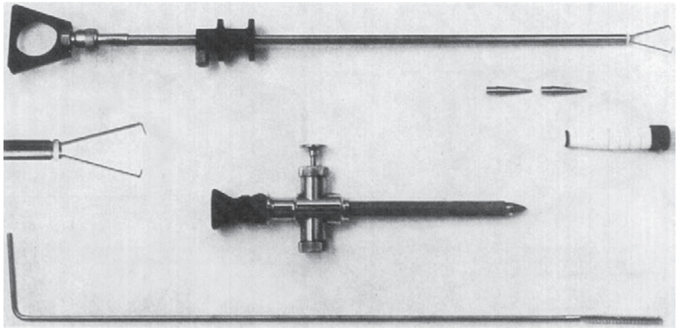


Fig. 12.21: Sterilisation: tubal occlusion. Yoon Fallopian tube ring applicator shown with laparoscopy operating trocar and cannula. Inset is close-up of the ring on the applicator.

Clips

The application of occlusive clips is probably the most satisfactory method of laparoscopic sterilisation. It is safe and relatively easy, although not immune to manipulative difficulty. The Hulka clip[102] has been largely replaced by the Filshie clip,[103] but both are popular and safe. Clips are applied to the oviduct rather closer to the uterus than other methods of sterilisation. It is most important that the whole width of the tube is embraced by the clip (Fig. 12.22). Two clips can be used, but this increases the risk of hydrosalpinx formation and the routine application of two Filshie clips is now not recommended by the RCOG Guidelines.

Vasectomy

Male sterilisation has a failure rate of around 1 in 2000 after postoperative azoospermia has been checked. Various techniques have been employed ranging from excision and/or ligation, surgical clips, thermal or electrocautery and chemical occlusion and/or diathermy of the vas deferens.[104] Clips are now regarded as inadvisable to occlude the vas in view of high failure rates. A no scalpel approach is recommended to identify the vas as this lowers rate of early complications and vas deferens division should be accompanied by fascial interposition or diathermy. Excised portions should be sent for histological confirmation. Men are advised to use added contraception until azoospermia has been confirmed according to local protocols.

RESULTS

The most notable study from the Centre of Disease Control in the USA (CREST) reported on 10,685 women 10 years from surgery.[105] A life table probability of pregnancy was 2.5% for bipolar cautery and 3.6% for Hulka clip sterilisation. For women under 28 years of age, the figure was increased to 5%. The results for Fallope rings were marginally better. Filshie clips have had reported failure rates between 2 and 3 per 1000 sterilisation procedures.[106,107]

When pregnancy occurs as a result of failure of sterilisation, the risk of it being ectopic is greatly increased, being as high as 50% for failures following cautery, particularly those under the age of 30. After failure of other methods of sterilisation, the ectopic pregnancy rate is of the order of 5%.

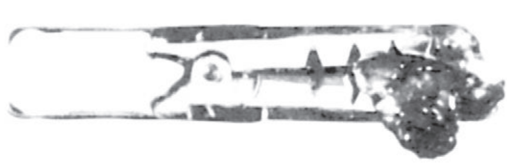


Fig. 12.22: Sterilisation: attempted tubal occlusion. This oviduct supports an imperfectly closed Hulka-Clemens clip. The tube was inadvertently avulsed during attempts to manipulate the clip to full closure; it would have been preferable to have applied a second clip alongside as this might have been achieved without additional trauma.

MENSTRUAL DISTURBANCE AND PAIN

Sub-clinical infection and inflammation may lead to hydrosalpinx formation (Fig. 12.23). Some studies have suggested that this is not a significant problem.

Wilcox et al.[108] reported on over 5000 patients followed prospectively for 5 years with an increase in menstrual disturbance, including pain, bleeding and spotting. It is believed that women after sterilisation are less tolerant of menstrual disturbance and report increased menstrual symptoms irrespective of pre-sterilisation symptoms or contraception, and may be more likely to request hysterectomy.[109–111]

REASONS FOR STERILISATION FAILURE

1. **The patient was pregnant at the time of operation:** Studies by Kasliwal–Farquharson[112] and Farquharson[113] reported that as many as 2.5–5% of women are pregnant at the time of sterilisation. A conceptus in the luteal phase may not even have implanted so that ectopic pregnancy may result. It seems unfair that a surgeon who carries out a perfectly correct operation designed to prevent future pregnancies should be held liable for a pregnancy already conceived before this event. Nevertheless, there are enough legal decisions in favour of this liability to suggest that clinical practice should be modified to take account of this situation. The safest course of action is to assume that every woman is potentially pregnant at the time of sterilisation and to perform a beta-HCG pregnancy test immediately beforehand. A rider may be added to the consent form to the effect that the patient accepts full responsibility for any pregnancy that could have been conceived prior to the operation (see above).
2. **Failure to perform a satisfactory procedure:** Usually this would be because the operation has been carried out on

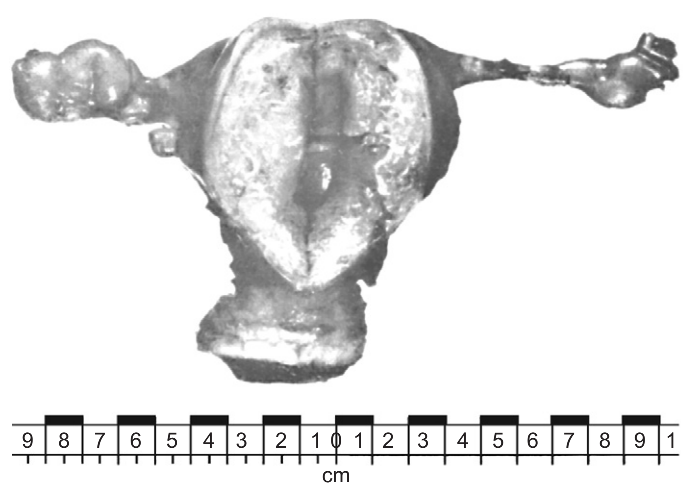


Fig. 12.23: Sterilisation operations. Operation specimen of uterus and both tubes removed by total hysterectomy and bilateral salpingectomy, showing bilateral hydrosalpinx. The patient had been sterilised by tubal ligation 10 years previously.

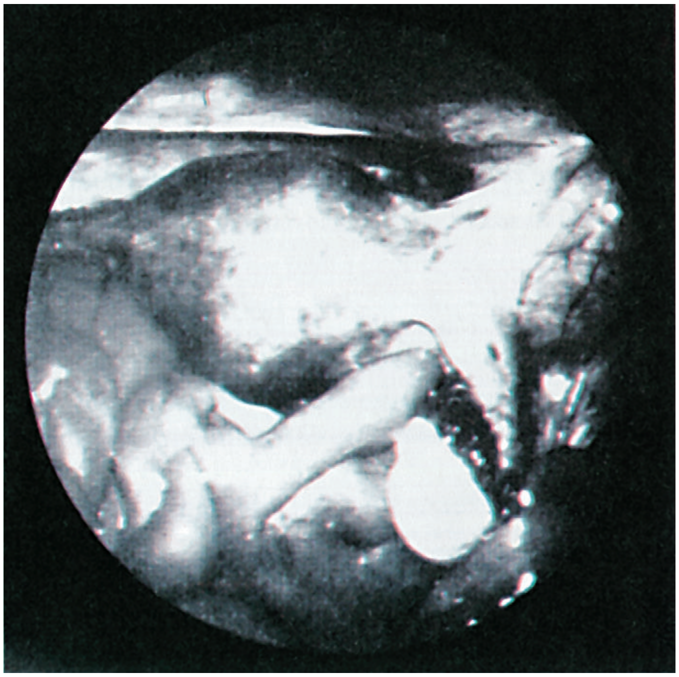


Fig. 12.24: Sterilisation: operative laparoscopy. View of operative field obtained with the laparoscope. The fimbrial end must be identified to avoid inadvertent confusion with the round ligament (by courtesy of Wolff).

some structure other than the oviduct, namely the round ligament or a fold of peritoneum between the oviduct and round ligament. It is prudent always to confirm the identity of the Fallopian tube by visualising the fimbrial end (Fig. 12.24). Another mechanism would be failure to occlude one Fallopian tube either because the cautery has been insufficient, or because the mechanical occlusive device has failed to encompass the full lumen of the tube, or failed to crush it, whether due to mechanical failure of the clip equipment or operator-failure to adequately lock the clip.

Another cause of early failure could be unrecognised incomplete severance of the proximal tube on the uterine side of the clip that has been applied, leading to early formation of a tubo-peritoneal fistula. Application techniques are important and operators are advised to perform a minimum of 25 supervised procedures prior to independent practice.[87]

3. **Late failure may occur after a correctly performed procedure:** If the tube is in continuity re-canalisation can occur. If a Pomeroy procedure has been carried out incorrectly, by using an unabsorbable suture, this is much more likely because the two segments of tube remain in direct apposition and the amount of local tissue damage by inflammation with such a suture is reduced. Rarely a correctly performed Pomeroy procedure in which the tubal ends are separated by a centimetre or so of healed mesosalpinx may still re-canalise by formation of an epithelial-lined tract along the free margin of mesosalpinx between the two separated tubal ends.

   An alternative reason for failure is the formation of a tubo-peritoneal fistula (from the proximal stump, either at its end or from the side through a salpingeal diverticulum). Sperm then has free access to the peritoneal cavity; a fertilised ovum would normally be picked up by the remaining fimbriated ampulla, where it will lodge as an ectopic pregnancy. Only rarely will the fertilised ovum be wafted into the proximal tubo-peritoneal fistula for either an isthmic ectopic or intra-uterine pregnancy.

4. **Clip migration:** Mesothelial envelopment is normal after the application of an occlusive clip, which will tend to hold it in place. If, however, this is unduly delayed for any reason, a properly applied clip may later migrate without necessarily restoring fertility. Such a loose foreign body may then be enveloped and incarcerated in omentum or, having fallen into the pouch of Douglas, migrate into the lumen of an adjacent hollow viscus thence to be passed to the exterior. Evidence of migration may be discovered incidentally on imaging for some other purpose. In the absence of attributable symptoms, there is little case for intervention.
5. **Other sequels:** Hydrosalpinx formation (see above). Single band adhesion from the omentum can be responsible for small bowel obstruction. Rarely, small bowel itself may adhere to the site of sterilisation and be responsible for non-specific colicky pain. This possibility should be borne in mind when performing a vaginal hysterectomy on a patient who has been sterilised in the past.

PREGNANCY AFTER STERILISATION

With timely diagnosis, the patient will have the option for termination, but this will not, it seems, reduce the liability of the surgeon for damages for the costs of an unwelcome pregnancy. If the patient decides to continue the pregnancy the surgeon can be sued for 'wrongful birth', with a claim for all the costs of child rearing until the age of 18. If she opts for re-sterilisation, it may be prudent to pass this task to a different operator and in any event, the woman may seek to have an independent observer present so that the findings and condition of the Fallopian tubes at surgery may be carefully described and photographed. If total bilateral salpingectomy is to be carried out, not only should the excised tubes be examined histologically, but before this is carried out it may be valuable to perform post-surgical salpingography on the excised tubes, as this may disclose a fistulous track not visible to the naked eye. Literature reports place a 5–90% risk of ectopic pregnancy after a failed tubal sterilisation.[114] Care must be taken to identify this at an early stage and careful follow up of the cases together with prompt treatment is a must.

SUMMARY

1. This socially important procedure should not be regarded as a minor operation suitable in all cases. There may well be medical, social or psychological contraindications.

2. The risks, alternatives and intent should not only be discussed but the discussion should be documented, especially risk of failure.
3. A pregnancy test should always be performed and the possibility of and responsibility for coincidental early pregnancy should have been discussed.
4. Sterilisation should never be carried out without consent (see Chapter 23).
5. The fimbriated end of each tube must be identified. The correct site for application or intervention chosen and an oblique application avoided. The tube must not be under tension when a clip is applied. It is better to apply a second clip if the efficacy of the first application is in doubt. An operative photograph of the completed operative site should be taken for retention in the notes.
6. If cautery is to be used, it should be bipolar. The tube should be seen to be clear of other structures during the procedure. Care must be taken to ensure that the cannula does not become live.
7. Most of these cases are carried out on a day case basis. Adequate aftercare is essential, and the patient informed of arrangements in place whereby she can seek urgent medical advice in the event of undue pain or malaise.
8. Menstrual irregularity, particularly missed periods occurring after a sterilisation procedure, should be reported to the doctor.

Ectopic Pregnancy

The clinical picture of tubal pregnancy has altered in Europe and the Western world in recent years, in that a majority of ectopic pregnancies are diagnosed before rupture, and the dramatic presentation of tubal rupture with a massive haemoperitoneum and a shocked patient is now less frequently seen. However, it must not be forgotten that ectopic pregnancy remains a potentially lethal condition and remains the leading cause of pregnancy-related first trimester deaths in the UK.[115,116] The Confidential Enquiry into Maternal Deaths in the UK (2003–2005) reported 10 deaths from an estimated 32,100 ectopic pregnancies during that period. Early diagnosis is partly due to women's increased awareness of early pregnancy, its symptoms and deviation from normal pregnancy, and partly due to a high index of suspicion by general practitioners and gynaecologists, coupled with the availability of good ultrasound and quantitative beta-human chorionic gonadotrophin (HCG) assays. Hence, the majority of ectopic pregnancies are able to be diagnosed prior to rupture, which opens up a range of more conservative forms of management.

PATHOLOGY

A consideration of the pathology of ectopic pregnancy is of great help in the diagnosis of this condition. Many patients are misdiagnosed as suffering from acute appendicitis because the severity of their physical state leads to a hurried and inadequate history. It is important to remember that in women of reproductive age who present to practitioners with diarrhoea and vomiting and/or fainting, the possibility of ectopic pregnancy should be considered.[115]

Ectopic gestation may arise by primary implantation within the tube (Fig. 12.25), the ovary or elsewhere within the peritoneal cavity. The majority, however, occur in the isthmic, ampullary or interstitial portions of the tube. A study of 1800 surgically treated ectopic pregnancy patients between 1992 and 2001 gives an insight as to the distribution of ectopic pregnancy sites.[117] Results reported were as follows:

Ampullary	70%
Isthmic	12%
Fimbrial	11.1%
Ovarian	3.2%
Interstitial	2.4%
Abdominal	1.3%

No cervical pregnancies were observed. Cervical pregnancies in themselves are rare and literature reports incidence being less than 1% of all ectopics.[118]

Breen[119] in a 21 years survey of 654 ectopic pregnancies reported nine abdominal; one ovarian; four cornual and one cervical. The remaining 639 were tubal:

Fimbrial	30
Distal third	265
Middle third	245
Proximal third	79
Interstitial	9

Risk factors for ectopic pregnancy include previous ectopic, tubal and pelvic surgery, smoking, documented tubal pathology, in utero diethylstilbestrol exposure, pelvic inflammatory disease affecting the tube—especially with infections, such as *Chlamydia trachomatis*, prior attempt at sterilisation,[120] assisted conception and past and current use of an intra-uterine contraceptive device (IUCD).[121–125]

Overall rates of ectopic pregnancy are lower in women using birth control as compared with those who are not, but should pregnancy occur in a woman who has undergone tubal ligation there is a 30–80% chance of ectopic pregnancy.[126] Women currently using an IUCD are also at increased risk of ectopic pregnancy if they conceive—this increased risk persists after discontinuation of use.[127]

CLINICAL PRESENTATION

It must not be forgotten that extra-uterine gestation is a pregnancy, however short-lived, and there may be some symptoms and signs of early conception if these are carefully sought. The most important of these is menstrual aberration and, though not absolutely invariable, there should be a short period of amenorrhoea, classically 6 weeks. The actual duration of amenorrhoea is related to the site of implantation within the tube. Thus, at the narrowest (isthmic) portion, rupture may occur as early as 2 weeks after conception so that the uterine decidual bleeding may be mistaken for the next period. An ectopic gestation within the widest ampullary portion may proceed to 12 weeks before rupture. The rarer angular pregnancy, arising in the interstitial portion of the tube, may progress to 16 weeks before rupture. In all cases the period of amenorrhoea is the time that elapses before the eroding trophoblast has sufficiently advanced to cause enough tubal damage to give rise to obvious symptoms. The tubal epithelium and musculature are a poor defence against the trophoblast and roughly 1 month after ectopic implantation, their vessels are breached. This gives rise to a small intratubal haemorrhage, which causes the tube to be distended. This haemorrhage is an intratubal rupture since it takes place through the thin decidua capsularis produced by the embedding of the ovum within the tubal folds. It is a more common feature of ectopic gestation in the ampullary rather than the isthmic portion of the tube, the latter tending to rupture directly in the peritoneal cavity without much intratubal haemorrhage. The tubal distension causes at first a dull aching pain localised to one lower quadrant and classically pinpointed just above the midpoint of the inguinal ligament. If seen, and this is unusual at this phase, the lower quadrant is slightly tender and vaginal examination may rarely reveal a small appendage swelling, which is also tender to the examining finger. It is essential to realise that an early tubal pregnancy does not become palpable as an appendage tumour until there is a mass of organising blood clot present within the tube, and by this time the pregnancy will almost certainly have succumbed and uterine bleeding occurred. Earlier than this the only pelvic physical signs will be local tenderness of the affected tube and pain felt when the cervix is moved across so as to put the affected tube on the stretch.

With further erosion of the tube, more haemorrhage occurs, and the tube becomes tensely distended with the possible formation of a tubal mole, in which case the ovum is dead. This distension gives rise to tubal colic or violent tubal peristalsis, which is merely an attempt on the part of the tube to expel its contained foreign body. This colicky pain is again classical but not invariable.

It remains only to explain the uterine bleeding, which forms such an important diagnostic symptom in extra-uterine gestation. As in all pregnancies, there is a well-marked decidual reaction in the endometrium and, when the ovum dies, this decidua is shed—occasionally as a cast. The presence of uterine bleeding, therefore, follows the death of the ovum though some of the blood lost may be a reflux from the tube.

It should be remembered that the great majority of ectopic pregnancies occur in the isthmus or the ampulla of the tube—the remainder occupy the interstitial part of the tube, the cornu or the ovary.

SPECIAL SITUATIONS

1. **Chronic ectopic pregnancy:** A large and steady tubal leakage may cause a big pelvic tumour that gradually fills the pelvis. This gives rise to the chronic ectopic gestation, a major source of diagnostic confusion. The clot may laminate and solidify and be mistaken for a fibroid uterus. It may cause retention of urine or adhere to bowel and present with intestinal obstruction.

   In tropical countries where both ectopic pregnancy and profound anaemia are common, the presentation can be even more bizarre as a medical problem. Examples are coma, jaundice and heart failure.
2. **Broad ligament ectopic pregnancy:** Intraligamentary or broad ligament rupture and haematoma gives rise to a similar picture except that a large abdomino-pelvic tumour may form, displacing the uterus to one side. If extensive, the shock is as equally remarkable as that of the intraperitoneal bleeding.
3. **Interstitial extra-uterine pregnancy:** In this situation, the uterotubal myometrium provides a stouter and more resistant capsule to the eroding trophoblast and this contains the ovum for a longer period before rupture or perforation occurs, sometimes as late as the 3rd or 4th month. This site of the ectopic pregnancy is very vascular and the bleeding when rupture does occur is dangerous and dramatic.
4. **Angular pregnancy:** A similar situation of the extra-uterine gestation is seen in angular pregnancy except that here the interstitial pregnancy presents into the uterus and usually results in an intra-uterine abortion. The clinical picture is one of abortion plus interstitial extra-uterine gestation—pain being a marked feature. Pelvic examination may reveal a lopsided asymmetrical enlargement of the uterus. In rare instances abortion does not occur and a kind of secondary intra-uterine gestation results from the primary angular extra-uterine gestation. If this occurs, the placenta is liable to retention and its manual removal may be very difficult or impossible so that hysterectomy is needed to control the post-partum haemorrhage. The exact diagnosis of an angular pregnancy is usually made by laparotomy.
5. **Cornual extra-uterine pregnancy:** This term signifies pregnancy in a rudimentary horn where one half of the uterus is imperfectly developed. There is usually no communicating channel with the main uterine cavity and the position of the round ligament is characteristic—it is attached to the lateral aspect of the gestation sac. The myometrium of a rudimentary horn varies in its development and, if poor, rupture occurs about the 4th month of gestation. On rare occasions pregnancy may continue into the later months.
6. **Ovarian pregnancy:** Though extremely rare—the rarest of all extra-uterine gestations—primary ovarian pregnancy does occur. In order to diagnose this condition, certain features must be present:
   (a) The tube on the side of the ovarian pregnancy must be anatomically quite normal and, if removed, histologically normal and free and separate from the ovarian gestation sac.
   (b) The wall of the gestation sac must contain histologically demonstrable ovarian structures.
   (c) The inner or medial attachment of the sac to the uterus must be the ovarian ligament. Most ovarian pregnancies, owing to inadequacy of the ovarian tissues in containing the trophoblast, end in early rupture with profuse internal bleeding.

7. **Abdominal pregnancy** (see below): It sometimes happens that with tubal rupture the ovum is partially extruded while retaining sufficient attachment to the tube to continue alive. In this event its extruded trophoblast invades whatever visceral organ happens to be adjacent where it forms a secondary parasitic placenta, thus establishing a secondary intra-abdominal extra-uterine pregnancy. Such a placenta may involve any organ in the pelvis including the parietal peritoneum. Its attachment has no natural plane of cleavage comparable to the decidua basalis of the endometrium so that its separation at operation may be impossible (Fig. 12.25).

   A similar event can occur if the rupture is intraligamentary—in which case a secondary retroperitoneal extra-uterine pregnancy results.

   Primary abdominal pregnancy. The criteria for this diagnosis demand:
   (a) That both tubes and ovaries are normal and show no evidence of recent or remote injury.
   (b) Absence of any uteroperitoneal fistula.
   (c) A pregnancy related exclusively to the peritoneum and young enough to eliminate the possibility of secondary implantation following primary nidation in the tube.

   The most likely situations are posterior wall of the uterus and base of the broad ligament.[128]
8. **Bilateral ectopic tubal pregnancy:** Though extremely rare this has been described and is one good reason why the contralateral tube should always be examined when operating on the affected tube. A haematosalpinx is occasionally found in the tube not affected by the ectopic gestation and this perhaps explains how some of the reported cases of bilateral tubal pregnancy have crept into the literature. The rare possibility of bilateral ectopic gestation must nevertheless always be investigated and excluded when the abdomen is opened.

Fig 12.25: Ectopic pregnancy: fetus still attached in early tubal gestation.

9. **Combined intra-uterine and extra-uterine gestation:** In this uncommon variety of twinning one ovum is implanted in the uterus and one ectopically, usually in the tube. The diagnosis is rarely made pre-operatively, except by ultrasound, but should be borne in mind in cases of abortion or ectopic pregnancy where the symptoms and signs are confusing, especially when an ectopic pregnancy is found at laparotomy, the uterus is discovered to be larger than would be expected, where there is little or no vaginal bleeding, where the signs of early pregnancy are more obvious than is usual with an extra-uterine gestation, or where there is a strong family history of twins. Roughly 60% of patients who have a combined intra- and extra-uterine gestation present some of the above symptoms and signs.

   Combined intra- and extra-uterine pregnancy should also be suspected when there is a definite intra-uterine pregnancy associated with unaccountable abdominal pain, an adnexal swelling or a swelling in the pouch of Douglas. Very rarely both fetuses survive to late pregnancy.

   The treatment of this rare combination in early pregnancy is laparotomy, and removal of the tube affected by the extra-uterine gestation leaving the intra-uterine pregnancy undisturbed. If diagnosed late in pregnancy immediate laparotomy is recommended, when the extra-uterine pregnancy is dealt with according to the circumstances (see below) while the intra-uterine pregnancy is delivered by Caesarean section, if necessary.

   The incidence in spontaneous conceptions is 1:4000 to 1:7000. It is significantly higher following in vitro fertilisation and embryo transfer with a reported rate of 1–30% of all clinical pregnancies.[129]
10. **Ectopic pregnancy after total hysterectomy:** There have been over 30 reported cases of ectopic pregnancy after hysterectomy. These are classified as early when an 'in transit' pre-implantation conceptus is trapped in the Fallopian tube at hysterectomy and late, the result of migration of sperm through a fistulous connection into the peritoneal cavity.[130]
11. **Cervical ectopic pregnancy:** Implantation in the cervical canal may be associated with severe haemorrhage during vaginal abortion (see Fig. 12.26).[131]

DIAGNOSTIC PROCEDURES

It has been stressed that the classical association of pain, bleeding and amenorrhoea with signs of internal haemorrhage presents little difficulty in indicating prompt laparotomy. The diagnosis of the less acute forms of ectopic pregnancy may be more difficult and attempts to diagnose the condition at an earlier stage in its natural history depend upon the use of vaginal ultrasound and biochemical assay.

1. **Transvaginal ultrasound:** This provides a higher definition image than abdominal ultrasound and is particularly useful in establishing whether or not there is an intra-uterine pregnancy. An intra-uterine gestation sac will be visible as early as 5½ weeks after the last menstrual period, but it is important to distinguish this from the 'pseudo-gestational sac', which is decidualised endometrium around an empty uterine cavity. The identification of a yolk sac within the gestational sac is diagnostic of an intra-uterine pregnancy. At a later stage, more obvious ultrasound evidence of ectopic pregnancy may be present, with a sac visible within a Fallopian tube adjacent to the ovary, with or without a pocket of fluid in the pouch of Douglas (Fig. 12.27).
2. **Beta HCG assays**, either in urine or blood, are of considerable value in the diagnosis of ectopic pregnancy and its differentiation from a failing intra-uterine pregnancy. The presence of a positive test with no evidence of an intra-uterine pregnancy should lead to a strong suspicion of an ectopic pregnancy. The actual quantity of beta HCG does not reach the same level as an intra-uterine pregnancy at a comparable gestational age, and the doubling time of HCG is prolonged. Plasma progesterone is a less useful predictor, but may provide some contributory evidence in confusing cases. A combination of vaginal ultrasound and beta HCG assay has been shown to have a sensitivity of 100% and a specificity of 96%.[132] An HCG level of between 1000 and 2000 IU/L, in conjunction with a transvaginal scan that reveals little or nothing within the uterine cavity, is highly suggestive of an ectopic pregnancy.[133]
3. **Laparoscopy** is extremely valuable in the diagnosis of ectopic pregnancy, both in settling the diagnosis in difficult and confusing cases, and confirming the diagnosis before embarking upon treatment. The majority of ectopic pregnancies may now be treated laparoscopically (see below), but in the case of an obviously ruptured ectopic with a patient who is haemodynamically compromised, an immediate laparotomy is likely to be safer other than in exceptionally skilled hands.
4. **Diagnostic curettage:** Although this is not a usual aid to diagnosis nowadays, on occasion, the finding of a well-marked decidual reaction without chorionic tissue is highly suggestive of an ectopic pregnancy. When a pregnancy is terminated, or evacuation of retained products reveals much less tissue than expected, sending a sample for histopathology may lead to this result. Sometimes the Arias-Stella phenomenon is described histologically in which there is marked secretory and proliferative activity, with tall vacuolated cells with hyper-chromatic nuclei and bizarre forms. Although this phenomenon is not seen in all cases of ectopic pregnancy, its finding on an endometrial biopsy or curettage is highly suggestive, but not diagnostic of an ectopic pregnancy.

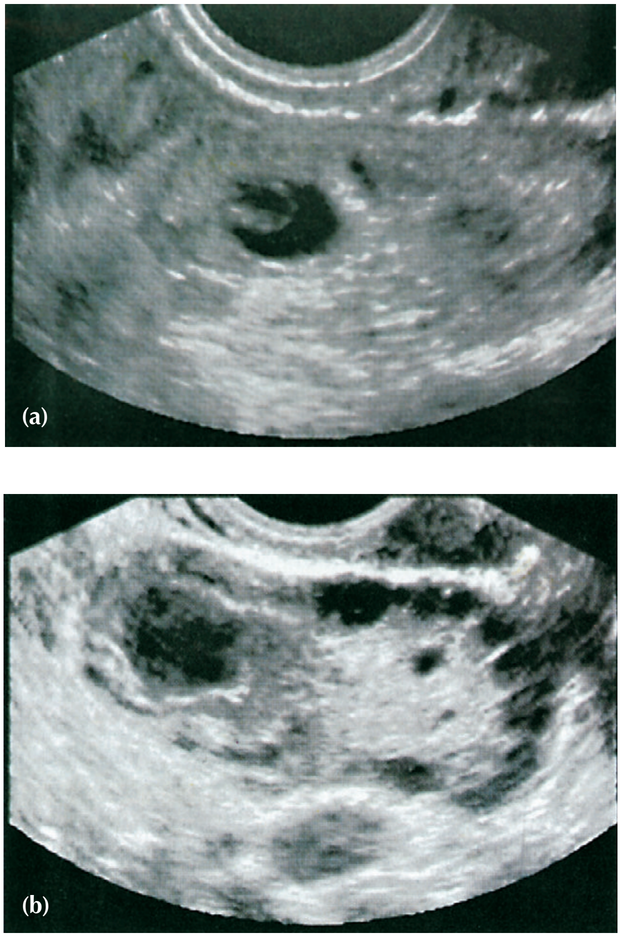


Fig. 12.27: Transvaginal scan showing unruptured ectopic pregnancy. **(a)** Ovarian, **(b)** Tubal (by courtesy of Mr. D. Economides and Mr. G. Michalidis).

Fig. 12.26: Cervical ectopic pregnancy: erosion of the cervical branch of the uterine artery.

5. **Radiography:** Plain X-rays may give some clue to the presence of a secondary abdominal pregnancy but have been largely superceded by ultrasound. Magnetic resonance imaging may be helpful in confirming the diagnosis.[134] Angiography before surgery can identify the 'feeding' artery of the placenta.

TREATMENT OF ECTOPIC PREGNANCY

In the last 20 years, there have been major changes in the management of ectopic pregnancy as a result of earlier diagnosis, the recognition that subsequent intra-uterine pregnancy is possible after conservative surgery for ectopic pregnancy, and the advent of medical treatment and good laparoscopic surgical equipment. In some centres, more than 90% of ectopic pregnancies are now dealt with laparoscopically, and several authors have shown intra-uterine pregnancy rates of over 50% when conservative surgery as opposed to salpingectomy has been carried out.[135]

1. **Surgical treatment of acute ruptured ectopic pregnancy with massive intraperitoneal bleeding**
   The patient should be immediately prepared for an emergency abdominal operation. If acutely ill, the surgeon does the preparation after induction of anaesthesia, the patient being admitted direct to the theatre from the ambulance. Time should never be wasted on time-honoured rituals of admission in a ward.

   Although in such an emergency the operation should never be delayed for the need of a blood transfusion, the careful cross-matching of blood should begin immediately the diagnosis is made. At least two units will be necessary, and often more, depending upon the patient's condition. Until cross-matched blood (or, in dire emergency, Group O Rhesus negative blood) is available, transfusion with plasma substitute, through a large cannula into a large vein, is started. The essential factor in treatment is to stop the intraperitoneal bleeding and remove rapidly the blood and blood clot in the peritoneal cavity. The achievement of these two objectives always results in improvement of the general condition.

   If possible any Trendelenburg tilt should be avoided as fluid blood will become inaccessible in the upper abdomen. No tilt is needed to gain access to the tubes through a midline sub-umbilical or suprapubic transverse incision. Free blood clot is rapidly scooped out with the hand and the offending tube delivered at once. The mesosalpinx is clamped with the fingers until haemostatic forceps can be applied. The operation of salpingectomy should be performed and the usual technique should be followed. Sometimes both Fallopian tubes seem to be normal, as the ovum has been discharged through the abdominal ostium and, apart from oedema, the affected Fallopian tube may show little damage. In these circumstances, it may be thought advisable to refrain from removing the Fallopian tube. Usually, however, the Fallopian tube, which is responsible for the extra-uterine gestation, shows signs of previous inflammation and, provided that the opposite Fallopian tube looks normal, it should be removed. It sometimes happens that the opposite Fallopian tube, i.e. the one in which the extra-uterine pregnancy has not occurred, is distended as a haematosalpinx, which inevitably attracts the attention of the surgeon. The side on which the corpus luteum is situated will usually indicate which is the side of the extra-uterine gestation and which tube is to be removed. This sign is not, however, infallible as transperitoneal migration of the ovum is well recognised so that a left tubal pregnancy may occur with a right-sided corpus luteum and vice versa. The surgeon should, therefore, exercise restraint and caution before finally clamping and removing the tube. A careful inspection of both sides will usually indicate the correct procedure.

   It occasionally happens that a haemorrhage from a ruptured Graafian follicle or a corpus luteum causes sufficient intraperitoneal bleeding to give the symptoms and signs of an extra-uterine gestation, as a result of which a laparoscopy or laparotomy is performed. In such an event the surgeon should first clear the pelvis of all blood and clot, after which he can inspect the appendages. Both tubes will be quite normal and the site of the bleeding point will be clearly demonstrated as originating from a follicular or corpus luteum haemorrhage. Only the most inexperienced will be tempted to perform any resection in such circumstances. All that is needed is one or two suture ligatures in the affected ovary. A small curved atraumatic needle carrying 4/0 polyglactin is the best. Salpingo-oophorectomy is almost never indicated, though it is unfortunately too often performed in the hands of the less-experienced pelvic surgeon.

   All blood clot should be removed from the pouch of Douglas and blood aspirated with a sucker. The method of scooping out blood, passing it through a muslin filter and returning it intravenously into the patient is time honoured and well worthwhile when adequate supplies of compatible blood are not available. Provided that the patient's condition allows, great care should be taken to remove all the blood that has gravitated into the upper abdomen. It is useful to tilt the patient, feet down, for a short time while all the blood returning down the paracolic gutters can be swabbed out. Failure to remove all blood may result in a prolonged period of paralytic ileus and, possibly, even intestinal obstruction. The abdomen is then closed in the usual way and the patient treated for shock and anaemia continued. It is important that a careful watch be kept on urine output in case acute renal failure has been precipitated. A central venous pressure line is invaluable in the control of fluid replacement, particularly if the patient may have been anaemic.

   When pregnancy occurs in an accessory cornu it will usually rupture during the 4th month. In these cases the intra-abdominal haemorrhage is of great severity, and frequently a 4-month fetus is found lying free in the abdominal cavity. It is necessary to excise the affected cornu. The position of the round ligament, with its attachment on the lateral side of the accessory cornu, identifies the nature of the pregnancy. The patients respond extremely well and although the internal haemorrhage is usually of great severity the prognosis is good. In an isthmic pregnancy the round ligament lies on the inner side of the gestation sac.

In interstitial pregnancy patients suffer from severe abdominal pain unassociated with the symptoms and signs of severe intraperitoneal bleeding. The tender swelling in the region of the cornu may establish the diagnosis. It is necessary to excise the cornual part of the uterus.

In the rare event of ovarian pregnancy, severe haemorrhage will have so disorganised the ovary that its removal is indicated and unilateral salpingo-oophorectomy will be performed.

2. **Surgical treatment of sub-acute or unruptured ectopic pregnancy**

As already stated, the majority of ectopic pregnancies will nowadays come into this category, and most of them can be treated by salpingotomy and removal of the gestational products with conservation of the Fallopian tube. Whether this procedure is performed at laparotomy or laparoscopically will depend upon the skill of the surgeon and the extent of the tubal damage.

For laparoscopic treatment of ectopic pregnancy, the special equipment required is suction irrigation apparatus, a selection of good grasping forceps and needle point unipolar diathermy. Laser equipment is not required, but is used by some surgeons. A back-up abdominal laparotomy set of equipment should always be available.

The patient is prepared for laparoscopy in the usual way and initially a diagnostic laparoscopy is performed. Very careful inspection of both Fallopian tubes is carried out, and the extent of adhesions noted. It is particularly important to record the condition of the contra-lateral tube. If the surgeon finds that the diameter of the distended tube is greater than 5 cm, or the wall is ruptured, or there is a larger than expected haemoperitoneum, a laparoscopic salpingectomy, should be considered, and if necessary a laparotomy carried out. However, in most cases, it will be possible to perform laparoscopic salpingotomy (Fig. 12.28).

Using a needle diathermy, an incision is made over the anti-mesenteric border of the tube at the site of maximal thickening. Some surgeons inject a dilute vasopressin solution along the site of incision, but there have been reports of serious reactions and caution is advised in the use of this substance. The length of the incision will depend upon the size of the ectopic, but an incision of 2 cm will usually be adequate. Removal of the tissue may be difficult and should be commenced with grasping forceps, and separation may be facilitated by using the irrigation apparatus for hydro-dissection. Residual bleeding should be controlled with very careful use of electrocoagulation. Once the surgeon thinks that the trophoblastic tissue has all been removed, it is important to irrigate the pelvis with normal saline or Hartmann's solution and aspirate as much blood and debris as possible. Closure of the salpingotomy is not necessary unless it is required for haemostasis, in which case one or two laparoscopic sutures may need to be inserted. It is important that patients treated conservatively are followed up with serial beta HCG measurements as there is a small incidence of growth of residual trophoblast material leading to secondary intra-abdominal bleeding. Should this situation develop, further surgery may be required or medical treatment with methotrexate (see below).

If tubal rupture is discovered, or the ectopic pregnancy is found to be burrowing into the mesosalpinx, partial or total salpingectomy may be required. Bipolar diathermy to coagulate the vessels in the mesosalpinx may be used prior to excision, or clips or sutures may be utilised. The application of an extra-corporeal 'endo-loop' is a simple way of ligaturing the whole mesosalpinx.

In the following circumstances, a sub-acute ectopic pregnancy may need to be dealt with by laparotomy:

1. Laparoscopic equipment is not available.
2. The surgeon does not have laparoscopic skills.
3. The presence of adhesions prevents adequate visualisation of the pelvic organs.

The abdomen is opened through a Pfannenstiel incision, if the diagnosis has been confirmed by laparoscopy. If there remains diagnostic doubt, a midline incision may be preferred. The intestines are packed away, a self-retaining retractor is introduced and the pelvic organs are exposed. Adhesions are gently broken down, the affected tube mobilised and brought out of the abdominal wound (Fig. 12.29). In this way the nature of the ectopic pregnancy can be established. The opposite tube and ovary are then inspected. If they are normal and the fallo-

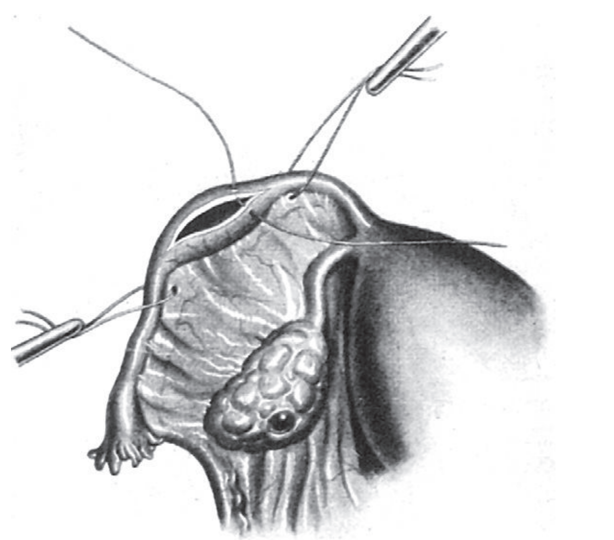


Fig. 12.28: Conservative operation for ectopic pregnancy. The tube has been incised and the conceptus removed. The opening in the tube is being cloned with fine, interrupted high polymer sutures. Laparoscopically the operation is essentially the same, the incision being made with diathermy scissors or needle, without stay sutures shown above, and usually without closure of the tubal incision.

pian tube healthy and patent the affected Fallopian tube should be removed by salpingectomy (Figs 12.30 and 12.31). If the opposite Fallopian tube is irreparably damaged by previous inflammation and if the patient is young and anxious to have children, instead of the affected Fallopian tube being removed a salpingotomy operation may be employed. The procedure consists of incising the tube over the convexity of the tubal pregnancy and shelling out the pregnancy from the Fallopian tube (see Fig. 12.28).[136]

The wound in the tube may be closed by a series of interrupted sutures of fine nylon. Care must be taken to obtain complete haemostasis, but it is rare to see severe bleeding from the wall of the tube and some surgeons do not suture the tubal incision.

Fig 12.29: Operation for ectopic pregnancy. Left haematosalpinx and pelvic haematocoele as illustrated at operation. A large fleshy blood clot is being mobilised from the pouch of Douglas where it is fixed by light adhesions, which can be easily broken down with the fingers.

Fig. 12.30: Operation for ectopic pregnancy in a case of large haematosalpinx. The distended Fallopian tube is being drawn up out of the pelvis.

The operation is extremely simple to perform and leaves the patient with a potentially patent tube. It must always be fully realised that such conservation exposes the patient to the risk of another extra-uterine pregnancy since the original pathological condition of the tube is unlikely to resolve. Following an ectopic pregnancy, over 50% of women conceive and the incidence of a second ectopic is reported to be between 8% and 22%.[135]

Sometimes the rupture of an ectopic pregnancy leads to the development of a broad ligament haematoma, and this event may cause much alarm and great difficulty to inexperienced surgeons. The first step is to remove the Fallopian tube, to ligature all pedicles and to obtain haemostasis. The next step is to evacuate the blood from the broad ligament by opening up the peritoneum. The severity of the haematoma varies greatly and it may spread upwards to the region of the iliac fossa. Certain principles must be kept in mind. In the first place, the vessels that have been responsible for the formation of the haematoma may have been either the tubal branch of the ovarian artery or the tubal branch of the uterine artery. It is therefore essential to ligate both these vessels before an effort is made to turn out the haematoma from the broad ligament.

Provided these vessels have been ligated and reasonable care is taken to evacuate the blood clot, further severe bleeding is unlikely to occur. It may be necessary to open the broad ligament widely by cutting through the peritoneum; this should be done at right angles to the direction of the mesosalpinx, but on the posterior ovarian side great care must be taken to avoid injury to the ovarian vessels. It is preferable to ligate the infundibulopelvic fold far out near the pelvic wall than to remove the ovary. If reasonable care is taken the evacuation of the haematoma presents little technical difficulty, but it is quite impossible to remove all traces of blood clot, and old adherent blood clot should not be removed because of the risk of opening up pelvic vessels. If oozing persists the raw area should be drained by a soft polythene suction drain brought out through a separate stab incision in the flank. Fortunately packing is hardly ever required if the surgeon is prepared to accept the fact that old adherent blood clot will become absorbed. If drainage or pack-

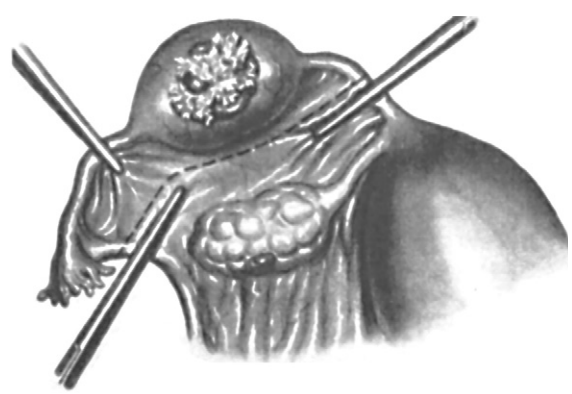


Fig. 12.31: Operation for ectopic pregnancy. Removal of the Fallopian tube for ectopic gestation. Further clamps are placed across the broad ligament so that no part escapes ligation.

ing is employed the risk of infection is greater so that the patient must be treated postoperatively with antibiotics.

Medical Treatment of Ectopic Pregnancy

In recent years, several medical methods of treating ectopic pregnancy have been tried, with varying success. These include systemic administration of drugs, such as methotrexate, RU486 (mifepristone) and prostaglandins. Local injection with drugs either via the laparoscope or ultrasound directed has also been tried using potassium chloride, methotrexate and prostaglandins. Only systemic methotrexate has been assessed in detail and there are now favourable reports of its use in early small ectopic gestations. Methotrexate treatment is only suitable when the size of the unruptured tube does not exceed 3 cm in diameter, beta HCG does not exceed 2000 IU and there is a haemoperitoneum of no more than 50 mL. Intramuscular methotrexate is given in a dosage of 50 mg/m^2. It is probably not necessary to administer folinic acid when only a single dose is being given, but the beta HCG level must be monitored twice weekly until the level has dropped to less than 10 IU/mL. Failure of the level to fall, or a small rise, prompts the administration of a further dose of methotrexate. Several large series have now been published, indicating 90–95% success with this form of treatment. The subsequent pregnancy rate and risk of recurrent ectopic gestation do not appear to differ from patients treated with laparoscopic surgery. There may, however, be side effects from methotrexate which some patients may not wish to risk, but serious effects from a single dose are unlikely.

EXPECTANT MANAGEMENT OF ECTOPIC PREGNANCY

In some cases of very small ectopic gestation with beta HCG levels that are static or almost so, it may be reasonable to manage the case expectantly. This management may be particularly appropriate in women who acquire an ectopic pregnancy as a result of assisted conception, where close observation by serial beta HCG and ultrasound scan may be achieved. There may, however, be a need for operative treatment in as many as 25% of patients managed in this way and Fernandez et al.[137] report that tubal occlusion occurs in 30% of patients so managed.

SECONDARY ABDOMINAL PREGNANCY

The classical history of pain and bleeding in early pregnancy will suggest the diagnosis of an extra-uterine gestation though this is usually missed and a threatened abortion misdiagnosed. Subsequent months of pregnancy are uncomfortable and a vague abdominal pain may persist. Pain, however, is not invariable. Theoretically, the signs are those of an easily palpable fetus together with a separate pelvic tumour—the uterus. Surprisingly, the lie and presentation of the fetus are usually normal.[138] External version, if attempted, is unsuccessful. The abdomen is tense, often extremely so. If a bimanual examination is made, the presenting part may be felt separate from the lower uterine segment which is withdrawn upwards. The cervix is difficult to reach or displaced. If the observer sits with the patient and can observe Braxton Hicks contractions of the wall of the gestation sac, then the pregnancy must be within the uterus. The converse of this does not hold.

Rarely, it is possible to recognise the condition of secondary abdominal pregnancy and to rescue the fetus by laparotomy provided that the pregnancy advances to a maturity to warrant this. At such an operation the placenta may be left undisturbed if its removal incurs the risk of severe bleeding. It can be expected to be largely absorbed though it may be many months before this finally occurs. If it is left in situ convalescence can be expected to be stormy with high fever and there is the additional danger of disseminated intravascular coagulation. More commonly, however, the final diagnosis is definitely made when the fetus dies and a spurious labour results. A vaginal examination at this time will establish the diagnosis. Once the diagnosis of secondary intra-abdominal extra-uterine pregnancy has been made, no matter what the stage of gestation, laparotomy should be performed (Fig. 12.32). The chances of fetal malformation and a 50% neonatal mortality rarely justify the risk of expectant treatment where the ever-present menace of a sudden maternal haemorrhage may endanger the mother's life.

If the fetus has died, the placenta is already degenerate and may be stripped from the placental site without much risk of opening up large vessels or of damaging the wall of the intestine. In such cases the procedure is to incise the gestation sac and to remove the fetus, and then, with the greatest possible care to remove the placenta. If large vessels are opened up or if there is any possibility of damaging the wall of the bowel it is far better to leave the placenta behind and to allow it to degenerate and become spontaneously absorbed. As a general rule the amnion can be stripped away quite easily from the surrounding adhesions and there is no necessity to try and remove the extra-

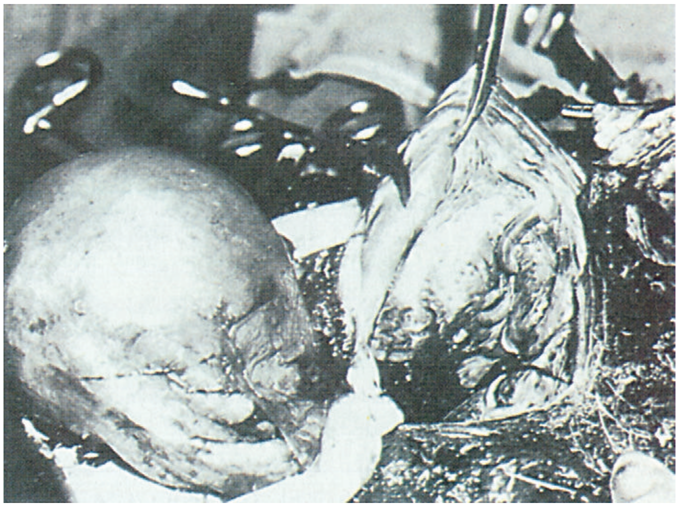


Fig. 12.32: Secondary abdominal pregnancy. After delivery of the fetus the placenta is still in position. Notice the uterine enlargement that occurs as a result of hormonal stimulation even through the uterus is empty (by courtesy of the late Mr. Donald Fraser).

placental chorion. The old method of marsupialisation is no longer practised.

If, on the other hand, the placenta is alive after the removal of the fetus, judgement is required to decide upon the treatment of the placenta. The placenta usually lies low down, attached partly to the wall of the Fallopian tube, partly to the extra-peritoneal tissues of the broad ligament and partly to adhesions that have formed inside the peritoneal cavity in the pelvis. For the nutrition of the ovum large maternal vessels must pass to the choriodecidual space. If the placenta is separated these vessels must be clamped and ligated with the great risk of damage to the sigmoid colon and even to the small intestine. Venous spaces may be so large that they cannot be properly controlled by ligature and appalling haemorrhage may be encountered, which can only be controlled by intra-abdominal pack. If no attempt is made to remove the placenta it may not be necessary to attempt to strip away the amnion, so that the whole of the amniotic sac with the placenta and with a short piece of cord attached to the placenta can all be left behind. Although the procedure is not regarded as being surgically sound on theoretical grounds, the results obtained are better and safer than any other method. The absorption of the placenta, however, may take many months and troublesome cysts may form. Lawson,[139] with experience of over 30 cases, never found it necessary to leave a placenta behind, although hysterectomy has sometimes been required.

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SECTION C

Urogynaecology and the Pelvic Floor

SECTION OUTLINE

Stress Urinary Incontinence

13

Dudley Robinson

Introduction

The term urinary stress incontinence (USI) may be used to describe the symptom or sign of urinary leakage on coughing or exertion but should not be regarded as a diagnosis. A diagnosis of USI may only be made after urodynamic investigation, and this is defined as the involuntary leakage of urine during increased abdominal pressure in the absence of a detrusor contraction.[1]

Epidemiology

Stress incontinence is the most commonly reported type of urinary incontinence in women. A large epidemiological study has recently been reported in 27,936 women from Norway.[2] Overall 25% of women reported urinary incontinence, of which 7% felt it to be significant, and the prevalence of incontinence was found to increase with age. When considering the type of incontinence, 50% of women complained of stress, 11% urge and 36% mixed incontinence.

Further analysis has also investigated the effect of age and parity. The prevalence of urinary incontinence among nulliparous women ranged from 8% to 32% and increased with age. In general, parity was associated with incontinence and the first delivery was the most significant. When considering stress incontinence in the age group of 20–34 years, the relative risk was 2.7 (95% CI: 2.0–3.5) for primiparous women and 4.0 (95% CI: 2.5–6.4) for multiparous women. There was a similar association for mixed incontinence although not for urge incontinence.[3]

Pathophysiology

There are various different underlying causes that result in weakness of one or more of the components of the urethral sphincter mechanism (Table 13.1). The bladder neck and proximal urethra are normally situated in an intra-abdominal position above the pelvic floor and are supported by the pubourethral ligaments. Damage to either the pelvic floor musculature (levator ani) or pubourethral ligaments may result in descent of the proximal urethra such that it is no longer an intra-abdominal organ, and this results in leakage of urine per urethram during stress.

Table 13.1: Causes of urodynamic stress incontinence

Urethral hypermobility
Urogenital prolapse
Pelvic floor damage or denervation
Parturition
Pelvic surgery
Menopause
Urethral scarring
Vaginal (urethral) surgery
Incontinence surgery
Urethral dilatation or urethrotomy
Recurrent urinary tract infections
Radiotherapy
Raised intra-abdominal pressure
Pregnancy
Chronic cough (bronchitis)
Abdominal/pelvic mass
Faecal impaction
Ascites
(Obesity)

More recently the ‘mid-urethral theory’ or ‘integral theory’ has been described by Petros and Ulmsten.[4] This concept is based on earlier studies suggesting that the distal and mid-urethra play an important role in the continence mechanism[5] and that the maximal urethral closure pressure is at the mid-urethral point.[6] This theory proposes that damage to the pubourethral ligaments supporting the urethra, impaired support of the anterior vaginal wall to the mid-urethra and weakened function of part of the pubococcygeal muscles that insert adjacent to the urethra are responsible for causing stress incontinence.

Investigation of Lower Urinary Tract Dysfunction

When assessing a woman presenting with lower urinary tract symptoms it is imperative to take an accurate history in addition to performing a detailed clinical examination. However, it is now widely accepted that there is a poor correlation between symptoms and diagnosis.[7,8] If therapeutic decisions are based on symptoms alone then more than 25% of patients may be treated with inappropriate and potentially harmful therapy.

BASIC INVESTIGATIONS

Mid-Stream Urine (MSU) Sample

Urinary tract infection (UTI) may cause or exacerbate lower urinary tract symptoms. The results of urodynamic investigations will also be invalidated if tests are performed when the patient has a UTI.

Frequency–Volume Charts

While a clinical interview may provide information on the voiding habits of a patient the impression of symptom severity obtained is largely subjective and to some extent retrospective. The frequency volume chart (urinary or bladder diary) provides an objective assessment of a patient's fluid intake and urine output.

Pad Test

A simple way of verifying urinary leakage and the quantity of urine lost is to compare the difference in weight of a perineal pad before and after use. This is usually done with a standardised volume of fluid in the bladder over a predetermined time period or as a home test over 24–48 hours. However, it is important to remember that this simply documents the degree of urinary leakage and gives no indication to the aetiology.

URODYNAMIC INVESTIGATIONS

Uroflowmetry

Uroflowmetry is the simple and non-invasive measurement of urine flow. To obtain a representative record of flow parameters the woman is asked to void in private when her bladder is comfortably full. Several types of flowmeter can be used but the commonest are those with either a strain gauge weighing transducer placed under a receptacle into which the woman voids or devices with a disc that rotates at a speed dependent upon the flow of urine.[9] The maximum flow rate and volume voided are recorded (Fig. 13.1) and an estimation of the post-micturition residual determined either by catheterisation or ultrasound.

Cystometry

The aim of cystometry is to reproduce the patient's symptoms and hence provide an objective diagnosis. The cystometrogram (CMG) is used to measure bladder sensation, capacity, compliance, contractility and also urethral function.

Pressure measurements are made by external transducers connected to the patient by either fluid filled or solid-state catheters. Pressure lines are used to measure both abdominal

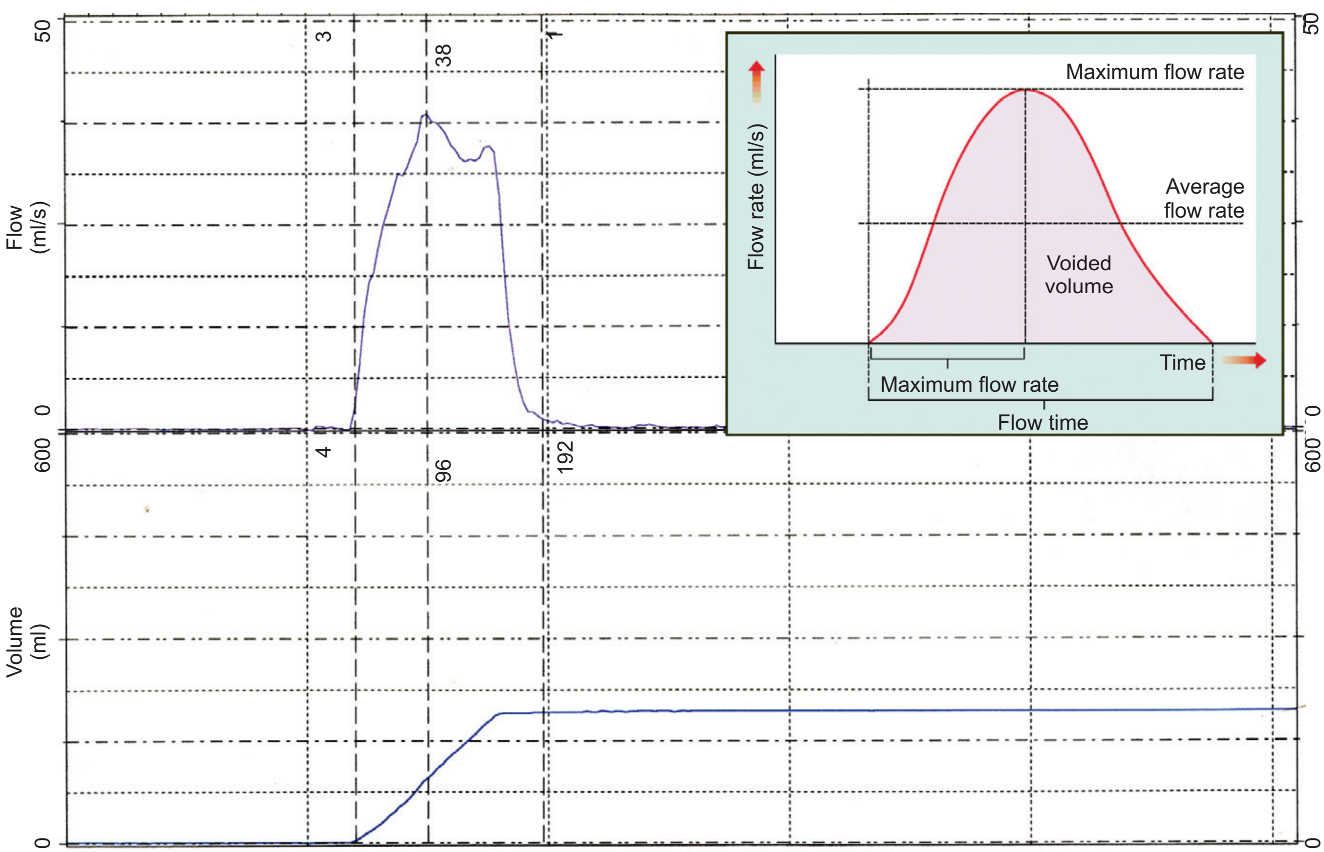

Fig. 13.1: Uroflowmetry.

(p_{abd}) (rectal or vaginal) and intravesical pressure (p_{ves}). In order to measure the subtracted detrusor pressure created by active and passive forces in the bladder wall the former is subtracted from the latter ($P_{det} = p_{ves} - p_{abd}$).

An urethral filling catheter is also inserted and the bladder is filled with either normal saline or contrast medium in those patients who are to undergo X-ray screening. This technique is called videocystourethrography (VCU). Filling rate is generally fast (>100 mL/min) or medium (50–100 mL/min). *First sensation* (150–200 mL) and *maximum cystometric capacity* (400–600 mL) are noted during the filling phase and the bladder is generally filled to a maximum of 500 mL. During the filling phase, the bladder pressure is constantly recorded. In the normal physiological state, the bladder is a low-pressure *compliant* storage organ. *Low compliance* is the term used to indicate a gradual steep rise in pressure during bladder filling and is generally regarded as being ≥15 cm H_2O at a capacity of 500 mL. Detrusor overactivity is characterised by involuntary bladder contractions that occur during the filling phase (Fig. 13.2). These may be spontaneous or provoked and cannot be suppressed. Provocation may include rapid filling, tap running, hand washing and coughing.

At the end of filling the urethral catheter is removed and the patient stands up. A series of coughs are then performed testing for urodynamic stress incontinence. In those women having VCU, simultaneous X-ray screening is performed to assess the anatomy of the bladder neck and also to screen for leakage.

Voiding Cystometry

The final stage of urodynamics is to ask the women to void on the flowmeter with both the abdominal and vesical pressure lines in situ, thus producing a pressure flow study. Women normally void with a detrusor pressure of <60 cm H_2O and a peak flow rate of >15 mL/s for a voided volume of at least 150 mL.[10] A low flow rate in conjunction with a relatively high voiding pressure and urinary residual may be indicative of voiding difficulties. In addition, in some women with long-term voiding difficulties the detrusor muscle may decompensate and lead to a picture of low pressure and low flow.

Urethral Pressure Profilometry

Urethral pressure profilometry (UPP) is a graphical recording of pressure within the urethra at successive points along its length. A catheter mounted solid-state pressure transducer with the two transducers 6 cm apart is passed into the bladder. As the catheter is withdrawn, the pressure differential between the two transducers is recorded giving the *maximum urethral closure pressure* (MUCP) and *functional urethral length* (FUL) (Fig. 13.3). Whilst not diagnostic of urodynamic stress incontinence a very low maximum urethral closure pressure has been shown to be associated with a poor outcome following continence surgery.[11] It may also be useful in those women with voiding difficulties in order to exclude a urethral stricture.

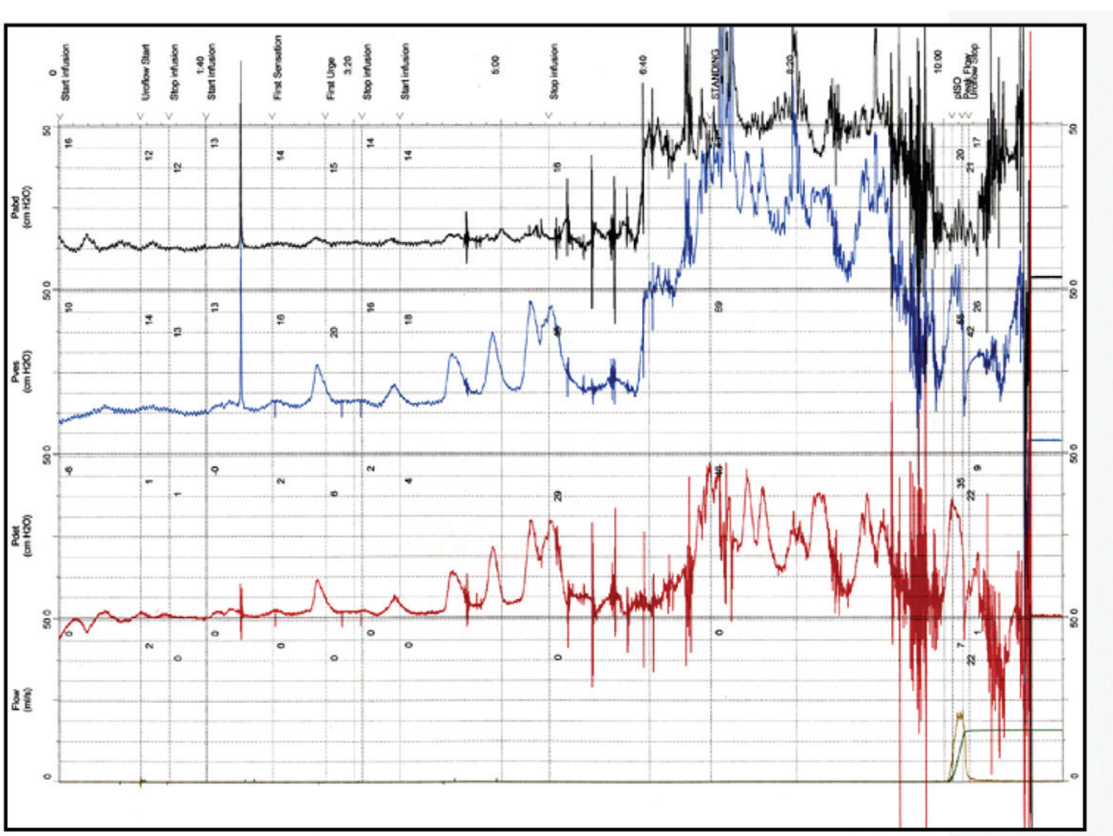

Fig. 13.2: Cystometrogram showing severe systolic and provoked detrusor contractions during filling.

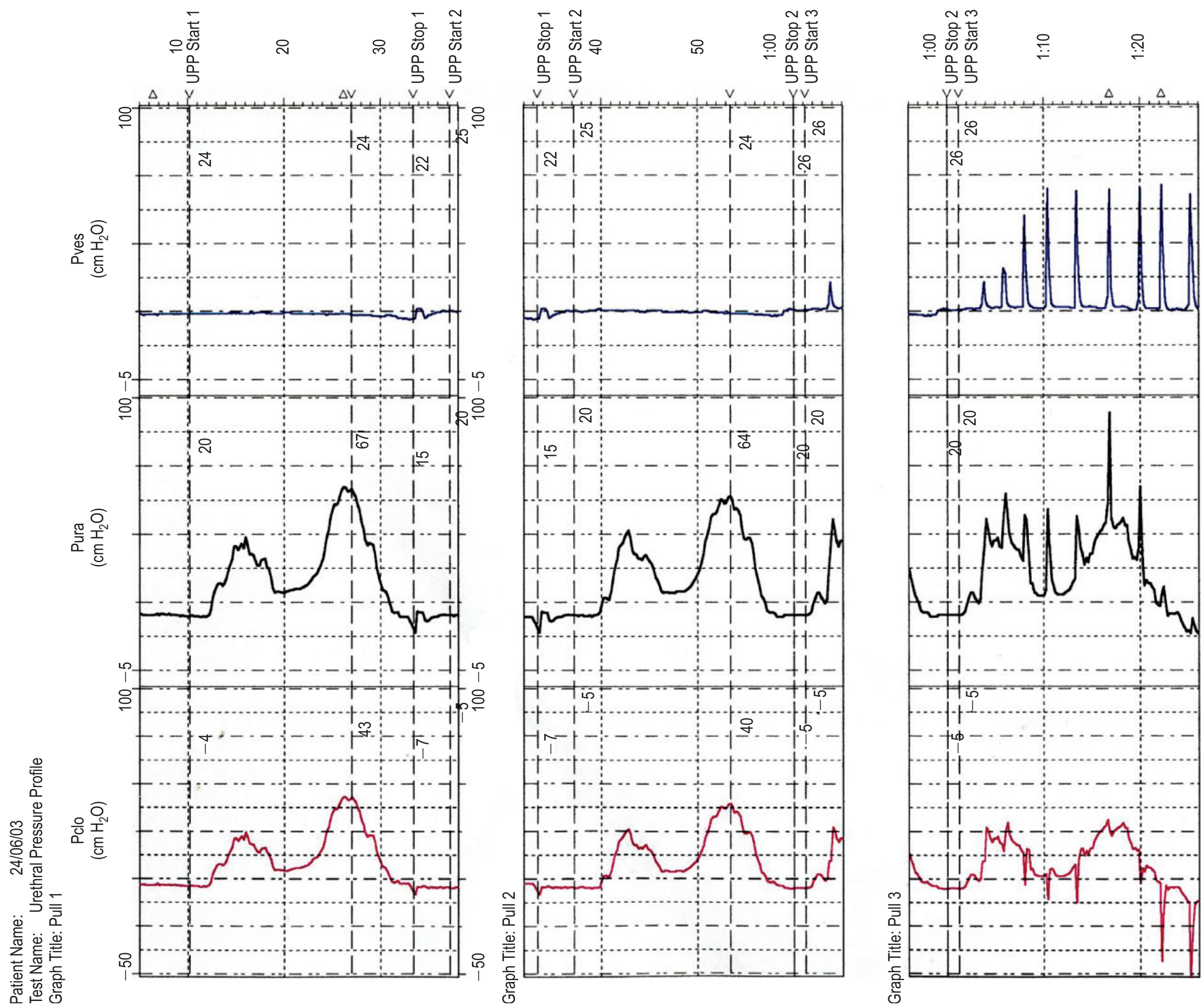

Fig. 13.3: Urethral pressure profilometry in a patient with a urethral diverticulum.

Conservative Therapy for Stress Urinary Incontinence

Whilst some women will ultimately require surgery for stress urinary incontinence, many will benefit initially from a conservative approach using a combination of pelvic floor muscle training with, or without, concomitant medical therapy.

PELVIC FLOOR MUSCLE TRAINING

Pelvic floor muscle training (PFMT) and pelvic floor physiotherapy remain the first-line conservative measure since their introduction in 1948.[12] PFMT appears to work in a number of different ways:

- Women learn to consciously pre-contract the pelvic floor muscles before and during increases in abdominal pressure to prevent leakage ('the knack').
- Strength training builds up long-lasting muscle volume and thus provides structural support.
- Abdominal muscle training indirectly strengthens the pelvic floor muscles.[13]

In addition during a contraction the urethra may also be pressed against the posterior aspect of the symphysis pubis producing a mechanical rise in urethral pressure.[14] Since up to 30% of women with stress incontinence are unable to contract their pelvic floor correctly at presentation,[15] some patients may simply need to be re-taught the 'knack' of squeezing the appropriate muscles at the correct time.[16] Cure rates varying between 21% and 84% have been reported.[17,18] Success appears to depend upon the type and severity of incontinence treated, the instruction and follow-up given, the compliance of the patient and the outcome measures used. However, the evidence would suggest that PFMT is more effective if patients are given a structured programme to follow rather than simple verbal instructions.[19]

The success of PFMT may be further enhanced by the use of biofeedback.[20] This technique allows patients to receive visual or audio feedback relating to contraction of their pelvic floor. The most commonly used device in clinical practice is the perineometer, which may give women an improved idea of a pelvic floor contraction and provide an effective stimulus to encourage greater and continued effort.

MEDICAL THERAPY

Whilst various agents such as α1-adrenoceptor agonists, oestrogens and tricyclic anti-depressants have all been used anecdotally in the past for the treatment of stress incontinence, duloxetine is the first drug to be specifically developed and licensed for this indication.

Duloxetine is a potent and balanced serotonin (5-hydroxytryptamine) and noradrenaline re-uptake inhibitor (SNRI), which enhances urethral-striated sphincter activity via a centrally mediated pathway.[21] The efficacy and safety of duloxetine (20 mg, 40 mg, 80 mg) has been evaluated in a double-blind randomised parallel group placebo-controlled phase II dose finding study in 48 centres in the United States involving 553 women with stress incontinence.[22] Duloxetine was associated with significant and dose-dependent decreases in incontinence episode frequency. Reductions were 41% for placebo and 54%, 59% and 64% for the 20, 40 and 80 mg groups, respectively. Discontinuation rates were also dose dependent—5% for placebo and 9%, 12% and 15% of 20 mg, 40 mg and 80 mg, respectively; the most frequently reported adverse event being nausea.

A further global phase III study of 458 women has also been reported.[23] There was a significant decrease in incontinence episode frequency and improvement in quality of life in those women taking duloxetine 40 mg once daily when compared to placebo. Once again nausea was the most frequently reported adverse event occurring in 25.1% of women receiving duloxetine compared to a rate of 3.9% in those taking placebo. However, 60% of nausea resolved by 7 days and 86% by 1 month. These findings are supported by a further double-blind, placebo-controlled study of 109 women awaiting surgery for stress incontinence.[24] Overall there was a significant improvement in incontinence episode frequency and quality of life in those women taking duloxetine when compared to placebo. Furthermore, 20% of women who were awaiting continence surgery changed their mind whilst taking duloxetine. More recently, the role of synergistic therapy with pelvic floor muscle training and duloxetine has been examined in a prospective study of 201 women with stress incontinence. Women were randomised to one of four treatment combinations; duloxetine 40 mg b.d., PFMT, combination therapy or placebo. Overall duloxetine, with or without PFMT was found to be superior to placebo or PFMT alone whilst pad test results and quality of life analysis favoured combination therapy to single treatment.[25]

Surgery for Stress Urinary Incontinence

ANTERIOR COLPORRHAPHY

Anterior colporrhaphy is now rarely performed for the treatment of stress urinary incontinence and due to relatively low short-term success rates can no longer be recommended. Although it is usually the best operation for a cystourethrocoele, the cure rates for urodynamic stress incontinence are poor compared to suprapubic[26] and mid-urethral tape procedures.

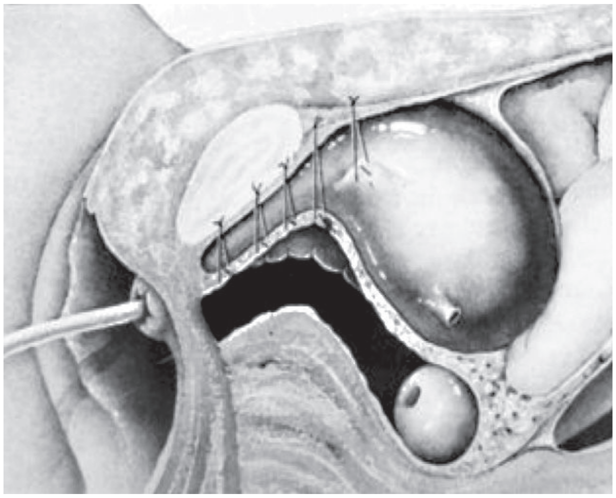

Fig. 13.4: Marshall–Marchetti–Krantz procedure.

MARSHALL–MARCHETTI–KRANTZ PROCEDURE

The Marshall–Marchetti–Krantz[27] procedure is a suprapubic operation in which the para-urethral tissue at the level of the bladder neck is sutured to the periostium and/or perichondrium of the posterior aspect of the pubic symphysis (Fig. 13.4). This procedure elevates the bladder neck but will not correct any concomitant cystocoele. It has been largely superceded by the Burch colposuspension because its complications include osteitis pubis in 2–7% of cases.

BLADDER NECK SUSPENSION PROCEDURES

Endoscopically guided bladder neck suspensions[28–30] are simple to perform but are less effective than open suprapubic procedures and are now seldom used. In all these operations a long needle is used to insert a loop of nylon on each side of the bladder neck; this is tied over the rectus sheath to elevate the urethrovesical junction (Fig. 13.5). Cystoscopy is employed to ensure accurate placement of the sutures and to detect any damage to the bladder caused by the needle or the suture. In the Stamey procedure, buffers are used to avoid the sutures cutting through the tissues and in the Raz procedure, a helical suture of Prolene is inserted deep into the endopelvic fascia lateral to the bladder neck to avoid cutting through. The main problem with all these operations is that they rely on two sutures and these may break or pull through the tissues. However, endoscopically guided bladder neck suspensions are quick and easy to perform. They can be carried out under regional blockade and postoperative recovery is fast. Temporary voiding difficulties are common after long needle suspensions but these usually resolve and there are few other complications.

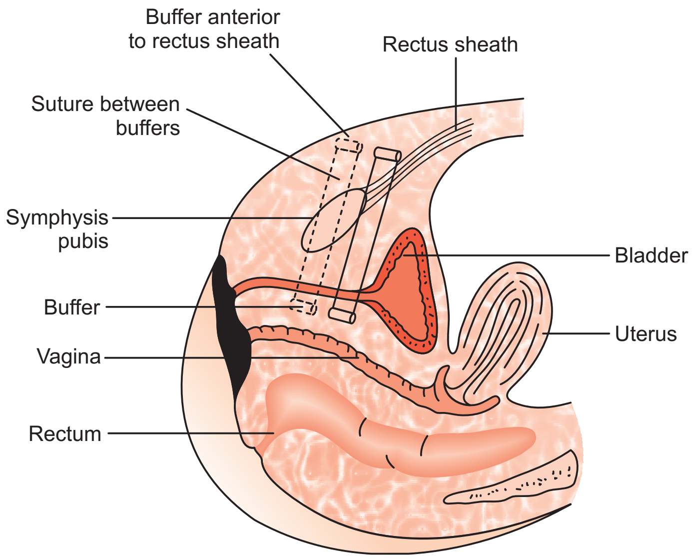

Fig. 13.5: Retropubic needle suspension.

COLPOSUSPENSION

The Burch colposuspension has been modified by many authors, since its original description.[31] Until relatively recently colposuspension has been the operation of choice in primary urodynamic stress incontinence as it corrects both stress incontinence and a cystocoele. However, it may not be suitable if the vagina is scarred or narrowed by previous surgery.

Whilst the colposuspension is now well recognised as an effective procedure for stress incontinence, it is not without complications. Detrusor overactivity may occur de novo or may be unmasked by the procedure,[32] which may lead to long-term urinary symptoms. Voiding difficulties are common postoperatively; although these usually resolve within a short time after the operation, long-term voiding dysfunction may result. In addition, a rectoenterocoele may be exacerbated by repositioning the vagina.[33] However, the colposuspension is the only incontinence operation for which long-term data are available. Alcalay et al.[34] have reported a series of 109 women with an overall cure rate of 69% at a mean of 13.8 years.

Technique

The patient is positioned on the operating table in the modified lithotomy position using Lloyd-Davies stirrups. The abdomen and vagina are then prepared as a sterile operating field in order to allow manipulation of the vaginal fornices and bladder neck by the surgeon. An indwelling Foley catheter is then inserted and the balloon inflated with 6 mL of water to allow identification of the bladder neck.

A low transverse suprapubic incision approximately 1 cm above the pubic symphysis is made and the rectus fascia incised taking care not to open the peritoneal cavity unless a concomitant intra-abdominal procedure is being performed. A Turner–Warwick self-retaining retractor may then be inserted and the retropubic space (Cave of Retzius) is opened using both sharp and blunt dissection until the white para-vaginal tissue lateral to the bladder neck and urethra is identified. Vaginal manipulation is also used to further assist in the elevation of the lateral vaginal fornices whilst the bladder is swept medially (Fig. 13.6a). Two to four delayed absorbable sutures are inserted into the para-vaginal fascia on each side and each tied down onto the vaginal tissue ensuring haemostasis. The first suture is at the level of the bladder neck and 1 cm lateral. The suture is then passed vertically through the ipsilateral iliopectineal ligament, taking care not to pull the bladder neck open and left untied. Each subsequent suture is then placed 1 cm lateral and 1 cm cephalad and all left untied before the sutures are placed on the opposite side (Fig. 13.6b). Once all the sutures are positioned correctly, each lateral fornix is elevated by an assistant allowing the sutures to be tied easily without tension. After checking for adequate haemostasis, the retropubic space is drained with a redivac suction drain and the abdomen closed. The bladder is left on free drainage

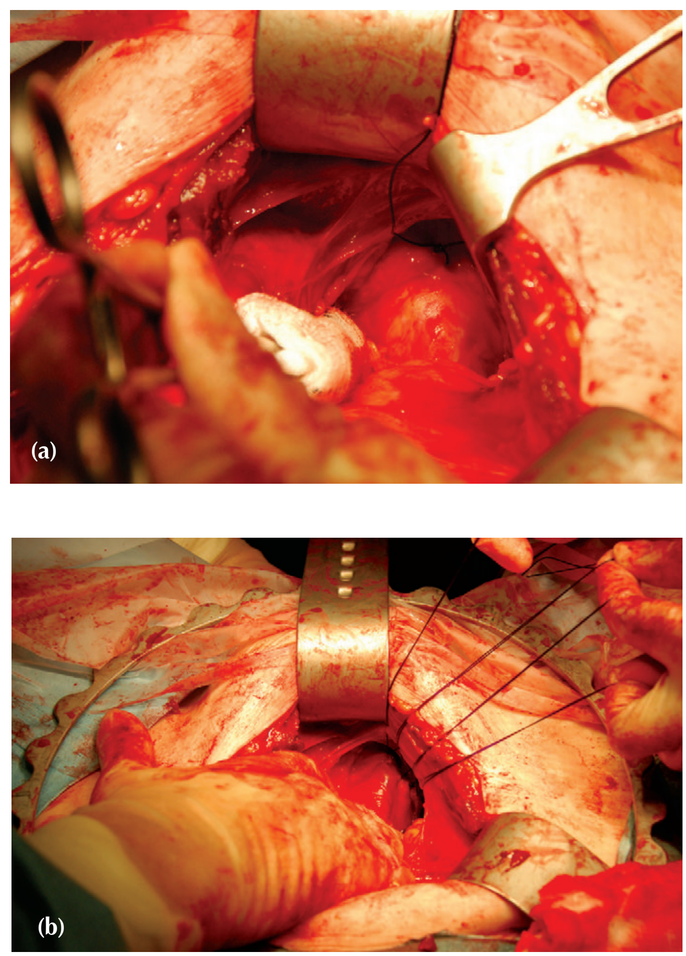

Fig. 13.6a,b: Colposuspension.

using a suprapubic catheter for 48 hours prior to starting a clamping regimen. When the urinary residuals are less than 100 mL, the suprapubic catheter may be removed.

LAPAROSCOPIC COLPOSUSPENSION

Minimally invasive surgery is attractive, and this trend has extended to surgery for stress incontinence and the development of laparoscopic colposuspension. Although many authors have reported excellent short-term subjective results from laparoscopic colposuspension,[35] early studies have shown inferior results to the open procedure.[36,37]

More recently, two large prospective randomised controlled trials have been reported from Australia and the United Kingdom comparing laparoscopic and open colposuspension. In the Australian study, 200 women with urodynamic stress incontinence were randomised to either laparoscopic or open colposuspension.[38] Overall, there were no significant differences in objective and subjective measures of cure or in patient satisfaction at 6 months, 24 months or 3–5 years. Whilst the laparoscopic approach took longer (87 vs. 42 min; $p < 0.0001$), it was associated with less blood loss ($p = 0.03$) and a quicker return to normal activities ($p = 0.01$).

These findings are supported by the UK multicentre randomised controlled trial of 291 women with urodynamic stress incontinence comparing laparoscopic to open colposuspension.[39] At 24 months intention to treat analysis showed no significant difference in cure rates between the procedures. Objective cure rates for open and laparoscopic colposuspension were 70.1% and 79.7%, respectively, whilst subjective cure rates were 54.6% and 54.9%, respectively.

These studies have confirmed that the clinical effectiveness of the two operations is comparable although the cost effectiveness of laparoscopic colposuspension remains unproven. A cost analysis comparing laparoscopic to open colposuspension was also performed alongside the UK study.[40] Healthcare resources use over the first 6-month follow-up period translated into costs of £1805 for the laparoscopic group versus £1433 for the open group.

PUBOVAGINAL SLING

Sling procedures are often performed as secondary operations where there is scarring and narrowing of the vagina. The sling material can either be organic (rectus fascia, porcine dermis) or inorganic (Prolene, Mersilene, Marlex, or Silastic). The sling may be inserted either abdominally, vaginally or by a combination of both. Normally the sling is used to elevate and support the bladder neck and proximal urethra, but not intentionally to obstruct it.

Sling procedures may be associated with a high incidence of side effects and complications. It is often difficult to decide how tight to make the sling. If it is too loose, incontinence will persist and if it is too tight, voiding difficulties may be permanent. Women who are going to undergo insertion of a sling must be prepared to perform clean intermittent self-catheterisation postoperatively. In addition, there is a risk of infection, especially if inorganic material is used. The sling may erode into the urethra, bladder or vagina, in which case it must be removed and this can be exceedingly difficult.

Technique

13

The procedure is performed in the dorsal lithotomy position and utilises an abdominal and vaginal approach. A transverse suprapubic incision is first made just above the pubic symphysis and the rectus fascia identified. Two parallel horizontal incisions 2 cm apart are then made in the fascia and a 16 cm sling of rectus fascia is mobilised. Each end of the strip of fascia is then secured with a non-absorbable suture and the ends left long.

Following insertion of an indwelling Foley catheter, a curvilinear vaginal incision is made in the anterior vaginal wall just below the level of the bladder neck. Next, a tunnel is created superficial to the pubocervical fascia using a combination of both sharp and blunt dissection in a plane towards the patient's ipsilateral shoulder until the endopelvic fascia is perforated. A long curved clamp may then be carefully passed downwards from the abdominal incision using the vaginal finger as a guide and also to protect the bladder and urethra. The long sutures attached to the end of the harvested fascial sling may then be pulled through the abdominal incision on each side allowing placement of the sling under the bladder neck. Two small incisions are then made in the rectus fascia and the suture ends are pulled through prior to tying them over the rectus fascia without tension. The rectus fascia may then be closed using a delayed absorbable suture prior to closing the abdominal and vaginal incisions (Fig. 13.7). At the end of the procedure a suprapubic catheter is left in situ and the bladder left on free drainage for 48 hours before a clamping regimen is instituted.

The advent of the newer mid-urethral tape procedures has largely replaced the use of traditional sling procedures and whilst efficacy rates are comparable complications tend to be fewer with the newer synthetic slings. A prospective, randomised study comparing tension free vaginal tape, a pelvicol sub-urethral sling and a traditional autologous fascial sling has been reported.[41] Overall 201 women were randomised in four centres over 6 years and an interim analysis was performed after 50 patients were completed in each arm. Due to high failure and re-intervention rates, the pelvicol arm was closed after this analysis. At 1-year follow-up cure and improvement rates were no different between the TVT arm and the fascial sling arm (55% vs. 45%) and (93% and 90%), respectively. In the pelvicol arm, cure rates were 22% and improvement 61%. The re-intervention rate was 20% in the pelvicol arm compared to 0% in the other two arms. Consequently, the evidence from this study would suggest that the newer mid-urethral retropubic tapes are as efficacious as a traditional sling.

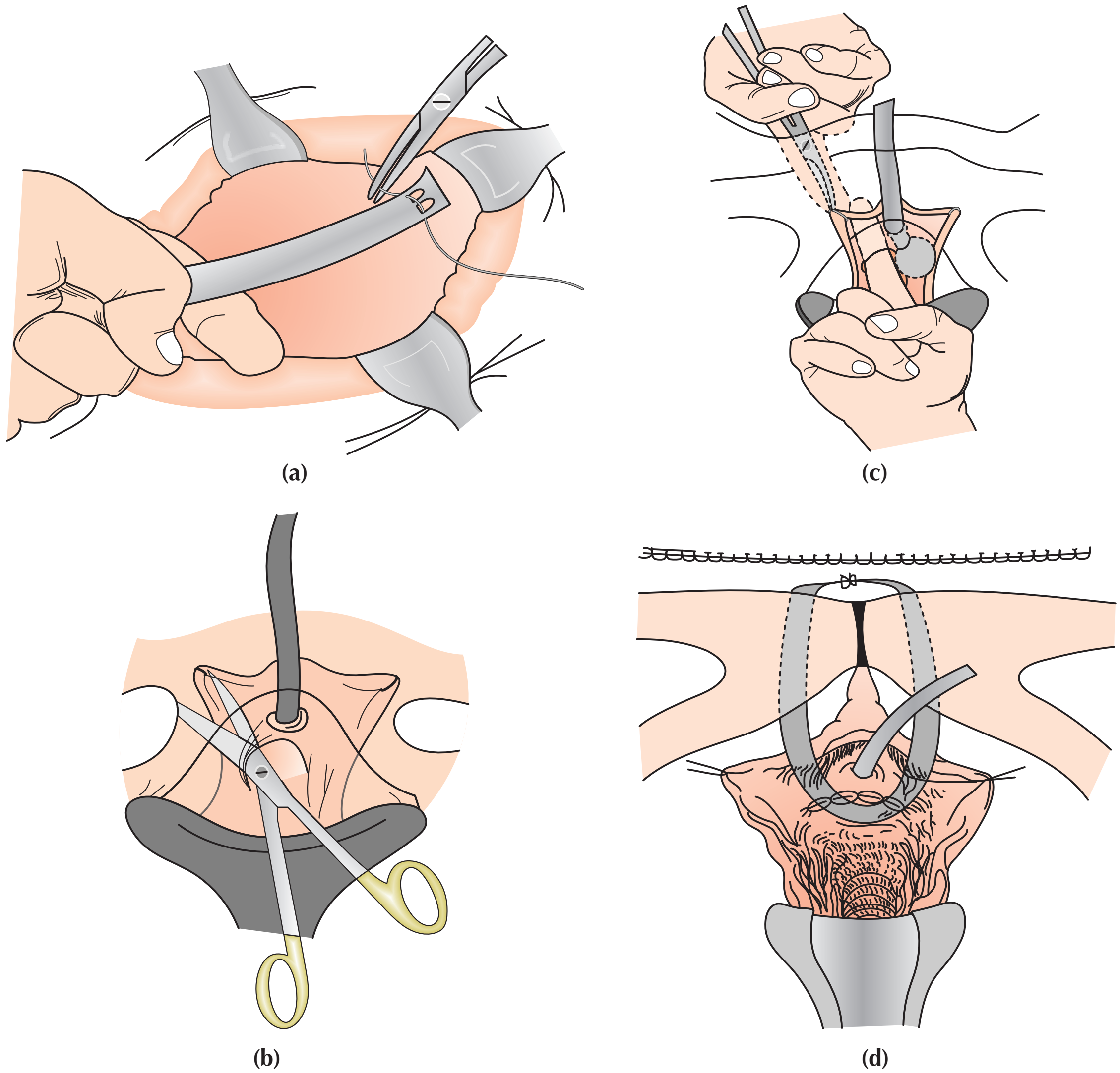

Fig. 13.7: Rectus fascial sling. **(a)** Harvesting of rectus sheath. A non-absorbable suture is placed at each end of the graft and the ends left long. **(b)** A tunnel is created behind the pubic bone either side of the urethra allowing passage of the fascial sling. **(c)** A long curved clamp is guided through the endopelvic fascia to grasp the sutures on the harvested fascial sling. **(d)** Following placement of the fascial sling at the bladder neck, the abdominal and vaginal incisions are closed and an indwelling catheter left in place.

Mid-Urethral Tape Procedures

RETROPUBIC MID-URETHRAL TAPES

Tension-Free Vaginal Tape

The tension-free vaginal tape (TVT, Gynaecare), first described by Ulmsten in 1996,[42] is now the most commonly performed procedure for stress urinary incontinence in the UK, and more than two million procedures have been performed worldwide. A knitted 11 mm × 40 cm polypropylene mesh tape is inserted transvaginally at the level of the mid-urethra, using two 5 mm trochars (Fig. 13.8a). The procedure may be performed under local, spinal or general anaesthesia. Most women can go home the same day, although some do require catheterisation for short-term voiding difficulties (2.5–19.7%). Other complications include bladder perforation (2.7–5.8%), de novo urgency (0.2–15%) and bleeding (0.9–2.3%).[43]

The initial multicentre study carried out in six centres in Sweden reported a 90% cure rate at 1 year in women undergoing their first operation for urodynamic stress incontinence, without any major complications.[44] Long-term results would confirm durability of the technique with success rates of 86% at 3 years,[45] 84.7% at 5 years,[46] 81.3% at 7 years[47] and 90% at 11 years.[48]

The tension-free vaginal tape has also been compared to open colposuspension in a multicentre prospective randomised trial of 344 women with urodynamic stress incontinence.[49] Overall there was no significant difference in terms of objective cure; 66% in the tension-free vaginal tape group and 57% in the colposuspension group. However, operation time, postoperative stay and return to normal activity were all longer in the colposuspension arm. Analysis of the long-term results at 24 months using a pad test, quality of life assessment and symptom questionnaires showed an objective cure rate of 63% in the tension-free vaginal tape arm and 51% in the colposuspension arm.[50] At 5 years, there were no differences in subjective cure (63% in the tension-free vaginal tape group and 70% in the colposuspension group), patient satisfaction and quality of life assessment. However, whilst there was a significant reduction in cystocoele in both groups there was a higher incidence of enterocoele, rectocoele and apical prolapse in the colposuspension group.[51] Furthermore, cost utility analysis has also shown that at 6-months follow-up tension-free vaginal tape resulted in a mean cost saving of £243 when compared to colposuspension.[52]

A smaller randomised study has also compared tension-free vaginal tape to laparoscopic colposuspension in 72 women with urodynamic stress incontinence. At a mean follow-up of 20 months objective cure rates were higher in the tension-free vaginal tape group when compared to the laparoscopic colposuspension group; 96.8% vs. 71.2% respectively ($p = 0.056$).[53]

Technique

The TVT device consists of an 11 mm wide by 40 cm long tape of polypropylene mesh, both ends of which are attached to a stainless steel curved 5 mm diameter needle. The tape is covered by a protective plastic sheath and a reusable stainless steel handle is used to insert the needles.

The procedure may be performed under local or general anaesthesia. The patient is placed in the dorsal lithotomy position

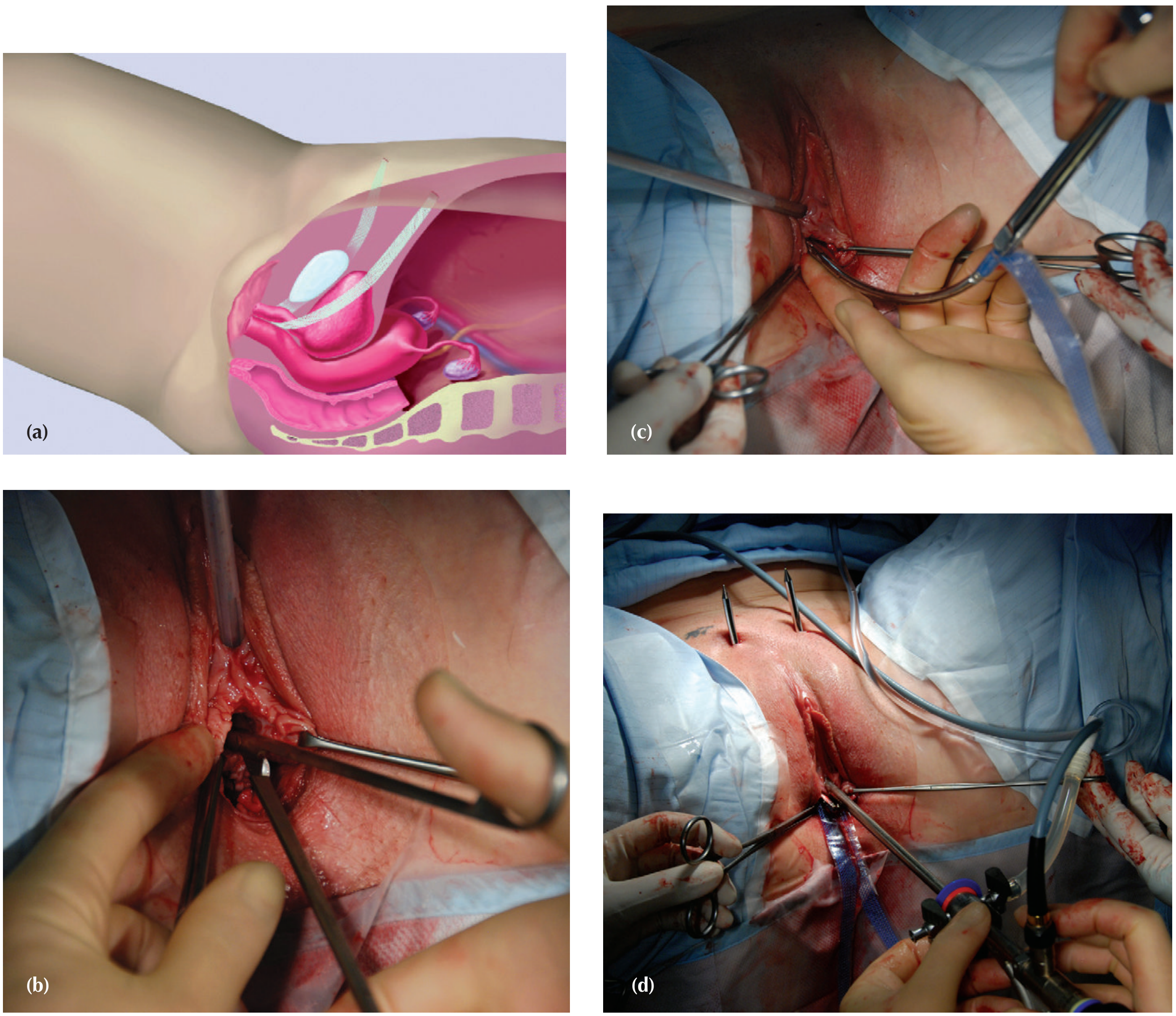

Fig. 13.8a–d: Tension-free vaginal tape (TVT).

and having prepared the vagina and suprapubic area an indwelling 18Fr Foley catheter is inserted into the bladder. Once the bladder has been emptied a rigid catheter guide is then inserted down the catheter in order to deflect the bladder away from the passage of the needle introducers. The use of local anaesthesia (20 mL bupivacaine 0.5% with 1 in 200,000 adrenaline – diluted in 100 mL normal saline) allows effective hydrodissection and vasoconstriction whilst at the same time providing effective intra-operative and postoperative analgesia. Twenty millilitres of dilute local anaesthetic is injected on each side retropubically immediately behind the pubic tubercle. In addition, further 20 mL is injected para-urethrally on each side up to the level of the urogenital diaphragm and 5 mL sub-urethrally.

A 2-cm-midline sub-urethral vaginal incision is made and para-urethral dissection performed using sharp dissection with McIndoe scissors between the vaginal mucosa and pubocervical fascia to the level of the inferior pubic ramus and the urogenital diaphragm (Fig. 13.8b). Two small 0.5 cm suprapubic incisions at the upper border of the pubic tubercle 2 cm lateral to the midline may be made to facilitate needle passage through the skin.

The TVT needle is then placed in the starting position within the dissected para-urethral tunnel with the tip of the needle between the index finger (in the vagina) and the lower border of the pubic ramus. Prior to the passage of the needle the bladder is pushed away from the track of the needle using the rigid catheter guide. In a controlled movement the needle is then pushed through the urogenital diaphragm, the retropubic space and the rectus fascia keeping in close contact to the dorsal aspect of the pubic bone. The procedure is then repeated on the contralateral side (Fig. 13.8c).

With the needles still in position a cystoscopy using a 70° cystoscope is performed to check that there is no bladder injury (Fig. 13.8d). Should a bladder perforation be noted the needle is withdrawn, replaced, passed once again and the cystoscopy repeated. Once the integrity of the bladder is confirmed the bladder is again emptied completely and the tape pulled through.

In the centres that continue to use the cough stress test, the bladder is then refilled with 300 mL normal saline and the patient asked to cough vigorously. The tape may then be adjusted to a point where there is only a drop of leakage from the urethral meatus. After this final adjustment the tape is held in position beneath the urethra using a pair of McIndoe scissors whilst the plastic sheaths are removed on each side.

In the centres where a cough stress test is no longer used the tape is positioned loosely below the mid-urethra without tension. Finally, the vaginal incision is closed using an absorbable suture and the suprapubic incisions are closed with Steri-strips. Whilst an indwelling catheter is not required in all cases a urethral catheter should be left on free drainage for 48 hours following a bladder injury.

SPARC—MID-URETHRAL SLING SUSPENSION SYSTEM

The SPARC sling system (American Medical Systems) is a minimally invasive sling procedure using a knitted 10-mm-wide polypropylene mesh, which is placed at the level of the mid-urethra by passing the needle via a suprapubic to vaginal approach.[54] The procedure may be performed under local, regional or general anaesthetic. A prospective multicentre study of 104 women with urodynamic stress incontinence has been reported from France.[55] At a mean follow-up of 11.9 months the objective cure rate was 90.4% and subjective cure 72%. There was a 10.5% incidence of bladder perforation and 11.5% of women complained of de novo urgency following the procedure. More recently SPARC has been compared to tension-free vaginal tape in a prospective randomised trial of 301 women.[56] At short-term follow-up, there were no significant differences in cure rates, bladder perforation rates and de novo urgency. There was, however, a higher incidence of voiding difficulties and vaginal erosions in the SPARC group.

Technique

The procedure may be performed under local or general anaesthesia. The patient is placed in the dorsal lithotomy position and having prepared the vagina and suprapubic area an indwelling 18Fr Foley catheter is inserted into the bladder. The use of local anaesthesia (20 mL bupivacaine 0.5% with 1 in 200,000 adrenaline – diluted in 100 mL normal saline) allows effective hydrodissection and vasoconstriction whilst at the same time providing effective intra-operative and postoperative analgesia. Twenty millilitres of dilute local anaesthetic is injected on each side retropubically immediately behind the pubic tubercle.

Two 0.5 cm incisions are made directly above the level of the pubic tubercle on each side 1.5 cm from the midline. After identification of the bladder neck, a 2 cm midline sub-urethral incision is then made prior to para-urethral sharp dissection between the vaginal epithelium and peri-urethral fascia using McIndoe scissors. Dissection is continued to the inferior border of the pubic ramus at the level of the mid-urethra.

The insertion needles are passed from above to below. The needle is first passed through the suprapubic incision down to the pubic tubercle before being rotated around the superior aspect of the bone to perforate the rectus fascia and muscle. The needle is then passed over the posterior aspect of the pubic bone to reach the endopelvic fascia before being guided through the vaginal incision using a finger placed in the vagina or incision itself. The procedure is then repeated on the opposite side.

Following passage of both needles, cystoscopy—using a 70° cystoscope—is performed to exclude a urethral or bladder injury. Should a perforation be noted, the bladder is emptied, needles re-positioned and a repeat cystoscopy performed.

Next, the connectors on each end of the tape are attached to the needles in the vaginal incision and the tape is gently pulled through on each side taking care to make sure that the tape remains flat under the mid-urethra. If there is any suspicion of bladder injury then a repeat cystoscopy should be performed. The tape is then held loosely in position beneath the urethra using a pair of McIndoe scissors, whilst the protective plastic sheaths are removed ensuring that there is no tension on the urethra. The vaginal incision may then be closed using an absorbable suture and Steri-strips are used to close the two small suprapubic incisions. Whilst an indwelling catheter is not required in all cases, a urethral catheter should be left on free drainage for 48 hours following a bladder injury (Fig. 13.9).

TRANSOBTURATOR SLING PROCEDURES

The transobturator route for the placement of synthetic mid-urethral slings was first described in 2001.[57] As with the retropubic sling procedures, transobturator tapes may be performed under local, regional or general anaesthetic and have the theoretical advantage of eliminating some of the complications associated with the retropubic route, such as bladder and urethral perforation. However, the transobturator route may be associated with damage to the obturator nerve and vessels; in an anatomical dissection model, the tape passes 3.4 cm and 4.8 cm from the anterior and posterior branches of the obturator nerve, respectively, and 1.1 cm from the most medial branch of the obturator vessels.[58] Consequently, nerve and vessel injury in addition to bladder injury and vaginal erosion remain a potential complication of the procedure.

The transobturator approach may be used as an 'inside-out' (TVT-O, Gynaecare) (Fig. 13.10a) or alternatively an 'outside–in' (Monarc, American Medical Systems) technique. To date there have been several studies documenting the short-term efficacy of transobturator procedures. Initial studies have reported cure and improved rates of 80.5% and 7.5%, respectively at 7 months[59] and 90.6% and 9.4%, respectively at 17 months.[60]

More recently the transobturator approach (TVT-O) has been compared to the retropubic approach (TVT) in an Italian prospective multicentre randomised study of 231 women with urodynamic stress incontinence.[61] At a mean of 9 months subjectively, 92% of women in the TVT group were cured compared to 87% in the TVT-O group. Objectively, on pad test testing, cure rates were 92% and 89%, respectively. There were no differences in voiding difficulties and length of stay, although there were more bladder perforations in the TVT group—4% vs. none in the TVT-O group. A further multicentre prospective randomised trial comparing TVT and TVT-O has also recently been reported from Finland in 267 women complaining of stress urinary incontinence.[62] Objective cure rates at 9 weeks were 98.5% in the TVT group and 95.4% in the TVT-O group (p = 0.1362). Whilst complication rates were low and similar in both arms of the study, there was a higher incidence of groin pain in the TVT-O group (21 vs. 2; p = 0.0001).

This data is supported by a recent meta-analysis of the five randomised trials comparing TVTO with TVT and six randomised trials comparing TOT with TVT.[63] Overall subjective cure rates were identical with the retropubic and transobturator routes. However, adverse events such as bladder injuries (OR 0.12; 95% CI: 0.05–0.33) and voiding difficulties (OR 0.55; 95% CI: 0.31–0.98) were less common, whereas groin pain (OR 8.28; 95% CI: 2.7–25.4) and vaginal erosions (OR 1.96; 95% CI: 0.87–4.39) were more common after the transobturator approach.

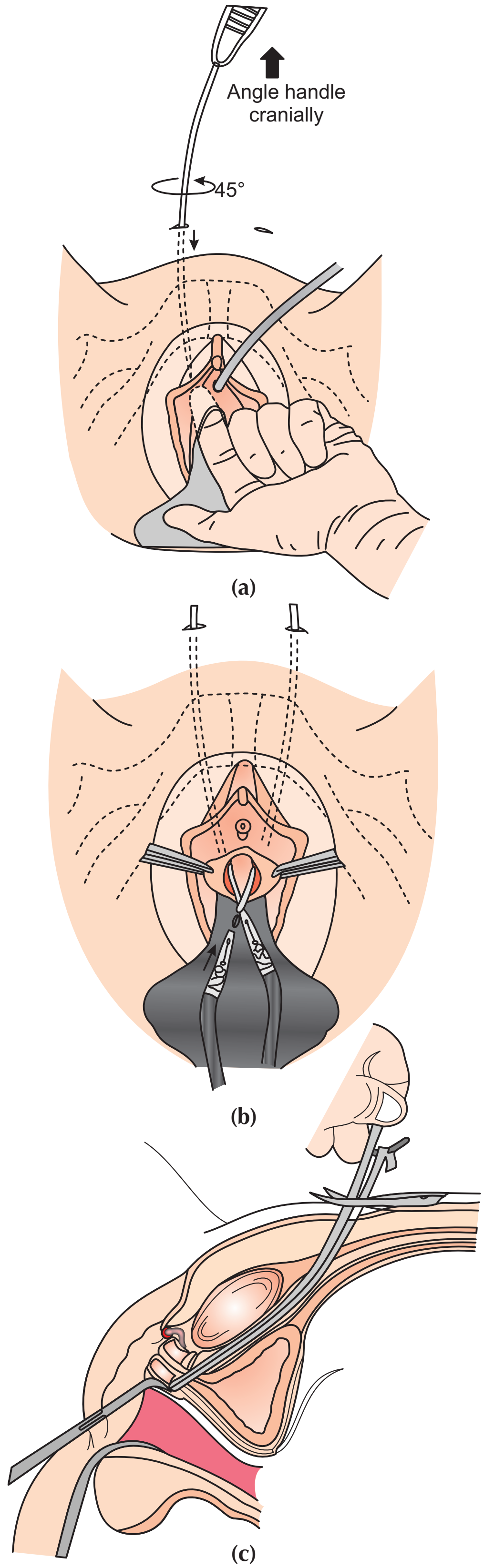

Fig.13.9: SPARC sling system. **(a)** Placement of the needle tip and perforation of the endopelvic fascia. **(b)** Once the needles have been passed, the tape may then be connected prior to being pulled through and positioned correctly. **(c)** The tape is carefully positioned under the mid-urethra without tension.

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Long-term data would also seem to support the durability and efficacy of the transobturator approach. A 3-year follow-up study of a prospective, observational study evaluating the use of TVT-O has recently been reported.[64] Of the 102 patients recruited, 91 (89.2%) were available for follow-up at a minimum of 3 years. The objective cure rate was 88.4% with an improvement in 9.3% of cases and there was no statistical difference in outcome as compared to the results reported at 1 year. In addition there was also a significant improvement in subjective outcome including incontinence severity and quality of life. Whilst four patients required tape division there were no cases of erosion or persistent pain.

Technique

Transobturator 'Inside-Out'

The TVT-O device consists of an 11 mm wide by 40 cm long tape of polypropylene mesh both ends of which are attached to a plastic sheath that threads over the helical needle introducer. A winged needle guide is also provided to facilitate passage of the needle through the obturator membrane.

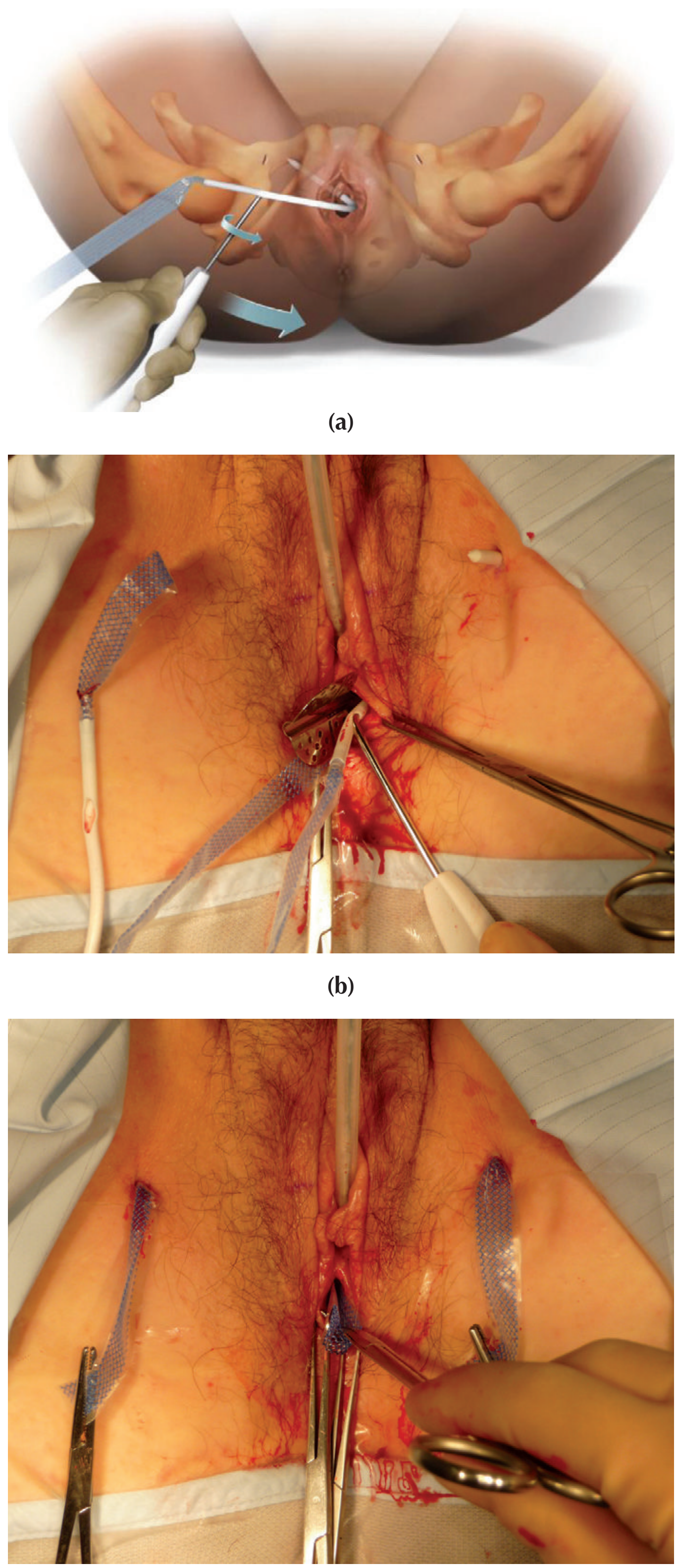
The procedure may be performed under local or general anaesthesia. The patient is placed in the dorsal lithotomy position in 120º hyperflexion. The vagina and thighs are then prepared and an indwelling 12Fr Foley catheter is inserted into the bladder. Next two 0.5 cm incisions are made 2 cm superior to a horizontal line level with the urethra and 2 cm lateral to the thigh folds. This marks the exit point for the helical needle introducer.

The use of local anaesthesia (20 mL bupivacaine 0.5% with 1 in 200,000 adrenaline – diluted in 100 mL normal saline) allows effective hydrodissection and vasoconstriction whilst at the same time providing effective intra-operative and postoperative analgesia. Twenty millilitres of dilute local anaesthetic is injected paraurethrally on each side in the direction of the inferior pubic ramus.

A midline sub-urethral incision is then made at the level of the mid-urethra prior to para-urethral sharp dissection between the vaginal epithelium and peri-urethral fascia using McIndoe scissors. Dissection is continued laterally to the inferior border of the pubic ramus at the level of the mid-urethra and the medial aspect of the obturator membrane is perforated.

The winged needle guide is then passed at 45º relative to the sagittal plane of the urethra until reaching the posterior aspect of the inferior pubic ramus and perforating the obturator membrane. Having mounted the tape onto the helical introducer the tip is then placed along the guide channel in the winged guide to pass through the obturator membrane and is then rotated so as to exit trough the inner thigh incision. The tip of the tubing is then clamped and the helical introducer withdrawn. The procedure is then repeated on the contralateral side (Fig. 13.10b). Once both needles have been passed and the tape inserted a cystoscopy may be performed to exclude bladder or urethral injury.

The tape is then held loosely in position beneath the urethra using a pair of McIndoe scissors whilst the protective plastic sheaths are removed ensuring that there is no tension on the



(a)

(b)

(c)

Fig. 13.10a–c: TVT-O Transobturator System (inside-out).

urethra and the tape is lying flat (Fig. 13.10c). The vaginal incision is then closed using an absorbable suture and Steri-strips are used to close the two small incisions on the thighs. Whilst an indwelling catheter is not required in all cases a urethral catheter should be left on free drainage for 48 hours following a bladder injury.

Transobturator 'Outside-In'

The procedure may be performed under local or general anaesthesia. The patient is placed in the dorsal lithotomy position in 120° hyperflexion. The vagina and thighs are then prepared and an indwelling 12Fr Foley catheter is inserted into the bladder. The use of local anaesthesia (20 mL bupivacaine 0.5% with 1 in 200,000 adrenaline – diluted in 100 mL normal saline) allows effective hydrodissection and vasoconstriction, whilst at the same time providing effective intra-operative and postoperative analgesia. Twenty millilitres of dilute local anaesthetic is injected paraurethrally on each side in the direction of the inferior pubic ramus.

A midline sub-urethral incision is then made at the level of the mid-urethra prior to para-urethral sharp dissection between the vaginal epithelium and peri-urethral fascia using McIndoe scissors. Dissection is continued laterally to the inferior border of the pubic ramus at the level of the mid-urethra and the medial aspect of the obturator membrane is perforated. Next, a small incision is made 1.5 cm lateral to the ischiopubic ramus on each side at the level of the clitoris. The helical needle introducer is then passed 'outside – in' through the incision to perforate the medial aspect of the obturator membrane. With the index finger in the vaginal incision palpating the ischiopubic ramus and obturator internus muscle the tip of the helical needle may then be guided through to the vaginal incision. Care should be taken to avoid perforating the lateral vaginal fornix and the urethra is guarded by the operator's finger. Once the tip of the needle has been passed through the vaginal incision the tape may then be attached to the needle and pulled through to exit through the thigh incision. The procedure is then repeated on the contralateral side.

The tape is then held loosely in position beneath the urethra using a pair of McIndoe scissors, whilst the protective plastic sheaths are removed ensuring that there is no tension on the urethra and the tape is lying flat. The vaginal incision is then closed using an absorbable suture and Steri-strips are used to close the two small incisions on the thighs. Whilst an indwelling catheter is not required in all cases, a urethral catheter should be left on free drainage for 48 hours following a bladder injury.

MINIMALLY INVASIVE TAPE PROCEDURES

Whilst the development of the mid-urethral retropubic and transobturator tapes has transformed the surgical approach to stress urinary incontinence by offering a minimally invasive day case procedure, there has recently been interest in developing a new type of 'mini sling' that may offer a truly office-based approach. The TVT-Secur is the first of these mini slings to be introduced although there are several other devices currently under investigation and development.

GYNECARE TVT-SECUR

The TVT-Secur was launched in 2006 and currently there is little long-term data supporting its use although several short-term studies have been reported. The first published case series reported on a small sample of 15 women with an overall subjective cure rate of 93% at 1–3 month follow-up.[65] More recently a multicentre prospective trial has been reported from Italy in 95 women with primary stress incontinence who had a TVT-Secur. Follow-up at 1 year reported a subjective and objective cure rates of 78% and 81%, respectively whilst 8% of women complained of voiding difficulties. In addition there were two cases of mesh erosion.[66] This data is supported by a multicentre prospective observational study in France of 150 patients with 1 year follow-up. Cure and improvement rates were 76.9% in those women with pure stress incontinence although this fell to 60% in a smaller group with intrinsic sphincter deficiency.[67]

The current evidence would appear to suggest that TVT-Secur efficacy rates may be slightly inferior to those of the retropubic mid-urethral tapes[68] and current experience would suggest that the procedure is technically different from a retropubic or obturator approach. Initial success rates have been disappointing in some series and the effect of the 'learning curve' has been clearly documented with objective success rates increasing from 76.2% to 94.7% depending on the experience of the operating surgeon.[69]

From the available clinical evidence available to date it would appear that TVT-Secur offers an alternative, minimally invasive approach for the treatment of stress urinary incontinence although more data are required to document the long-term efficacy and safety.

Technique

The TVT-Secur device consists of an 11 mm wide by 8-cm-long tape of polypropylene mesh both ends of which are sandwiched between a fleece pad composed of a woven polyglactin and poly-p-dioxane fibres (Fig. 13.11a). The pads are locked in position on the end of two stainless steel inserters allowing accurate retropubic placement. Following the release of the locking mechanism the pads may then be released at the time of insertion.

The procedure may be performed under local or general anaesthesia. The patient is placed in the dorsal lithotomy position and having prepared the vagina and suprapubic area an indwelling 18Fr Foley catheter is inserted into the bladder. Once the bladder has been emptied a rigid catheter guide is then inserted down the catheter in order to deflect the bladder away from the passage of the needle introducers. The use of local anaesthesia (20 mL bupivacaine 0.5% with 1 in 200,000 adrenaline – diluted in 100 mL normal saline) allows effective hydrodissection and vasoconstriction whilst at the same time providing effective intra-operative and postoperative analgesia. Twenty millilitres are injected para-urethrally on each side up to the level of the urogenital diaphragm and 5 mL suburethrally.

A 1.5 cm midline sub-urethral vaginal incision is made and para-urethral dissection performed using sharp dissection with McIndoe scissors between the vaginal mucosa and pubocervical fascia to a depth of 1 cm. If the placement is retropubic ('U' position) the angle of dissection is 45º whilst if an obturator (Hammock) placement is planned dissection is at 90˚ or horizontally.

U Position

Once the protective cover has been removed from the tip the introducer is then held using a needle holder making sure the inserter is inline with the handle of the instrument. The tip of the introducer is then carefully placed within the paraurethrally dissected tunnel using the index finger on the finger pad. The

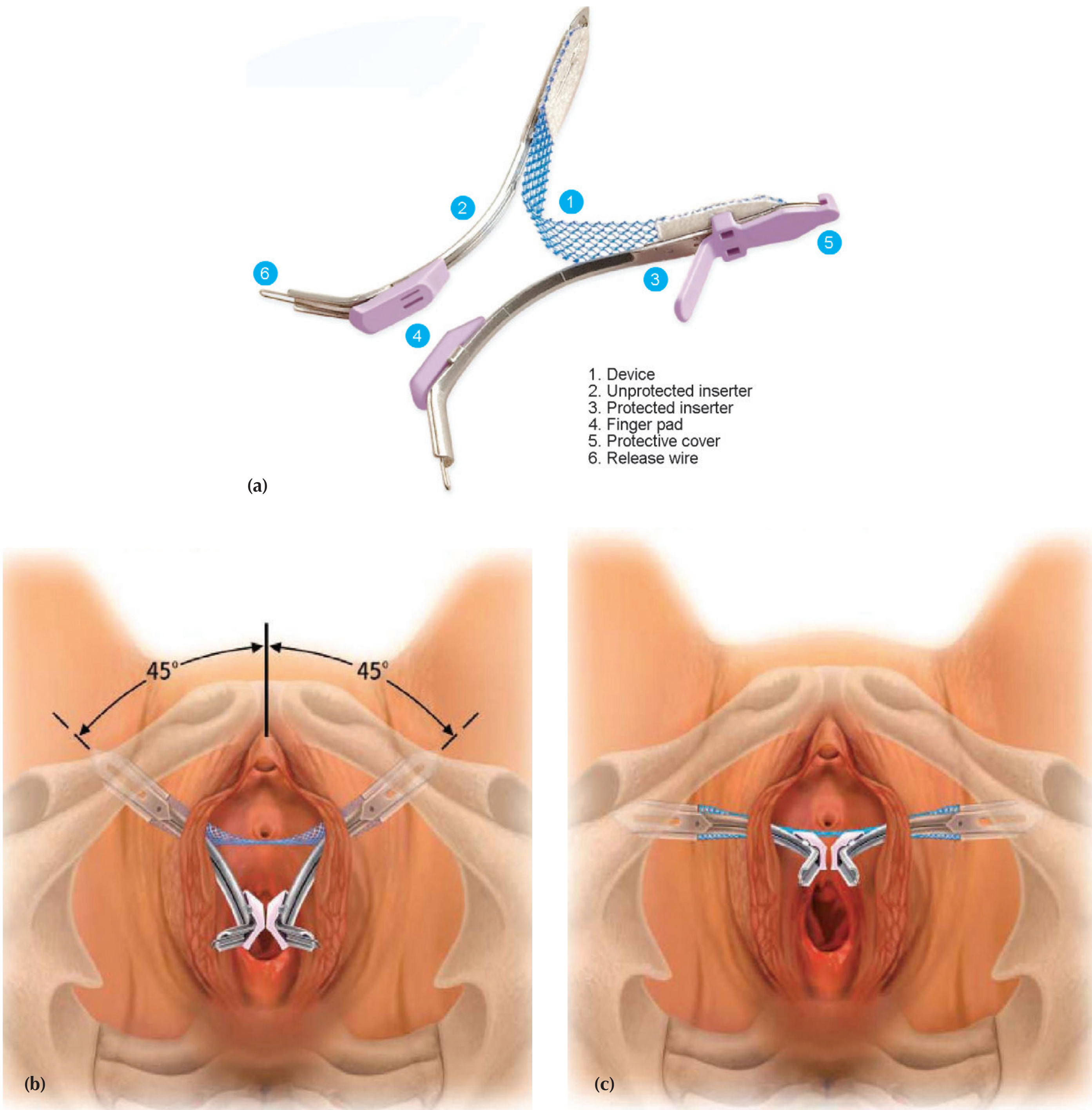


Fig. 13.11: **(a)** TVT-Secur. **(b)** TVT Secur: 'U' placement. **(c)** TVT Secur: 'Hammock' placement.

inserter should then be pushed at 45° towards the ipsilateral shoulder using gentle pressure. When contact is made with the posterior surface of the pubic bone the pad is held carefully in place against the bone whilst the needle holder is released leaving the inserter in position. The procedure is then repeated on the contralateral side. (Fig. 13.11b)

Hammock Position

Once the protective cover has been removed from the tip the introducer is then held using a needle holder making sure the inserter is inline with the handle of the instrument. The tip of the introducer is then carefully placed within the para-urethrally dissected tunnel using the index finger on the finger pad. The inserter tip should then be orientated at 45° from the midline towards the ischiopubic ramus whilst holding the needle holder parallel to the floor. Once contact is made with the posterior surface of the pubic bone the pad is held carefully in place against the bone whilst the needle holder is released leaving the inserter in position. The procedure is then repeated on the contralateral side (Fig. 13.11c).

After both inserters have been passed final tape positioning may be performed by adjusting the depth of insertion on each side. Care should be taken to ensure that the inserter tip remains in contact with the posterior surface of the pubic bone on each side and that the tape is flat and lies immediately beneath the urethra. Prior to removal of the inserters cystourethroscopy should be performed to exclude injury to the bladder or urethra. Should a bladder perforation be noted, the inserter should be removed and replaced.

Once the tape is properly positioned, the first inserter is released by gently pulling on the release wire and then sliding the inserter out from the incision. Care should be taken not to dislodge the anchoring pad from the posterior surface of the pubic bone. The procedure should then be completed on the opposite side.

The vaginal incision is then closed using an absorbable suture. Whilst an indwelling catheter is not required in all cases, a urethral catheter should be left on free drainage for 48 hours following a bladder injury.

Urethral Bulking Agents

Urethral bulking agents are a minimally invasive surgical procedure for the treatment of urodynamic stress incontinence and may be useful in the elderly and those women who have undergone previous operations and have a fixed, scarred fibrosed urethra.

Although the actual substance that is injected may differ the principle is the same. It is injected either peri-urethrally or transurethrally on either side of the bladder neck under cystoscopic control and is intended to 'bulk' the bladder neck, in order to stop premature bladder neck opening, without causing out-flow obstruction. They may be performed under local, regional or general anaesthesia. There are now several different products available. (Table 13.2) The use of minimally invasive implantation systems (Fig. 13.12) has also allowed some of these procedures to be performed in the office setting without the need for cystoscopy.

In the first reported series 81% of 68 women were dry following two injections with collagen.[70] There have been long-term follow-up studies most of which give a less than 50% objective cure rate at 2 years but a subjective improvement rate of about 70%.[71,72]

Table 13.2: Urethral bulking agents

Urethral bulking agent	Application technique
Glutaraldehyde cross-linked bovine collagen (Contigen)	Cystoscopic
Polydimethylsiloxane (Macroplastique)	Cystoscopic MIS Implantation System
Pyrolytic carbon coated zirconium oxide beads in β Glucan gel (Durasphere)	Cystoscopic
Calcium hydroxylapatite in carboxymethylcellulose gel (Coaptite)	Cystoscopic
Polyacrylamide hydrogel (Bulkamid)	Cystoscopic

Fig. 13.12: Macroplastique urethral bulking agent and implantation device.

Macroplastique has more recently been compared to Contigen in a North American study of 248 women with urodynamic stress incontinence. Outcome was assessed objectively using pad tests and subjectively at 12 months. Overall objective cure and improvement rates favoured Macroplastique over Contigen (74% vs. 65%; $p = 0.13$). Whilst this difference was not significant subjective cure rates were higher in the Macroplastique group (41% vs. 29%; $p = 0.07$).[73]

Whilst success rates with urethral bulking agents are generally lower than those with conventional continence surgery they are minimally invasive and have lower complication rates meaning that they remain a useful alternative in selected women and in those with multiple comorbidities.

Artificial Urinary Sphincter

An artificial urinary sphincter is a mechanical device that may be employed when conventional surgery fails.[74] This is implantable and consists of a fluid-filled inflatable cuff, which is surgically placed around the bladder neck. A reservoir, containing fluid, is sited in the peritoneal cavity and a small finger-operated pump is situated in the left labium majus. The three major components are connected via a control valve. Under normal circumstances the cuff is inflated, thus obstructing the urethra. When voiding is desired the pump is utilised to empty the fluid in the cuff back into the balloon reservoir so that voiding may occur. The cuff then gradually refills over the next few minutes.

Whilst they may be useful in women with recurrent stress incontinence artificial sphincters may be associated with many problems. In addition they are expensive, the surgery required to insert them is complicated and the tissues around the bladder neck following previous failed operations may be unsuitable for the implantation of the cuff. In addition, mechanical failure may occur, necessitating further surgery. However, there remains a place for these devices and their technology continues to evolve and improve.

Unfortunately, there are a few unfortunate women in whom neither conventional nor even the newer forms of incontinence surgery produce an effective cure. For them a urinary diversion may be a more satisfactory long-term solution than the continued use of incontinence aids.

Conclusion

Urinary stress incontinence is the most commonly reported type of urinary incontinence in women and is known to have a significant impact on Quality of Life.[75] Whilst the majority of women will benefit from a conservative approach initially surgery remains integral in the management of women with moderate to severe symptoms.

The last decade has seen a dramatic change in our approach to continence surgery and, following the description of the integral theory, the focus has shifted from the bladder neck to the level of the mid-urethra. With the development of both the retropubic and transobturator tapes, continence surgery has moved from being an inpatient procedure to the day surgery setting and may now be performed under local or regional anaesthesia. Consequently, the number of continence procedures has increased dramatically and the move towards the development of the 'mini tapes' may mean that surgical options for stress urinary incontinence become an office-based procedure. An increased choice of surgical procedures and techniques should ultimately benefit both patients and clinicians.

However, despite the rapid pace of innovations in the field of continence surgery it remains paramount that new procedures should be evidence based and only be introduced following adequate clinical studies demonstrating both efficacy and safety.

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Pelvic Organ Prolapse

14

Clive Spence-Jones

Introduction

Pelvic organ prolapse (POP) is defined as the descent of one or more of the anterior vaginal wall, posterior vaginal wall, the uterus (cervix) or the apex of the vagina (vaginal vault after hysterectomy). The symptoms are described as a departure from normal sensation, structure or function experienced by the woman in reference to the position of her pelvic organs.[1] Definitions of degrees of prolapse should include evaluation of symptoms but do not do so at the moment.[2]

Up to 11% of women before the age 80 undergo surgery for uterovaginal prolapse.[3] The annual aggregated rate of associated surgery is 10–30/10,000 women.[4] The incidence of prolapse in developing countries is hard to evaluate—a recent review suggested a mean prevalence of 19.7%, but the range was enormous 3.4–56%.[5] The rate of surgery for prolapse in the USA is stable in women >52 years old but has fallen by 60% in women <52 years old between 1979 and 2006.[6]

The natural history of prolapse is poorly understood—it is likely that some patients with minor prolapse will regress, but stage 3 and 4 do not resolve.[7]

Factors that may contribute to an increased incidence of prolapse include the increase in the number of women over the age 35 having their first child and the demographic shift to an older population. Caesarean section is partially protective.[8] The incidence of surgery for pelvic organ prolapse is doubled among women who have had a sub-total hysterectomy and almost eight times more likely in women who have had a previous vaginal hysterectomy, or four or more children.[9]

Anatomy of Pelvic Floor Support

The vagina and uterus are supported by a combination of two strengths, fascial supports to the pelvic side walls and the activity of the levator ani muscle. Activation of the levator ani muscles reduces the levator hiatus and provides a platform on which the upper two-thirds of the vagina and associated structures rest.

The vagina is a fibromuscular tube. The anterior wall is 8.5 cm long and the posterior wall is 9.5 cm long. The shape of the vagina in women who have not had children shows five characteristic shapes.[10] The vagina is lined with non-keratinising squamous epithelium. Deep to the vaginal epithelium, there are three layers: (*i*) the lamina propria, which consists of loose connective tissue; (*ii*) the vaginal muscularis, which is a fibromuscular layer with smooth muscle collagen/elastin; and (*iii*) adventitia, which contains fat, blood vessels and nerves. The muscle fibres of the vagina are arranged in a circular pattern. The fibromuscular layer is known as the pubocervical fascia anteriorly and the rectovaginal fascia posteriorly. The rectovaginal fascia (Dennonvillier) is fused with the uterosacral ligaments superiorly and the perineal body inferiorly. Altered histological and biomechanical properties have been identified in women with prolapse.[11]

The way fascial structures support the pelvic structures is considered at three levels[12] (see Fig. 14.1):

Level I: The cervix and upper vagina are supported by condensations of the endopelvic fascia forming the uterosacral and cardinal ligaments. The uterosacral ligament attaches to the area over the lateral border of the sacrum and the sacroiliac joint, and is almost vertical. The cardinal ligament attaches to the fascia over the obturator internus and greater sciatic notch. Both these ligaments fuse together for 2 cm before attaching to the posterior and lateral cervix and upper vagina.

Level II: The mid-vagina is supported anteriorly by pubocervical fascial attachments to the arcus tendineus from the inferior border of the pubic ramus to the ischial spine and posteriorly by rectovaginal fascial attachments to the fascia over iliococcygeus and pubococcygeus, just below the arcus tendineus.

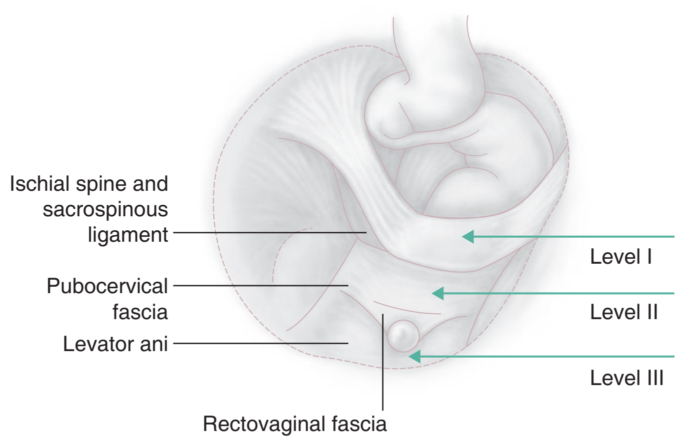

Fig. 14.1: Levels of vaginal support.[12]

Level III: The lower vagina is supported posteriorly by attachments of the rectovaginal fascia to perineal body together with some fibres from the pubococcygeus muscle. Anteriorly the urethra is supported by the pubourethral ligament. The endopelvic fascia is better developed under the urethra and attaches laterally to the arcus tendineus supporting the bladder neck. The perineal body is a pyramid-shaped structure formed by fusion of bulbocavernosus muscle, transverse perineal muscles and the perineal membrane.

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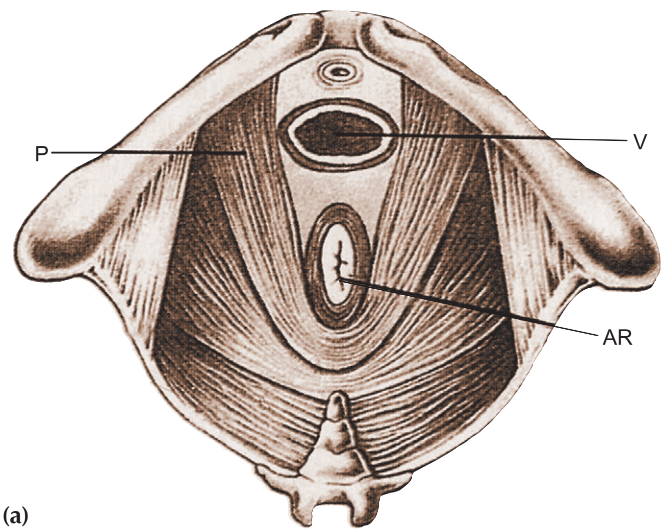
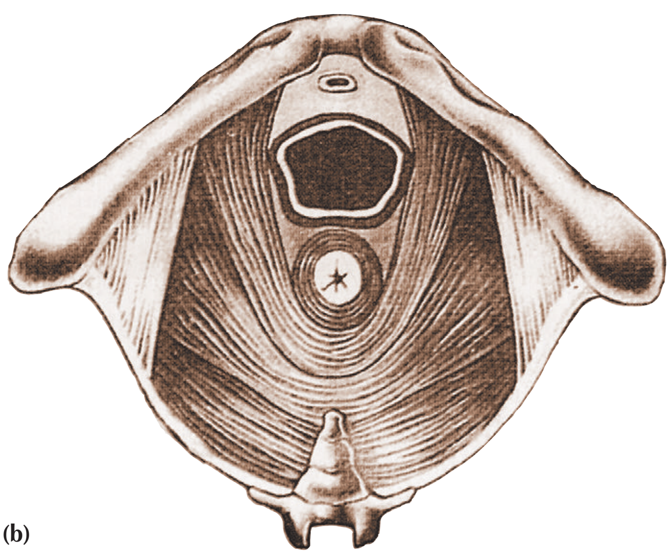
The upper two-third of the vagina rests on the sling created by the muscles of the levator ani, which has two portions (see Fig. 14.2): The pubovisceral muscle (pubococcygeus and puborectalis) is a U-shaped muscle, which arises from the pubic bone and forms a sling behind the rectum. The ileococcygeus, which arises from the arcus tendineus and fans out almost horizontally, posterior to the rectum. These muscles are in a constant state of activity, including during sleep; disruption of the muscle function either as a result of denervation or tearing in childbirth, aggravated by changes of ageing and reduced exposure to oestrogen, will reduce support of the pelvic organs.[13]



(a)



(b)

Fig. 14.2: The pelvic floor: childbirth and prolapse effects. **(a)** Before childbirth. **(b)** After childbirth, with enlargement of the urogenital hiatus. V – vagina, AR – anorectum, P – pubococcygeus.

Pre-operative Assessment

HISTORY

The importance of taking a complete history to establish details of pelvic floor function including urinary/bowel function and sexual history, together with general history of drug treatments, smoking, chronic cough, family history and obstetric history, cannot be over emphasised. The history should include identification of childhood problems such as enuresis over the age of five, recurrent urine infections and any lifelong characteristics, including infrequent bowel habit/straining, which may contribute to the development of prolapse.[14] This will allow a discussion about expectations of what can be realistically achieved, when treatments are advised.

The use of structured quality of life questionnaires introduced recently has greatly improved our understanding of what symptoms are most disruptive, and also how our interventions alter pelvic floor function. There is no consensus however on which validated questionnaire to use. Examples include (*i*) for a woman's assessment of prolapse symptoms, e.g. prolapse quality of life (P-QOL), Sheffield prolapse symptoms questionnaire; (*ii*) for quality of life assessment, e.g. Short Form 36; (*iii*) for urinary symptoms, e.g. Bristol Female Lower Urinary Tract Symptoms (BFLUTS), International Consultation on Incontinence – Short Form (ICI–SF); (*iv*) for sexual function, e.g. Pelvic organ prolapse urinary Incontinence and Sexual function Questionnaire (PISQ).

PRESENTING SYMPTOMS—FUNCTION VS. ANATOMICAL STRUCTURE

Most patients notice a bulge when doing strenuous activity. A sensation of dragging and lower abdominal heaviness are thought to be a result of stretching of the peritoneum. Backache, due to stretching of the uterosacral ligaments, is an occasional symptom, but is more likely to be caused by a primary back problem. There is poor correlation between the anatomical position of pelvic structures and their function, both before and after treatment interventions. It is generally agreed that until prolapse descends below the plane of the introitus, it is unlikely to be associated with symptoms. Weber undertook a randomised study of three surgical interventions for cystocoele. The severity of prolapse symptoms improved, despite low rates of anatomical cure - only 30–40% stage I prolapse postoperatively.[15]

URINARY SYMPTOMS

There is no direct relationship between pelvic organ prolapse (POP) and urinary symptoms. Patients with cystocoele have increased incidence of urinary urgency and frequency, stress incontinence and impaired voiding. The predominant lower urinary tract symptom in women with POP is mixed urinary incontinence, identified in 73% of women in a study of 336 women.[16] A large rectocoele or a long cervix protruding through the introitus can cause urinary urgency, which resolves after successful treatment.[17,18] Difficulty emptying the bladder may be overcome by adopting unusual positions to void, or digital pressure The presence of a cystocoele does not impair voiding, unless the patient complains of reduction in urinary flow.[19] See Chapter 13 for description of complete assessment of urinary symptoms.

Occult urinary incontinence is urinary leakage that is masked by prolapse—when the prolapse is reduced, the urinary leakage becomes apparent. There is no consensus on how to test for occult incontinence, and indeed no agreement about how it should alter choice of surgical procedure. Siting a ring pessary before surgery might identify those patients likely to become incontinent after surgery.[20]

BOWEL

Full history should include dietary assessment/use of laxatives/suppositories and drugs to relieve diarrhoea, frequency of bowel movement, straining and whether there is a need to use perineal vaginal or rectal digitation during defecation. Incontinence of flatus, liquid stool and solid stool may be a result of long-standing anal sphincter trauma. In a study of 463 women presenting with POP, 55% had to strain to have a bowel movement and 10.5% had poor control of solid stool.[21] Rectocoele may cause symptoms of obstructed defecation.

Symptoms of bowel dysfunction may be due to intrinsic bowel disorders such as intussusception, polyps and anal fissure/haemorrhoids.

SEXUAL FUNCTION

Women with pelvic organ prolapse are more likely to suffer sexual dysfunction, defined as a disorder of libido, arousal, orgasm and sexual pain that leads to personal distress or interpersonal difficulties.[22] Evaluation using validated questionnaires improves our understanding of the effect of treatments. The Female Sexual Function Index[23] and the Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire are most widely used. Studies have shown improvement after pelvic floor repair and incontinence surgery.[24] Posterior vaginal repair in particular, however, may be associated with de novo dyspareunia. One study of 81 women showed a 17% incidence.[25]

EXAMINATION

Assessment of general health to exclude signs of diabetes, reduced mobility and neurological state is important. In young women, pelvic organ prolapse is more common in patients with spina bifida occulta/connective tissue disorders.[26] As a general guide, if there are no areas of reduced skin sensation below the waist, and the patient walks normally, neurological disease is unlikely to have a role in pelvic floor disorders. Abdominal/pelvic examination to exclude a mass or ascites, which can provoke prolapse to present for the first time, is essential.

Pelvic examination should be done with the bladder empty, as increasing bladder volume can restrict the descent of prolapse. The choice of a woman's position during examination, i.e. left lateral, supine, standing or lithotomy at 45°, is the one that can best demonstrate the prolapse, and which the patient can confirm reveals maximal descent.

There have been four systems used to describe descent of the pelvic organs: Porges (1963); Baden[27]; Beecham[28] and Quantitative POP ICS/IUGA/SGS 1996.[29] The hymen remains the fixed point of reference. The majority of clinicians use the Baden half-way system—urethrocoele, cystocoele, rectocoele, enterocoele and uterine or vaginal vault descent. (See Fig. 14.3).

The cervix often shows supravaginal elongation (characterised by a difference between point D and point C of >8 cm). The cause of this is not known, but studies have shown that oestrogen and progesterone receptor levels are increased.[30]

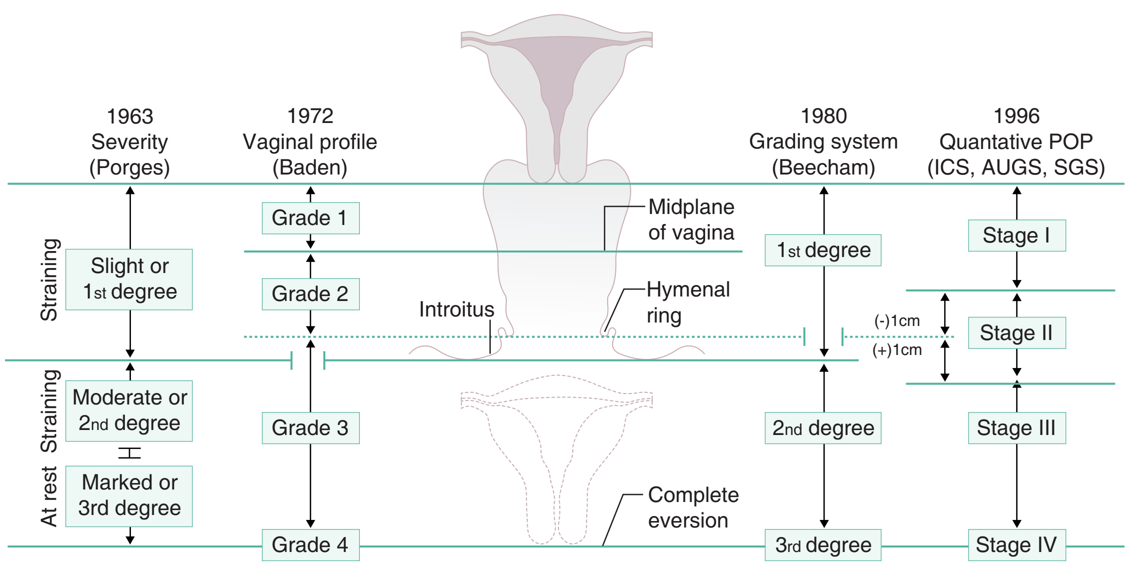


Fig. 14.3: Grading systems of pelvic organ prolapse.

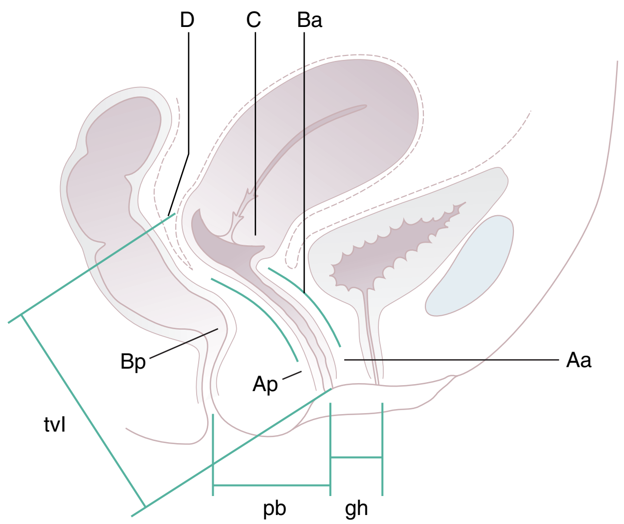


Fig.14.4: The pelvic organ prolapse quantification (POPQ) uses 6 points: Aa, Ba, C, D, Ap and Bp.

The Pelvic organ prolapse staging (POPQ) was used in conjunction with six point assessment. (See Fig. 14.4).

Stage 0 No prolapse demonstrated
Stage 1 Most distal portion of the prolapse is more than 1 cm above the level of the hymen
Stage 2 Most distal portion of the prolapse is 1 cm or less proximal to or distal to the hymen
Stage 3 Most distal portion of the prolapse is more than 1 cm below the plane of the hymen
Stage 4 Complete eversion of the total length of the lower genital tract

Conservative Treatment

Conservative treatment includes lifestyle changes, altering diet to help constipation (which predisposes to prolapse), reduction in caffeine and avoidance of activities that increase the degree of prolapse. Oestrogen deficiency with atrophic changes in the vagina, with or without increased bacterial presence, will increase the symptoms of soreness and awareness of prolapse. This can be corrected with topical (gel, pessary or estring) or systemic oestrogen replacement. Similarly, urinary tract infection should be identified and treated.

SUPPORTIVE PESSARIES

With an improved range of pessaries available, including a range that is designed to be removed, washed and replaced by the patient; it is almost always sensible to try fitting a pessary. It is not acceptable to dismiss the use of pessaries as a treatment reserved for women too old or too ill to consider surgery—indeed it is very often older patients who present with very large prolapse and poor function of the pelvic floor, for whom it is very difficult to find a pessary to fit. It is not easy to find a pessary that is helpful for symptoms from a low rectocoele. A recent prospective study of quality of life showed similar improvement with surgery or pessary use.[31]

Pessaries That can be Removed by the Patient

A *ring pessary* (covered or open) is useful for the management of apical and anterior wall prolapse, if there is sufficient support from the posterior vaginal wall/perineum. A notched version of the pessary is available, which enables the patient to remove and replace the pessary herself. Intercourse is possible with a ring in place. If urinary incontinence is worse after siting a ring pessary, it will sometimes lessen if a slightly smaller pessary is used. There is a range of ring pessaries available designed to help with stress incontinence—they have an additional knob added to apply more pressure at the level of the bladder neck.

The *cube pessary*, 'space occupying pessary', is available with or without perforations, and is very helpful for supporting vault/uterine prolapse, and can be removed and replaced by the patient. The cube without perforations has to be removed daily. The perforated cube can be left in situ for up to a week. Intercourse is not possible with the cube in place.

Pessaries Not Normally Removable by the Patient

The Shelf pessary/Gellhorn pessary is useful for support of the vaginal vault, but the patient is not normally able to remove the pessary herself, and intercourse is not possible.

The Gehrung pessary helps for cystocoele and/or high rectocoele. Intercourse is possible but the patient cannot remove it herself. (See Fig. 14.5).

Objectives of Surgery

The ideal operation for pelvic organ prolapse would consistently give symptomatic relief, normal bladder function, bowel function and intercourse, be long lasting and not be associated with the development of new unwanted symptoms. Unfortunately no procedure has such perfect results. All surgery is therefore a compromise between the expectations of clinicians and the expectations of the patient and her family.

Techniques for surgery involve vaginal or abdominal operations, with and without incorporating mesh, which may be permanent or non-permanent. As more operations are carried out and women live longer, recurrent prolapse is increasing.

ANTERIOR COMPARTMENT PROLAPSE

Surgical correction of cystocoele remains one of the most challenging problems for pelvic floor surgeons. Laxity of the anterior vaginal wall is normal in women who have had children. Anterior vaginal repair is not an operation for stress incontinence but paradoxically around 10%[32] of patients who undergo cystocoele repair who did not complain of stress incontinence pre-operatively, will develop this postoperatively. Finally, although there is up to 30% incidence of recurrent cystocoele, there is a lack of correlation between symptoms and descent.[15]

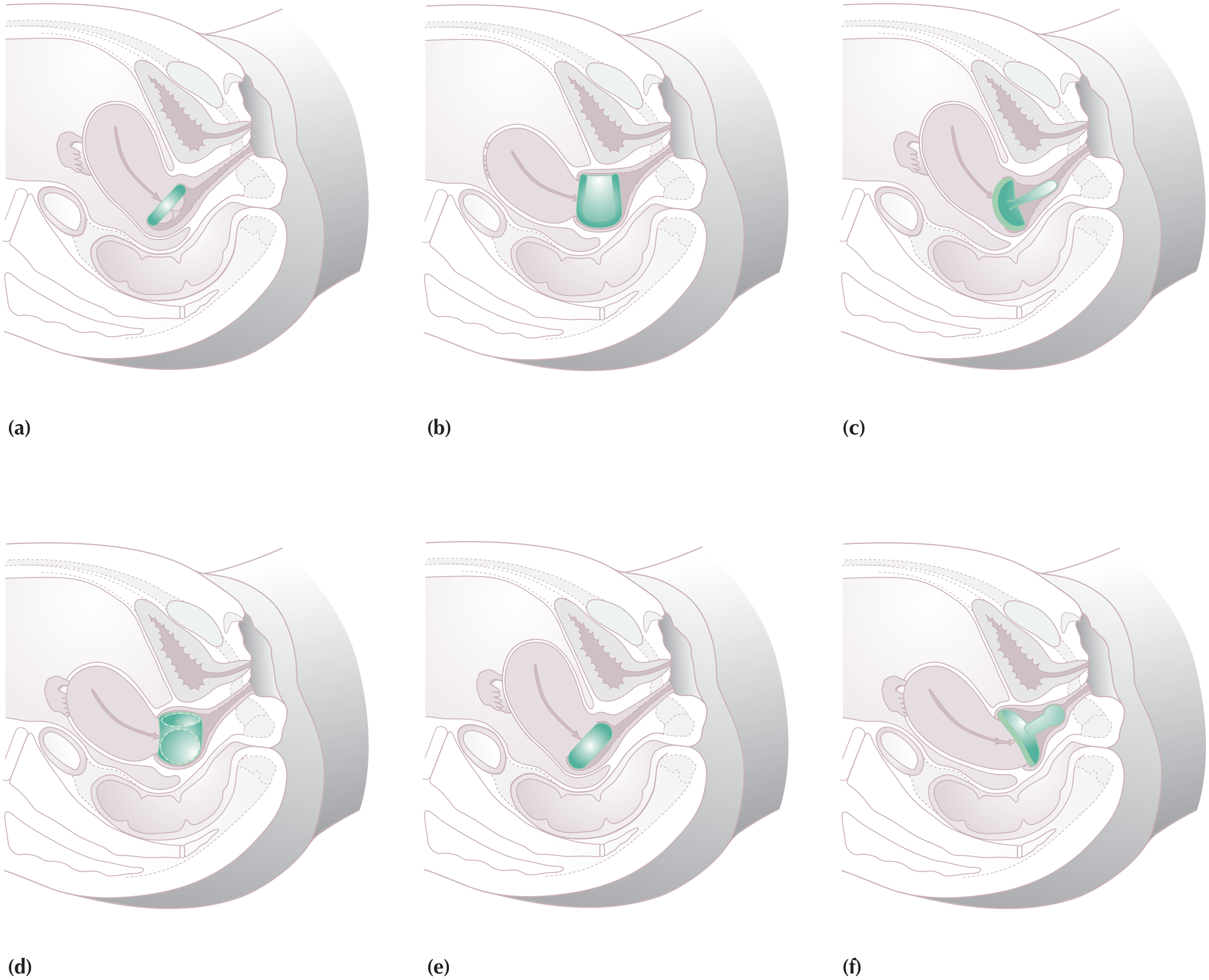


Fig. 14.5: Illustration of **(a)** ring, **(b)** Gehrung, **(c)** shelf, **(d)** cube, **(e)** doughnut and **(f)** Gellhorn pessaries.

The mechanism by which symptomatic anterior wall prolapse forms is poorly understood. Central defects of the pubocervical fascia cause central cystocoele with loss of vaginal rugae. Paravaginal defects caused by separation of the lateral attachments of vaginal muscularis layer to the arcus tendineus, may be bilateral or unilateral, and result in cystocoele with preservation of rugae. Standard clinical examination is a poor predictor of where the fascial defects occur, compared with intra-operative findings.

Recent studies using dynamic MRI raise the possibility that the para-vaginal defect may be secondary to loss of anterior vaginal support and that loss of apical support of the anterior vaginal wall may have greater importance as a primary event. Additionally, if the perineal body is disrupted, this allows the lower anterior vaginal wall to descend through the introitus thus increasing the size of the cystocoele.[33]

The choice of operation for anterior vaginal prolapse includes vaginal or abdominal, with or without mesh and alone or in combination with other procedures for continence/prolapse in other compartments. It is rare for cystocoele repair to be carried out alone.

ANTERIOR COLPORRHAPHY

A midline incision is made from approximately 3 cm below the external urethral meatus to 2 cm from the cervix. No vaginal skin is removed at the time of initial incision, as it is not possible to assess the amount of skin to be removed, until the fascial repair has been done. The depth of the incision ensures that the muscularis fascia remains on the underlying detrusor—if the correct layer is reached the separation may be almost completely bloodless. (See Fig. 14.6).

The skin edges are grasped with small Kocher forceps and the tissue plane is developed using a knife initially and then sharp dissection with fine scissors. The dissection is greatly aided by counter traction of the underlying bladder away from the vaginal skin. Many surgeons use blunt dissection using a

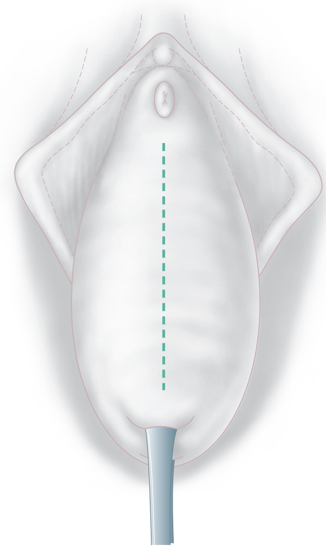


Fig. 14.6: Cystocoele repair. Initial midline incision.

gauze swab wrapped over a finger, but this can allow dissection to go too deep into large blood vessels which are in the adventitial layer. The dissection is continued until just below the inferior border of the pubic ramus, but sometimes it is necessary to extend the dissection further laterally. (See Fig. 14.7).

It is important to leave the fascia attached to the detrusor, not attached to the vagina. If the cystocoele is large and has been dependent for a while, the vaginal wall is very thick and bleeding occurs even when dissection is in the correct plane.

An alternative approach is to leave the pubocervical fascia attached to the vaginal skin. This is achieved by dissecting deep to the fascia, separating the bladder from it, and hence leaving the fascia attached to the skin. After completion of this dissection, the repair sutures are placed into the fascia on the inner aspect of the skin on both sides. The author does not use this technique because of the risks of bladder injury, and of reducing vaginal capacity.

The next step is to mobilise the bladder from the cervix. The cervix is pulled down with a vulsellum forceps. The bladder is lifted with Russian dissecting forceps and the vesicocervical ligament is divided with scissors. On each side, the bladder pillar is also divided. The peritoneum of the uterovesical pouch is exposed. The lateral extensions of the bladder are separated from the lateral border of the uterus and the front of the broad ligament. (See Fig. 14.8).

Once the bladder has been mobilised from the cervix, it ensures that the ureters are excluded from the risk of inclusion in the subsequent suturing of the fascia. In most cases, the margin of the defect in the fascia cannot be readily identified, but interrupted Lembert sutures produce a musculofascial buttress to support the bladder. It is helpful to take a double bite of fascia on each side, to spread the load on each suture. Furthermore, if there is sufficient mobility, a second layer of

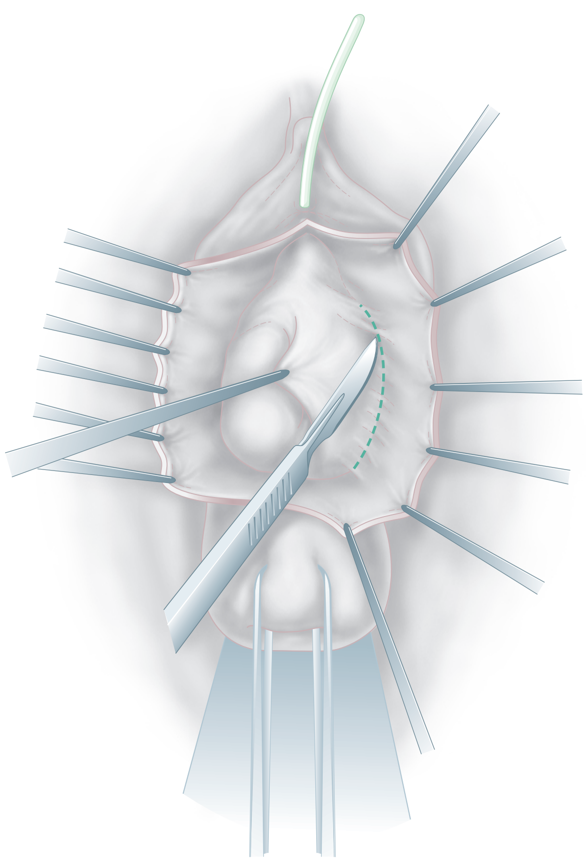


Fig. 14.7: Cystocoele repair. The bladder, with attached pubocervical fascia, is dissected from the vaginal skin initially with sharp dissection using a knife and subsequently with scissors.

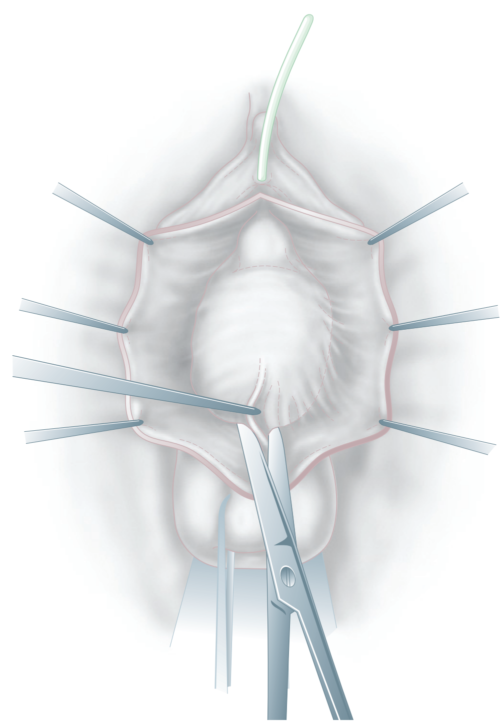


Fig. 14.8: Cystocoele repair. The bladder is mobilised from the underlying cervix using sharp dissection with scissors and diathermy.

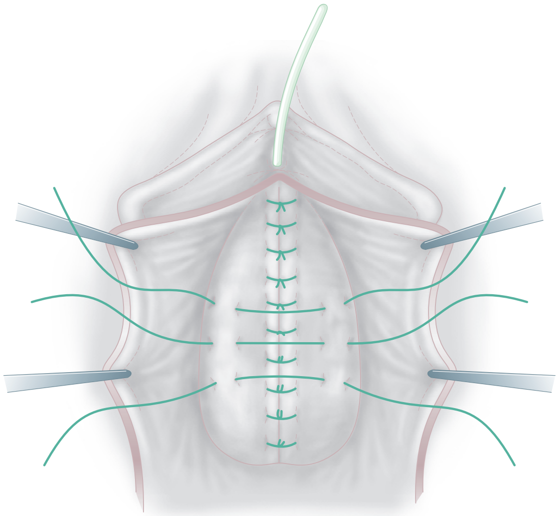


Fig. 14.9: Cystocoele repair. The repair of cystocoele including a second layer of sutures through pubocervical fascia. Sometimes, it is necessary to include a third layer but this is not illustrated.

sutures helps to 'laminate' the repair. Finally, a row of interrupted sutures are placed laterally, in the pelvic diaphragm on the pelvic side of the inferior border of the inferior pubic ramus. These sutures are tied without tension in a sling-like way. (See Fig. 14.9).

To reduce the risk of stress incontinence appearing for the first time following surgery, especially if there is laxity of the pubourethral supports, careful sub-urethral support is necessary.[34] After redundant vaginal skin has been excised, the vaginal wall is closed with interrupted or continuous 2/0 vicryl suture.

Injuries to the bladder are rare, but if the bladder has been damaged the wound can be repaired immediately using a two layer technique with absorbable sutures. One of the advantages of not emptying the bladder before this type of surgery is that an inadvertent injury is immediately apparent.

PARAVAGINAL REPAIR

The objective of paravaginal repair is to reattach the pubocervical fascia to the fascia over the obturator internus at the level of the arcus tendineus on both sides of the pelvis. The operation can be carried out vaginally or retropubically via an open incision or laparoscopically.

VAGINAL PARAVAGINAL REPAIR

First described by White in 1909,[35] the technique is recognised as technically demanding. The anterior vaginal wall is opened in the midline and if needed, a midline fascial defect is closed as with an anterior colporrhaphy. The dissection is extended laterally beneath the inferior pubic ramus, to expose the fascia over obturator internus at the level of the white line, as far as the ischial spine. At this point, the para-vaginal defect can be palpated. Beginning 1 cm proximal to the ischial spine, a series of non-absorbable sutures is placed in the white line. The sutures pass through the white line, through the lateral edge of the pubocervical fascia and through the underside of the vaginal skin. The sutures are tied and after trimming excess vaginal skin the vagina is closed in the same way as anterior colporrhaphy. (See Figs. 14.10, 14.11).

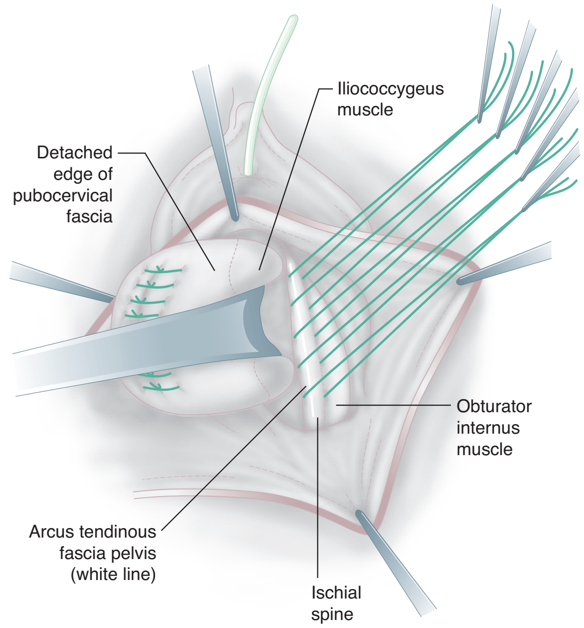


Fig. 14.10: Vaginal paravaginal repair. Untied sutures are shown passing through the white line.

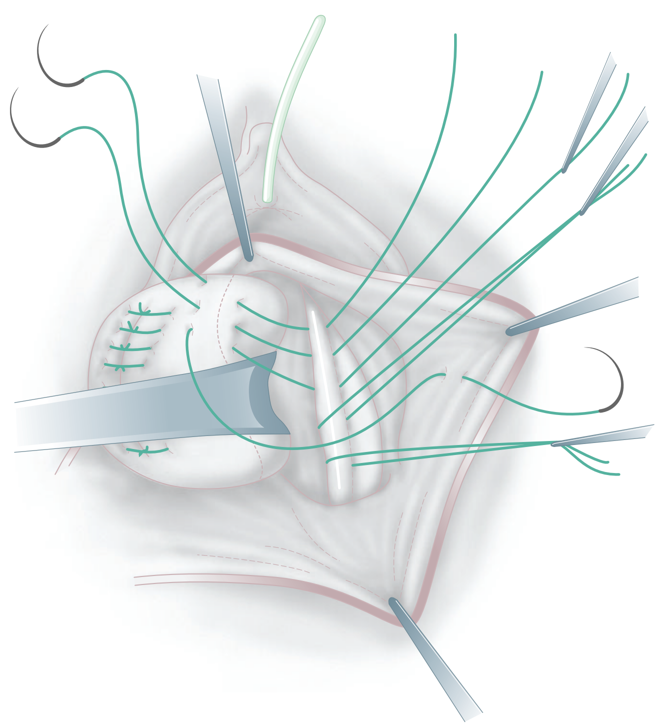


Fig. 14.11: Vaginal paravaginal repair. The sutures are then passed through the lateral pubocervical fascia and the underside of the vaginal skin.

RETROPUBIC PARAVAGINAL REPAIR

Through a low-transverse incision or laparoscopic ports, the retropubic space is opened. Addressing one side at a time, the bladder is pulled medially with blunt dissection, and simultaneously the surgeon has a finger in the vagina which is used to elevate the anterolateral vagina. The defect in the attachment of the vaginal fascia to the arcus tendineus is revealed. A series of sutures (delayed absorbable, or some surgeons prefer non-absorbable) is placed through the vagina (almost full thickness) and then into the fascia over obturator internus at the arcus tendineus. The sutures should extend from 1 to 2 cm anterior to the ischial spine, to the anterior limit of the fascial defect. Care is taken to avoid the obturator vessels, which lie lateral to the white line.

Other Techniques

COLPOSUSPENSION

When stress incontinence is associated with cystocoele extending below the plane of the hymen, a colposuspension incorporating sutures slightly more laterally will give relief of stress incontinence and support of a low-to-mid cystocoele. This procedure will aggravate apical and posterior wall prolapse however and is not often used.

TRANSABDOMINAL WEDGE RESECTION

When carrying out an abdominal hysterectomy for a non–prolapse-related problem, in a patient with cystocoele, it is possible to perform a wedge resection of a triangle of vaginal skin from the anterior vagina. This procedure was popularised in USA and is only occasionally used, but can be useful.[36]

Outcomes for Surgery

ANTERIOR COLPORRHAPHY VS. PARAVAGINAL REPAIR

The assessment of outcomes for anterior vaginal wall surgery has relied on anatomical success as the primary outcome. Anatomic recurrence rates of around 30% are frequently described, but this includes women with stage I or II cystocoele who are not symptomatic. A prospective randomised study comparing abdominal para-vaginal repair to anterior colporrhaphy showed no difference between the two techniques in objective (around 70%) or subjective success rates (around 90%).[37]

If re-operation rates are taken as a proxy for symptomatic recurrence, only 3.4% at 2 years[38] or 4.6% at 10 years[39] require re-operation for cystocoele.

Because surgeons are aware of the high rate of anatomic cystocoele recurrence, techniques using mesh have been developed.

MESH VS. NO MESH

The success with permanent mesh in the management of abdominal hernias, and the success of mesh when used as sub-urethral tape for stress incontinence over the last two decades[40] without major long-term complications, has encouraged the introduction of mesh for vaginal repair procedures.

Meshes are biological or synthetic. Synthetic meshes are absorbable or non-absorbable. Synthetic meshes are classified on the basis of their physical characteristics.[41] Type I mesh, which is used most frequently in vaginal reconstructive surgery, has a pore size greater than 90 microns and is constructed using monofilament fibres. The pore size allows macrophage access and fibrous tissue ingrowth. Type II and type III meshes are constructed using multifilament fibres, and have a small pore size that encourages bacterial colonisation. Type IV meshes are not used because they are relatively solid and inflexible.

Type I mesh used in the anterior vaginal wall is either hand cut or factory shaped into multi-arm kits. A recent Cochrane review concluded that there is currently no evidence to support the widespread introduction of the use of mesh in the management of anterior vaginal wall prolapse, citing insufficient evidence that it reduces the incidence of recurrence.[32] The same review concluded that when anterior vaginal repair is supplemented with absorbable mesh there are fewer recurrent cystocoeles, but data on morbidity and other clinical outcomes was lacking.

More recently, in a prospective study of anterior transobturator mesh kit for the management of recurrent anterior vaginal prolapse, 53% of patients had ≤ stage 1 prolapse 6 months to 2 years after surgery, and mesh exposure occurred in 19%, but the majority of women felt an improvement in their symptoms, which did not correlate with the anatomical outcome.

The high incidence of adverse side effects resulting from mesh use has resulted in the publication by IUGA (International Urogynaecology Association) of a classification of complications specified as mesh contraction, prominence, exposure and extrusion. The classification also documents the site of the complication, namely the operation site, the urinary tract, the rectum and the presence of pain (Table 14.1).[42]

ANTERIOR REPAIR VS. ANTERIOR REPAIR PLUS CONTINENCE SURGERY

Should a patient with stage II or greater cystocoele and stress incontinence have anterior repair alone, repair plus sub-urethral tape[43] or a colposuspension? There is currently no consensus.

The addition of colposuspension to abdominal sacrocolpopexy reduces the incidence of stress incontinence,[44] but has not been widely adopted.

POSTERIOR COMPARTMENT PROLAPSE

Tears in the rectovaginal fascia, disruption of the perineal body, reduced function of the puborectalis muscle and enlargement of the urogenital hiatus all contribute to posterior vaginal

Table 14.1: International Urogynaecological Association (IUGA) classification of mesh complications

	CATEGORY				
	General description	**A (Asymptomatic)**	**B (Symptomatic)**	**C (Infection)**	**D (Abscess)**
1	**Vaginal:** No epithelial separation. Include prominence (e.g. due to wrinkling or folding), mesh fibre palpation or contraction (shrinkage)	**1A:** Abnormal prosthesis or graft finding on clinical examination	**1B:** Symptomatic e.g. unusual discomfort/pain; dyspareunia (either partner); bleeding	**1C:** Infection (suspected or actual)	**1D** = Abscess
2	**Vaginal:** Smaller ≤ 1cm exposure	**2A:** Asymptomatic	**2B:** Symptomatic	**2C:** Infection	**2D** = Abscess
3	**Vaginal:** Larger > 1cm exposure, or any extrusion	**3A:** Asymptomatic 1–3Aa if no prosthesis or graft related pain	**3B:** Symptomatic 1–3B (*b-e*) if prosthesis or graft related pain	**3C:** Infection 1–3C/1–3D(*b–e*) if prosthesis or graft related pain	**3D** = Abscess
4	**Urinary tract:** Compromise or perforation. Including prosthesis (graft) perforation, fistula and calculus	**4A:** Small intraoperative defect e.g. bladder perforation	**4B:** Other lower urinary tract complication or urinary retention	**4C:** Ureteric or upper urinary tract complication	
5	**Rectal or bowel:** Compromise or perforation including prosthesis (graft) perforation and fistula	**5A:** Small intraoperative defect (rectal or bowel)	**5B:** Rectal injury or compromise	**5C:** Small or Large bowel injury or compromise	**5D** = Abscess
6	**Skin and/or musculoskeletal:** Complications including discharge pain lump or sinus tract formation	**6A:** Asymptomatic, abnormal finding on clinical examination	**6B:** Symptomatic e.g. discharge, pain or lump	**6C:** Infection e.g. sinus tract formation	**6D** = Abscess
7	**Patient:** Compromise including haematoma or systemic compromise	**7A:** Bleeding complication including haematoma	**7B:** Major degree of resuscitation or intensive care*	**7C:** Mortality* *(additional complication - no site applicable - **S 0**)	
	TIME (clinically diagnosed)				
	T1: Intraoperative to 48 hours	**T2:** 48 hours to 2 months	**T3:** 2 months to 12 months	**T4:** over 12 months	
	SITE				
	S1: Vaginal: area of suture line	**S2:** Vaginal: away from area of suture line	**S3:** Trocar passage Exception: Intra-abdominal (**S5**)	**S4:** other skin or musculoskeletal site	**S5:** Intra-abdominal

N.B. 1. Multiple complications may occur in the same patient. There may be early and late complications in the same patient. i.e. All complications to be listed. Tables of complications may often be procedure specific.
2. The highest final category for any single complication should be used if there is a change over time. (patient 888)
3. Urinary tract infections and functional issues (apart from 4B) have not been included.

CODE ☐ ☐ ☐ - T ☐ - S ☐

prolapse. Unlike anterior colporrhaphy, corrective surgery is less likely to develop recurrence, but is more frequently associated with the development of dyspareunia. There is consensus amongst surgeons that techniques using mesh are rarely needed for the posterior vaginal wall.

Rectovaginal fascia tears occur most frequently just above the perineal body, or just below the cervix, transversely. Lateral tears are also identified at the junction between the rectovaginal fascia and its attachment to the fascia over the puborectalis muscle. In practice, pre-operative evaluation rarely corresponds to intra-operative findings.

POSTERIOR COLPOPERINEORRHAPHY

The term 'posterior repair' covers a range of procedures from perineal reconstruction, to complete pelvic floor repair including repair of hernia of the pouch of Douglas (enterocoele). The operation performed before the concept of fascial repair[45,46] was to approximate puborectalis together in the midline, which almost always caused a constriction and dyspareunia.

The objectives of posterior repair are:

1. Treatment of rectocoele by repair of the rectovaginal fascial defect.
2. Reconstruction of the perineal body.
3. To reduce the size of the urogenital hiatus—not needed very often.

Pre-operatively the lower rectum should be empty, if necessary using a small enema. A pair of Littlewoods forceps is placed at the posterior end of the labium minus bilaterally. A small Kocher forceps is placed on the vaginal wall in the midline, 4 cm from the introitus. The two lateral tissue forceps are drawn outwards and the skin of the perineum is put on the stretch. A thin layer of the stretched skin is excised with a scalpel, in a diamond shape, extending on to the perineal skin. (See Fig. 14.12) If there is no indication to reduce the size of the introitus, a vertical rather than horizontal incision is used.

Two pairs of forceps are attached to the cut edge of the vagina near the midline and pulled posteriorly. The midline vaginal incision is extended with scissors or a scalpel to 3 cm below the cervix. The incision must be made with care, as the anterior wall of the rectum or the anal canal may be closely adherent to the vaginal wall.

Using sharp dissection, the vaginal walls are separated from the underlying rectovaginal fascia and the rectum, as far laterally as the attachment to the fascia over the obturator internus (see Fig. 14.13).

Rectal examination (a 'urology prostrate drape' can greatly help and avoid the need to keep changing gloves) will demonstrate the fascial defects, which can then be repaired. If a large enterocoele is identified (containing loops of small bowel or rarely a sigmoidocoele), it is sensible to open, mobilise and excise the peritoneal sac. The sac is then closed in a double layer of vicryl suture (see Fig. 14.14). If the enterocoele is small (less than 3 cm) there is no need to open the sac, as long as it is possible to close the fascial defect over it. If there is a need to

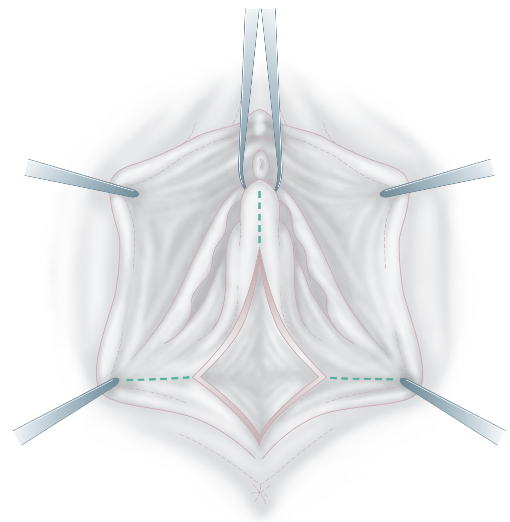


Fig. 14.12: Posterior colpoperineorrhaphy. Diamond shaped incision in posterior vaginal wall.

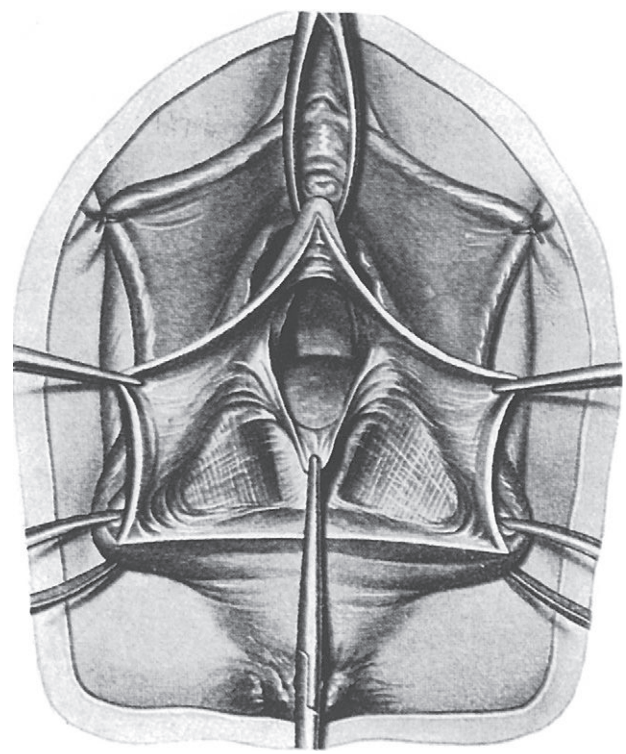


Fig. 14.13: Colpoperineorrhaphy operation. In this operation, the rectovaginal space has been opened up. On each side of the space, the rectal pillars can be seen; the tissue held down in the midline with forceps is the cut prerectal fascia.

provide apical support other techniques are used (see later in this chapter).

To repair the fascial defect, start with the transverse defect, which is almost always present where rectovaginal fascia is separated from the uterosacral ligaments, and work towards the

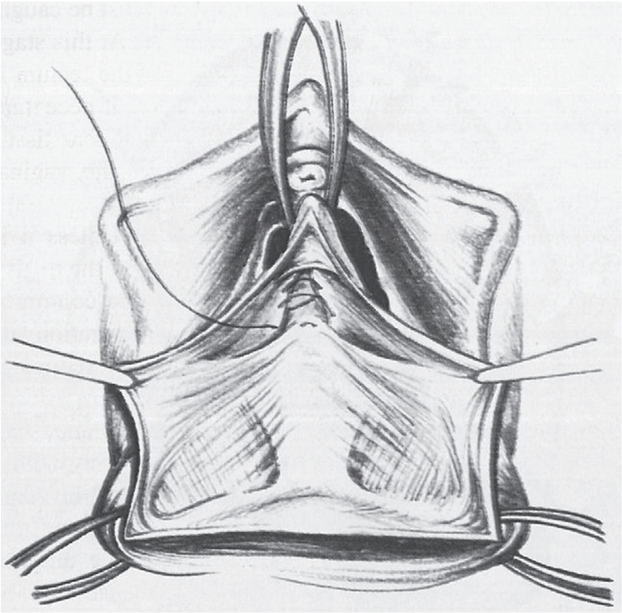


Fig. 14.14: Colpoperineorrhaphy operation. The prerectal fascia is reconstituted by a tier of imbricating sutures.

perineum (some surgeons prefer to start at the perineum). If possible, a two-layer technique is used, starting with site-specific repair and then using a second continuous layer if there is sufficient mobility and vaginal capacity. This lamination will hopefully provide additional strength as it does with a construction beam.

If a patient has a pelvic floor with almost no support, and a large levator hiatus, it is necessary to add sutures laterally and further up the vagina to create a levatorplasty. This inevitably produces a ridge of tissue in the middle of the vagina. To minimise the prominence of the ridge, it is necessary to reconstruct the perineal body more than normally, using a combination of lateral incision of the perineal muscles and a further layer of sutures. The posterior vaginal wall is now sutured down to the hymen (see Fig. 14.15).

Perineoplasty is performed in three layers of interrupted vicryl sutures, after sufficient lateral incision in the perineal muscles to allow lengthening of the perineum (see Fig. 14.16).

Discussion

Rectocoele repair will result in resolution of symptoms of straining and incomplete emptying in the majority of patients,[47] it will not improve patients with slow transit constipation and other primary colorectal problems. Transvaginal repair is associated with less risk of recurrent prolapse than transanal repair.[48] A randomised study compared three techniques, posterior colporrhaphy, site-specific repair and site-specific repair with porcine graft inlay. There were no differences in subjective (15%) failure rate. At 1 year however, there was a lower objective failure rate in the posterior colporrhaphy group as compared to the graft inlay group.[49]

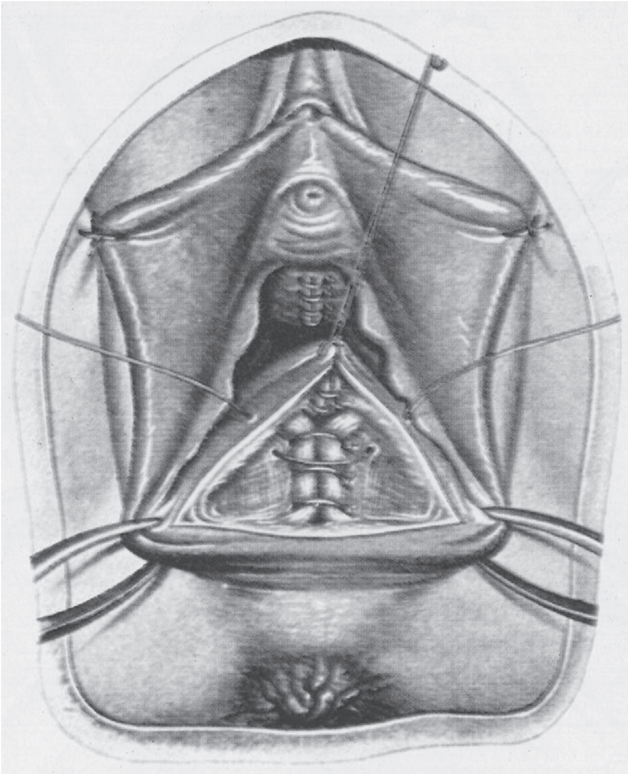


Fig. 14.15: Colpoperineorrhaphy operation. Posterior vaginal wall closure is carried out caudally as far as the apex of the perineal body.

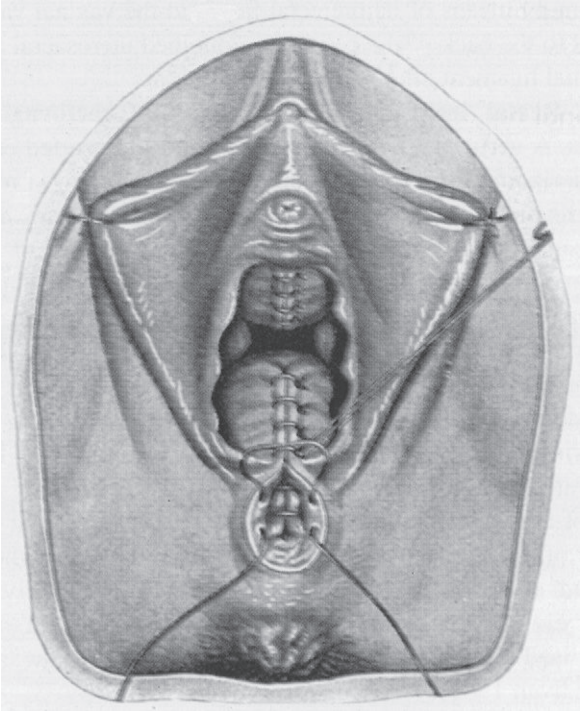


Fig. 14.16: Colpoperineorrhaphy operation. The sub-cuticular method of suturing the tissues of the perineum is shown.

14

APICAL PROLAPSE

Descent of the apex of the vagina (loss of level I support) happens when the uterosacral ligament, the cardinal ligament and the upper fascial attachments of the anterior and posterior vaginal wall give way. It happens very frequently in association with cystocoele and rectocoele. The management of apical prolapse depends on whether hysterectomy has been carried out. There is great variation amongst surgeons as to which procedure to use – this bears witness that no one operation gives a perfect result, and it is necessary to individualise surgery. Hysterectomy itself is not a treatment for vaginal apex prolapse. It has been shown for example that sacrospinous fixation with or without hysterectomy made no difference to the incidence of recurrent vault prolapse.[50]

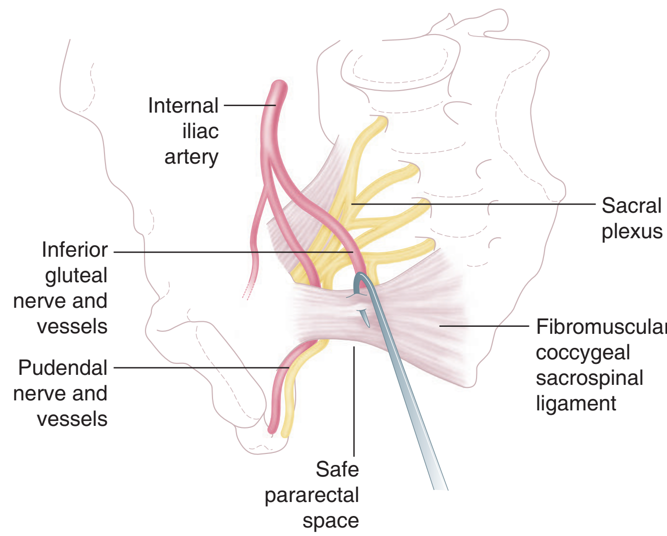


Fig. 14.17: Sacrospinous fixation.

Vaginal Operations to Support the Vault

SACROSPINOUS FIXATION

The following description is for a patient who has had a previous total abdominal hysterectomy. The vagina is incised in the midline. If anterior vaginal repair is needed, this is carried out first, but the vaginal skin incision is not closed. The skin incision is then extended from the apex of the vagina down the midline of the posterior vaginal wall, using the same incision as for a posterior vaginal repair/perineoplasty.

If an enterocoele is present, the pouch of Douglas hernial sac is identified, opened, mobilised, excised and closed. The 'angles' of the vaginal vault are identified and marked with a suture.

The next step is the mobilisation of the right para-rectal space to gain access to the sacrospinous ligament. The tissue between the lateral side of the rectum and the sacrospinous ligament is the rectal pillar, and it is necessary to create a window in the rectal pillar to gain access to the ligament. Some surgeons are happy to pass sutures through the sacrospinous ligament using palpation alone, but the majority of surgeons use two or three single-bladed retractors to support the rectum medially, the peritoneum anteriorly and para-vaginal tissues laterally. The dissection continues until the glistening fibres of the ligament are clearly visible.

The sacrospinous ligament runs posteromedially from the ischial spine to the lateral border of the sacrum and coccyx. The pudendal nerve and vessels run through Alcock's canal posterior to the ischial spine, the sciatic nerve runs superiolaterally to the SSL, and superior to the ligament are the inferior gluteal vessels. The safe place to pass a suture through the ligament is therefore two fingers' breadth medial to the spine, without allowing the suture to go deep to the ligament or superior to the ligament.

Two sutures of delayed absorbable sutures are sited using a specially designed needle passer (miya hook or capio). (see Fig. 14.17) Permanent suture can cause pain that only settles if the suture is removed. One end of each of the sutures is brought through the complete thickness of the vaginal vault. The other end is sutured and tied into the underside of the vaginal vault skin/fascia and is then brought through the vaginal skin so that at the end of the procedure pulling on the free end of each of the two sutures will act like a pulley. The posterior vaginal repair is completed, leaving enough room in the fascial repair for the vault to invert and reach the SSL. The skin of the vagina is pushed upwards towards the sacrospinous ligament and the sutures are tied without tension, even if the vault does not physically reach the SSL. If the sutures are under tension, they are more likely to give way and very likely to cause disabling buttock pain. The procedure can be done in one or both sides.

HIGH UTEROSACRAL LIGAMENT SUSPENSION

This procedure to support the vaginal apex is rarely performed in Europe, but is frequently used as an alternative to sacrospinous fixation in the USA.

The skin over the vaginal vault is incised in the midline, the peritoneum of the enterocoele sac is opened and mobilised from the surrounding structures, posteriorly, up to the level of adherence to the front wall of the rectum. Small bowel adhesions are mobilised and the small bowel packed away, superiorly. Allis' clamps are used to hold the free edge of the vagina at 5 and 7 o'clock, where the remnants of the uterosacral ligaments are thought to be. Using traction, the uterosacral ligament is identified and the ureter is palpated laterally and the rectum medially. Two or three delayed absorbable sutures are placed in each uterosacral ligament but not tied. The distal 2 cm of the uterosacral ligaments are sutured together in front of the rectum to obliterate the Pouch of Douglas. The previously placed delayed absorbable sutures are then brought through the fascia and full thickness of the vagina and tied. The technique will need to be evaluated against other methods of providing apical support, but the incidence of per operative ureteric injury is around 2%, despite intraoperative cystoscopy.

THE MANCHESTER (FOTHERGILL) OPERATION

The objectives of this procedure are:

1. To amputate the cervix leaving approximately 7 cm of uterus.
2. Approximation of the 'connective tissue on either side of the cervix' (i.e. the uterosacral and cardinal ligaments), in front of the cervix. This shortens these ligaments and thus elevates and displaces the cervix posteriorly. This backward displacement encourages anteversion and helps prevent prolapse.

The operation is almost always combined with anterior repair, posterior vaginal repair and perineoplasty.

Preliminary preparation is exactly the same as for the operation of anterior colporrhaphy. The patient is placed in the lithotomy position. The cervix is grasped with vulsellum forceps, and dilated and endometrial curettage performed. The reason for dilating the cervix is that the repair of the cervix can be carried out more easily after the cervical canal has been dilated.

The vaginal incision is in the shape of an inverted tennis racquet with the anterior apex, 3 cm below the urethral opening, encircling the cervix. The classical description of Fothergill's four points makes the operation unnecessarily complicated. The more vaginal skin that is removed lateral to the cervix, the greater the degree of vaginal shortening which must therefore be avoided. It is easy to remove additional skin later in the operation, but you can never put it back once it has been excised.

The vaginal skin is mobilised as for anterior colporrhaphy. The vaginal skin lateral to the cervix is also mobilised to expose the cardinal ligaments (see Fig. 14.18). The bladder (and therefore the ureters) is mobilised, including division of the bladder pillars, but the peritoneum anteriorly is not opened. If needed anterior vaginal repair is carried out.

The cervix is now pulled upwards and forwards to expose the posterior fornix. The vaginal skin is mobilised by sharp and blunt dissection from the pouch of Douglas and from the uterosacral ligaments. The pouch of Douglas is opened, and if an enterocoele sac is present, it is mobilised to the level of the rectum recognisable by longitudinal muscle fibres.

The uterosacral/cardinal ligaments on either side of the cervix can now be seen (they are fused for 2 cm from the cervix). The ligaments and para-cervical tissue to just below the uterine vessels are clamped, divided and sutured for haemostasis. A second suture using a double bite of the avascular pedicle is taken, and left long without cutting off the needle.

The cervix is amputated using needle diathermy or scalpel, just below the internal os (Fig. 14.19).

The next step is to suture the vaginal skin to the back of the cervix. The classical description is to use the Bonney–Sturmdorf suture so that the vaginal skin is enfolded into the cervical canal. This encourages stenosis of the cervix. Therefore, simply suture the vaginal skin edge to the outer edge of the cut surface of the cervix, leaving the cut edge of the cervix to heal as with LLETZ.

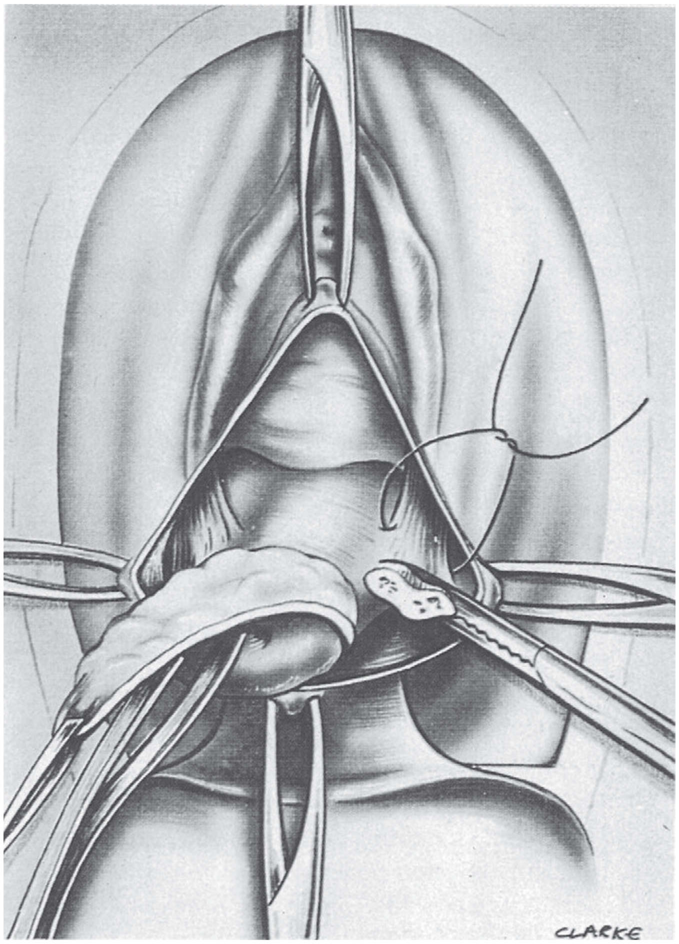


Fig. 14.18: Manchester operation. The left cardinal ligament is exposed, clamped, cut and ligated.

To suture the cardinal/uterosacral ligaments to the anterior lip of the cervix, the classical description is by using Fothergill's key suture. This enters the vaginal skin at the level of Fothergill's lateral point and transfixes a good bite of the cut cardinal ligament pedicles. The needle next enters the cervical canal by being passed from without inwards through the full substance of the anterior cervical muscle near the midline at 12 o'clock. At this stage, the edges of the two lateral flaps are picked up to constitute the anterior part of the Sturmdorf suture. The needle is now re-passed from within outwards and through the cardinal ligament pedicle of the other side and finally out at Fothergill's other lateral point (see Fig. 14.20).

As a modification of this technique, instead of using Fothergill's key suture, I suture the uterosacral/cardinal ligament complex to the front of the cervix using an overlap, as might be used to repair the anal sphincter. The vaginal skin is sewn separately to the anterior edge of the cervix. After excising redundant anterior vaginal wall skin, the vagina is closed with continuous 2/0 vicryl.

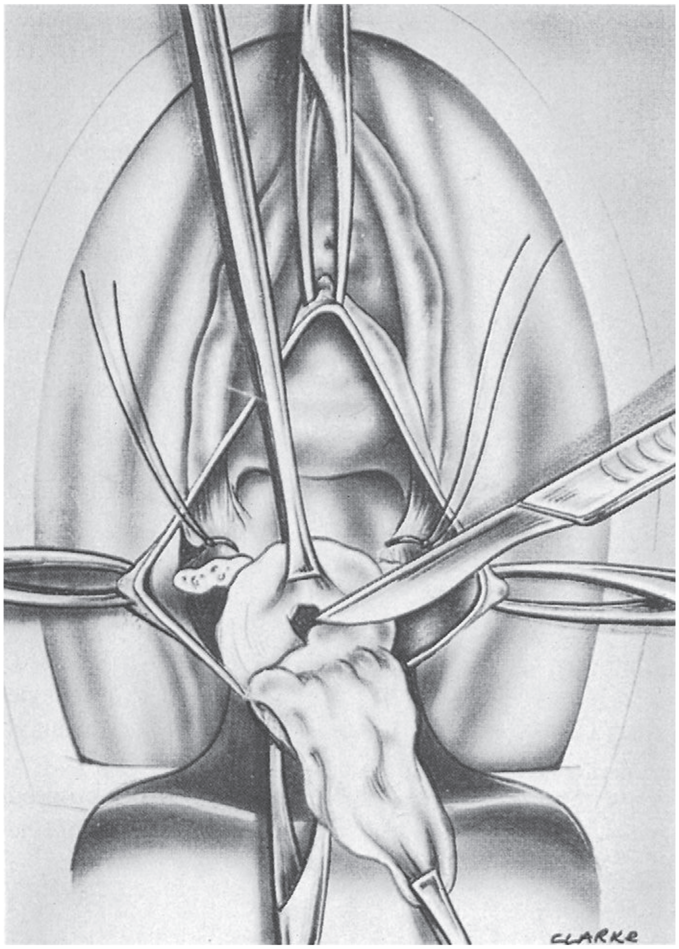


Fig. 14.19: Manchester operation. After cutting and ligating both cardinal ligaments, the cervix is amputated at a high level.

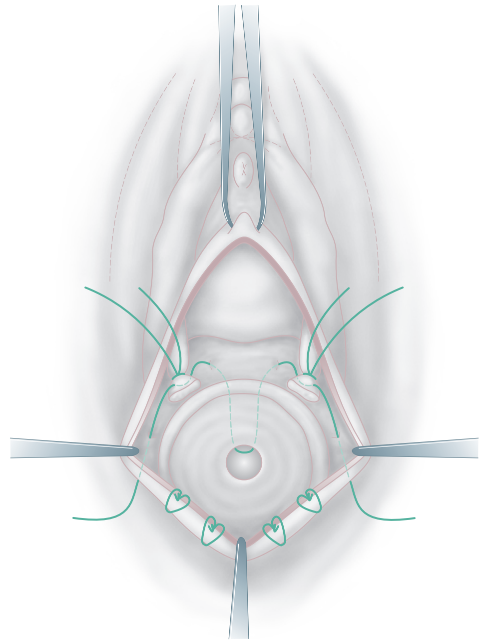


Fig. 14.20: Manchester repair. The posterior lip of the cervix is re-epithelialised with vaginal skin.

ABDOMINAL SACROCOLPOPEXY

Suspension of the vaginal vault from the sacrum using mesh can be done laparoscopically or through laparotomy. Vaginal placement of the mesh is associated with a higher chance of infection and mesh erosion and is not recommended. The patient is placed in Lloyd Davis leg supports. A swab on a stick is placed in the vagina and a rectal sizer is placed in the rectum.

Adhesions throughout the pelvis are freed. The vaginal vault is identified and the peritoneum is opened in order to mobilise the bladder for at least 3 cm anteriorly. Posteriorly the rectum is mobilised for at least 7 cm—some surgeons prefer to free the posterior vaginal surface as far as the pelvic floor.

Attention is turned to the sacrum. After identification of the pelvic structures including the course of the ureter, the peritoneum over the sacral promontory is divided and the incision in the peritoneum is continued across the right side of the pelvis to the vaginal vault. Pre-sacral tissues are gently dissected over S1 S2, trying not to destroy the para-sympathetic nerves and attempting to avoid causing bleeding from the median sacral vessels and the iliac veins.

The mesh is placed over the vaginal vault and sutured using at least three pairs of interrupted prolene sutures posteriorly, one pair of sutures at the vault and two pairs of sutures anteriorly. Sutures are placed using figure of eight bites of the full thickness of the vagina but not entering the vaginal lumen if possible.

The mesh is trimmed and placed across the pelvis without tension. Two or three sutures are placed through the median sacral ligament to attach the mesh.

The peritoneum is closed from the sacrum down to the pelvis and across the vaginal vault in order to achieve complete coverage of the mesh.

Discussion

Abdominal sacrocolpopexy is used as a treatment for vaginal vault prolapse, additionally it can be used at the time of hysterectomy as a measure to prevent future vault prolapse. Sacrospinous fixation is also used as treatment for vaginal vault prolapse and can be used at the time of hysterectomy to prevent future vaginal vault prolapse. A Cochrane review[32] concluded that abdominal sacrocolpopexy was associated with a lower rate of recurrent vault prolapse (0–6%) and less dyspareunia, but there was no difference in the reoperation rates for prolapse. A systematic review for the NICE guidelines[51] showed that the median mesh erosion rate was 4.0% for non-absorbable synthetic mesh. Long-term effects of sacrocolpopexy include an increased incidence of obstructed defaecation[52] and cystocoele. Some degree of cystocoele is very frequently identified after vault suspension procedures, but most are asymptomatic.[53]

UTERINE PRESERVATION OPERATIONS FOR APICAL PROLAPSE

It is very difficult to establish from literature review why hysterectomy was introduced to the management of uterine prolapse and has been the mainstay of surgical management since the 1950s. The uterus can be supported abdominally or vaginally for the management of POP.

Abdominal operations: The uterus has been suspended from the anterior abdominal wall[54] but this was abandoned because it predisposed to a high incidence of posterior prolapse. Alternatively the fundus of the uterus was suspended from the sacrum.[55] More recently, laparoscopic techniques have used mesh sutured around the cervix suspended from the sacrum and these await evaluation.[56]

The Manchester operation was first performed in 1888 by Archibald Donald in Manchester. One of his trainees, Edward Fothergill, modified the operation by adding parametrial fixation.[57] It was performed extensively until the 1950s when it was replaced by vaginal hysterectomy—the reason for the change to hysterectomy did not appear to be evidence based. A few studies comparing vaginal hysterectomy with Manchester repair report similar outcomes with less morbidity[58] and more recently De Boer[59] showed no middle compartment prolapse after Manchester repair at 1 year.

All procedures that provide support to the apex of the vagina alone will need to be combined with procedures to repair vaginal fascial defects and rebuild the perineum if needed.

COLPOCLEISIS

One surgical option for a patient with complete collapse of the pelvic floor, often associated with ulceration of the skin, with or without previous hysterectomy in an elderly patient who is no longer having intercourse, is colpocleisis. This procedure may be performed under regional or local anaesthesia. Several techniques are described, two of which are described below. Stress urinary incontinence is a problem postoperatively due to occult incontinence, which can be prevented by siting a sub-urethral tape.[60]

Partial Colpocleisis

If the patient has not had a hysterectomy, a rectangular incision extending from the cervix to 3 cm below the urethra is made in the anterior vaginal wall and the vaginal epithelium is stripped from the underlying pubocervical fascia. A similar rectangular incision is made in the posterior vaginal wall from the cervix to the perineum, leaving a bridge of vagina 3 cm wide on each side and sufficient vaginal epithelium in front and behind the cervix to allow the first row of sutures to bury the cervix. The vagina is now sutured across the front of the cervix, and the entire anterior vaginal wall is sutured to the posterior vaginal wall in a series of sutures. Laterally there is a tunnel for cervix secretions to drain.

Total Colpocleisis

If the patient has had total hysterectomy, a circumferential incision is made round the base of the prolapse at the level of the hymen. All the vaginal epithelium is stripped off, from the apex of the prolapse to the circumferential incision. A series of delayed absorbable sutures is placed starting with a purse string at the apex of the prolapse (not opening the enterocoele, if possible) and gradually obliterating the vagina. It is wise to place some sutures at the bladder neck to try and prevent stress incontinence, and a modified colpoperineorrhaphy can also be performed. At the lower end of the vagina, the vaginal skin edges are sutured.

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SECTION D

Gynaecological Cancer Surgery

SECTION OUTLINE

Vulval and Vaginal Cancer

15

John Butler, John H. Shepherd

Introduction

Malignant disease of the vagina and vulva are rare conditions, and it is essential that these patients are managed in centres with surgical, radiological, pathological and nursing expertise. Malignant disease of the vulva is the fourth most common malignancy of the female genital tract and accounts for 3% of gynaecological malignancy. There are around 1000 new cases each year in the United Kingdom and 400 deaths. Many vulval cancers occur on the background of pre-invasive disease.

In the United Kingdom, there are around 250 new cases of primary vaginal carcinoma each year.[1] The median age of diagnosis is 63 but the disease can affect all age groups including the very young and elderly. Vaginal adenocarcinomas in younger women are usually of clear cell type, and in women under 30 years of age there is usually a history of vaginal adenosis due to in utero diethylstilbestrol exposure (Fig. 15.1). In infancy, malignant disease of the vagina or cervix is likely to be rhabdomyosarcoma: sarcoma botryoides with a characteristic grape-like appearance.

Fig. 15.1: Adenocarcinoma of the vagina. Clear cell carcinoma of the vagina arising in association with vaginal adenosis in a young woman aged 29. Hysterocolpectomy performed by the synchronous combined technique was followed by immediate split skin graft to the pelvic cavity.

Vulval Intra-Epithelial Neoplasia

Vulval intra-epithelial neoplasia (VIN) is a pre-malignant condition of the vulva with two sub-groups: differentiated VIN (dVIN) and usual VIN (uVIN). uVIN is associated with HPV and is more common in younger women, whereas dVIN is predominantly seen in older women and not related to HPV infection. VIN may progress to vulval cancer and a variety of treatment modalities have been used in order not only to treat disease, but also reduce treatment-related morbidity. The malignant potential of dVIN is greater than uVIN and increases with age.[2] The risk of invasion is around 9% in untreated VIN3 and 3.3% after treatment. Spontaneous regression occurs in 1.3%.[3]

When assessing VIN, it is essential that the vagina, cervix and anal canal are examined as there may be similar changes elsewhere. The progression rate of VIN to invasive cancer is substantially greater than for CIN.[4]

INVESTIGATION

When there is hyperkeratosis, colposcopy of the vulva is of limited value because the keratin prevents assessment of the capillary vascular pattern, which is a key feature in the assessment of cervical intra-epithelial neoplasia. Within the vestibule and adjacent thin skin colposcopy is usually feasible using acetic acid. Toludine blue may be utilised to target biopsy sites.[5]

Obtaining material for histological examination is essential to identify invasion and margins, as naked eye assessment of the margins is unreliable. For more widespread lesions, multiple drill biopsies should be performed using a Keyes punch biopsy.

TREATMENT

A variety of treatment modalities have been used to treat VIN: local excision, total vulvectomy, skinning vulvectomy, photodynamic therapy, laser ablation and imiquimod.[6,7]

The choice of treatment depends on the location of disease, surrounding skin tissue quality, cosmesis and previous treatments. Radical vulvectomy is rarely indicated for VIN, and historically there has been significant overtreatment of pre-invasive lesions, as described in earlier editions of this and other recognised text books.

Where there is extensive involvement of the vulva, a skinning vulvectomy may be performed. The skin alone may be removed preserving the contour of the underlying fat and sparing the glans of the clitoris.[8] On occasion, if local skin flaps cannot be used, skin grafts may be required.[9,10] Following extensive grafting forced immobilisation may be necessary to reduce physical stress on the operative sites.

Alternative treatments are topical cytotoxic agents, the immune response modifier imiquimod and laser ablation therapy. Laser therapy to the vulva is often extremely painful. Invasion must be excluded prior to any non-excisional technique.

Carcinoma of the Vulva

Although carcinoma of the vulva occurs most commonly between the ages of 60 and 70, the incidence is rising in younger patients with HPV-related tumours. The tumour usually develops in the labium majus, but it also arises in the labium minus (Fig. 15.2), clitoris, perineum, Bartholin's gland and rarely in episiotomy sites.[11]

The FIGO international staging was revised in 2009 and is shown in Table 15.1.

The histological type is usually squamous (90%), and the remainder are verrucous and basal cell carcinomas, malignant melanoma, adenocarcinomas, carcinoma of Bartholin's gland, sarcomas, metastatic tumours and Paget's disease. The pattern of spread is initially local and then to the regional inguino-femoral lymph nodes. It was originally thought that all tumours would spread to the superficial and then the deep femoral nodes, but many patients with negative superficial nodes will have disease in the deeper nodes.[12–14]

Patients usually present with pruritus, a vulval ulcer, warty growth, pain or bleeding. Most patients have been symptomatic for over 6 months before diagnosis and many patients seek medical advice only when the tumour has reached appreciable dimensions.[15] It is rare for the tumour to ulcerate in the early stages and elderly patients often self-treat the condition conservatively with ointments prior to seeking medical attention. Carcinoma of the vulva arising in one labium majus may be followed by the development of a similar tumour at the corresponding position in the opposite labium.

Modern oncological practice in carcinoma of the vulva has moved away from universal radical surgery to a more individually tailored approach (Figs. 15.2a and 15.2b).[16] Uniform application of a Way-Bassett radical vulvectomy and en bloc dissection of the groins is rarely appropriate. Conversely, some form of infra-levator exenteration may occasionally be required (see Chapter 16). Posterior lesions that encroach upon the anal canal may be treated by combination chemoradiotherapy which, in some cases, is so successful that radical surgery involving the anus can be avoided (see Fig. 15.3).[17,18] Fixed inguinal nodes may also be treated by radiotherapy (with or without chemotherapy).

Table 15.1: FIGO staging of carcinoma of the vulva

Stage I	Tumour confined to the vulva
IA	Lesions ≤2 cm in size, confined to the vulva or perineum and with stromal invasion ≤1.0 mm*, no nodal metastasis
IB	Lesion >2 cm in size or with stromal invasion >1.0 mm*, confined to the vulva or perineum, with negative nodes
Stage II	Tumour of any size with extension to adjacent perineal structures (1/3 lower urethra, 1/3 lower vagina, anus) with negative nodes
Sage III	Tumour of any size with or without extension to adjacent perineal structures (1/3 lower urethra, 1/3 lower vagina, anus) with positive inguino-femoral lymph nodes
IIIA	(i) With 1 lymph node metastasis (≥5 mm), or
	(ii) 1–2 lymph node metastasis(es) (<5 mm)
IIIB	(i) With 2 or more lymph node metastases (≥5 mm), or
	(ii) 3 or more lymph node metastases (<5 mm)
IIIC	With positive nodes with extracapsular spread
Stage IV	Tumour invades other regional (2/3 upper urethra, 2/3 upper vagina), or distant structures
IVA	Tumour invades any of the following:
	(i) upper urethral and/or vaginal mucosa, bladder mucosa, rectal mucosa, or fixed to pelvic bone, or
	(ii) fixed or ulcerated inguino-femoral lymph nodes
IVB	Any distant metastasis including pelvic lymph nodes

*The depth of invasion is defined as the measurement of the tumour from the epithelial-stromal junction of the adjacent most superficial dermal papilla to the deepest point of invasion.

(Revised FIGO staging for carcinoma of the vulva, cervix, and endometrium. *Int J Gynaecol Obstet*. 2009;105(2):103–4.)

Fig. 15.2a: Left-sided primary carcinoma of vulva.

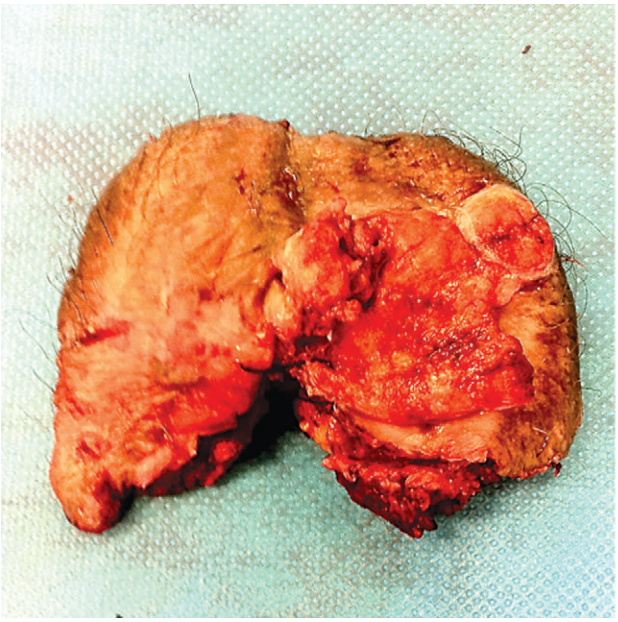


Fig. 15.2b: Surgical excision specimen of tailored (anterior horse-shoe) vulvectomy.

Fig. 15.2c: Primary skin closure of vulval defect.

However radical radiotherapy may produce as many distressing side effects as radical surgery.

All treatment modalities are associated with morbidity, and despite cure many patients are left with long-term sequelae from their treatment, such as lower limb lymphoedema, groin lymphocyst and psychosexual problems.

Lymph node metastases may occur with all invasive tumours but metastasis is very rare if the depth of invasion is less than 1 mm.[19] Lymph node metastases are more common with

Fig. 15.3: Carcinoma of vulva. A very extensive fungating carcinoma of the vulva involving the whole of the left labium minus and majus and extending over the perineum to invade the anal canal.

increasing depth of invasion and tumour diameter, lymphovascular or perineural invasion and poor tumour differentiation. Well-lateralised small tumours (<2 cm diameter and >2 cm from midline) are thought to drain only to the ipsilateral inguino-femoral lymph nodes and can safely be managed with unilateral lymphadenectomy.[20]

SURGICAL CONSIDERATIONS

The surgical approach should consider: (*i*) the management of the vulval lesion/s, (*ii*) the management of the lymph nodes and (*iii*) the reconstruction of defects.

Management of the Vulva

It is most important to have adequate clear margins of the tumour. This will always involve wider and deeper excision on the side of the tumour, particularly on the deep aspect and on the vestibular aspect. It is illogical to compromise proximal margins by preserving the distal urethra while taking large expanses of skin on the outer aspect. In addition, it has to be remembered that the lymphatics decussate around the terminal

15

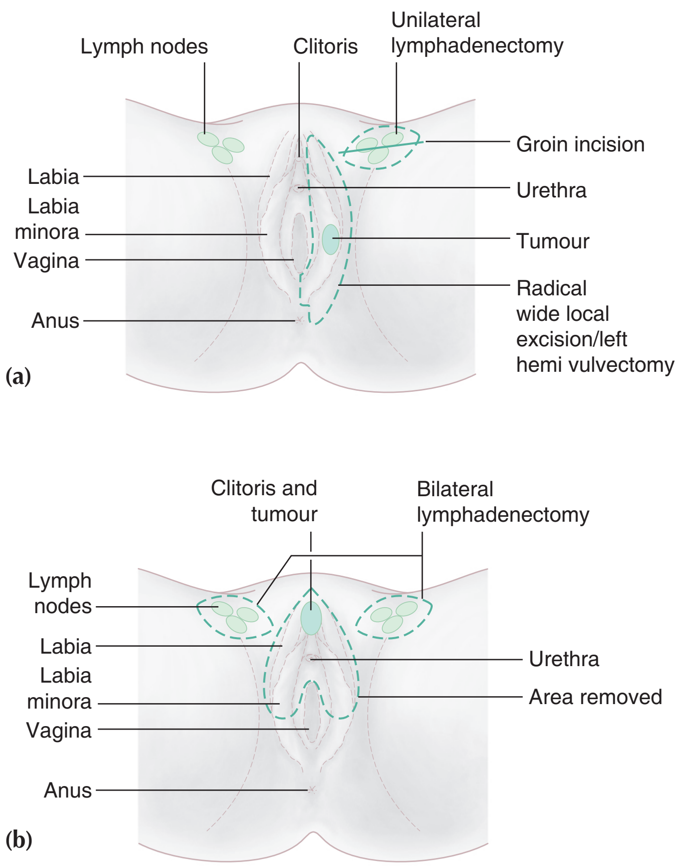


Fig. 15.4: **(a)** Lateral tumour – radical wide local excision on the left with ipsilateral groin node dissection. **(b)** Clitoral tumour – Upper partial "horseshoe" vulvectomy/radical wide local excision. **(c)** Posterior centrolateral tumour: Radical posterior wide local excision of a central vulval tumour with a bilateral groin node dissection. **(d)** Large central tumour: radical vulvectomy with total removal of the vulva and bilateral lymphadenectomy.

urethra. Local recurrence rates are low if the paraffin section margin is greater than 8 mm, and this typically equates to a 15–20 mm surgical margin.[21,22]

The excision may involve resection of the distal 1 cm of the urethra without compromising bladder function.[23] If a clear resection margin would involve resecting the anal sphincter consideration should be given to pre-operative radiotherapy. Particular attention and pre-operative discussion with the patient should be made for tumours near or involving the clitoris that may compromise sexual function.

Excision of the Vulva

Although magnetic resonance imaging is useful to assess the extent of disease, in most cases examination under anaesthesia should be conducted prior to definitive surgery. This will allow a surgical and histological assessment of the extent of invasive disease to plan the extent of vulval resection. This is particularly important in patients with multifocal disease where radical local excision rather than radical vulvectomy is being considered.

The patient should be placed in the Lloyd-Davies or lithotomy position and the vulval skin excision lines marked including the inner resection margin from the vagina, which may include the terminal urethra. Intravenous antibiotics should be administered.

The excision is best carried out from behind forwards (Fig. 15.4). Careful scissor dissection is required in the midline inferiorly to avoid unnecessary damage to the anal sphincter mechanism and at the same time to avoid 'buttonholing' the vagina. It may be necessary to remove part of the lower vagina on the side of the tumour in order to get an adequate excision margin. On the side of the tumour all fat should be excised from the ischiorectal fossa on the deep aspect. Cutting diathermy is the best operating tool and by working from behind forwards, the operating field is not continually obscured by blood. For anterior excisions, the depth should reach the inferior pubic rami and the perineal membrane exposing the periosteum of the symphysis pubis anteriorly. The posterolateral internal pudendal vessels and clitoral vessels should be identified clamped and tied.

There is unusually sufficient lax skin in order to obtain primary closure without tension on the tissues, particularly if a radical wide local excision of the tumour is performed that does not involve the mons pubis. Adequate subcutaneous fascia should be retained if undercutting is necessary in order to preserve the blood supply of the skin.

Tailored Surgery

In many instances, part of the distal vagina and lowest portion of the urethra must be sacrificed with the operation specimen.

Management of the Lymph Nodes

All tumours with a depth of invasion of greater than 1 mm should have a surgical and pathological assessment of regional lymph nodes. A variety of incisions have been used for inguino-femoral node dissection, and in the absence of intervening tumour, there is no benefit in excision of the skin bridge between the vulval tumour and nodal bed even in the presence of metastatic disease. Therefore, for most tumours the lymphadenectomy can be performed by separate incisions from those for the vulvectomy and a unilateral dissection in well-lateralised tumours.[24] With fixed groin nodes, excision of the overlying skin will often be necessary.

In selected cases (unifocal tumour less than 4 cm), sentinel node dissection appears to be a safe alternative to a full inguino-femoral lymphadenectomy.[25]

Clinically Relevant Anatomy

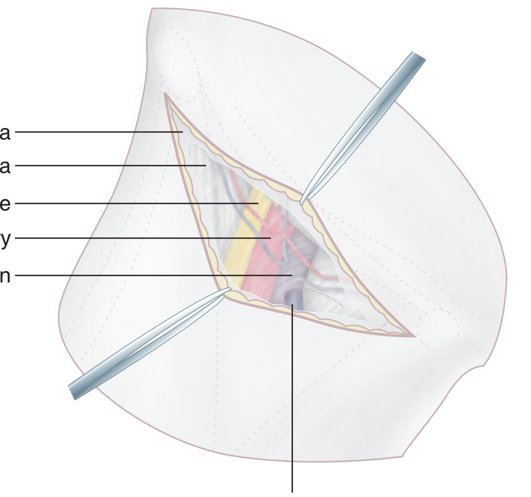
There are two groups of inguino-femoral lymph nodes: superficial and deep. The nodes lie within the femoral triangle bordered laterally by sartorius, medially by adductor longus and superiorly by the inguinal ligament (superior). The roof of the femoral triangle is formed by fascia lata, and the floor is comprised of the iliopsoas and pectineus. The superficial lymph nodes are found deep to Camper's fascia and superficial to fascia lata in the femoral triangle. The deep nodes usually lie just deep to the sapheno-femoral junction in the fossa ovalis medial to the femoral vein.

Groin Incision

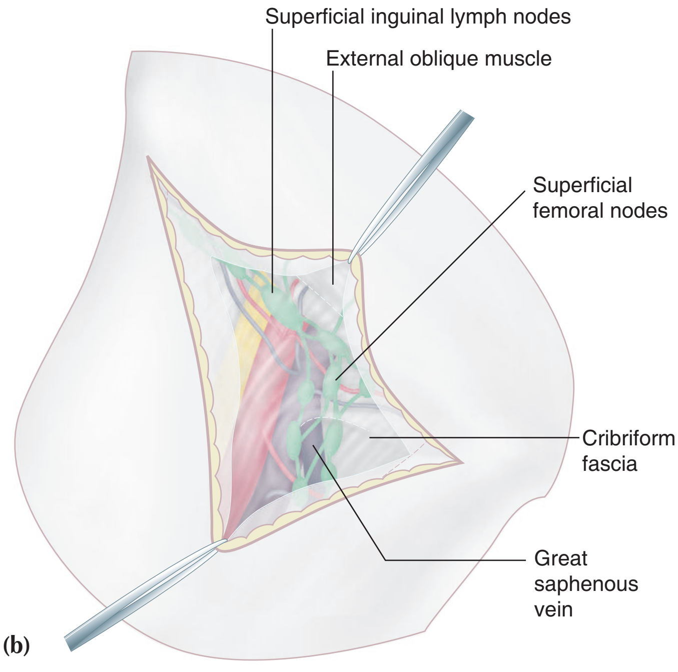
There are a variety of approaches to access the femoral triangle including transverse, vertical and 'lazy-S'. A transverse incision is preferred and should be in the medial section along a line between the anterior superior iliac spine and pubic tubercle. This is typically 1–2 cm above and parallel to the groin crease. The incision should be made cosmetically in a skin crease corresponding to Lange's lines. A vertical incision through the skin and subcutaneous fat should be performed in order to preserve a well-vascularised skin flap. The superficial node bearing tissues lie deep to the superficial fascia and above the fascia lata, i.e. in Scarpa's fascia. This tissue should be dissected extending 2 cm above the inguinal ligament (Fig. 15.5).

Further dissection of the femoral triangle will identify and allow isolation of the great saphenous vein and superficial veins near the fossa ovalis (superficial epigastric, superficial iliac circumflex and superficial external pudendal veins) (Fig. 15.6).

The separation is easy except in the vicinity of the inguinal ligament, where it will be found that the subcutaneous fat is



(a)



(b)

Fig. 15.5: **(a)** Transverse incision in the medial section of a line between anterior-superior iliac spine and pubic tubercle. **(b)** Superficial node bearing tissue deep to superficial fascia and above cribriform fascia.

adherent to the ligament. In the lower part of the wound lies the saphenous vein together with two large tributaries that lie on its lateral aspect. Each of these may be ligated in two places and divided between the ligatures. If possible the saphenous vein may be preserved in order to reduce lymphoedema.[26] Above and laterally, the superficial circumflex vessels together with their associated fascia and fat are divided between ligatures, and the same procedure is employed for the superficial epigastric vessels.

The pad of fat containing the superficial inguinal nodes is now turned medially and the falciform edge of the saphenous ring

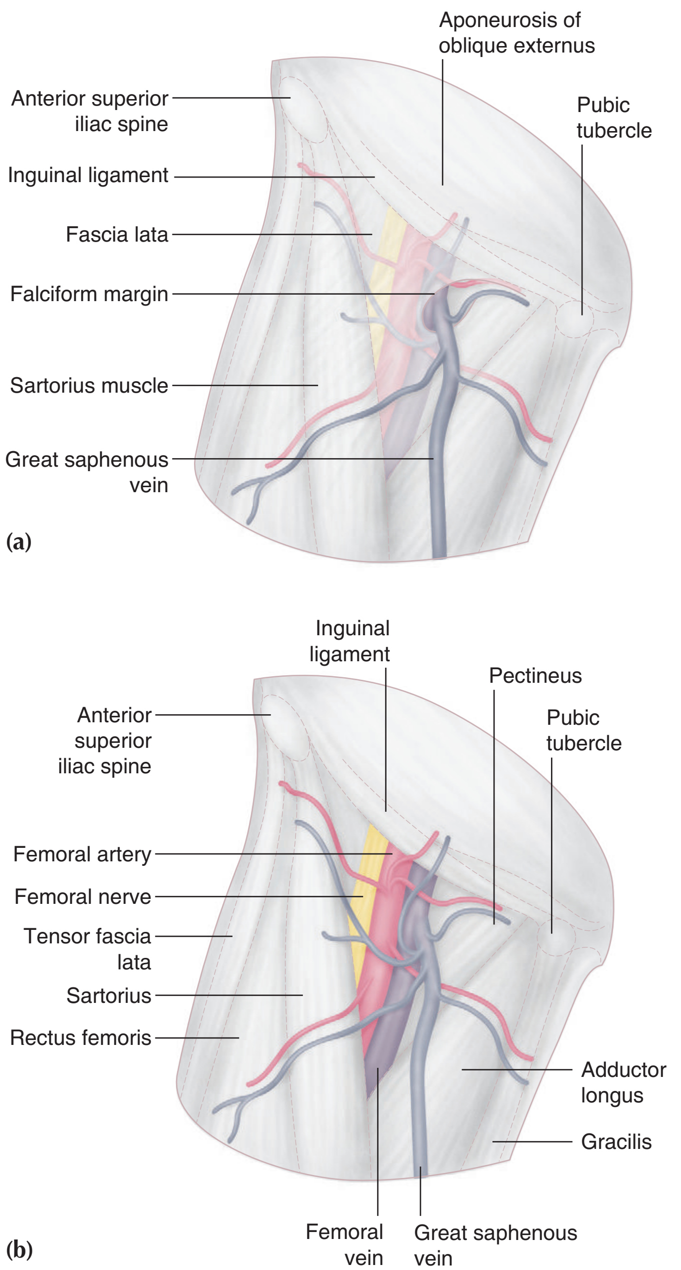


Fig. 15.6: Important anatomical landmarks for **(a)** superficial node dissection and **(b)** deep node dissection.

exposed. The saphenous vein is identified at the lower end of the thigh incision and may be clamped and ligated in this distal position. The saphenous vein together with the longitudinal group of associated lymph nodes can be dissected right back to the sapheno-femoral junction where the saphenous vein may be clamped and ligated. Since the femoral vein is, by this method, readily visualised, the risk of damage to it is very largely avoided. Providing the subcutaneous fascia (Camper's fascia) is left attached to the skin, primary closure is usually feasible.

The deep inguinal nodes are up to three in number, the most distal being adjacent to the sapheno-femoral junction, with others lying proximally in the femoral canal, the most proximal being the (inconstant) node of Cloquet within the canal. The cribriform fascia is fenestrated and a distinction between superficial and deep inguinal nodes in this region is often not clear. It is rarely appropriate to carry out an intra-pelvic lymphadenectomy as if positive inguinal or pelvic nodes are present, radiotherapy or chemoradiotherapy is preferred. If warranted an extra-peritoneal dissection may be performed. A closed suction drain should be placed after completion of the lymphadenectomy and the wound closed in layers.

In cases where the skin overlying skin is fixed or tethered to nodes, the overlying skin and skin bridges to the vulva should be excised—a traditional butterfly vulvectomy, as it is likely that there is significant extra-capsular spread of disease to the subcutaneous tissues.

Sentinel Node

The concept of the sentinel node is that there will be a lymph node that receives lymphatic flow from a tumour before widespread dissemination to the regional nodal basin. If this node is removed, examined and does not contain metastatic tumour then other nodes will not contain tumour and a full lymphadenectomy with its attendant morbidity avoided.

The sentinel node may be identified by injection of methylene blue and/or a radioactive tracer (e.g. Technetium-99m-labelled nanocolloid). Pre-operative lymphoscintigraphy may also be used to identify the number and location of sentinel nodes.

Suitable patients are those with: unifocal tumours <4 cm, no enlarged or fixed nodes or suspicious nodes on CT, MRI or ultrasound. A combined technique using pre-operative radioactive tracer injection and intra-operative blue dye injection is most effective in identifying sentinel nodes. The gamma probe is used to identify the 'hot spot' and a small incision made in the groin to follow the blue lymph channels and excise the sentinel node. The node is then sent for histopathological ultrastaging and a full lymphadenectomy performed if positive.[25]

POSTOPERATIVE CARE AND COMPLICATIONS

Although there has been a significant reduction in morbidity and mortality following surgery for vulval cancer, the morbidity following surgery remains high. Complications include wound dehiscence of the groin or vulva, cellulitis, lymphocyst formation, thrombosis, lymphoedema and psychosexual dysfunction. The most frequent serious complication is wound dehiscence of the groin incision and the cause of this complication is twofold. The blood supply to this area of skin may have been compromised by the division of the small arteries coming out of the saphenous opening (skin undercutting should always be close to the membranous layer of the superficial fascia); also the lymphorrhoea following the lymphadenectomy fills a dead space and provides a pabulum for infection. It is important to use

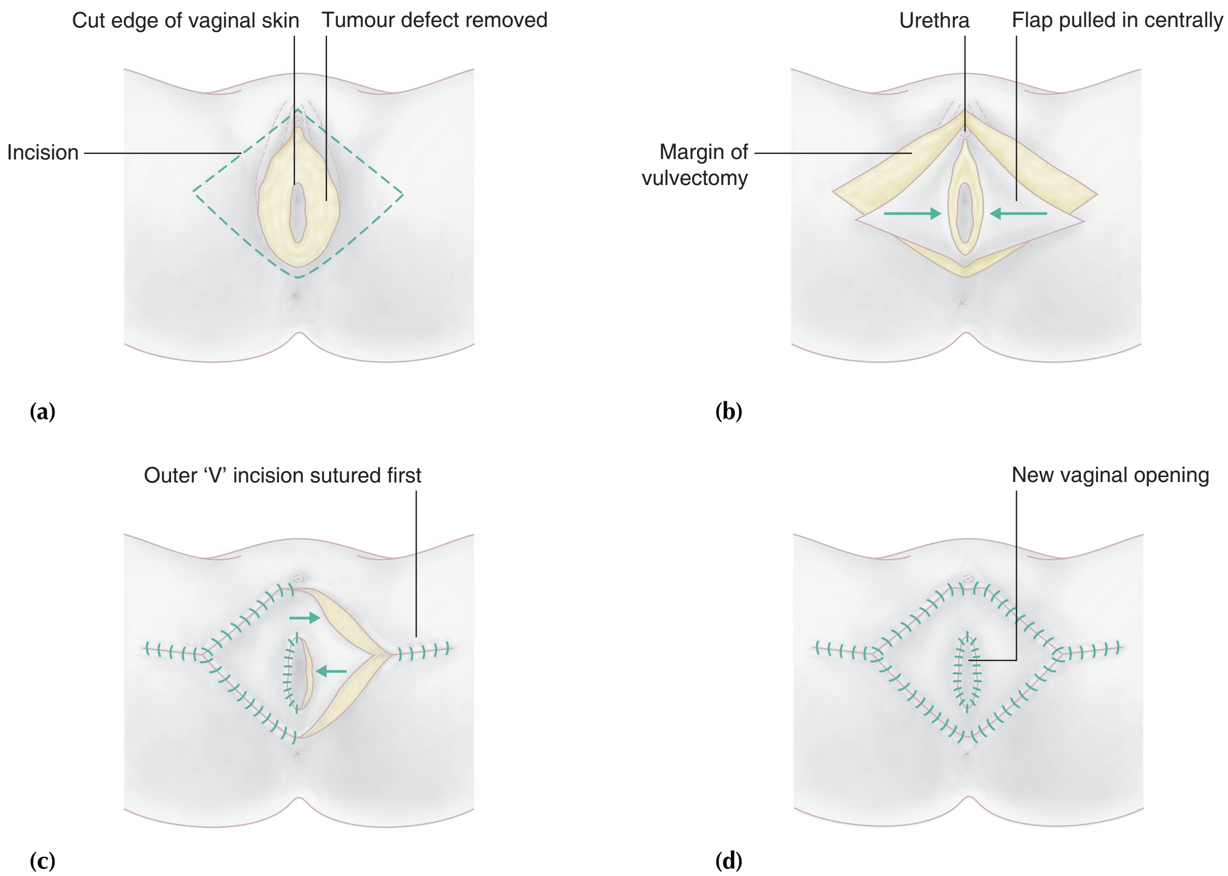


Fig. 15.7: V-Y advancement flap to close vulval defect.

suction drains and to maintain them for much longer than would ordinarily be the case – typically 3–5 days. Urethral catheterisation should remain until mobility and peri-urethral oedema have improved. In cases where a distal urethrectomy has been performed, the catheter should remain for 7–10 days. It is the authors' practice to alternate daily taping of catheter to each thigh to help ensure a normal urinary stream. Vulval douching should be performed with a bladder syringe and water three times a day, or with a positioned showerhead with bidet. A mirror is often helpful to educate the patient for self-care. If there have been extensive resections or tissue tension, consideration should be given to bed rest and flexion of the hip to reduce strain. Infected areas of wound breakdown may be successfully treated with Manuka honey.[27,28]

RADICAL VULVAL SURGERY

Unfortunately some patients will present late with large tumours, develop locally advanced recurrences, or recurrences in a radiotherapy field where local excision and simple closure is not feasible. Many of these patients may be suitable for exenterative procedures with myocutaneous flap reconstruction and urinary and/or bowel diversion.

Local flaps commonly used are rhomboid, lotus petal and VY advancement.[29] Pedicled myocutaneous flaps include rectus abdominis, rhomboid, gracilis, tensor fascia lata and gluteus maximus.[30] It is important that tissue is not under tension and is healthy and well vascularised or breakdown is likely.

The most straightforward flap is the V-Y advancement flap. A triangular incision is made in the lax area of skin adjacent to the defect. If possible the height of the triangle should be twice the diameter of the defect. Closing the defect and donor site should be performed without tissue tension, and care taken, as with all flaps, to ensure good vascularisation and minimal stretching of the flap with mobilisation (Fig. 15.7).

Rhomboid (Fig. 15.8) and lotus petal (Fig. 15.9) transposition and rotation flaps may be used to close larger defects.[31] If local flaps are not feasible due to large defects or skin quality after radiotherapy or previous treatment then pedicled myocutaneous flaps may be used. The rectus abdominis and gracilis are the most commonly used sites and these may used for both vulva and groin defects.[32–36]

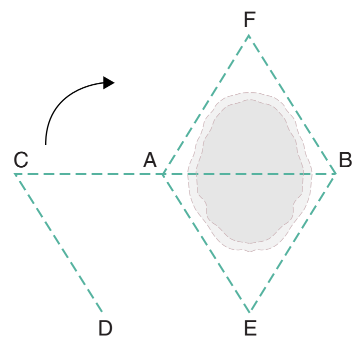


Fig. 15.8: Schematic representation of a rhomboid flap (AB = AC).

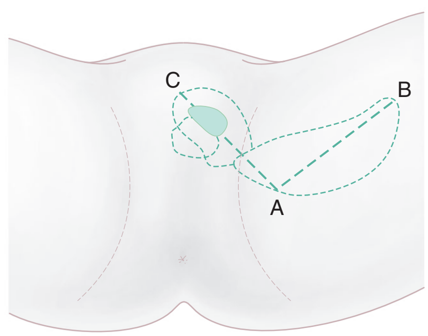


Fig. 15.9: Schematic representation of a lotus petal flap (AB = AC).

Other Forms of Vulval Malignancy

MALIGNANT MELANOMA

Vulval melanoma is the second most common vulval malignancy (5% of vulval cancers) but accounts for only 1% of melanomas. The tumours can present at any age but usually arise in patients aged between 50 and 60 and develop either from the clitoris, the labium majus or the labium minus. They are generally easily recognised because of their dark brown colour, but the amelanotic variety should not be forgotten.[37] Nevertheless all pigmented lesions on the genitalia, as in the male, should be regarded seriously. They are of the junctional variety and are potentially if not actually malignant. Treatment for localised primary vulvar melanomas is local excision with clear (1–2 cm) margins.[38]

Tumours with a depth of ≤1 mm do not need a lymphadenectomy, as they have a very low risk of nodal metastasis and lymphadenectomy may be avoided. For deeper tumours, sentinel node biopsy or lymphadenectomy may be performed. Inguino-femoral lymphadenectomy should be performed if there is nodal involvement to improve locoregional control, but this may not influence survival, as it is usually distant rather than local disease that accounts for treatment failures.

METASTATIC TUMOURS OF THE VULVA

These are occasionally seen, arising from primary growths of the uterus and ovaries, including choriocarcinoma. Local treatment is not required unless the primary growth is removed.

CARCINOMA OF BARTHOLIN'S GLAND

Primary carcinoma of Bartholin's gland is a rare disease. It may be squamous, transitional, adenoid cystic or an adenocarcinoma arising from the gland. It usually arises between the ages of 40 and 55. The treatment recommended is the same as for carcinoma of the vulva for most tumour types. Attention should be paid to excision margins as the tumour may extend deeply into the ischiorectal. It should be remembered that the lymphatics from Bartholin's gland drain into the anorectal glands as well as into the inguinal group.

Adenoid cystic tumours require local excision with lymphadenectomy reserved for clinically or radiologically suspicious lymph nodes. Radiotherapy should be considered for close margins or in the presence of peri-neural invasion.[39]

BASAL CELL CARCINOMA OF THE VULVA

Rodent ulcers of the vulva are rare. Piura et al.[40] estimated the incidence from a review of the literature to be 7% of all vulval cancers. The average age of the patient was found to be 70.5 years and the usual site is the labium majus, though rodent ulcers have been reported in the scar of a simple vulvectomy. The commonest single symptom is pruritus, and the growth presents as an ulcer or obvious tumour, which is noted by the patient. Serous discharge and crust formation are sometimes present.

Diagnosis is made by biopsy and treatment is either by radiation or excision. If surgically feasible, a wide local excision is satisfactory since the tumour is not considered to be metastatic. It is naturally important to include a generous margin of healthy skin. One advantage of surgical excision as opposed to radiation is that a full histological examination of the specimen is available for confirmation of the diagnosis and establishment of the extent of the growth.

SARCOMA

Although rare, there are several forms of sarcoma more usually found in other parts of the body that may arise in the vulva.[41] Some are of relatively low-grade malignancy and may respond well to wide local excision. Others are very aggressive and are best treated by a full range of multimodal therapy.

Malignant Diseases of the Vagina

PRESENTATION

Presenting symptoms of vaginal cancer include irregular painless vaginal bleeding, discharge, pain, dyspareunia and incidental findings during speculum or pelvic examinations. Risk factors include a history of cervical cancer, CIN or HPV, smoking, multiple sexual partners and DES exposure.

ASSESSMENT AND STAGING

The diagnosis of primary cancer of the vagina requires confirmation that the disease is arising from the vagina and

Table 15.2: Carcinoma of the vagina: FIGO nomenclature

Stage 0	Carcinoma in situ; intra-epithelial neoplasia Grade III
Stage I	The carcinoma is limited to the vaginal wall
Stage II	The carcinoma has involved the subvaginal tissue but has not extended to the pelvic wall
Stage III	The carcinoma has extended to the pelvic wall
Stage IV	The carcinoma has extended beyond the true pelvis or has involved the mucosa of the bladder or rectum; bullous oedema as such does not permit a case to be allotted to Stage IV
IVa	Tumour invades bladder and/or rectal mucosa and/or direct extension beyond the true pelvis
IVb	Spread to distant organs

does not involve the cervix, urethra, vulva or other areas of the anogenital tract. It is not always possible to be certain where a cancer in the vaginal vault involving the cervix has originated and if in doubt it should be attributed to the cervix. If the vulva is involved the disease should be classified as vulval carcinoma.

The patient should be examined under anaesthetic including colposcopic examination, cystoscopy, sigmoidoscopy and representative biopsies to assess invasive and pre-invasive disease to guide treatment. A partial vaginectomy may be required to assess invasion.

An MRI scan should be performed of the pelvis to examine soft tissue invasion and lymphadenopathy. If extra-pelvic disease is suspected, CT scan of the abdomen and thorax should also be performed. There should be histologic verification of the disease.[34]

The international staging is recorded in Table 15.2.

MALIGNANT MELANOMA

This rare but serious malignancy of both vagina and urethra is usually in the group with poor prognostic features. The management principles are as for melanoma of the vulva, i.e. radical wide local excision.

Surgical Treatment of Cancer of the Vagina

Due to the rarity of vaginal cancer there have been no major studies to prospectively compare the outcomes of surgery and radiotherapy. Surgery may be applicable in the following cases:

Stage 1 squamous cell cancer, stage IVA disease in the presence of fistula, central recurrence after radiotherapy, clear cell cancer, verrucous carcinoma, melanoma, embryonal rhabdomyosarcoma and endodermal sinus tumour. Surgery may be preferred to radiotherapy in younger patients seeking to preserve sexual and ovarian function that would be more compromised by radiotherapy.

Stage 1 vaginal cancer is limited to the vaginal epithelium and may be treated by surgery and/or radiotherapy. Lymph node involvement is present in around 5%–16% of patients. Surgical treatment includes wide local excision with clear margins, partial vaginectomy, simple vaginectomy and radical vaginectomy.[42] Surgical treatment alone for stage 1 vaginal cancer has reported 5 year survival rates between 56% and 90%. Surgical treatment will depend on anatomical location, it being easier to obtain clear margins with posterior upper tumours than at other sites that may involve resection of bladder (anterior), or rectum (posterior). Tumours close to the cervix should be treated by radical hysterectomy and upper colpectomy to obtain both adequate tissue margins and access. This may be performed either laparoscopically or by open surgery.

To perform a wide local excision intact vaginal epithelium around the tumour should be grasped and a full thickness elliptical excision made with a scalpel to achieve 1–2 cm margins. Metzenbaum scissors should be used to free the specimen from the rectovaginal fascia. The defect should be closed with interrupted absorbable sutures. Lymphadenectomy should be performed using a standard technique – pelvic lymphadenectomy for tumours of the upper two-thirds and inguino-femoral lymphadenectomy for tumours of the lower third.[43] It should be noted that it is rarely possible in the older population to perform an adequate wide local excision without a concurrent radical hysterectomy.

Fertility preservation remains an option in young women with stage 1 cancers and this may include a trachelectomy and preservation of the uterus.[44–47]

Lower vaginal tumours may involve a partial or total vaginectomy and radical partial or total vulvectomy, to ensure a wide excision of adjacent vulval tissue.

Stage 2 vaginal cancers involving the vaginal sub-epithelial tissue but not the parametrium may also be appropriate for surgical treatment, with or without postoperative radiotherapy. There may also be a role for surgery for patients receiving neoadjuvant chemotherapy and a good response is often seen perhaps due to the rich vascular supply of the vagina.[48]

Surgical Technique

A variety of surgical approaches for the radical excision of vagina, cervix and uterus have been described. The operation of synchronous combined abdominovaginal hysterocolpectomy was devised by Howkins[49] to extend the scope of surgical treatment of cervical cancer.[50] A laparoscopic approach may be taken to perform radical hysterectomy and vaginectomy.[51]

TECHNIQUE

A combined vaginal and abdominal approach may be performed by two teams. The patient should be positioned in an extended lithotomy position. The abdominal approach should be performed appropriate for a radical hysterectomy. The vaginal approach commences with a circumferential incision around the vaginal opening, or vulva if the vaginal tumour encroaches the introitus (Fig. 15.10).

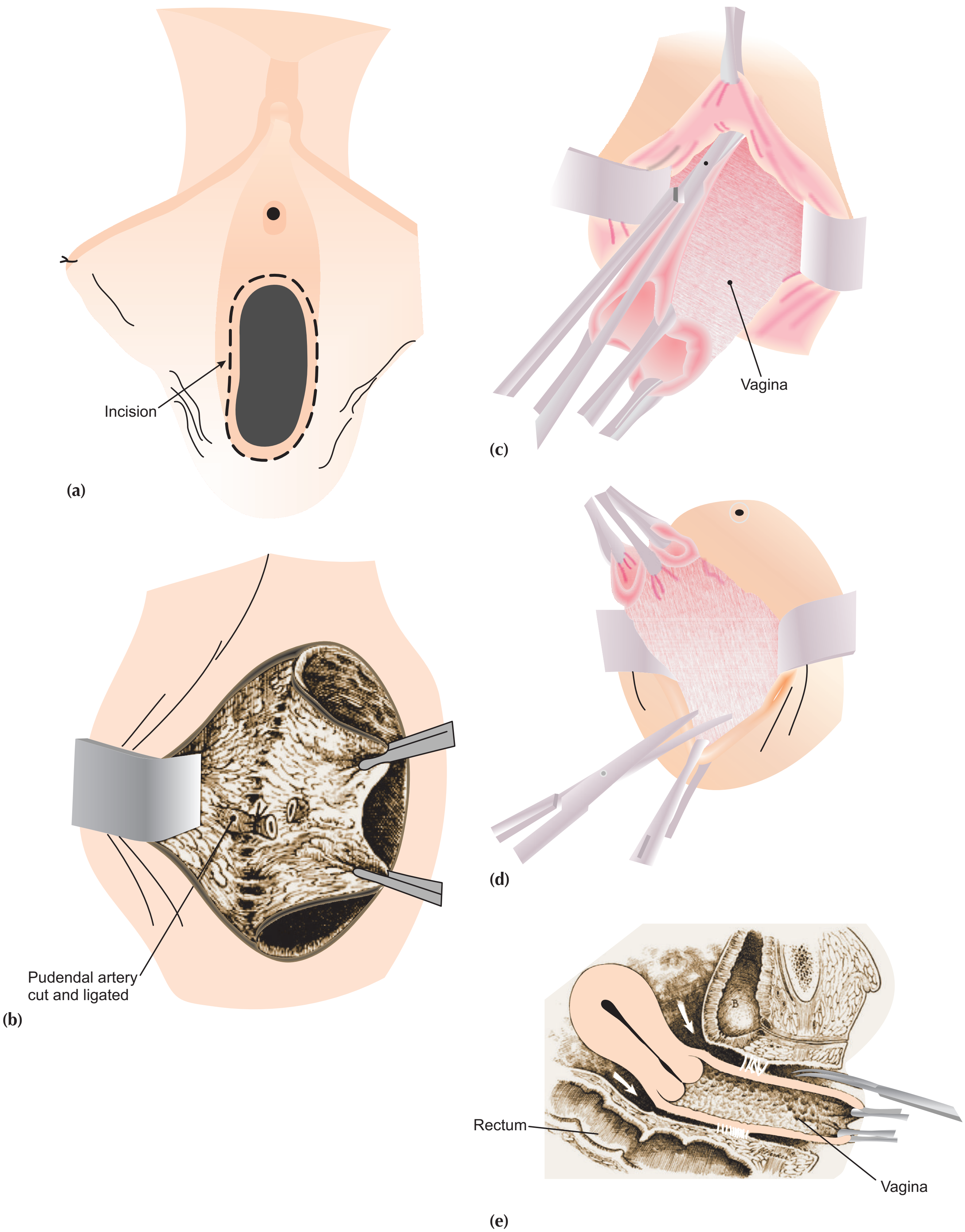


Fig. 15.10: Radical vaginectomy. **(a)** Circumferential vaginal incision. The dissection continues with sharp dissection and ligation or diathermy to the vaginal and pudendal vessels. (**b)** Dissection of the vaginal and division of pudendal and vaginal vessels. **(c)** Further dissection of vagina. **(d)** Separating vagina from rectum. **(e)** Separating vagina from bladder.

The anterior vaginal wall is dissected from the urethra and the posterior vaginal wall from the perineal body and rectum. When a cuff of 2 or 3 cm has been freed, the vagina may be packed with gauze to aid dissection.

The dissection then proceeds anteriorly, posteriorly and laterally. The bladder is separated by sharp dissection as far as the cervix. The ease of this dissection depends on the position of the growth.

Posteriorly, the rectovaginal space is soon reached as in the operation for colpoperineorrhaphy and the peritoneum of the pouch of Douglas comes into view. Laterally, the puborectalis muscle is attached through a broad fan-like muscular base to the vagina and this has been divided with scissors. Haemostasis is achieved with diathermy. The levator ani may be identified below the cardinal ligaments. At this point the vaginal and abdominal surgeons will meet.

Vaginal Reconstruction

This is rarely indicated in older patients and depends on patient preference. A number of different reconstructions have been described and it is the authors' preference to perform a caecal vaginoplasty (Fig. 15.11)—a modification of the technique originally described by Turner-Warwick and Kirby.[52] This offers a wide introitus, good length, is self-lubricating, has lower mucus production than the small bowel and is unlikely to stenose or need dilatation.

To form the neovagina, a 10–15 cm segment from the caecum to the middle third of the ascending colon including the paracolic peritoneum should be mobilised on its vascular pedicle (ileocolic artery) and divided between non-crushing bowel clamps. Bowel continuity is restored using either hand sewn or stapled ileocolic anastomosis. The appendix is removed

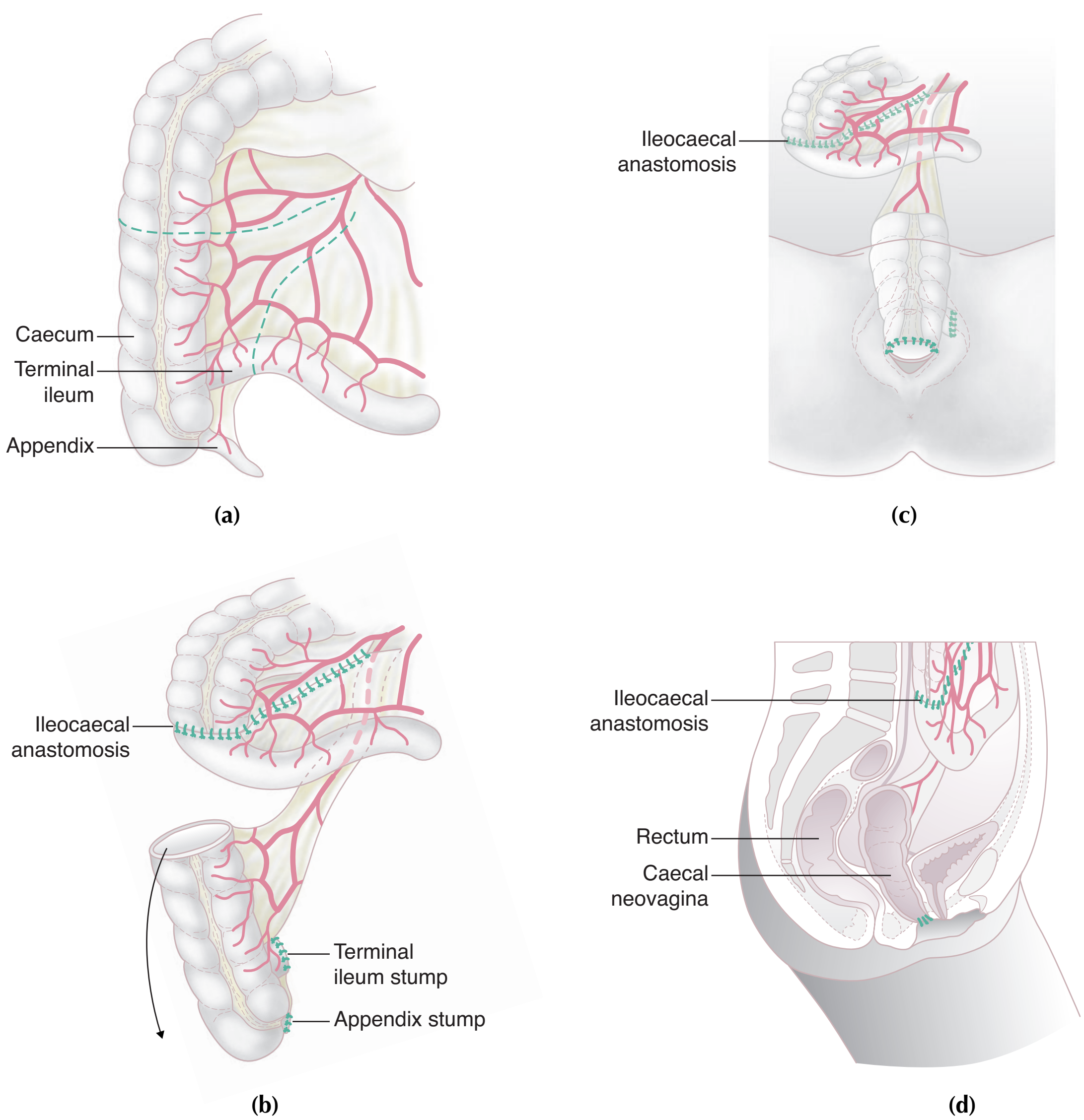


Fig. 15.11: Caecal vaginoplasty.

and the caecum/ascending colon segment is then advanced through the pelvic floor and the proximal end closed in two layers. Interrupted sutures are then placed to form an anastomosis between the neovagina and vulva. Although bilateral flaps can be used they will usually have too much bulk of subcutaneous tissue and fascia that will obliterate the vagina.

Conclusion

The treatment of vaginal cancer requires a highly individualised approach and for some patients radical surgery may offer either the possibility of cure, or palliation of distressing symptoms.

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Uterus and Cervix Cancer

16

John H. Shepherd

Introduction

The standard surgical treatment for carcinoma of the cervix remains either a radical hysterectomy with pelvic node dissection or radiotherapy now in combination with chemotherapy. Carcinoma of the corpus uteri is primarily treated by a less radical or extra fascial hysterectomy with a pelvic and para-aortic lymph node dissection carried out for high-grade tumours. More advanced endometrial cancers may require a more radical surgical excision, as may uterine sarcomas, if they involve the cervix.

This chapter will describe a standard surgical approach for treating both types of uterine cancer, i.e. the cervix and endometrium, and then describe modifications of management that may be necessary for certain circumstances including fertility-sparing surgery, uterine sarcomas and also the surgical extirpation of recurrent cervical cancer by pelvic exenteration.

By careful pre-operative assessment of the histopathology as well as staging by MRI scans, it is now possible to select those women who are highly likely to require radiotherapy for cervical cancer, and by avoiding a primary surgical procedure, prevent the morbidity of combining radical surgery with radical radiotherapy. Chemoradiotherapy, in the form of concomitant cisplatin chemotherapy to sensitise the tumour to radiotherapy, should be given to women with either advanced or locally advanced cervical cancer, keeping surgery for salvage purposes if residual or recurrent disease is detected.

Similarly, cancer of the corpus uteri is only treated by adjuvant radiotherapy if there are significant high-risk factors determined from the final histopathology of the surgical specimen. On occasions, for high-grade metastatic poor prognostic tumours, chemotherapy may be given as an alternative. These decisions regarding the individual treatment of both uterine and cervical cancers are best decided by multidisciplinary team (MDT) meetings when all gynaecological malignancies are reviewed.

Presentation and Diagnosis

CERVICAL INTRAEPITHELIAL NEOPLASIA AND SUPERFICIAL INVASION

The majority of women with a cancer of the cervix either present with irregular inter-menstrual or post-coital bleeding or having had an abnormal smear detected on routine screening. Colposcopic assessment with a biopsy is then undertaken. In the majority of cases, pre-malignant lesions (cervical intraepithelial neoplasia, CIN III) are adequately treated by a therapeutic conisation, usually a long loop excision of the transformation zone (LLETZ) or on occasions a cold knife cone biopsy (see Chapter 7). Superficially invasive cancers, especially of squamous morphology, may also be treated by a cold knife cone biopsy providing that an adequate clear margin can be obtained.

Women with a carcinoma of uterine corpus usually present with post-menopausal bleeding, or if in a younger pre-menopausal age group, with menorrhagia or inter-menstrual bleeding. A diagnostic uterine curettage or pipelle aspiration usually confirms the diagnosis, a transvaginal ultrasound scan having shown a thickened endometrium.

Whilst a formal examination under anaesthesia for staging purposes is still a clinically useful procedure for cervical cancer, an MRI scan of the abdomen and pelvis is recognised as being a more accurate way to stage both endometrial and cervical tumours.[1] A clear delineation of the margins of the tumour with any involvement beyond the uterus into the parametrial and paracervical tissues may be seen. Involvement of the bladder or rectum may be assessed and any lymphadenopathy in the pelvis or para-aortic regions noted. Such a pre-operative staging will determine the extent of surgery necessary. [See Table 16.1, FIGO staging for carcinoma of the cervix (1994) and Table 16.2 for FIGO staging of carcinoma of the endometrium (2009).]

Table 16.1: Carcinoma of the cervix uteri

Stage I	The carcinoma is strictly confined to the cervix (extension to the corpus would be disregarded)
IA	Invasive carcinoma that can be diagnosed only by microscopy, with deepest invasion ≤5 mm and largest extension ≥7 mm.
IA1	Measured stromal invasion of ≤3.0 mm in depth and extension of ≤7.0 mm.
IA2	Measured stromal invasion of ≥3.0 mm and not >5.0 mm with an extension of not ≤7.0 mm.
IB	Clinically visible lesions limited to the cervix uteri or pre-clinical cancers greater than stage IA*
IB1	Clinically visible lesion ≤4.0 cm in greatest dimension.
IB2	Clinically visible lesion >4.0 cm in greatest dimension

Contd. on next page

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Table 16.1: ***Contd.***

Stage II	Cervical carcinoma invades beyond the uterus, but not to the pelvic wall or to the lower third of the vagina.
IIA	Without parametrial invasion.
IIA1	Clinically visible lesion ≤4.0 cm in greatest dimension.
IIA2	Clinically visible lesion >4.0 cm in greatest dimension.
IIB	With obvious parametrial invasion.
Stage III	The tumour extends to the pelvic wall and/or involves lower third of the vagina and/or causes hydronephrosis or non-functioning kidney**
IIIA	Tumour involves lower third of the vagina, with no extension to the pelvic wall
IIIB	Extension to the pelvic wall and/or hydronephrosis or non-functioning kidney
Stage IV	The carcinoma has extended beyond the true pelvis or has involved (biopsy proven) the mucosa of the bladder or rectum. Bullous edema, as such, does not permit a case to be allotted to Stage IV.
IVA	Spread of the growth to adjacent organs.
IVB	Spread to distant organs.

*All macroscopically visible lesions—even with superficial invasion—are allotted to stage IB carcinomas. Invasion is limited to a measured stromal invasion with a maximal depth of 5.00 mm and a horizontal extension of not >7.00 mm. Depth of invasion should not be >5.00 mm taken from the base if the epithelium of the original tissue—superficial or glandular. The depth of invasion should always be reported in mm, even in those cases with 'early (minimal) stromal invasion' (apprx. 1 mm).

The involvement of vascular/lymphatic spaces should not change the stage allotment.

**On rectal examination, there is no cancer-free space between the tumour and the pelvic wall. All cases with hydronephrosis or non-functioning kidney are included, unless they are known to be due to another cause.

Table 16.2: Carcinoma of the endometrium

Stage I*	Tumour confined to the corpus uteri.
IA*	No or less than half myometrial invasion.
IB*	Invasion equal to or more than half of the myometrium.
Stage II*	Tumour invades cervical stroma, but does not extend beyond the uterus**.
Stage III*	Local and/or regional spread of the tumour.
IIIA*	Tumour invades the serosa of the corpus uteri and/or adnexae†.
IIIB*	Vaginal and/parametrial involvement†.
IIIC*	Metastases to pelvic and/or para-aortic lymph nodes†.
IIIC1*	Positive pelvic nodes.
IIIC2*	Positive para-aortic lymph nodes with or without positive pelvic lymph nodes.
Stage IV*	Tumour invades bladder and/or bowel mucosa, and/or distant metastases.
IVA*	Tumour invasion of bladder and/or bowel mucosa.
IVB*	Distant metastases, including intra-abdominal metastases and/or inguinal lymph nodes.

*Either G1, G2 or G3.
**Endocervical glandular involvement only should be considered as Stage I and no longer as Stage II.
†Positive cytology has to be reported separately without changing the stage.

Classification of the Extent of Surgery

Extension beyond the standard conservative total abdominal hysterectomy as performed for benign uterine disease, such as uterine fibroids, is a matter of degree as described by Rutledge[2] and Piver.[3]

TYPE 1

This is the so-called 'extra-fascial' hysterectomy in which the dissection and mobilisation of the supravaginal cervix is carried out in an extra-fascial plane. This operation is often combined with removal of a small (1 cm) cuff of the vaginal vault. The attachments of the cardinal and uterosacral ligaments to this area need to be separately divided and ligated. Anterolaterally, the ureter is at risk unless some mobilisation of the bladder pillar is undertaken.

TYPE 2

This corresponds to the classical Wertheim operation which may or may not be undertaken with pelvic lymphadenectomy depending on the primary tumour site. The medial third of each cardinal ligament is included in the surgical specimen as is the upper one-third of the vagina. This procedure therefore includes removal of the parametrium, but not beyond the line of the course of the ureter, which itself needs to be mobilised and reflected laterally.

TYPE 3

The Bonney–Meig's operation consists of a radical hysterectomy including removal of the medial two-thirds of the cardinal ligaments and the upper two-thirds of the vagina. The uterine artery is ligated at source from the anterior division of the internal iliac artery. This is the technique that will be described in detail later in this chapter.

TYPE 4 AND MORE ADVANCED PROCEDURES

Virtually total removal of the upper female genital tract may be achieved by surgical virtuosity as an abdominal procedure but is more easily achieved by an abdomino-vaginal approach, often with two teams working simultaneously.[4] A more extensive procedure is the 'mid-pelvic exenteration' in which segments of adherent adjacent organs including the bladder, ureters and upper rectum are resected en bloc, and their functional continuity individually restored by colorectal anastomosis and ureteric re-implantation. A more extensive total pelvic exenteration may be performed for recurrent disease, usually after radiotherapy, when both urinary and faecal diversions are necessary either to a colostomy and ileal conduit with urostomy or if possible by continent bladder diversion. Rectal continuity may be achieved depending on the site of the pathology and extent of radiotherapy.

Alternative Classification of Radical Hysterectomy

A new classification proposed by Querleu and Morrow (2008) following principles laid down by the Japanese School, Okabayashi and Fuji (2001) has been proposed. This includes the concept of nerve-sparing surgery in order to try and reduce bladder and rectal dysfunction by conserving branches of the hypogastric nerves and lateral pelvic plexus. Four types of surgical procedure are described.

TYPE A: EXTRA-FASCIAL HYSTERECTOMY

The position of the ureter is determined by palpation or directly after opening the ureteric tunnels but without freeing the ureters from their surrounding tissue. Vaginal removal is minimal, less than 1 cm. There is no resection of the paracolpos.

TYPE B

i. Modified radical hysterectomy. Partial resection of the uterosacral and vesico-uterine ligaments. The ureter is unroofed and rolled laterally; the paracervix is resected at the level of the ureteric tunnel. The neural component of the paracervix caudal to the uterine vein is not resected. At least 10 mm of vagina is removed.
ii. The same as B(i) with additional removal of the lateral paracervical lymph nodes.

TYPE C

i. Nerve-sparing radical hysterectomy. Transection of the uterosacral ligament at the rectum after the separation of the hypogastric nerves and vesico-uterine ligament at the bladder following preservation of the bladder branches in the lateral part of the bladder pillar. The ureter is completely mobilised. At least 15–20 mm of vagina and the corresponding paracolpos are removed. The paracervix is resected at the junction with the internal iliac vascular system.
ii. Radical hysterectomy without preservation of the autonomic nerves. The paracervix is resected including the part caudal to the deep uterine veins.

TYPE D

i. Lateral extended resection. Resection of the entire paracervix at the pelvic sidewall along with the hypogastric vessels, exposing the roots of the sciatic nerve.
ii. The same as D(i) with resection of adjacent fascial or muscular structure.

The main reason behind this alternative and newer classification was to try and avoid bias derived from using different terms for the same anatomical structures by using internationally accepted anatomical nomenclature. It will be seen however that the basic surgical principles are the same as for the traditional Wertheim and Bonney–Meig's procedures, except that recognition of the pelvic nerve supply to the bladder and rectum is respected. Hence the classical types of radical hysterectomy will continue to be described in this chapter, whilst accepting that nerve-sparing surgery modifications may be carried out depending on the circumstances.

Surgical Approach

ROUTE OF SURGICAL PROCEDURE

Traditional surgery is carried out by open laparotomy either via a midline incision or a transverse incision in the lower abdomen (Pfannenstiel incision). As with many surgical procedures it is now possible to perform this laparoscopically, as a wholly abdominal procedure extracting the dissected specimens through small incisions made at the end of the surgery. Alternatively, radical hysterectomy may be performed by a laparoscopically assisted vaginal approach, the specimen being removed through the vagina. A simultaneous pelvic node dissection is also feasible laparoscopically.

A further option is to carry out the hysterectomy vaginally as described by Schauta, or the more radical extended procedure described by Amreich. Regrettably the skills of vaginal surgery are less commonly taught and practised, but the principles of surgical anatomy and dissection remain the same (see later).

PRE-OPERATIVE COUNSELLING

The likely consequences of all types of surgery need to be discussed with regard to compromise of reproductive capability, sexual function and potential bladder and bowel dysfunction. The risks of fistula and lymphoedema need to be emphasised quite apart from the more common risks of pelvic surgery including haemorrhage and sepsis. The increased risk following radiotherapy should be considered.

In younger women the possibility of fertility-sparing measures may be introduced. Ovarian function may be preserved in women with early stage cervical cancer in order to retain hormonal activity and allow for potential oocyte retrieval and surrogacy in the future. For women who have a stable partnership, ova may be retrieved pre-operatively and embryos created for cryopreservation and later surrogacy. At the time of hysterectomy, oophoropexy may be considered, elevating the ovaries by the infundibulo-pelvic ligaments into the paracolic gutters in order to reduce exposure to radiotherapy. Regrettably this technique carries a more than 50% failure rate due to either scatter of X-rays or lengthening of pedicles and slippage of sutures.

In younger women with small early stage cervical cancers, consideration should be given to uterine preservation, and therefore reproductive potential, by carrying out a radical trachelectomy. This technique is now well established vaginally following principles of a Schauta procedure, but may also be performed abdominally, preferably by the laparoscopic route (see later).

'RADICAL' SURGERY IN BENIGN DISEASE

Severe pelvic endometriosis, pelvic inflammatory disease and serious intraperitoneal adhesion formation can present situations in which an extra-peritoneal approach including mobilisation of the ureters and identification of the uterine vessels can greatly simplify a planned complete or partial pelvic clearance. These techniques should be within the armamentarium of a well-trained 'generalist' surgical gynaecologist.

PRE-OPERATIVE PREPARATION

A simple purgative to ensure an empty bowel is desirable. For a less radical hysterectomy a straightforward enema should suffice. It is advisable to empty a loaded colon in order to facilitate mobilisation and retraction during the surgical procedure and also to reduce postoperative discomfort by colonic spasm due to faecal loading.

OPERATIVE TECHNIQUE

Whilst the standard operation for an invasive cancer of the cervix is commonly called the Wertheim's procedure, it is the modification described by Bonney and Meig's that is commonly performed in the United Kingdom. This technique will be described with modifications according to the individual circumstances. The procedure is classically carried out by open surgery and laparotomy but increasingly laparoscopic techniques are being used either as a total radical abdominal laparoscopic hysterectomy, or a laparoscopically assisted vaginal procedure. The latter has the advantage of mobilising a vaginal cuff from below and then extracting the specimen without having to perform a small mini laparotomy incision to remove the uterus. A variation of the traditional Wertheim's operation carried out in Europe and the USA is equally radical but nerve sparing approach described by Okabayashi and popularised in Japan.[5]

Incision: For open surgery, an appropriate incision will be required depending on the individual preferences of the surgeon concerned and the circumstances with which he is presented. Although it is important to explore the whole abdomen, the surgical resection is confined to the pelvis and pelvic side walls and therefore adequate access can be obtained by a low transverse incision. If however the uterine mass, an adnexal mass or multiple extensive adhesions make mobilisation and access difficult, a midline incision would be wiser and more appropriate.

Abdominal Exploration: When the abdomen is first opened, the surgeon should explore it systematically and any extra-pelvic metastases should be sought, especially in the lumbar lymph nodes and the liver. The kidneys should be palpated and when all is found to be satisfactory, the upper abdomen should be isolated by large swabs. At this stage, many surgeons take a biopsy consisting of the pre-caval and pre-aortic fat pad for frozen section.

It is often found that the caecum and sigmoid colon are adherent to the infundibulo-pelvic folds and before the abdominal packs are inserted, these segments of the intestine should be freed by scissor dissection so that they do not encroach upon the area of the pelvic operation.

Assessment of Operability: The fundus of the uterus is grasped with special uterus-holding forceps or by Howkin's forceps placed at each corner and drawn upwards. The mobility of the uterus crudely indicates the degree of infiltration of the parametrium. If the uterus is fixed firmly in the pelvis, a careful assessment of operability should be made. Clinically, positive nodes are not an absolute contraindication. They should preferably be removed, but the extent of the hysterectomy may be restricted. In doubtful cases, it is recommended that the peritoneum of the uterovesical pouch should be divided and an effort made to separate the bladder from the front of the cervix. If the separation is impossible without risk of damage to the bladder wall it may be thought advisable not to proceed with the simple Wertheim technique. If the case is regarded as suitable the steps of the operation are as follows.

Ligation and Section of Infundibulo-Pelvic Fold and Round Ligament: The uterus is drawn over to one side and the Fallopian tube and ovary of the opposite side drawn away from the wall of the pelvis to expose the infundibulo-pelvic fold. The upper part of the pelvic ureter is identified both by inspection and palpation and its exact relationship to the ovarian vessels established. Failure to observe this elementary precaution may lead to a high ureteric transsection, a particularly unfavourable place to cut the ureter. The round ligament is divided allowing further identification of the ureter on the posterior leaf of the broad ligament. The infundibulo-pelvic ligament containing the gonadal vessels is identified, clamped and divided. All pedicles are ligated with No. 1 vicryl ties. Both ovaries should normally be removed in cases of endometrial cancer, but in early cases of cervical cancer in young women ovarian conservation may be justified.[6] The ovary should be transposed upwards and laterally so that it may lie outside the field of postoperative radiotherapy, should this be necessary (Fig. 16.1).

Dissection of Pelvic Lymph Nodes: Opening the broad ligament gives access to the external iliac lymph nodes and the fatty cellular tissue that surrounds the iliac vessels. A block dissection of the external iliac, inter-iliac, internal iliac, common iliac and obturator nodes with surrounding fatty tissue is performed, thus exposing the lateral pelvic wall. A similar procedure is followed on the opposite side, after which the uterovesical peritoneum is divided transversely just below its fixed attachment to the uterus (Figs. 16.1–16.6) no longer follow this practice. The common iliac nodes are cleared up to the level of the aortic bifurcation.

Dissection of Ureter (Bilateral Ureterolysis): The next step is to identify and dissect the ureters clear of parametrium. The ureter can always be seen beneath the peritoneum at the point where it crosses the bifurcation of the common iliac artery, and it can be followed down by sight for at least 5 cm along the

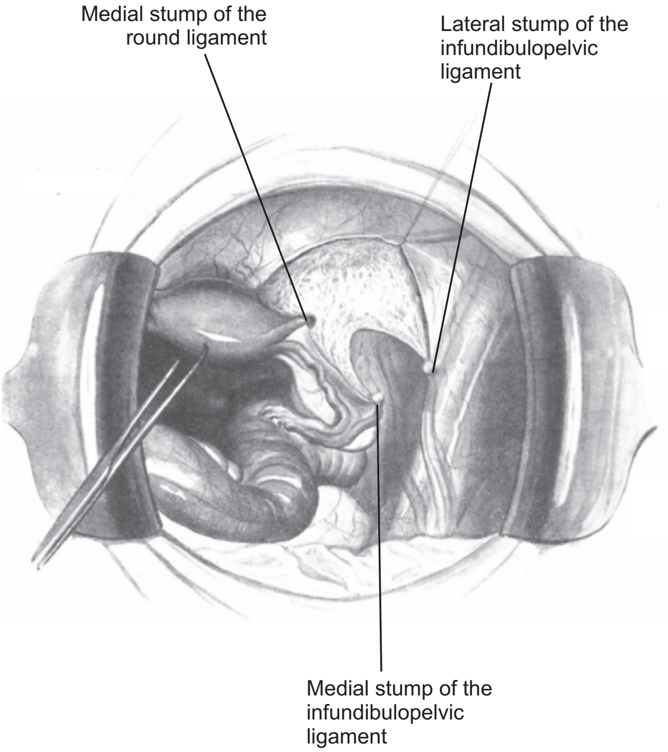

Fig. 16.1: Radical abdominal hysterectomy. The abdomen has been opened and the round ligaments have been divided. The infundibulo-pelvic ligament has also been divided between ligatures. The ligatures are left long and act as retractors. The peritoneum in front of the uterus has been cut through so that the broad ligament has been opened up. It is of the greatest importance to draw the uterus over to the opposite side.

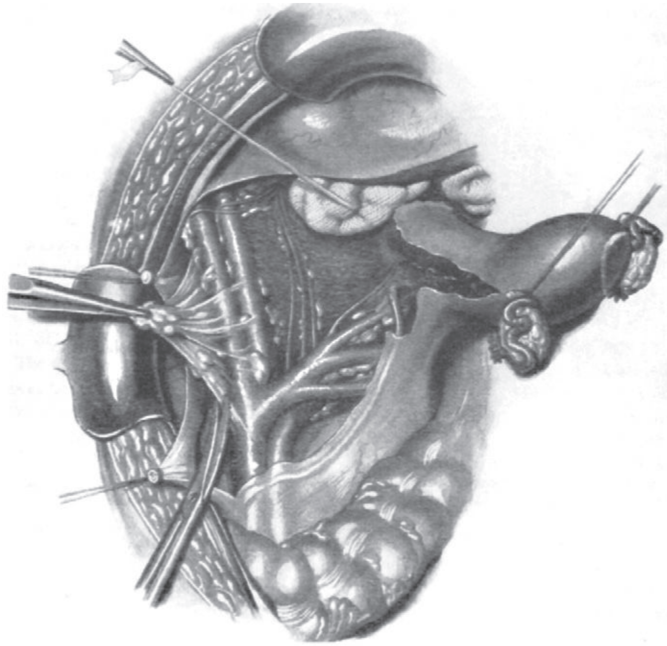

Fig. 16.3: Radical abdominal hysterectomy. The glands and cellular tissue are being cleared from the left external iliac vessels. The uterus is drawn well over to the opposite side so that the obturator fossa is exposed. The obturator nerve, artery and vein are well visualised and the left ureter can be seen passing under the uterine artery. The operating table has been tilted laterally to improve the view.

Fig. 16.2: Radical abdominal hysterectomy. The right external iliac vessels and their lymph nodes have been exposed by the division of the peritoneum between the right ovarian pelvic ligament and the right round ligament. A taped swab has been placed in the right paravesical fossa to arrest bleeding.

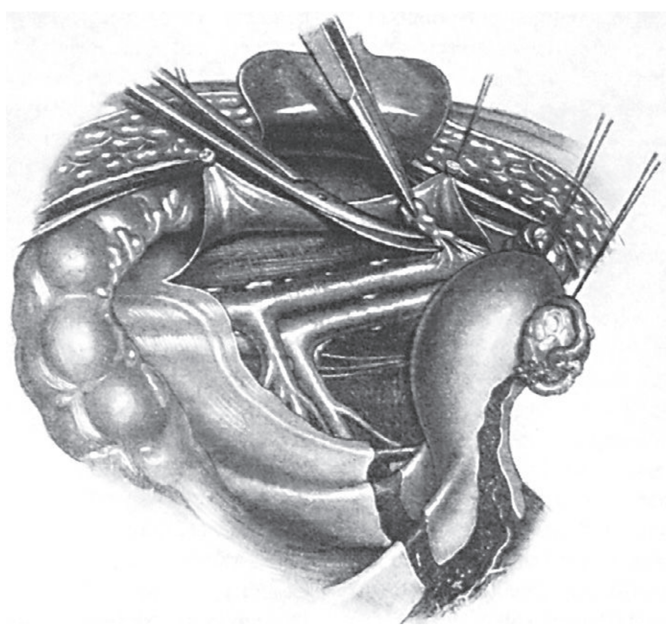

Fig. 16.4: Radical abdominal hysterectomy. Further stage of lymphadenectomy. The medial aspect of the external iliac vessels is clear.

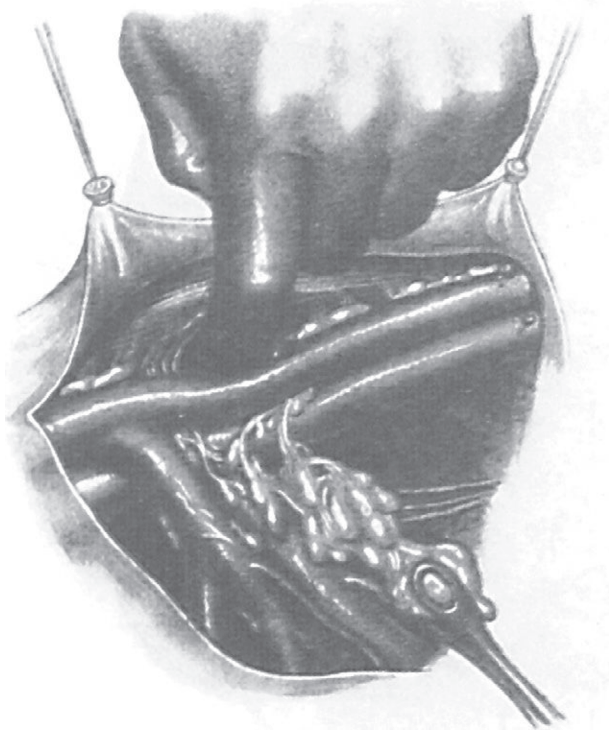

Fig. 16.5: Radical abdominal hysterectomy. The lymph nodes from the obturator fossa on the left have been cleared as far as the bifurcation nodes. A finger is now inserted on the outside of the external iliac artery in order to expose the lateral or external group of the nodes related to the external iliac vessels.

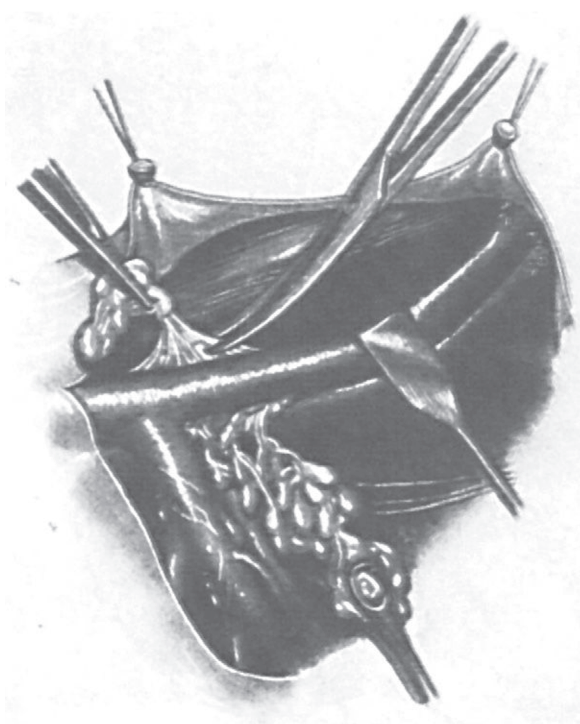

Fig. 16.6: Radical abdominal hysterectomy. The lateral and medial groups of external iliac nodes have now been removed and the artery and vein are quite clear. The inter-iliac nodes and fatty cellular tissue are attached only at the proximal end. The obturator fossa is clear.

lateral wall of the pelvis. The next step is to divide the peritoneum over the course of the ureter with scissors. The ureter lies immediately beneath the peritoneum, and it can be identified and mobilised in this way from its entry into the true pelvis until it reaches the ureteric canal in the parametrium. This method is different from the original Wertheim technique, but much time is saved and the procedure is extremely simple. A loose sheet of peritoneum then lies above this incision up to the level at which the infundibulo-pelvic fold was divided. This sheet of peritoneum is allowed to fall downwards and inwards. It is the authors' practice to use long curved Nelson's scissors, and without difficulty and quite rapidly the ureter can be dissected clear from the connective tissue that surrounds it. It will be remembered that the sheath of the ureter receives a small arterial supply from the internal iliac artery just below its origin, while, farther down, another vessel passes into the ureteric sheath from the uterine artery. It is rarely possible to avoid cutting this last vessel and it should be ligated. The object of the dissection is to separate the ureter from the pelvic cellular tissue that surrounds it, while preserving a delicate mesentery on the inferolateral aspect. Some surgeons prefer to strip the ureter completely from the pelvic cellular tissue so that the ureter lies loosely across the lateral wall of the pelvis; this is not necessary, for the ureter can be retracted away quite easily from the operation area with the aid of a Penrose drain looped around it if desired. The dissection of the ureter proceeds downwards until the ureter enters the ureteric canal in the cardinal ligament. The canal can be identified either visually or by introducing the tip of the little finger into the canal. It is sometimes helpful to introduce the tip of a closed Lahey's right angle forceps and gently to open the jaws. This stretches the roof of the ureteric canal and facilitates its subsequent section to free the ureter. The same procedure is followed on both sides.

Separation of Bladder: The next step is to separate the bladder still further from the cervix. The vesico-uterine ligament is divided deep to the peritoneum and the vesicocervical space identified. A small retractor should now be placed in this space and the bladder retracted forwards. In this way the bladder pillar on each side is exposed. The connective tissue mesentery of the round ligament can be traced downwards and inwards to the wall of the uterus anterior to the uterine vessels and lower down to where it becomes fused with the bladder pillar. Just as in Schauta's operation, the bladder pillar will be found to contain small vessels and veins, and when it is divided some degree of bleeding is to be expected. The assistant pulls the uterus over to the opposite side to put the tissues of the bladder pillar on the stretch, while the bladder is retracted in the opposite direction. The lateral angle of the trigone of the bladder is separated from the cervix with small fine scissors, such as Mclndoe's scissors. Bleeding from a leash of small veins that form the vesical venous plexus may obscure the field in this dissection and it is a great help to use the tip of the sucker as a retractor and to cut against this. The sucker acts as an effective temporary control of the oozing and enables the dissection to be completed under direct vision unobscured by haemorrhage. Once completed the bleeding points can be secured, ligated or touched with diathermy. With experience it is possible to separate the tissues until the paravesical space lying anterior to the cardinal ligament is reached. It is essential that the ureter be identified by sight where it lies under the bladder pillar at the uretero-vesical junction (Fig. 16.7).

Ligation of the Uterine Vessels: If the glands and cellular tissue have been cleared at an early stage from the external iliac vessels and the pelvic wall, the internal iliac artery is easily identified and the uterine artery can be seen as it leaves the anterior division of this artery. The uterine artery should be isolated, and divided as near to its origin as is possible and safe. The distal end of these cut vessels can be put on a gentle stretch and drawn towards the cervix. If the uterine artery is not readily visible, it may be found by picking up the obliterated hypogastric artery where it is a solid cord and putting it on the stretch. The last patent branch of the anterior division is the superior vesical artery and the penultimate is usually the uterine. The uterine artery can then be clamped and tied without danger to the ureter. This reversal of the standard technique starting laterally and working medially saves time and decreases danger of ureteric damage.[7] It is strongly recommended. Great care must be exercised not to tear the tributaries of the internal iliac vein as this leads to very severe haemorrhage, which is difficult to control. In fact it is best to leave this part of the venous system well alone though the artery can be sacrificed with impunity. The deep part of the cardinal ligament can now be seen and felt and, in front of it, the finger can easily clear the paravesical fossa while, behind it, lies the pararectal fossa. The base of this fossa is the levator muscle (Fig. 16.8).

Dissection of Ureter from the Cardinal Ligament: Once the ureteric vessels have been divided (Fig. 16.9), the ureter must now be freed from its canal and this is sometimes a long and tedious business requiring great patience and care (Fig. 16.10). It is often helpful to stretch the canal with Lahey's or Moynihan's forceps and, when the ureter can be seen, the roof is opened by

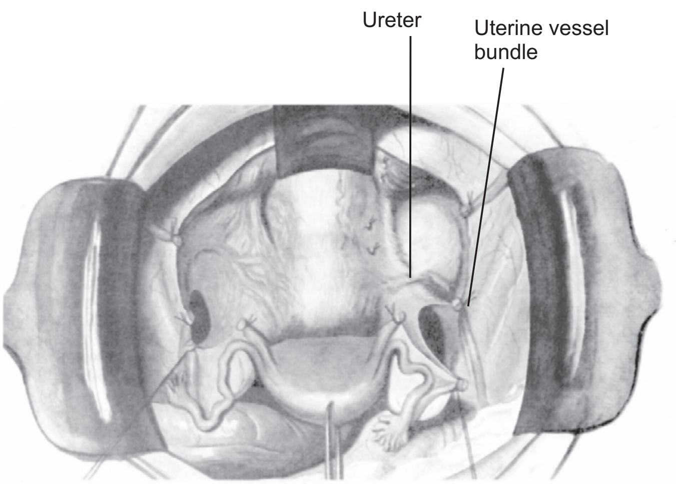

Fig. 16.7: Radical abdominal hysterectomy. The peritoneum has been opened up and the bladder has been separated from the cervix and vagina.

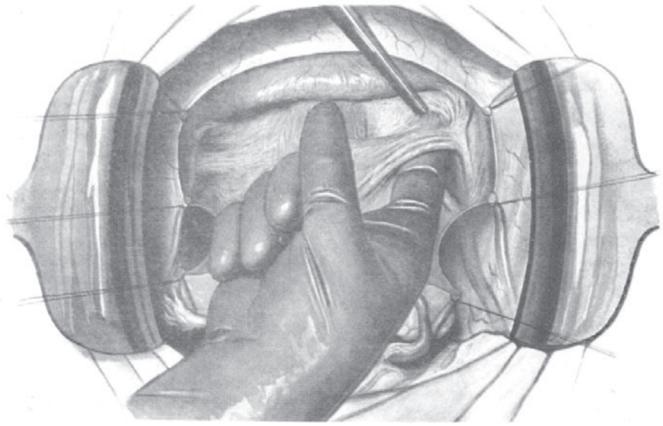

Fig. 16.8: Radical abdominal hysterectomy. The illustration shows the original Wertheim method of ligating the uterine vessels as they pass transversely across the pelvis in the roof of the ureteric canal.

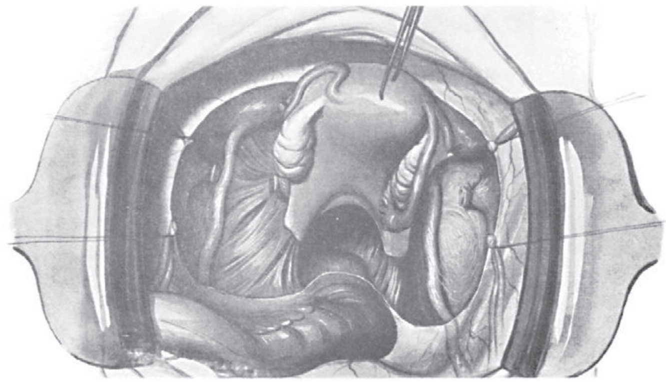

Fig. 16.9: Radical abdominal hysterectomy. The illustration shows the divided uterine vessels on both sides.

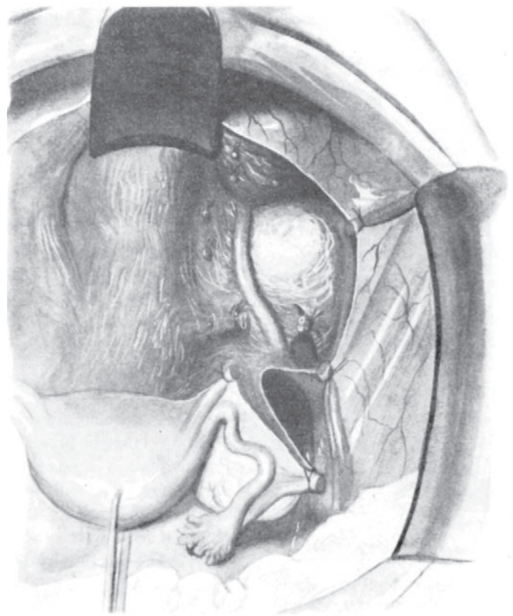

Fig. 16.10: Radical abdominal hysterectomy. The uterine vessels have been clamped and divided as they pass over the ureter. The cardinal ligament lies deep to the ureter in this area.

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small scissor snips from behind forwards. The medial stump of the uterine artery must be pulled medially over the ureteric canal as the roof of the canal is cut. Nothing must be cut until the ureter is seen as it has an unpleasant habit of making an upward kink at the lower end of the canal. This is known as the genu or knee of the lower part of the ureter. Once the roof is cut the canal can be opened and the ureter freed to the bladder (Fig. 16.11). As the bladder is approached vesical vessels will be injured and awkward venous oozing will need attention. It is a great help here to use the sucker at the point of the scissors as already mentioned.

Opening the Rectovaginal Septum: Having cleared the obturator fossa (Fig. 16.12), the next step is for one of the assistants to draw the fundus of the uterus upwards and forwards so that the pouch of Douglas is exposed. With non-toothed forceps and curved scissors the peritoneum of the pouch of Douglas is cut through, and the risk of damage to the bowel is reduced through holding the scissors with the curved tip directed away from the bowel. This part of the operation should be performed with great care because adhesions disturb anatomical relations so that the bowel may be injured. The bowel is stripped away from the uterus and vagina in the rectovaginal space, either with the fingers or with small swab-holding forceps. The peritoneum covering the uterosacral fold must now be divided and the uterosacral ligaments exposed.

Transection of the Uterosacral Ligaments (Figs. 16.13–16.15): Curved clamps are now placed on the ligaments and the tissue cut through distal to the clamps. Care must be taken to avoid injury to the blood supply of the rectum. The hypogastric nerve plexus of fibres may be observed at this point running along the lower third of the uterosacral ligaments in the peri-rectal tissue. These should be preserved.

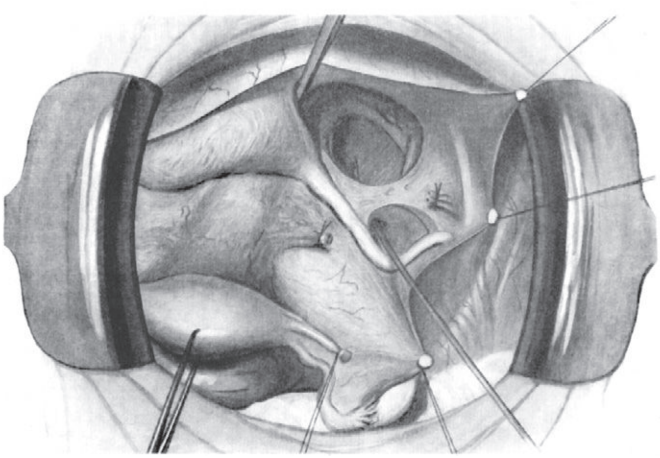

Fig. 16.11: Radical abdominal hysterectomy. The uterine artery has been divided between ligatures and the roof of the ureteric canal cut through. The cardinal ligament can be seen in the diagram with the aneurysm needle placed below it. In front of the cardinal ligament lies the paravesical space while behind the ligament lies the pararectal space.

Clamping and Section of the Cardinal Ligament (Fig. 16.16): The fundus of the uterus is now drawn upwards and backwards, and with further dissection the bladder is stripped away from the vagina as far down as is possible. On each side of the vagina lies the firm and strong paravaginal cellular tissue of the

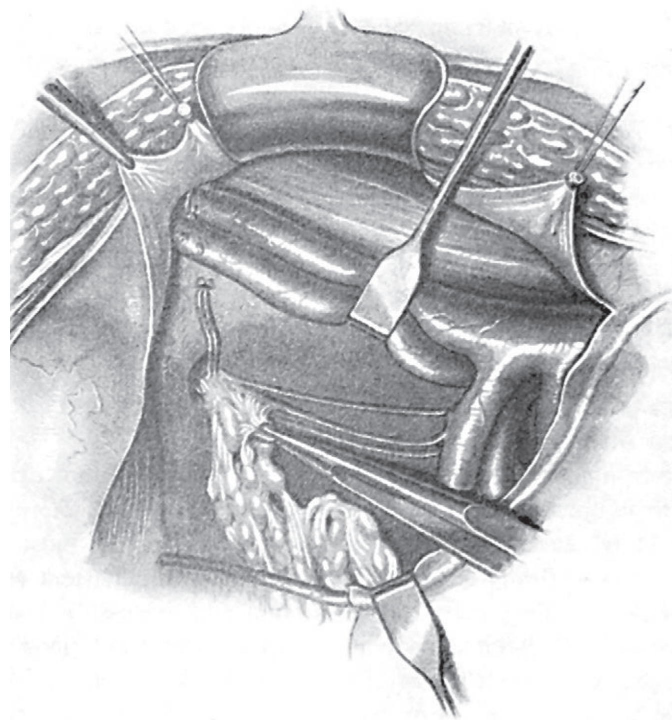

Fig. 16.12: Radical abdominal hysterectomy. The final stage of clearing the right obturator fossa. The obturator vessels and nerve have been spared but the accessory obturator artery and vein have been cut and tied. The obturator nerve should be spared if possible. The ureter is drawn medially out of danger. The table has been tilted to the right.

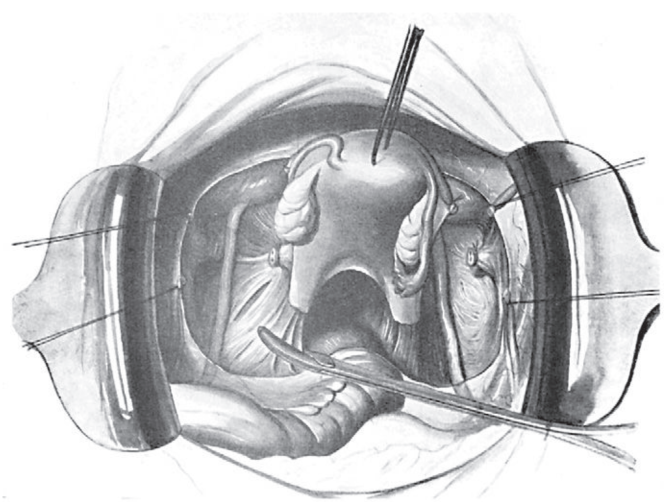

Fig. 16.13: Radical abdominal hysterectomy. The uterosacral ligament on the left side is being clamped. Fibres of the hypogastric nerves should be conserved.

endopelvic fascia together with the cardinal ligaments. Fibres of the lateral plexus may be seen and conserved in the lateral third of the cardinal ligament.

The uterus is drawn over to one side, and the bladder and ureter of the opposite side retracted away to expose this tissue. It is clamped with a curved clamp and the tissue distal to the clamp is cut through. It may be necessary to apply two or three clamps before sufficient parametrium and paracolpos can be removed. The same procedure is followed on the opposite side.

Transection of Vagina: A Wertheim clamp is now applied to the vagina as far down as is possible to include a 2–3 cm cuff of vagina. When the clamp is in place, the vagina is cut through

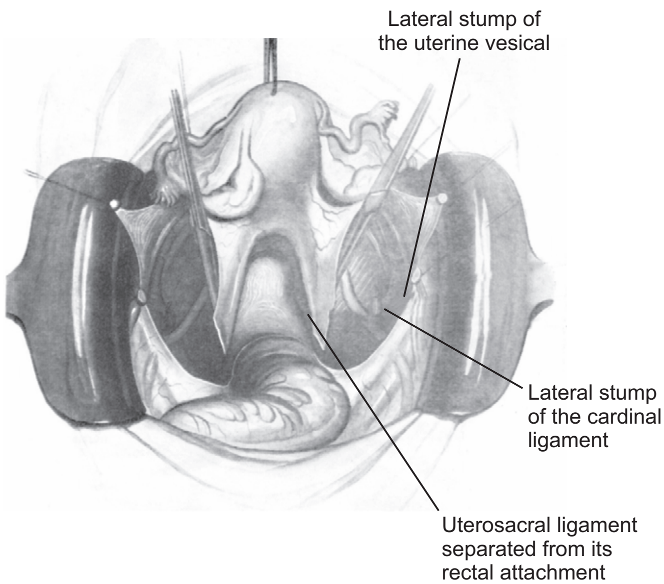

Fig. 16.14: Radical abdominal hysterectomy. The cardinal ligament has been divided on each side. The uterus has been drawn forwards, the peritoneum of the pouch of Douglas has been cut through transversely and the bowel has been separated from the posterior vaginal wall. Fibres of the lateral plexus are preserved.

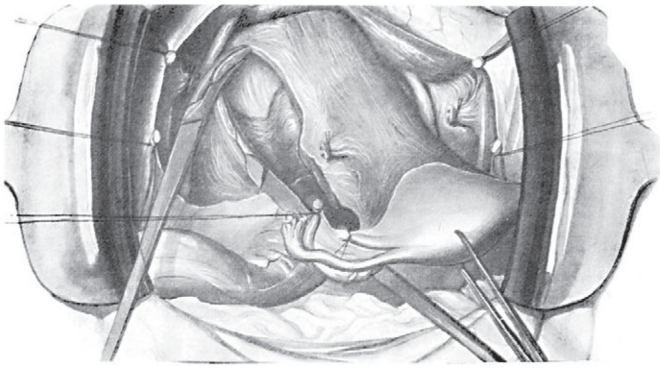

Fig. 16.15: Radical abdominal hysterectomy. The uterosacral ligament on the left side has been clamped and divided. A clamp has been placed across the left cardinal ligament, and the tissues proximal to the clamp have been cut through.

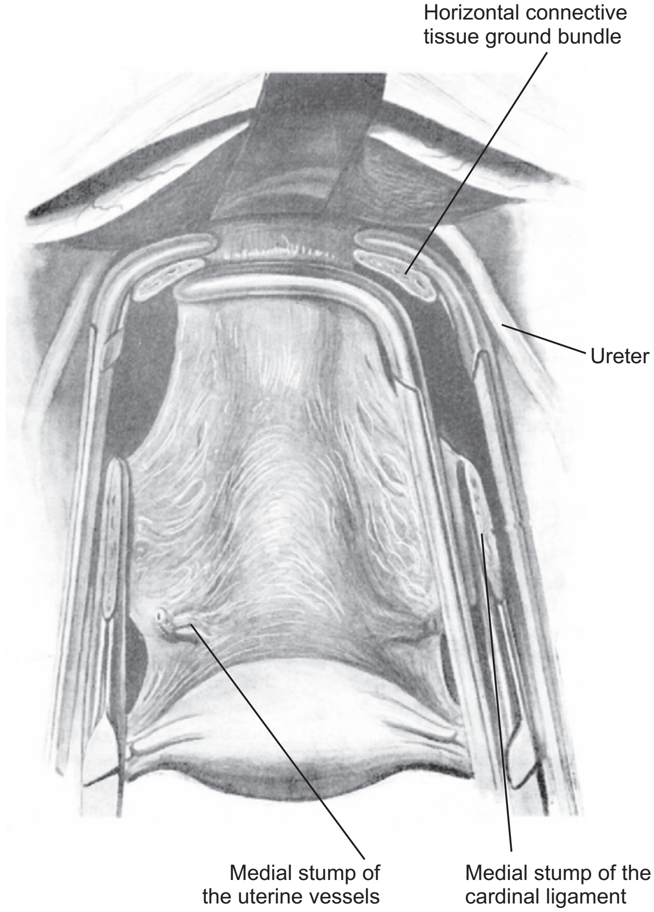

Fig. 16.16: Radical abdominal hysterectomy. The uterus and appendages have been separated from their attachments, the cardinal ligaments and the uterosacral ligaments having been divided. A large clamp has been placed across the vagina. On each side of the vagina below this level the paravaginal tissues have been clamped and divided.

below the clamp. The edges of the vagina are grasped with long forceps anteriorly and posteriorly. The object of the Wertheim clamp is to prevent infective material from the growth contaminating the raw area in the pelvis. If more vagina needs to be resected due to tumour extension then this may be included in the clamps after further mobilisation and dissection.

Haemostasis and Drainage: The tissues enclosed by the clamps are now ligated, and any bleeding vessels picked up and ligated. When passing suture ligatures around these clamps, care must be taken not to injure any veins of the internal iliac system as this invariably causes troublesome bleeding. The sutures themselves must be firmly but gently tied so that they do not tear the veins from the parent trunk. Venous oozing is usually troublesome, although it stops to a very large extent as soon as the uterus has been removed. Small bleeding vessels may be seen in the cut edges of the vagina; these must be underpinned and ligated. The vagina as a rule is closed using transfixion sutures to the angles followed by figure of 8 interrupted sutures with No. 1 Vicryl.

In the past, the vagina has been left partly open in order to allow drainage via a T-tube inserted through the vaginal vault and placed beneath the pelvic peritoneum, which is closed above this. However current practice is to close the vagina and then leave the pelvic peritoneum open in order to allow for re-absorption of any lymphatic fluid that may collect and thus reduce the incidence of lymphocysts. The policy for drainage in surgical procedures has changed gradually over the last 10 years and it is generally felt that leaving unnecessary drains within the pelvis only acts as a source of infection and promotes continuing lymphatic drainage and other serosanguinous oozing. Fibrillar or surgicel gauze may be placed across the vaginal vault and along the pelvic side walls to encourage haemostasis.

Reperitonisation of the Pelvis: This is now not regarded as important, as discussed above. However, it is important to ensure that when subsequently closing the abdomen then the pelvic organs, especially the sigmoid colon and caecum are replaced within the pelvis anatomically and covered by small bowel and then the omentum.

SURGICAL DIFFICULTIES OF WERTHEIM'S OPERATION

If the parametrium is extensively involved the uterus cannot be drawn up satisfactorily from the pelvis, which means that careful dissection must be made in the depths of the true pelvis, with persistent venous oozing around the dissection area, and these difficulties are aggravated if the patient is obese. Separation of the bladder from the front of the cervix and from the upper part of the vagina becomes extremely difficult if the bladder is infiltrated either by inflammatory reaction or by carcinoma. The separation must not be attempted by stripping the bladder away but must be made with curved scissors, with the points of the scissors directed away from the bladder. The separation may be long and laborious, and as the bladder wall is often thin there is a risk of injury to it.

Bladder Injury

Fortunately it is rare for the separation of the bladder to be difficult except over a limited area. There is no objection to part of the bladder being excised to ensure a clear margin, but the incision in the bladder must be sutured carefully and the correct after-treatment instituted. If the incision is situated near to the ureteric orifice, great care must be taken not to constrict the intramural part of the ureter. Retrograde ureteric catheterisation may be helpful.

Damage to the Ureter

Accidental division of the ureter is, in practice, a rare complication, almost always due to the surgeon failing to realise that the ureter is drawn inwards with the parametrium when the uterus is drawn over to the opposite side. On rare occasions it may be advisable deliberately to excise a portion of the ureter if there is local infiltration with growth. If the ureter is cut or injured, the management is as described later in this chapter. More insidious is occult damage from excessive mobilisation and stripping causing devascularisation.

Urinary Fistula

Any surgeon who performs this extensive operation in a large series of patients must expect a certain incidence of urinary fistula, either vesicovaginal or ureterovaginal. Such a fistula is not necessarily the result of direct operative trauma but appears after a lapse of days or even weeks as a result of avascular necrosis. Stallworthy[8] believed that preservation of an ureteric mesentery is an important factor in prevention of fistula. The formation of pelvic haematoma, particularly if infected, is an aggravating factor in fistula formation, and prior irradiation impairs the chance of primary healing. In a large Mayo clinic series the urinary fistula rate was 4.8%,[9] which is comparable to the 4.7% found in 358 women undergoing radiotherapy and surgery at the Royal Marsden Hospital.[10]

Injury to the Rectum

The rectosigmoid is particularly liable to injury when the Pouch of Douglas is obliterated due to adhesions, e.g. from endometriosis. It takes experience to know where to incise the peritoneum in order to separate the rectum from the vagina and it is a common fault to start too low, where the peritoneum is intimately fused to the bowel wall. The rectovaginal septum is thereby missed and the separation becomes obscured by haemorrhage from the haemorrhoidal vessels. The authors regard the separation of the rectum from the vagina as more difficult than separating the bladder from the cervix and vagina. It can be much facilitated by the use of long scissors, long dissecting forceps and clamps so that the hands of the surgeon do not obscure the field. One of the advantages of the Lloyd-Davies position is that the operator or an assistant can insert a finger into the rectum if the anatomy is obscure. If there has been previous radiotherapy, injuries to either the urinary or alimentary tract are very serious as the breakdown of any repair is likely. In such cases, rectal injury should be covered by transverse colostomy. This is usually unnecessary in irradiated cases unless faecal soiling is gross. The technical procedures are discussed later in this chapter.

Injury to the Large Vessels

It is not uncommon to find an abnormal distribution of vessels in the pelvis. The superior vesical and the middle vesical arteries are often found in unexpected positions and if divided may be followed by a brisk heamorrhage, but little difficulty is experienced in controlling the bleeding. Injury to the large veins, particularly when dissecting lymph nodes can cause profuse haemorrhage, which must be temporarily controlled by pressure. In most cases, the vein which is injured is the internal iliac, and this can be ligated without risk near its junction with the external iliac vein. It must be remembered that this vein receives large tributaries from the superior and inferior gluteal and pudendal veins, all of which may need separate ligation. Just as much blood wells up from the distal as the proximal end of the damaged vein. These tributaries are liable to retract when severed or torn and their bleeding is thereafter very difficult to control. As they are clamped and ligated they tend to tear further and thus constitute a very grave danger from blood loss. Blind clamping may result in serious damage to the lumbosacral plexus with permanent neurological injury. When dealing with bleeding from these veins the sucker is an invaluable help to the accurate placing of a ligature. Surgiclips may be the only effective means of controlling this type of haemorrhage as ligatures tend to tear a fresh hole in the delicate vein wall.

Larger injuries to the major vessels in the pelvis leading to the leg need repair by sutures using vascular surgical techniques. The injured segment may be isolated with tapes or small pulmonary artery clamps (Bulldog clips, Fig. 16.17). Continuous suturing using 5/0 arterial sutures should evert the vessel wall in contrast to the repair of intestine. If any constriction of the external iliac vein is likely to ensue, it is better to patch any defect with a piece of long saphenous vein taken from the groin.

Venous Oozing in the Depths of the Pelvis

Such bleeding, except in early cases, is always troublesome and prevents the easy dissection of the ureters under direct vision. In addition, if clamps are applied to the oozing veins and capillaries the ureter or bladder may be damaged. In early cases, when the ureteric canal can be easily identified, this oozing is restricted to the vicinity of the entrance of the ureter into the bladder. The oozing stops of its own accord after the removal of the uterus and the upper part of the vagina. Persistent oozing from small vessels should be temporarily controlled by firm pressure over a swab wrung out in hot saline or dilute aqueous flavine. When removed after a few minutes, the bleeding will often be found to have ceased spontaneously. Diathermy is invaluable for coagulating small bleeding points. Fibrillar or surgicel may be placed across the raw surface areas to encourage haemostasis prior to laying the bowel on top of the pelvis and along the pelvic sidewalls before to closure. If the omentum is readily available and adequate in size and length then this may be mobilised and appropriately placed to aid further haemostasis.

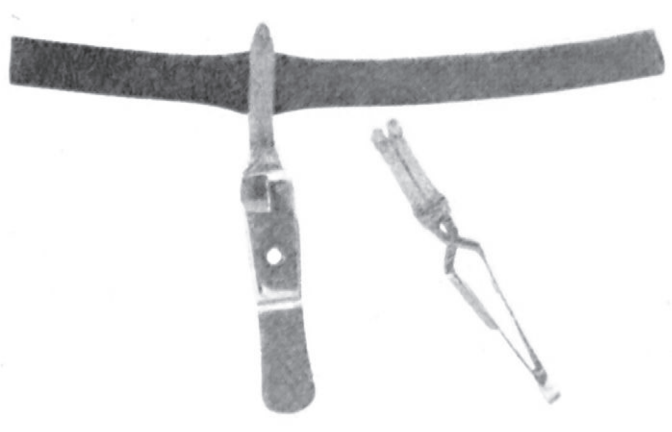

Fig. 16.17: Temporary vascular clamps. Blalock's pulmonary artery clamps or similar vascular instruments may be used for temporary occlusion of major pelvic vessels. Temporary respite from catastrophic arterial haemorrhage within the pelvis may be obtained by bilateral occlusion of common iliac arteries. Obviously these clamps should only be used in emergency and for as short a time as possible.

Shock

With modern anaesthesia, combined with adequate blood transfusion, the incidence of hypovolaemic shock is relatively low. If hypotension ensues, there is a risk of inducing spasm in the external iliac artery as a result of handling. There is a critical closing pressure below which the lumen of the artery cannot be maintained. Serious ischaemia in the leg can follow.

Sepsis

The danger of peritonitis after Wertheim's operation has largely been eliminated by the use of prophylactic broad spectrum antibiotics. These are administered intravenously on induction and continued for at least 24 hours. If there is a specific and increased risk due to some further problem or soiling then this prophylaxis may be continued for 48–72 hours. Thereafter should infection ensue a therapeutic policy with treatment either with the same broad spectrum drugs or a change should be undertaken for 5–7 days. Cefuroxime and metronidazole or amoxicillin–clavulanate would be appropriate choices. All cancers of the cervix are potentially infected; therefore some degree of local sepsis is to be expected in the pelvis. Careful pre-operative preparation by cleaning the vagina prior to commencing the procedure with either cetrimide or aqueous betadine helps to prevent this. If however, there is a pool of sero-sanguinous fluid forming a pelvic haematoma that subsequently becomes infected, this will usually discharge spontaneously through the vaginal vault, and unexplained postoperative pyrexia should always raise this possibility. If this does not settle with antibiotics then drainage may be necessary by gently probing the vaginal vault digitally or opening this more formally with sterile forceps to allow any collection of pus or blood to discharge.

Lymphocyst Formation

The extensive dissection of nodes and their pelvic lymphatic channels on the side wall of the pelvis is occasionally followed by the formation of a quite extensive thin-walled collection of exudate, which is thin, yellow or colourless. The lymphocyst is often lateral and fixed to the side wall of the pelvis in the region of the bifurcation of the common iliac vessels, and may be mistaken for a recurrence. Diagnostic ultrasound will distinguish the fluid-filled lymphocyst. Its time of appearance also varies from the second postoperative week up to 18 months after the original operation. Conservative management with observation and scanning after 6 weeks and then 3 months will indicate if the collection is enlarging. Slow spontaneous resolution usually occurs. Aspiration is only undertaken if the lymphocyst is symptomatic causing pain or ureteric back pressure and a hydronephrosis. Repeated aspiration risks introducing infection. Marsupialisation into the peritoneal cavity is rarely necessary as a last resort.

Radical Vaginal Hysterectomy (Schauta)

PREPARATION AND POSITION

The pre-operative preparation is as for a radical abdominal hysterectomy. The patient is placed in Lloyd Davies stirrups with the angulation of the thighs depending on whether any form of abdominal intervention (e.g. laparoscopic or extraperitoneal lymphadenectomy) is contemplated.

OPERATIVE TECHNIQUE

The first step is to enlarge access by paravaginal section with a Schuchardt's incision. This incision, made on the left side will enlarge the vaginal introitus and, at the same time, expose the levator ani muscle, together with the pelvic cellular fatty tissue which lies on its upper surface. An assistant retracts the vulva with a vaginal retractor, while the surgeon, inserting two fingers into the vagina, draws back the rectum. The incision is made at about four o'clock and passes through the skin and sub-cutaneous tissues, while more deeply the transverse perineal muscles together with the perineal membrane are cut through. The vaginal portion of the incision passes through the vaginal wall for about 4 cm upwards until the levator ani muscle, with its covering of fascia, is exposed. Bleeding vessels are fairly numerous and must be caught and ligated. The dissection must be such that the upper surface of the levator muscle can be identified so that the pelvic cellular tissue can be stripped away. Sometimes it is necessary to cut through the edge of the levator ani muscle together with its covering fascia, but this is not necessary if the vagina is patulous. Damage to the rectum is a danger and this is avoided by retracting the rectum backwards well away from the incision (Fig. 16.18).

Circumcision of the Vagina: A circular incision is made through the vaginal wall. The level should be at the upper end of the vaginal part of Schuchardt's incision. If the circumcision is made higher up than this less vagina and less paravaginal cellular tissue will be removed. If the circumcision is made at a lower level difficulties may be encountered in stripping away the rectum and the urethra. The vaginal incision is made through the wall and the vaginal fascia. Posteriorly, care must be taken to prevent damage to the rectum in the midline. If the circumcision is made at the correct level the rectovaginal space is opened up immediately and the rectum can be stripped from the vagina quite easily with the finger. Anteriorly, if the circumcision lies below the neck of the bladder, as it should, the vagina and its fascia must be separated from the post-urethral ligament with a scalpel until the vesicovaginal space is reached. In this way a moderate degree of mobilisation of the vaginal cuff is possible. The vaginal cuff must now be closed by a series of interrupted sutures; the ends are left long and can be used to draw down the vagina. Alternatively, long clamps (Kropeks) may be used.

Separation of the Rectum: Much depends upon knowledge of the anatomy, and the surgeon must be familiar with the prerectal fascia, the rectovaginal space and the downward prolongation of the uterosacral ligaments, which lie on each side of the rectovaginal space. A speculum is introduced into the rectovaginal space and the rectum drawn backwards by an assistant, while the other assistant draws the closed vaginal cuff upwards, using the long threads to obtain traction. The next step is to cut through the downward prolongations of the uterosacral ligaments. The tissues should be clamped close to the sides of the rectum and cut through on the vaginal side of the clamps. The tissues enclosed in the clamps should then be ligated. The uterosacral ligaments themselves are not divided as they lie at a higher level. It is advised that at this stage of the procedure the pelvic cellular tissue should be separated on each side from the upper surface of the levator ani muscles with the finger. This tissue lies lateral to the downward prolongations of the uterosacral ligaments, and if the correct layer is reached bleeding is relatively slight and can be temporarily controlled quite easily with a gauze pack.

Separation of the Bladder: A crucial part of the operation depends upon the ability of the surgeon to dissect out the ureters by the vaginal route, again with an understanding of the anatomy. In the midline, the vesicovaginal space is always well defined. Separation of the vagina from the bladder is relatively simple and can be accomplished by the assistant drawing the

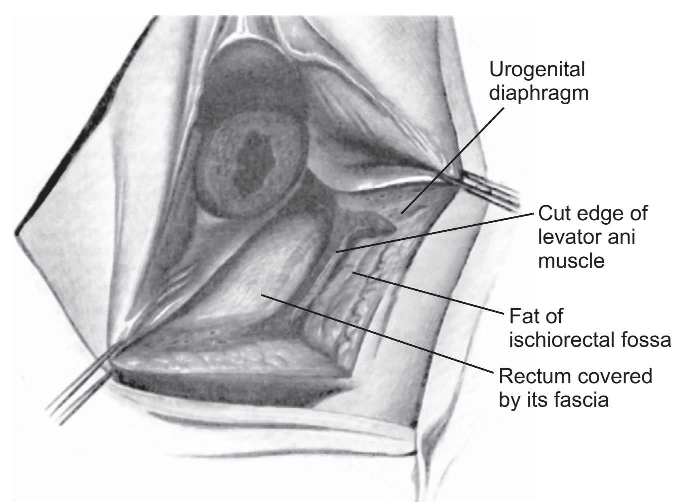

Fig. 16.18: Radical vaginal hysterectomy. The preliminary Schuchardt incision. The cervix and tumour are exposed by suitable retractors. The skin of the perineum is incised on one side of the midline extending deeply to expose the rectum covered by its fascia, the levator ani muscle and the fat of the ischiorectal fossa.

vaginal cuff posteriorly and the surgeon cutting through the loose tissue contained in the space with dissecting scissors. On each side of the vesicovaginal space is the downward prolongation of the bladder pillar. This tissue passes from the vesical fascia downwards and is attached to the vaginal fascia; posteriorly it passes into the medical aspect of the cardinal ligament. The ligament is divided as in a vaginal hysterectomy. In the midline, between the bladder pillar on each side, lies the vesicocervical ligament which limits the vesicovaginal space superiorly. Unless the growth has infiltrated anteriorly there should be no difficulty in dividing the vesicocervical ligament. A retractor is placed below the bladder and the bladder drawn up by an assistant to stretch the vesicocervical ligament; this is cut through with scissors and great care must be taken to avoid injury to the bladder when the subjacent growth has produced an inflammatory reaction between the vagina and the bladder. Normally the clear vesicocervical space lies above this level.

If the growth is advanced, difficulty may be experienced in separating the bladder from this part of the cervix (Figs. 16.19–16.21).

Identification of the Ureter: This is the most difficult and important part of the operation. For the right ureter to be dissected clear, using a deep vaginal retractor, one assistant draws the bladder upwards and retracts the right side of the vagina away from the operation site with a second retractor: the second assistant, standing on the left side of the patient, draws the traction

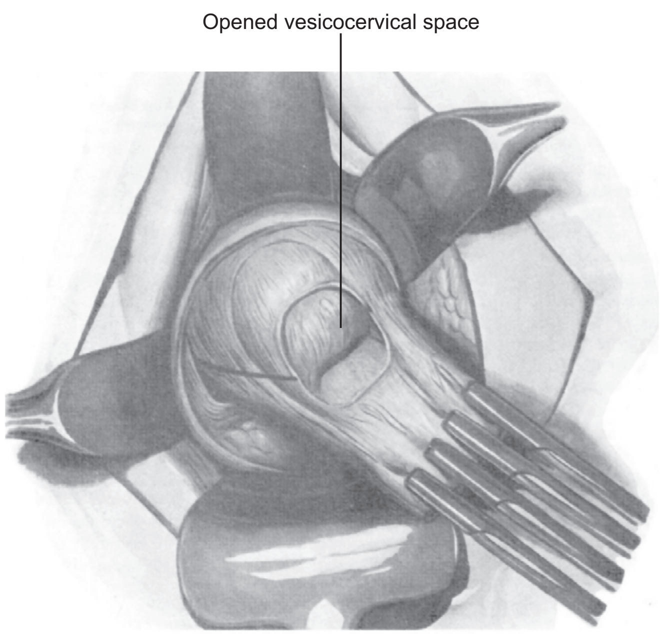

Fig. 16.20: Radical vaginal hysterectomy. The key figure to the operation. The vesicovaginal space has been opened. On the right side, the bladder is drawn downwards and laterally. The vesico-uterine ligament extends to the cardinal ligament. The vesicocervical space has also been opened. The attachments of the medial and lateral surfaces of the vesico-uterine ligament are exposed and can be divided without injury to the bladder.

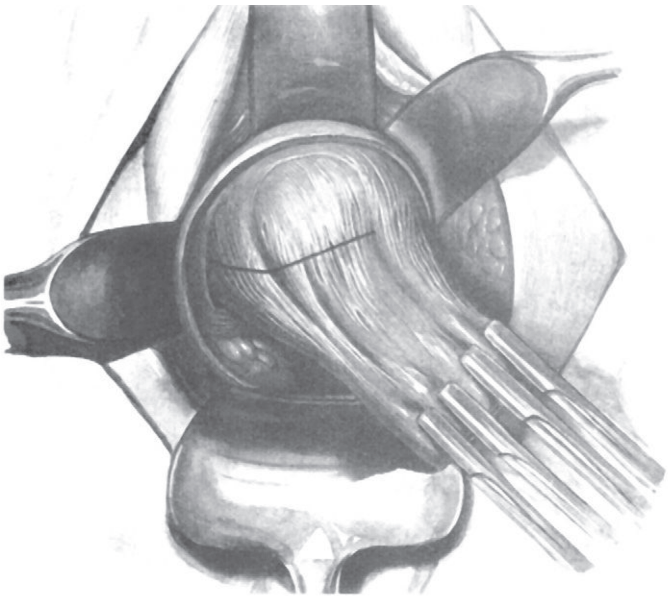

Fig. 16.19: Radical vaginal hysterectomy. A Schuchardt incision has been made, the vagina circumcised and the upper cuff of the vagina closed with clamps. The uterus and the top of the vagina are pulled downwards and to the patient's left side. The black line indicates the position through which the tissues are divided to separate the ureter and the bladder from the uterus and vagina. If made too close to the bladder and ureter there is a risk of damage to these structures, while if placed too near the cervix and the vagina some of the tumour may be left behind.

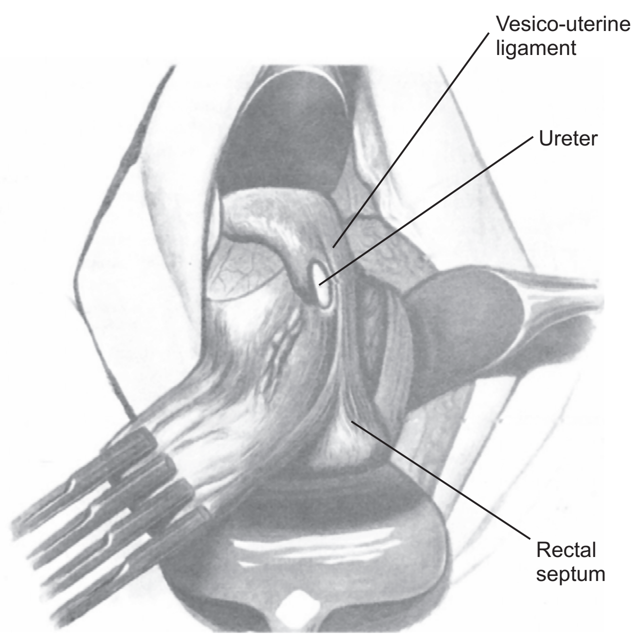

Fig. 16.21: Radical vaginal hysterectomy. The vagina and uterus are being pulled downwards to the patient's right side; the left levator ani is drawn over to the opposite side. The bladder is retracted upwards. The illustration shows the position of the ureter in its canal.

bundle, which has closed the vagina downwards and backwards. In the Figures, four clamps are shown as vaginal tractors but strong sutures are as effective and less in the way of the surgeon. In this way the bladder pillar is stretched. It must be cut through with scissors as near to the bladder as possible. The direction in which the bladder pillar is divided is important. Passing from the midline laterally the incision should pass mainly horizontally and a little upwards. Some haemorrhage is nearly always encountered and bleeding vessels must be picked up and ligated or diathermied. The mistake which is often made is to cut too superficially. The ureter, together with the ureteric canal, lies relatively high up, and the ureter and bladder are drawn up by the assistant. After the bladder pillar has been divided, fatty tissue appears surrounding the ureter as it lies in the ureteric canal. The fat is therefore the sign of the proximity of the ureter. The ureteric canal can now be felt quite easily with the finger, and its lateral wall should be carefully cut through. As soon as the ureter can be identified by sight, the major difficulty of the operation is overcome. The more the vaginal cuff is drawn downwards, the more easily can the ureter be dissected clear. A small curved vaginal retractor is placed laterally to expose the uterine vessels and to draw the ureter laterally. It is recommended at this stage of the operation that the ureter should be retracted laterally as far as possible, and the uterine vessels cut on the medial side of a ligature introduced with an aneurysm needle. The more laterally the uterine vessels are divided the more parametrium will be removed. Dissection of the ureter requires considerable training and experience. The inexperienced tend to cut through the bladder pillar too far away from the bladder and are apt to be worried by haemorrhage and oozing from the cut bladder pillar (Figs. 16.22 and 16.23).

The ureter is now dissected clear in a similar way on the left side. At this stage of the operation the urethra, the bladder and the ureters have been dissected clear but the uterovesical pouch of the peritoneum has not been opened (Fig. 16.24).

Opening of the Pouch of Douglas: The next step in the operation consists of the identification of the peritoneum of the pouch of Douglas. It will be remembered that the rectovaginal space can be identified quite easily and that the rectum can be pushed backwards by means of a finger introduced into the space. At the upper part of the space fatty tissue and the fascia of Denonvilliers lie below the peritoneum of the pouch of Douglas, and this tissue helps in the identification of the position of the peritoneum. The peritoneum is now divided and opened in the midline with curved scissors and the peritoneum cut through on each side as far as the uterosacral ligaments. The posterior cut edge of the peritoneum is then drawn backwards. The assistants draw the vaginal cuff upwards and also, by introducing a speculum into the pouch of Douglas, draw upwards the posterior surface of the vagina and uterus. On the two sides lie the uterosacral ligaments, together with their downward prolongations. These must now be divided, preferably distal to clamps appropriately placed, but if this is found impossible they can be cut through with scissors close to the rectum and the bleeding points picked up subsequently with artery forceps. In this way, the uterus is mobilised most effectively. Haemorrhage is not necessarily troublesome at this stage of the operation, although in some cases large vessels

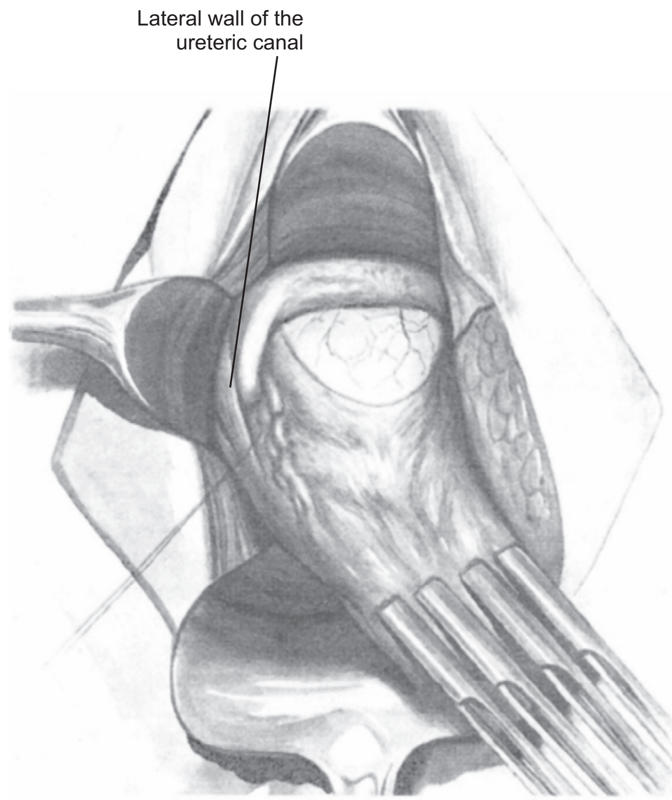

Fig. 16.22: Radical vaginal hysterectomy. The bladder is retracted away and the uterovesical pouch of peritoneum can be seen. The right ureter has been separated from its anterior attachments to the vesico-uterine ligament. The uterine vessels are ligated on the medial side of the ureter.

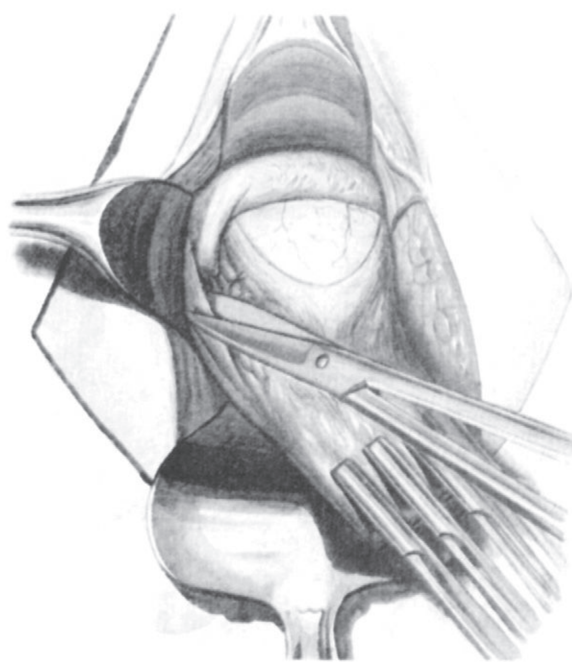

Fig. 16.23: Radical vaginal hysterectomy. The lateral wall of the ureteric canal is cut through with scissors.

are encountered. To overcome difficulties such as controlling haemorrhage and obtaining satisfactory exposure much depends on the skill of the assistant using a retractor (Fig. 16.25).

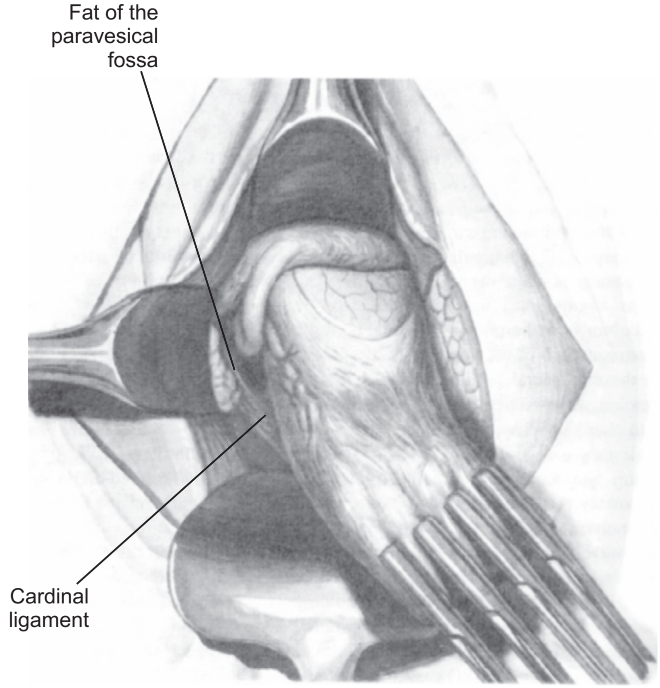

Fig. 16.24: Radical vaginal hysterectomy. The ureteric canal has been opened up completely and the cardinal ligament lying posterior to the canal is now exposed. At this stage the ureter should be separated from the medial wall of the canal. This may be accompanied by haemorrhage as blood vessels pass between the two structures.

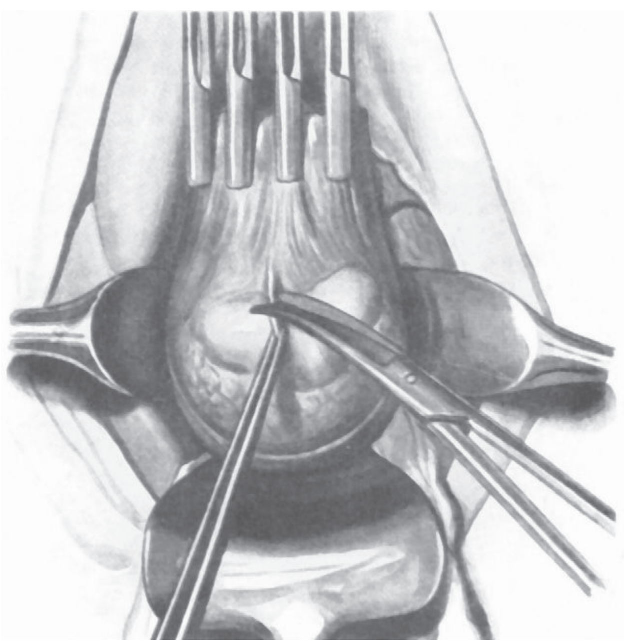

Fig. 16.25: Radical vaginal hysterectomy. The vaginal cuff is drawn upwards. The peritoneum of the pouch of Douglas is incised.

Division of Cardinal Ligaments: On each side the cardinal ligament must now be divided as far laterally as possible. First the assistant must ensure that the bladder and the ureter are retracted laterally well away from the danger zone. A finger is placed behind the cardinal ligament and the vaginal cuff drawn forcibly downwards and to the opposite side to put the ligament on the stretch. It is then cut through with scissors as far out as is possible, although it is not necessary, as a general rule, to clamp the tissue on its lateral side before the ligament is cut (Figs. 16.26–16.28).

Opening of Uterovesical Pouch and Completion of Hysterectomy: The next step is to expose the uterovesical pouch and to open it. Uterus-holding forceps are now applied to the fundus, and the uterus is drawn downwards and to the opposite side. A finger is introduced into the peritoneal cavity and the ovary and tube mobilised, adhesions being separated with the finger. The ovary is grasped with ovum forceps, drawn down and the infundibulo-pelvic ligament exposed. The ovarian vessels are now divided distal to a ligature placed in position with an aneurysm needle. Care must be taken to prevent the pedicle from

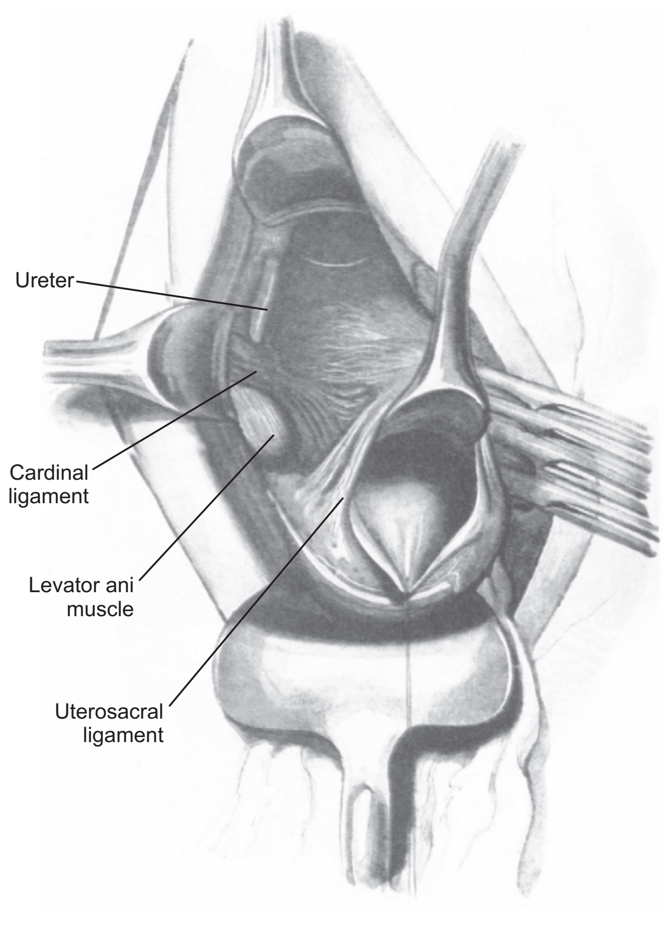

Fig. 16.26: Radical vaginal hysterectomy. Note the positions of the ureter, the cardinal ligament, the levator ani and the rectal pillar. The cervix and the uterus are being retracted upwards with a speculum. The next steps are to cut through the uterosacral ligament and the cardinal ligament as near to the rectum as possible.

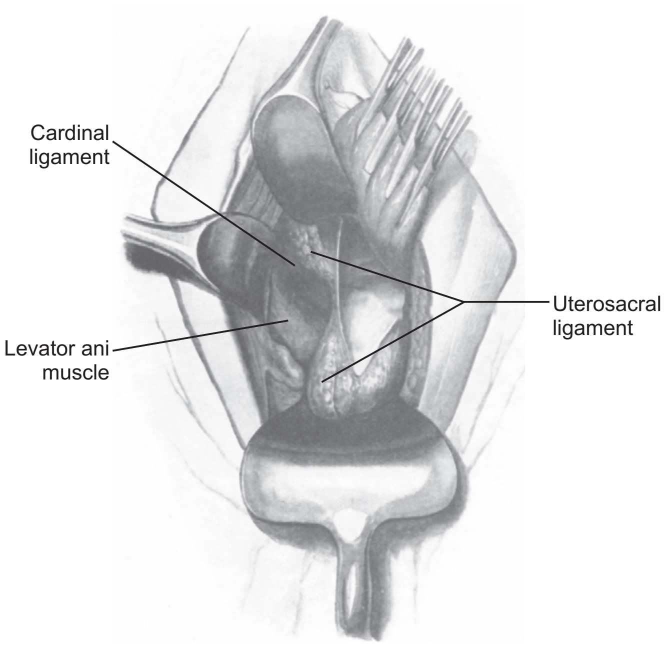

Fig. 16.27: Radical vaginal hysterectomy. The rectal pillar and posterior part of the cardinal ligament have been divided.

retracting upwards and it is wise always to place a second ligature just above the first on this pedicle as it is here that a vessel is most likely to retract and cause a serious haematoma. The remainder of the broad ligament, together with the round ligament, is now clamped and divided distal to the clamp. The tissues enclosed in the clamp are now ligated and the clamp removed. A similar procedure is carried out on the opposite side, and the surgical specimen that includes a wide cuff of parametrium and vagina is now removed.

Closure: Peritoneal closure is not of itself important, but small bowel prolapse might be prevented and there is theoretical advantage in ensuring that the pedicles of the infundibulo-pelvic folds, the round ligaments and all parametrial pedicles lie extra-peritoneally in case of bleeding (Figs. 16.29 and 16.30).

A gauze pack is now placed in the upper part of the wound and the Schuchardt's incision closed. First, the upper end of the vaginal incision is closed by interrupted sutures; after this the levator cut edges are sutured together if the levator has been divided, and subsequently the tissues are sutured in layers. The pack is then removed. Interrupted sutures draw the vaginal wound edges together, after which the skin of the perineum is united with interrupted sutures (Fig. 16.31).

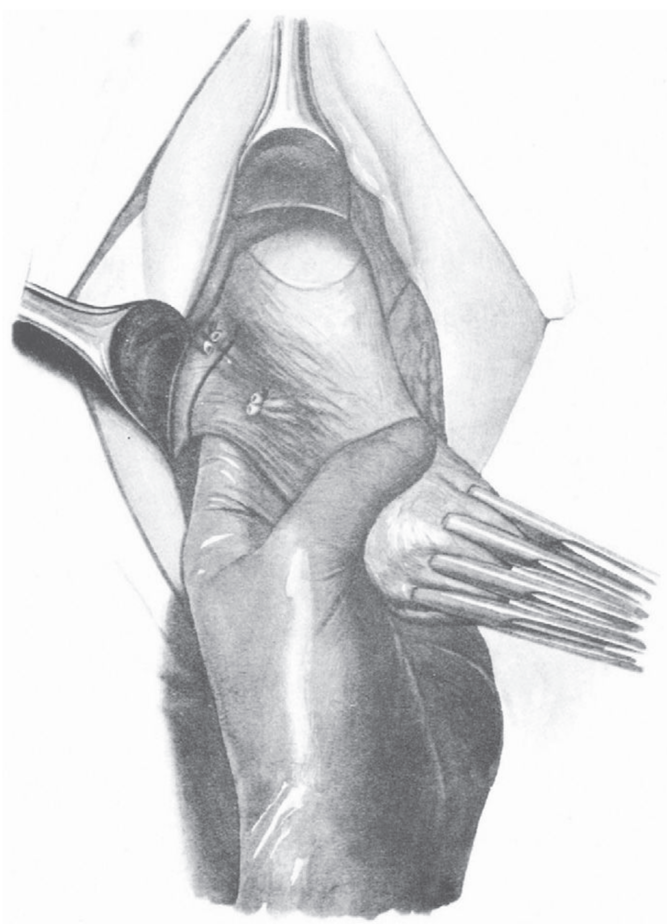

Fig. 16.28: Radical vaginal hysterectomy. The vaginal cuff is drawn downwards and towards the patient's left. The fingers are placed in the pouch of Douglas. The anterior portion of the cardinal ligament is now divided between forceps.

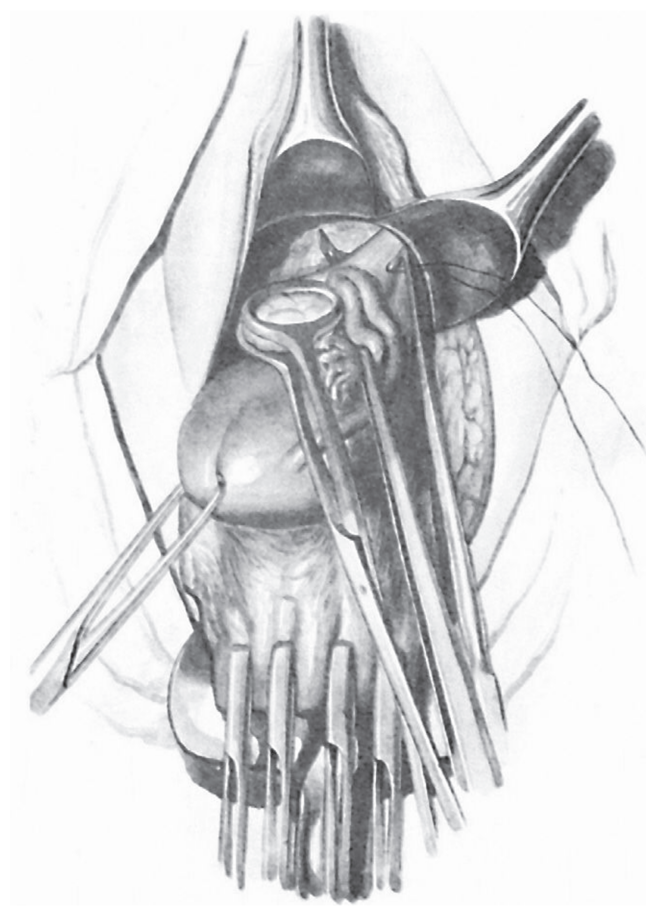

Fig. 16.29: Radical vaginal hysterectomy. The fundus of the uterus is drawn through the uterovesical pouch and in this case the left ovary also. The infundibulo-pelvic ligament is being ligated.

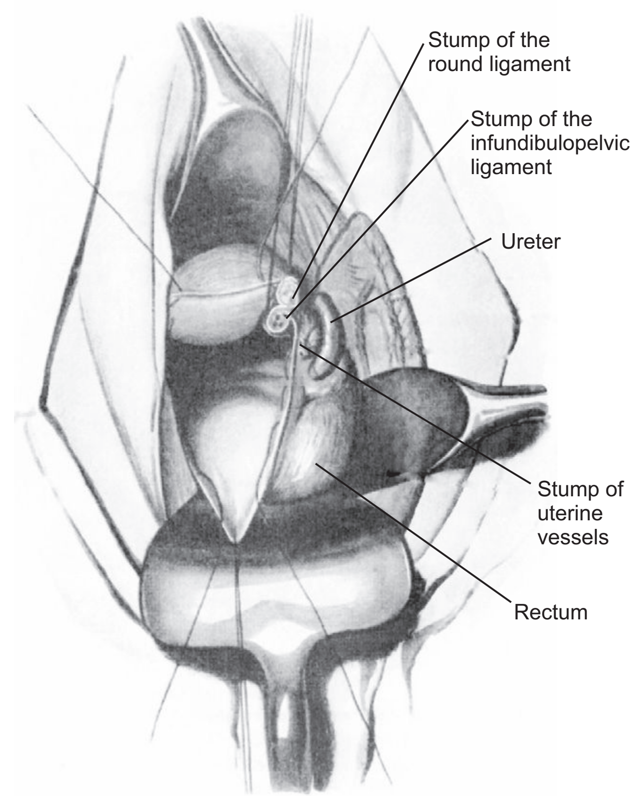

Fig. 16.30: Radical vaginal hysterectomy. The uterus and parametrium have been separated and removed. The pedicles can be seen.

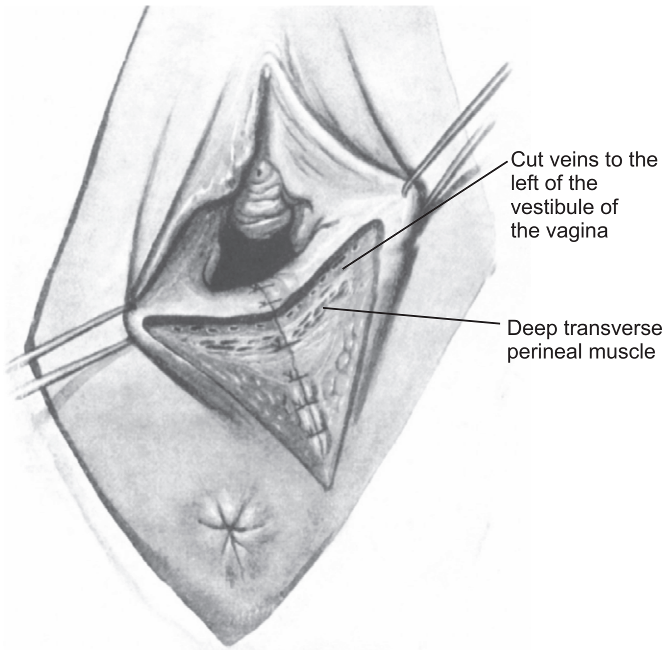

Fig. 16.31: Radical vaginal hysterectomy. Closure of the Schuchardt incision.

EXTENDED RADICAL VAGINAL HYSTERECTOMY (AMREICH)

The purpose of Amreich's extended vaginal extirpation technique is to remove the maximum amount of pelvic cellular tissue by the vaginal route. The operation consists of a preliminary Schuchardt's incision, followed by the formation of a vaginal cuff by the Schauta technique. The next step is to strip the pelvic cellular tissue on each side away from the upper surface of the levator ani muscle. Deep vaginal retractors are now introduced, and by means of blunt dissection the paravesical space and the pararectal space are identified. A retractor placed below and to one side of the bladder, combined with a lateral retractor, now enables both the uterine artery and the ureter to be identified far out near the pelvic wall. The uterine artery is ligated well out on the lateral wall of the pelvis and divided distal to the ligature. An aneurysm needle suture passer is now placed above the cardinal ligament well out on the lateral part of the pelvis below the ureter. This part of the cardinal ligament is then divided between two ligatures. The same procedure is followed on the opposite side. The uterosacral ligaments are identified with their downward prolongations extra-peritoneally. They are clamped and cut through in the usual way enabling the vaginal cuff to be drawn backwards. The last important part of the operation consists of dissecting the ureter from the bladder pillar and identifying the ureteric canal as in Schauta's operation.

The operation is far more extensive than Schauta's technique and requires very great anatomical knowledge. Bleeding from severed veins may be troublesome. Apart from the steps described above the usual Schauta technique is followed.

COMBINED ABDOMINAL AND PERINEAL METHODS

A combination of the Schauta and Wertheim techniques is an invaluable modification favoured for cervical cancer[11] and endometrial cancer.[12] In essence, the surgeon starts with the vaginal approach, circumcising below the cervix, thus closing off the upper vaginal pouch before commencing the abdominal operation. A synchronous approach by two surgeons facilitates this.[4] A variant of this approach is the combination of radical vaginal hysterectomy with laparoscopic assistance and pelvic lymphadenectomy.[13,14]

Laparoscopic Lymphadenectomy

This technique was introduced to replace extra-peritoneal lymphadenectomy through bilateral groin incisions. Several large series have shown that laparoscopic techniques for lymphadenectomy can produce as many lymph nodes for examination as can be obtained by open surgery, without increase in morbidity. Certainly an enhanced view of the pelvic side-wall may be obtained. In addition to therapeutic lymphadenectomy, the technique may be used for pre-treatment lymph node sampling. Dargent[15] has extended the concept of selective lymphadenectomy in an attempt to identify a 'sentinel node'. In this technique, a blue dye is injected into the substance of the cervix and laparoscopy carried out 15 minutes later. The broad ligament is opened and blue dye identified in lymphatic channels; any blue lymph nodes are removed. Ninety per cent of the dye-stained nodes have been found close to the external iliac vein distal to the bifurcation. Only those patients whose blue nodes contained tumour were found to have tumour in other lymph nodes.

Studies have shown that with increasing experience detection rates may be improved using the sentinel lymph node technique in uterine cancer.[16] Nevertheless this technique has not as yet found universal acceptance in the way that it has for detection of nodal metastases in breast cancer.

(a) Extra-peritoneal lymphadenectomy: The laparoscope is introduced into the pre-peritoneal space in the midline about 3 cm above the pubic symphysis. This space is developed by distension with carbon dioxide delivered via the laparoscope sheath. Two 5 mm trocars are inserted suprapubically, one at a higher level than the other. This technique does not allow a thorough inspection of the abdominal and pelvic cavities. However if there is a specific requirement to avoid opening or transgressing the abdomen, there is a small place for its use.

(b) Transperitoneal lymphadenectomy: In this technique, the first trocar is placed in the usual sub-umbilical position with two 5 mm trocars then inserted in either inguinal region. Finally a 10/12 mm trocar is inserted centrally just above the symphysis. The inter-iliac nodes are then approached through a standard parietal incision between the round and infundibulo-pelvic ligaments. The paravesical space is opened to expose the external iliac vein extending inferiorly to the obturator nerve medial to the obturator internus muscle, which is well visualised. The node-bearing tissue is dissected free in a cranial direction, exposing the obliterated umbilical artery medially and the external iliac vessels laterally, the dissection being carried to the bifurcation of the common iliac arteries. The tissue is extracted through the large suprapubic port. This is probably sufficient for diagnostic purposes, but for therapeutic lymphadenectomy it may be appropriate to extend the dissection cranially to the lower lumbar (para-aortic) nodes.

(c) Lumbar (para-aortic) lymphadenectomy: Above the pelvic brim, the retroperitoneal space may be entered either by making a horizontal parietal incision directly over the aorta, or by making an incision over the right common iliac artery.[17] Once the peritoneum has been elevated the node-bearing tissue is dissected out between the aortic bifurcation inferiorly and the pedicle of the inferior mesenteric artery or even the third part of the duodenum. It should be remembered that lymphatics accompanying the ovarian vessels drain to lumbar nodes at the level of the renal vessels (Fig. 16.32).

Fig. 16.32: The extent of full para-aortic lymphadenectomy.

RESULTS

Querleu[18] reported on 283 patients who had undergone laparoscopic pelvic lymphadenectomy [including 49 who had also had lumbar (para-aortic) lymphadenectomy]. The number of lymph nodes obtained increases with operator experience and is comparable to open surgery. No positive nodes were obtained in patients with stage IAl carcinoma of the cervix but stage IB yielded 24% positive, rising to 36% in stage II (A & B). Diagnostic lymphadenectomy therefore has a place in order to determine whether radical surgery or radiotherapy should be chosen to treat cervical cancer.

Laparoscopic Radical Hysterectomy

It is now apparent that laparoscopic techniques may be used for carrying out a radical hysterectomy using the same principles and steps as the classical procedure. Since the technique was first introduced some 20 years ago,[19] great advances have been made with improved equipment and more recently the introduction of robotic surgery. Whilst it was initially thought that operating time was always longer with laparoscopic and minimal access techniques, increasing experience and reducing unnecessary surgical steps, has shown that operative times may be shortened whilst at the same time pelvic and para-aortic node dissection techniques may be improved with an increasing and satisfactory nodal count achieved. An improvement in surgical performance has been demonstrated with increasing experience.[20]

Laparoscopic surgery for patients with uterine cancer has been shown to be a safe and reliable alternative to open surgery with a significantly reduced hospital stay and complications. Whilst operating time may be longer initially in robotic cases, clinical outcomes are similar for both robotic assisted and laparoscopic hysterectomy, and blood loss appears less for those undergoing surgery by robotic assistance.[21] Whilst laparoscopic surgery may be more difficult to learn initially this is undoubtedly aided by robotic assistance, which allows greater flexibility of movement and magnification of the operative field. The shorter learning curve means that the average surgeon will master the robotic technique more speedily than pure laparoscopic procedures.[22]

Surgical Technique

The technique for a radical hysterectomy performed laparoscopically follows the same principles as for open surgery. Pelvic lymphadenectomy is carried out initially identifying tissue plains and spaces. The paravesical spaces are identified and opened. The obturator nerve is located. The external iliac vein and artery are separated from the pelvic walls allowing identification of the external iliac lymph nodes as well as the obturator nodes. A standard pelvic node dissection may be performed.

The pararectal space is developed and the uterine artery either clipped or cauterised close to its origin on the anterior division of the internal iliac artery. The ureteric tunnel is opened and the dissection continued to obtain adequate parametrial and paracervical tissue exactly as for an open radical hysterectomy.

Mobilisation of the bladder by dividing the uterovesical ligament anteriorly and the uterosacral ligaments posteriorly, is carried out much as for a standard Wertheim's procedure. Nerve-sparing surgery is feasible and more successful by direct visualisation of the lateral pelvic and splanchnic nerves. If the procedure is to be completed by the vaginal route then the cuff of vagina is divided and mobilised vaginally but alternatively the vagina may be incised as for a standard abdominal procedure. The specimen may then be removed by the vaginal route and subsequently the vaginal vault closed using continuous 2/0 vicryl. The V lock suture is particularly useful for this ensuring safer haemostasis without the risk of sutures slipping.

DISCUSSION

Laparoscopic pelvic and lumbar lymphadenectomy should only be carried out by gynaecologists who have been trained in both advanced laparoscopic techniques and surgical oncology, including the management of major vascular injury. The principal diagnostic indication appears to be in early carcinoma of the cervix, in order to select appropriate surgical or irradiation therapy. The place of laparoscopic lymphadenectomy in endometrial cancer is less clear.[23] It may help to decide logically which high-risk patients require adjuvant therapy.

The major scope for therapeutic lymphadenectomy must be in support of radical vaginal hysterectomy or function-preserving procedures such as radical trachelectomy.[24]

The choice of route of operation, once surgery has been chosen as the therapeutic option, must depend upon the individual surgeon. The Bonney/Meig's/Wertheim operation has the great advantage that the lymph nodes can be excised and a wider dissection of the pelvic cellular tissue is possible. The Schauta operation went into disfavour because of inaccessibility of the lymph nodes and increasing bladder morbidity. Nevertheless, in a retrospective comparison of the results of Schauta's operation with those of Meig's in 793 consecutive women with stage IB and IAl cervical cancer there was no significant difference between the two procedures.[25] It may indeed be the preferred approach in many obese patients with carcinoma of the endometrium.[26] It has attracted a resurgence of interest because of its potential in association with laparoscopic-assisted lymphadenectomy

Long-Term Complications of Radical Pelvic Surgery and Their Prevention

The major long-term morbid sequel of radical hysterectomy is impairment of bladder function.[10,27,28] Incontinence may be of stress type but not due to hypermobility of the urethrovesical junction (as this lies above the reconstructed vaginal vault) but rather the reverse, namely fixed and open funnelling of the bladder neck due to peri-vesical scarring. Peri-vesical scarring may also seriously reduce bladder capacity (non-compliant bladder) and, finally, wide lateral parametrial dissection and division of the cardinal ligaments may transect the pelvic nerves and thus denervate the parasympathetic motor supply to the bladder. A lesser degree of nerve trauma (neuropraxia) may recover but have the opposite effect of producing inappropriate detrusor muscle activity (detrusor instability).

The relationship of bowel function to pelvic surgery is ill understood, but there is no doubt that some forms of defaecatory dysfunction can be related to hysterectomy, perhaps more so following the radical operation.

Identification and preservation of the hypogastric and lateral pelvic nerve plexuses will help to reduce this bladder and rectal dysfunction.[29] Sexual dysfunction and psychological trauma following fertility-sparing surgery are less than with radical excision by hysterectomy,[30] but pre- and postoperative counselling are important.

It is important to recognise that all the above sequelae may follow radical pelvic radiotherapy without surgical intervention. Surgical shortening of the vagina clearly has the potential for sexual dysfunction, although if the vault heals cleanly and tissue elasticity is maintained, with regular coitus and the use of vaginal oestrogen and dilators, virtually normal vaginal capacity can be restored. Radiotherapy alone can cause adhesive colpitis unless similar measures are taken. In such cases the potential need for reconstructive and restorative surgery should be borne in mind.

Fertility-Sparing Surgery: Radical Trachelectomy

With the detection of smaller tumours at an early stage, and the desire for preservation of fertility, the concept of uterus-preserving surgery and yet performing radical local excision of the primary cervical tumour has proven to be successful. Careful selection is crucial. The technique combines laparoscopic pelvic node dissection with radical local excision of the cervix, prior to re-anastomosing the uterine isthmus to the upper vagina.[31]

The procedure may be performed either abdominally or vaginally. Surgeons who are familiar with vaginal surgery and feel confident with mobilisation of the bladder and ureters by this approach maintain that adequate paracervical and paravaginal tissue with a vaginal cuff may be excised.[24]

Others believe that more paracervical tissue can be excised safely by an abdominal approach whether open surgery or laparoscopic.[32,33] Complication rates are similar with either technique, but the vaginal route, combined with laparoscopic pelvic node dissection has a lower morbidity, and results in shorter hospital stay and quicker recovery.

SURGICAL TECHNIQUE

Pelvic Node Dissection: Once selected for fertility-sparing surgery, pelvic node dissection may either be carried out at the same time as the trachelectomy, or as part of the initial staging assessment, leaving the trachelectomy to be performed once the histology of the lymph nodes is known.

The advantage of performing a pelvic node dissection first, as part of the overall staging assessment is to confirm MRI-predicted positive nodes. Sentinel node techniques may be performed as part of this procedure. The author's preference is to carry out a transperitoneal lymph node dissection either with robotic assisted or straight laparoscopy. A careful assessment of the peritoneal cavity is carried out, and any other pelvic or abdominal pathology such as endometriosis or chronic pelvic sepsis assessed. The pelvic sidewalls are exposed using a T-shaped incision into the peritoneum overlying the external iliac vessels proximal to the round ligaments. Care is taken to avoid the infundibulo-pelvic (IP) ligament and gonadal ovarian vessels. The ureter is identified running over the bifurcation of the common iliac vessels. The obturator fossa is located by careful dissection along the medial border of the external iliac vein and opening up the tissues deep to this in order to visualise the obturator nerve. The obliterated hypogastric artery is then elevated with the round ligament in order to open up the pelvic sidewall and obturator fossa. The paravesical space is identified and opened. Care is taken to identify any aberrant obturator vessels and avoid bleeding from these. A complete pelvic lymphadenectomy is performed removing the obturator lymph nodes as well as the internal and external iliac nodes. The distal common iliac nodes are removed, care being taken to avoid trauma to the gonadal vessels. The procedure is repeated on the contralateral side.

Radical Vaginal Trachelectomy: As discussed above this may either be carried out immediately pelvic lymph node dissection, or once histology of the pelvic nodes is known.

With the patient in an extended lithotomy position the cervix is carefully inspected and infiltrated with 1 in 200,000 adrenaline and 0.25% bupivacaine as a four quadrant paracervical block. This not only aids anaesthesia but opens up tissue planes with a reduction of bleeding. The tumour on the cervix is identified. A circumcervical incision is made to include a 2 cm cuff of vagina with the use of cutting diathermy and sharp dissection. The bladder is mobilised anteriorly identifying the bladder pillars and the paravesical space is thus opened on both sides. The incision around the cervix is continued posteriorly cutting across and identifying the uterosacral ligaments and also the rectovaginal septum. Using sharp dissection the incision is deepened. The author prefers the use of the Harmonic scalpel (Ultracision, Ethicon Endoscopy LLC) for dissection and haemostasis. This avoids the need for clamps and transfixion sutures. The bladder pillar is thus transected and the descending branch of the uterine artery (the cervical branch) identified. This is cauterised, divided and reflected cranially. The ureteric tunnel is identified and the ureter palpated. It is not necessary to open the tunnel formally as the uterine artery itself is not divided. However it is important to identify the ureter on both sides and ensure that it is pushed out of the operative field.

The dissection laterally is continued across the cardinal ligaments to include a 1.5–2 cm portion of tissue. The dissection is carried further posteriorly and across the uterosacral ligaments again with an adequate 1–2 cm of tissue included. The rectovaginal septum is divided posteriorly identifying a tissue plane that may be pushed cranially by blunt dissection with the use of pledgelets. It is not necessary to open the Pouch of Douglas and indeed it is the author's preference not to do so in order to try and avoid and limit possible pelvic sepsis spreading to the pelvis. The dissection is then continued onto the other side in the same way. Having mobilised the central cervix to include a 2 cm cuff of vagina and adequate paracervical and paravaginal tissue (Fig. 16.33), a Hegar dilator is placed into the endocervical canal and the cervix dilated up to Hegar 6. This dilator is left within the endocervical canal and cutting diathermy used to divide the cervical stroma at the isthmus down to and through the proximal portion of the endocervical canal (Fig. 16.34).

The specimen is removed and a suture inserted as a means of identification for orientation. If the Pouch of Douglas has been opened this is closed using 2/0 vicryl (polypropylene).

Isthmic Cerclage: An isthmic cerclage using a non-absorbable material such as No. 1 nylon or prolene is inserted with four adequate bites around the isthmus through the stroma of the cervix but care being taken not to occlude the isthmic os, which is protected by keeping the Hegar 6 dilator in situ. The knot is tied anteriorly around the Hegar dilator. This ensures patency of the os to allow an adequate passage for menstruation, and should it occur, spontaneous miscarriage, and/or the need for evacuation of retained products of conception.

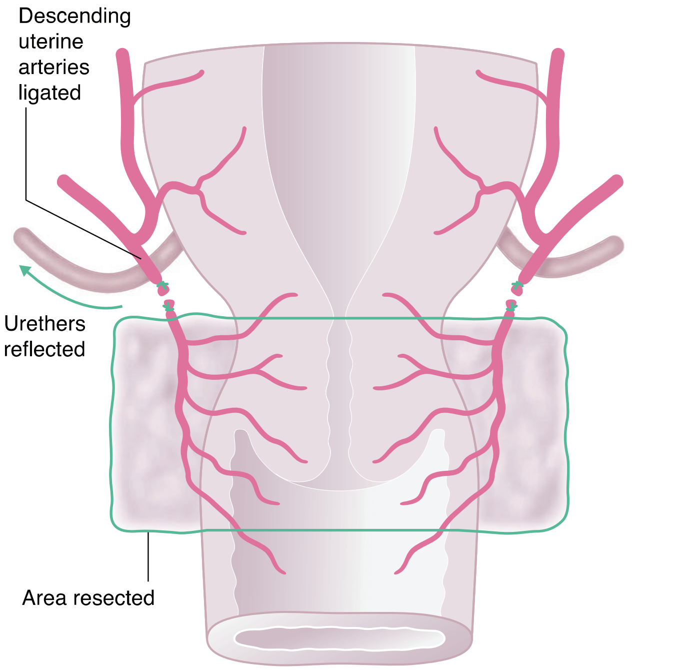

Fig. 16.33: Radical vaginal trachelectomy. Diagram to illustrate extent of tissue removed.

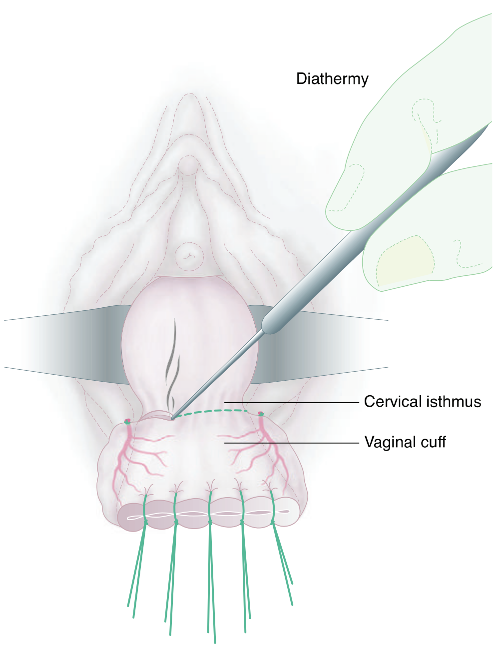

Fig. 16.34: Radical vaginal trachelectomy. The cervical stroma is divided at the isthmus to remove the endocervical canal and a 2 cm cuff of vagina.

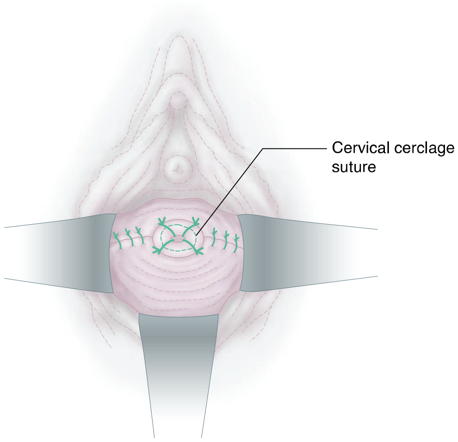

Fig. 16.35: Radical vaginal trachelectomy. Isthmic cerclage and closure of the vaginal angles after isthmic-vaginal anastomosis.

This suture is then held for identification and gentle traction applied. The vaginal margins are grasped and a vagino-isthmic anastomosis performed using interrupted mattress sutures of No. 1 vicryl. Four sutures are normally placed followed by a further two or three laterally on each side to close the lateral vaginal angles (Fig. 16.35). The Hegar dilator is removed and a number 12 Foley catheter inserted through the isthmus into the uterine cavity. The balloon is distended with 3–5 mL of fluid and the catheter left in situ for 72 hours in order to prevent the development of synechiae and consequent stenosis. A bladder catheter is also inserted and left for continuous drainage for a further 5 days before removal. A vaginal pack is placed for 24 hours to prevent haematoma developing behind the anastomosis.

RADICAL ABDOMINAL TRACHELECTOMY

The abdominal approach may be used for trachelectomy either via an open laparotomy or alternatively by laparoscopy. The procedure comprises the lower part of a radical abdominal hysterectomy. Paravesical spaces are opened once the lymph node dissection has been completed and the uterine vessels identified. The ureters are reflected laterally. The descending cervical branches of the uterine arteries are identified and divided. The pararectal spaces are opened by blunt dissection enabling adequate paracervical and paravaginal tissue to be dissected with a 2 cm cuff of vagina mobilised. The bladder is reflected distally. The uterosacral ligaments are divided deeply as for a radical hysterectomy and similarly the cardinal ligaments also. The specimen is removed and the vagino-isthmic anastomosis performed by the abdominal route. Most authorities agree that it is unnecessary to divide the uterine arteries in order to facilitate resection of the cervix and then attempt to re-anastomose these arteries. There is an adequate blood supply to the uterus after division of the descending or cervical branch of the uterine artery, and blood flow to a potentially pregnant uterus will not be compromised.

RESULTS OF TRACHELECTOMY

Trachelectomy appears to be a safe treatment for carefully selected women who are well motivated and determined to conserve their fertility. Squamous cell lesions that are confined to the ectocervix may be excised conserving a small cuff of up to 1 cm of the upper cervix at the isthmus. The aim should always be to obtain a 1 cm clearance from the tumour, which may be readily identified using current MRI techniques and especially endovaginal MRI.[34] Glandular tumours will necessitate complete resection of the endocervical canal and cervix. As a general rule, trachelectomy should be reserved for tumours less than 2 cm in diameter, although on occasions individual cases with larger lesions may be considered.

Conception rates are high although pre-term labour is common due to ascending chorioamnionitis. This results in pre-mature rupture of the membranes. Consideration should be given to antibiotics during pregnancy. The isthmic cerclage appears to be efficient and delivery must be by a classical (low vertical) Caesarean section either at the onset of labour or electively at 36–38 weeks of gestation. Recurrence rates are acceptably low with no significance between histological types or grade.[35]

Pelvic Exenteration

Pelvic exenteration, first devised and carried out by Brunschwig[36] in one form or another, may be applicable to locally extensive malignant disease of the pelvis, which cannot be contained by standard radical genital surgery and is usually considered after other forms of treatment have failed.[37] The primary tumour may be of the cervix, endometrium, vagina, ovary, rectum or bladder.[38] Its place is well established in the treatment of advanced and recurrent pelvic malignancy with quoted 5 year survival rates between 40% and 60%.[39] It also has a role as a palliative procedure in those with advanced/recurrent central pelvic disease who are symptomatic.[40]

A. Total Exenteration is removal of all three pelvic organs, often with lymph nodes and fascia. There are two varieties:

(i) *Infralevator*. A core of tissue is removed from the distal urogenital hiatus to include the vestibule, perineum and perianal area. This is in continuity with the endopelvic viscera. The specimen therefore consists of the anal canal with the rectum, the urethra as well as the bladder and the entire vagina.

(ii) *Supralevator*. In this, the distal organs are transected at the level of the levator ani (Figs. 16.36 and 16.37). The rectum is severed from the anal canal at the anorectal junction and the bladder is normally severed at or just above the internal urethral meatus (Fig. 16.38). The vagina is likewise normally severed just above its distal quarter.

The difference between these two procedures is that the supralevator operation permits continence saving and genital reconstructive surgery. If a significant part of the anterior wall of the bladder can be preserved in a supralevator exenteration,

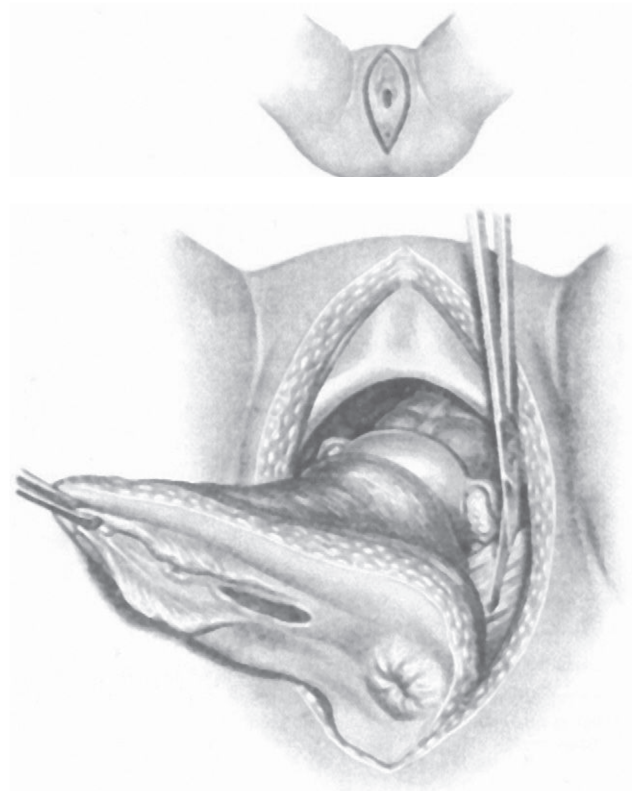

Fig. 16.36: Total exenteration. The removal of the vulva and perianal skin with the patient in the lithotomy position. The paracolpos is being cut on the left.

Fig. 16.37: Total exenteration. The lateral ligaments of the rectum are being severed on the left side. The two clamps above contain the base of the cardinal ligament and the paracolpos. The specimen will finally be delivered from below.

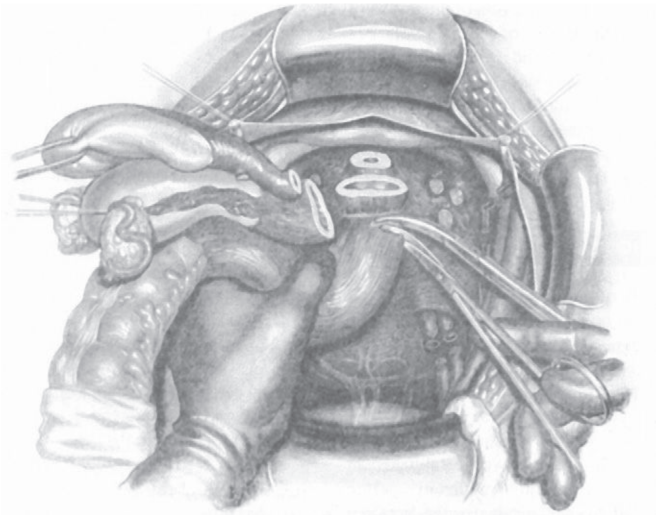

Fig. 16.38: Total exenteration (Hartmann's procedure). In this illustration the urethra and vagina have been divided above the level of the superior surface of the perineal membrane and levator ani. The rectum is being divided at the same level. This modified technique can be entirely carried out from the abdomen and may reduce the magnitude of the operation.

a mid-pelvic exenteration is sometimes preferred; it is an extension of the procedure described as radical oophorectomy, (see Chapter 17). (Figs. 16.39 and 16.40).

B. Partial Exenterations are rather more common and being less radical are likewise less morbid.

(i) *Posterior exenteration*. This term is applicable when abdominoperineal excision of a rectal carcinoma is carried out in continuity with the uterus and posterior vaginal wall. This operation is quite commonly followed by retrocession of the residual vagina, unless the omentum can be mobilised and placed into the pre-sacral hollow. After anal excision the perineal skin wound is closed. This covers a large pre-sacral cavity, which eventually epithelialises with squamous epithelium from the cut edge of the vagina. If the perineal sutures break down, the retroceded anterior vaginal wall becomes flush with the perineum and there is no cavity for coitus.

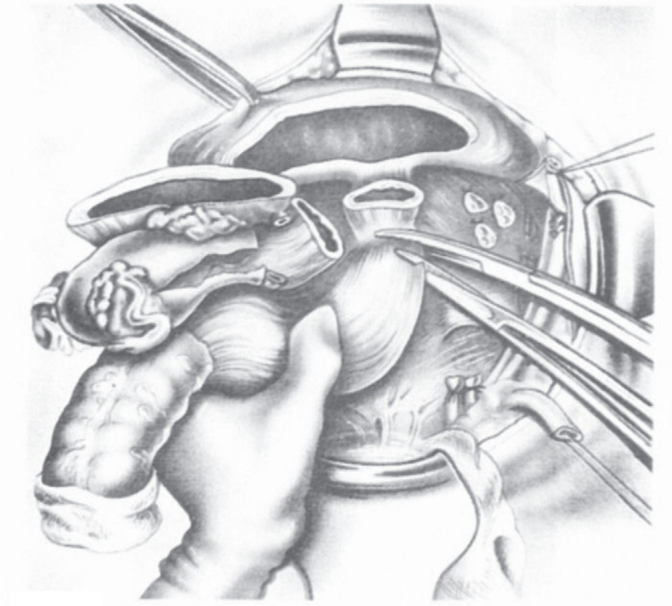

Fig. 16.39: Mid-pelvic exenteration. The divided bladder base and ureter may be seen. A short distal anorectal stump will nevertheless permit restorative colo-anal anastomosis.

Fig. 16.40: Mid-pelvic exenteration, Excretion urogram following a urinary tract reconstruction. The left ureter has been anastomosed end-to-side to the right ureter which has in turn been reimplanted into the reconstructed bladder. The bladder has in its turn been mobilised and approximated to the ureter by a 'psoas hitch'.

(ii) *Anterior exenteration*. This operation involves removal of the bladder in continuity with the uterus and anterior vaginal wall, usually including the urethra. If the anterior urethral and bladder walls can be preserved, they can be incorporated in a neovagina and the transitional epithelium will undergo squamous metaplasia. If part of the superior bladder wall can be preserved, this greatly facilitates closure of a surgical defect in the pelvic floor. The actual extirpative technique of pelvic exenteration is relatively easy compared with an extensive radical hysterectomy, as the internal iliac vessels can be ligated at source and ureteric dissection and preservation are not required.

Raising an 'end' colostomy is also relatively easy. The challenge comes when the opportunity for sphincter saving and function-preserving procedures is apparent. A very low colo-anal anastomosis and continence preserving urinary diversion are highly specialised procedures, which is why these operations are best carried out in a multidisciplinary team. The illustrations of the steps of the extirpative technique have been retained as a guide in case the gynaecologist is invited to join such a team. Furthermore, the scope and potential for these procedures should not be overlooked when counselling. It is too easy for seemingly authoritative negative advice to be offered to a patient with advanced or recurrent cancer without due consideration being given to the 'state of the art' in salvage procedures.

PRE-OPERATIVE PREPARATION

Any exenteration operation should be frankly discussed with the patient and the final choice of its performance or not should be left to her. The whole situation should be fully explained to the husband or nearest responsible relative and its risks and ultimate results freely admitted.

The authors feel strongly that in such a severe and mutilating procedure the patient has a right to know the full significance of what she is about to undergo, especially if a colostomy and/or urinary diversion is contemplated.

The counselling and pre-operative preparation should include all those features associated with an extended Wertheim's operation and also preparation of the bowel as, even if it is hoped to save the bladder, the surgeon cannot predict the feasibility or extent of the operation until the abdomen is open and the pelvis has been explored.

Multiple frozen section biopsies will be required before a decision to proceed can be taken. This is the final arbiter of operability. Modern imaging techniques, especially MRI, can prevent many patients getting to this stage, but ultimately the distinction between scar tissue and malignant tissue can only be made by microscopic examination.

TECHNIQUE OF EXENTERATION

Anterior Exenteration

This operation should always be performed using the Howkins' synchronous combined abdomino-vaginal approach.

The patient is placed in the Lloyd-Davies position and a long vertical incision extending above the umbilicus is made. The abdomen must be carefully explored for evidence of extra-pelvic malignancy. The infundibulo-pelvic fold and the round ligament on one side are then divided between ligatures, and the opening in the peritoneum extended upwards as high as the bifurcation of the aorta. The internal iliac artery (anterior division) is divided between ligatures and in some cases the corresponding veins are ligated, but this is avoided if possible. Lymph nodes and areolar tissue are stripped from the lateral wall of the pelvis so that the obturator nerve is exposed. The ureter is now cut through as low down as possible, but it must be divided above the level of any previously irradiated area. A similar procedure is now followed on the opposite side, after which the bladder is separated from the back of the symphysis pubis and from the pubic bones. The uterus is then drawn upwards and forwards, and the uterosacral ligaments divided (Figs. 16.38–16.41).

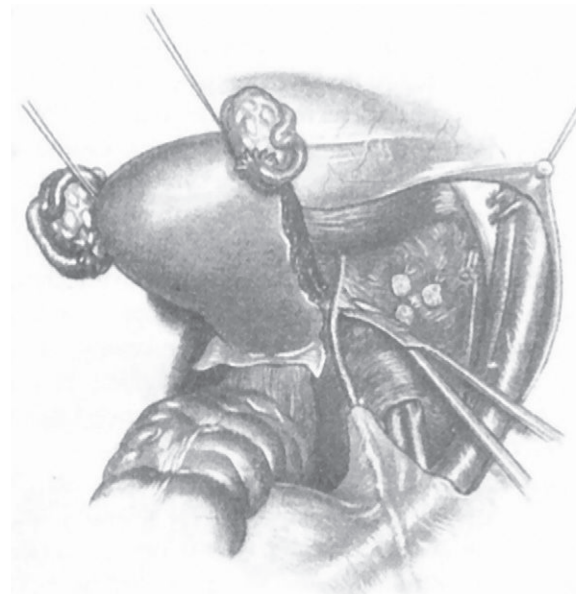

Fig. 16.41: Anterior exenteration. The ureter is being dissected from the ureteric canal, the roof of which has been transected and the uterine artery and veins ligated. The external iliac vessels have been cleared of all lymph nodes and associated cellular tissue.

Once the periureteric tissue and parametrium have been dissected to free the ureter from the pelvic brim to the bladder base, the ureter may be divided as low as possible , but ensuring a good blood supply to the remaining upper portion (Fig. 16.42). To control haemostasis it may be prudent to ligate the internal iliac artery. The uterosacral and cardinal ligaments are

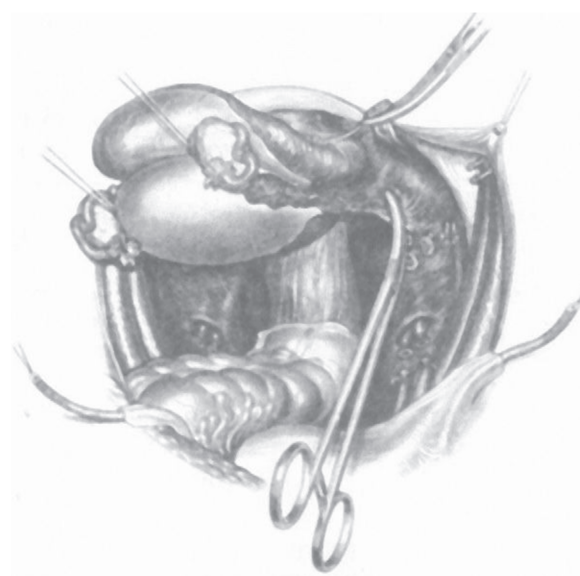

Fig. 16.42: Anterior exenteration. The ureter has now been cut and the distal end ligated. A stay suture is placed in the proximal end of the cut ureter, which is drawn upwards and laterally. The internal iliac artery, and in this instance the vein also, have been ligated and divided.

transected laterally on the pelvic side walls to obtain a complete clearance (Fig. 16.43). The retropubic space is opened anteriorly and the rectovaginal septum divided posteriorly to mobilise and separate the rectum from the specimen to be removed (Fig. 16.44).

Meanwhile the perineal operator has made incisions around the lower end of the vagina and the vestibule so as to include the external urethral meatus. If there has been malignant invasion of the urothelium, total urethrectomy is required as the risk of implantation is otherwise high. The position of these initial incisions will be dictated by the nature and extent of the pathology. Sometimes part of the vulva must be removed but sometimes the lower vagina can be spared. The incisions come together on the skin of the perineum just in front of the anus. The lateral incisions made in the vulva are now deepened and the vagina separated from the levator muscles on each side and from the tissues of the perineal body posteriorly. In front the incision is carried through the triangular ligament into the retropubic space to meet the abdominal operator. In this way the vagina and uterus, together with the bladder and ureters, are removed from below. The abdominal operator will perform urinary diversion by one of the methods described in Chapter 21. Unless the chances of cure of the cancer are very good, ureterosigmoidostomy may still be preferred for these patients. If irradiation has been used previously, both ureter and intestine from outside the field must be used otherwise there is a grave risk of anastomotic leak.[41]

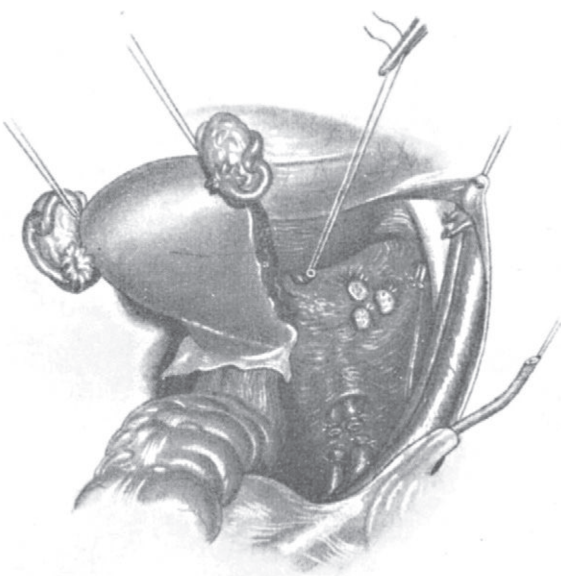

Fig. 16.43: Anterior exenteration. Division of the main bundle of cardinal and uterosacral ligaments. This structure should be divided as near the pelvic wall as possible. The vesical vessels are separately shown as clamped in the tap of the picture. The cut proximal end of the ureter is on the right.

Fig. 16.44: Anterior exenteration. The right hand frees the bladder from the retropubic space, while the left hand explores the plane of cleavage between rectum and vagina in the rectovaginal septum.

Posterior Exenteration

This operation is likewise carried out in the Lloyd-Davies position using two surgical teams. If anal excision is required, the canal should be closed by a purse-string suture. After full exploration in cases in which the rectum is involved in the growth, the rectum and sigmoid are resected with the uterus. The sigmoid mesentery is divided over the left common iliac vessels. A similar procedure is followed by dissecting clear the lymph nodes over the common iliac and external and internal iliac vessels; the pelvic cellular tissue together with the parametrium is removed as in the previous method. As the mesentery is elevated it should be transilluminated so that individual vessels may be picked up and ligated. The rectosigmoid is dissected from the sacrum as far down as the pelvic floor (Fig. 16.45).

At this stage the lateral ligaments of the rectum should be divided and the middle haemorrhoidal vessels ligated. When the rectosigmoid is fully mobilised the technique of hysterocolpectomy is carried out and it is possible to divide the posterior extension of the cardinal and uterosacral ligaments much wider than in a standard radical hysterectomy. The distal bowel should be divided, oversewn and invaginated as in Hartmann's operation. Alternatively, anal excision may be carried out as in abdominoperineal excision of the rectum (Miles operation). Finally, particular attention must be paid to closure of the lateral (paracolostomy) space.[42]

Total Exenteration

As with other exenteration procedures the synchronous combined abdominoperineal approach should be used.[4] The technical procedures are a combination of those described in the preceding sections (Fig. 16.46–16.50). The presence of removable organs in the front and back of the pelvis means that the limit of operability is reached laterally. The dissection should therefore always begin with pelvic lymphadenectomy,

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and if there is fixed malignant tissue on the pelvic side walls, the operation should be abandoned before mutilation has occurred. It is better to allow gradual bilateral ureteric obstruction to progress to its inevitable outcome rather than leaving the patient suffering prolonged terminal distress. Closure of the pelvic floor is difficult. The use of a pedicled graft of omentum is advocated, particularly when previous irradiation has been

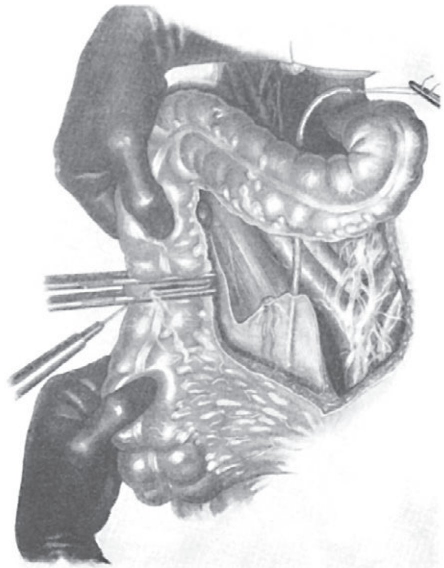

Fig. 16.47: Total exenteration. The sigmoid is divided by diathermy after ensuring that the blood supply to the proximal end is adequate.

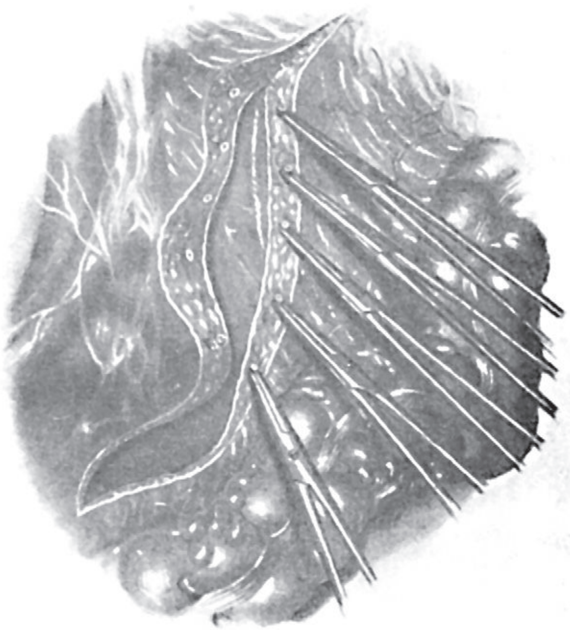

Fig. 16.45: Posterior exenteration. The vessels in the divided mesosigmoid are individually clamped and ligated.

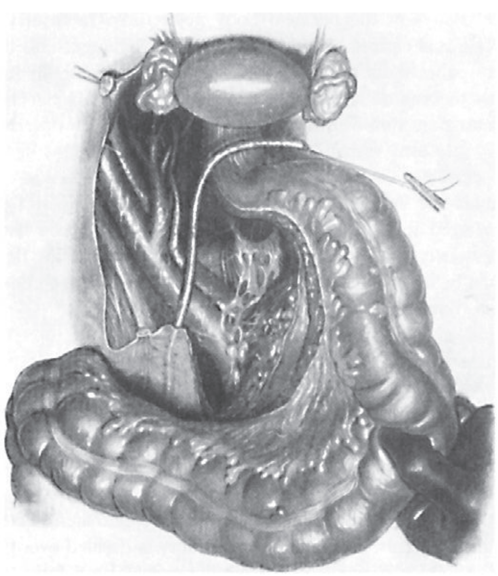

Fig. 16.46: Total exenteration. The left ureter has been exposed, divided near the bladder and freed from its bed. A stay suture is placed in the proximal end of the ureter, to act as an anchor suture when urinary diversion in performed.

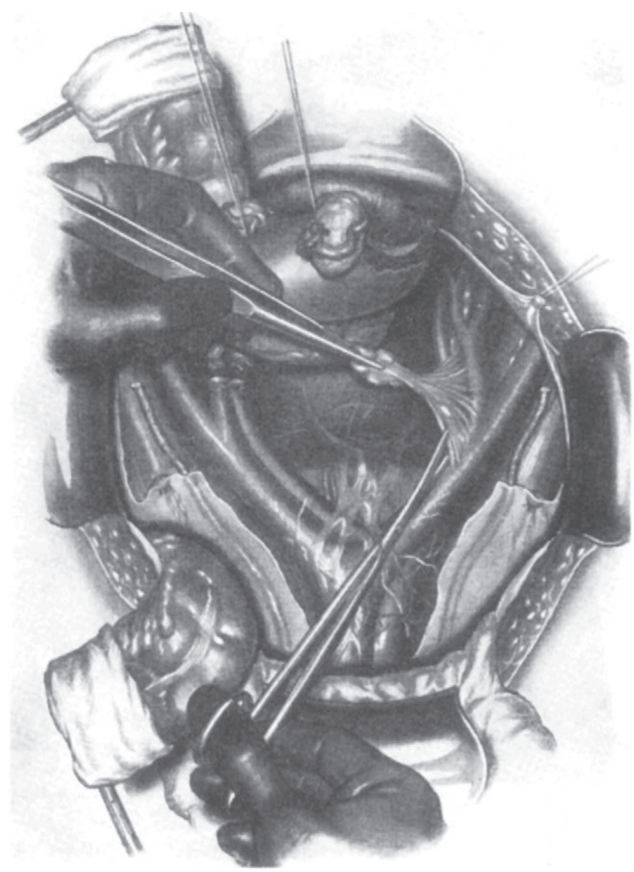

Fig. 16.48: Total exenteration. All nodes have been cleared from the great vessels on the left side of the pelvis. The left internal iliac artery and vein have been cut and tied. The right bifurcation nodes are being removed. Both cut ureters can be seen.

used. Isolation of the eviscerated pelvis from the general pelvic cavity may also be achieved by inserting a basket of synthetic mesh (polyglactin) to keep the mobile small bowel from a contaminated pool in the true pelvis.[43]

Fig. 16.49: Total exenteration. The cardinal ligaments are being cut on the right side, close to the wall of the pelvis. The sigmoid has already been divided and the cut ends draped with a swab, wrung out in mercuric chloride 1:1000.

Fig. 16.50: Total exenteration. The visceral contents of the pelvis are being freed in front by the left hand in the retropubic space and behind by the right hand in the hollow of the sacrum. The specimen is still held by the lateral ligaments of the rectum, which will need division.

EXTENDED LATERAL WALL EXCISION

Fixation to the pelvic side wall does not necessarily exclude radical excision and exenteration.[44] For those tumours fixed unilaterally above the sacral nerve, a wide excision including the pelvic side wall muscles, usually the obturator internus and psoas may be performed providing adequate clearance and free margins. Vascular reconstruction may be required. Re-irradiation intraoperatively or postoperatively, having inserted fine tubes to carry radioactive sources, has been advocated but with only limited success. Larger tumour fixation leading to severing of the sciatic nerve leads to a high and unacceptable morbidity.

POSTOPERATIVE CARE

These are probably the most extensive operations in pelvic surgery. Early postoperative care should be in a high dependency or intensive care units. The features of critical care are described in Chapter 20.

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Ovarian and Tubal Cancer

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John H. Shepherd

Introduction

Ovarian cancer remains a rare tumour with an incidence affecting 1 in 80 women. The majority of cases still present at an advanced stage and a significant proportion, between 50% and 60%, will die ultimately from their disease. However, the overall prognosis, 5 year survival and cure rate have significantly improved with a change of approach in the management of this enigmatic disease and the development of new chemotherapeutic drugs and regimens. A more aggressive and proactive approach to surgical resection followed by chemotherapy has changed the outlook for many patients. Advanced and widespread disseminated, often small volume, disease may be treated initially by neoadjuvant chemotherapy and then a definitive surgical procedure performed prior to completing chemotherapy postoperatively. Diagnosis of the disease is now less often made at an exploratory laparotomy for non-specific symptoms and signs. Screening of all patients with vague symptoms typically associated with ovarian cancer should be done using tumour marker assays, especially CA125[1] and other newer tumour markers including HE 4.[2] Prospective trials are underway to assess the value of population-based screening, whether this might be cost effective on a widespread basis.[3]

Presentation

Most patients will have non-specific clinical symptoms of vague abdominal pain, bloating, dyspepsia and a possible change in bowel habit. There is often a delay in investigation and diagnosis. A possibility of disseminated carcinomatosis and ovarian cancer should always be considered whenever such persistent vague symptoms are present. Even though a pelvic mass may not be present or easily palpated, an ultrasound scan of the pelvis will allow assessment of the ovaries and detect any free fluid or ascites that may be present. Diagnosis may be suspected whilst other abdominal or pelvic problems are being investigated. A small number of tumours will be detected as a result of screening which may be opportunistic or as a result of a family history of ovarian or other associated cancers being present. Prospective clinical trials are underway to assess the validity of a screening programme.

Investigations

The most sensitive test for detecting an abnormal ovarian mass remains an ultrasound scan preferably carried out transvaginally. Once an abnormality has been detected then the more specific study will be an MRI scan to characterise any mass that is detected within the pelvis. Ovarian tumour markers including CA125 for epithelial serous carcinomas and CA19-9 for mucinous epithelial tumours may then be estimated. A computed tomography (CT) scan of the abdomen and pelvis will assess the peritoneum and upper abdomen more precisely and thus staging may be determined pre-operatively by adequate imaging. A chest X-ray will always be necessary but a chest CT will give a better assessment of any possible pleural or mediastinal disease.

A full general examination physically, as with all potential cancer patients, is mandatory. A bimanual pelvic and rectal examination will indicate the mobility of a mass and the likelihood of lower colonic or rectal involvement, which may necessitate a bowel resection.

Staging

Whilst a good and accurate assessment of the stage of disease present may be obtained by pre-operative imaging, the definitive stage will be reached by a thorough laparotomy. In some patients, however, with very widespread disseminated (stage IIIC or IV) disease initial treatment may be by neoadjuvant chemotherapy, and therefore the staging needs to be decided non-surgically. If the patient subsequently undergoes interval-debulking surgery (IDS) or delayed primary surgery this staging may, or may not, be confirmed but it should not be changed, as there will usually have been a substantial response to chemotherapy, often with the resolution of ascites and pleural effusions.

The FIGO staging system is used (Table 17.1). This is based on a detailed assessment of sites of tumour spread both intra-abdominally and in the chest. Spread to other sites is rare. The majority of women with ovarian cancer will have distal spread from the pelvis to the abdomen or beyond. This will affect 60% of cases whilst only approximately 20% may remain localised to the ovaries. It is thus mandatory to fully explore the abdomen

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Table 17.1: FIGO staging of ovarian carcinoma

Stage I	Growth limited to the ovaries.
IA	Growth limited to one ovary; no ascites. No tumour on the external surface; capsule intact.
IB	Growth limited to both ovaries; no ascites. No tumour on the external surfaces; capsules intact.
IC*	Tumour either Stage IA or IB but with tumour on surface of one or both ovaries; or with capsule ruptured; or with ascites present containing malignant cells or with positive peritoneal washings.
Stage II	Growth involving one or both ovaries with pelvic extension.
IIA	Extension and/or metastases to the uterus and/or tubes.
IIB	Extension to other pelvic tissues.
IIC	Tumour either Stage IIA or IIB, but with tumour on surface of one or both ovaries; or with capsule(s) ruptured; or with ascites present containing malignant cells or with positive peritoneal washings.
Stage III	Tumour involving one or both ovaries with peritoneal implants outside the pelvis and/or positive retroperitoneal or inguinal nodes. Superficial liver metastasis equals Stage III. Tumour is limited to the true pelvis but with histologically proven malignant extension to small bowel or omentum.
IIIA	Tumour grossly limited to the true pelvis with negative nodes but with histologically confirmed microscopic seeding of abdominal peritoneal surfaces.
IIIB	Tumour of one or both ovaries with histologically confirmed implants of abdominal peritoneal surfaces none exceeding 2 cm in diameter. Nodes are negative.
IIIC	Abdominal implants greater than 2 cm in diameter and/or positive retroperitoneal or inguinal nodes.
Stage IV	Growth involving one or both ovaries with distant metastases. If pleural effusion is present, there must be positive cytology to allot a case to Stage IV. Parenchymal liver metastasis equals Stage IV.

*To evaluate the impact on prognosis of the different criteria for allotting cases to Stage IC or IIC, it would be of value to know: (1) if rupture of the capsule was (a) spontaneous or (b) caused by the surgeon, or (2) If the source of malignant cells detected was (a) peritoneal washings or (b) ascites.

and carry out both an intra-abdominal and retroperitoneal assessment, with appropriate biopsies of any suspicious nodules in order to obtain an accurate staging diagnosis.

Pathology

Ninety per cent of ovarian tumours are epithelial in origin with the majority being serous cystadenocarcinomas. A smaller number are mucinous in origin, endometrioid or of clear cell morphology. Approximately 5% will be germ cell or gonadal-stromal tumours with a further 5% being secondary tumours from other primary sites including the breast or gastrointestinal tract. These are commonly called Krukenberg tumours.

Decision for Surgery

Once the diagnosis has been either suspected or made then the decision as to who should operate, when and where needs to be taken. This decision should be made at a multidisciplinary team (MDT) review with gynaecology surgical oncologists, radiotherapy and medical oncologists, and also radiologists and pathologists with expertise in ovarian malignancy. Either primary surgery will be decided upon or neoadjuvant chemotherapy usually followed by a delayed laparotomy. The surgery should be undertaken by a trained abdomino-pelvic surgeon with an understanding of the natural history of the disease as well as its pathology. This surgeon should be a gynaecological oncologist and there is good evidence to show that the outcome for women with ovarian cancer will be better if this is the case.[4] Data indicate that advanced stage ovarian cancer patients have a better survival when treated by gynaecological oncologists or gynaecology trained surgeons. These specialists optimise surgical debulking and resection of tumour, also minimising the risk of a faecal diversion.[5] Similarly, staging is more complete when patients are operated on by a specialist gynaecological oncologist rather than by general gynaecologists or general surgeons.[6] Arguably the most important prognostic fact in advanced ovarian cancer is complete surgical cytoreduction[7] and gynaecological oncologists are twice as likely to achieve this than general gynaecologists.[8] This has been shown in other studies where patients with advanced disease are more likely to undergo optimal debulking and resection if operated on by a gynaecological oncologist compared to a general gynaecologist or general surgeon.[9] Of patients with advanced stage disease having sub-optimal surgery, 0–15% will survive 5 years, compared to 30–40% of patients who have an optimal surgical resection and cytoreduction.[10] Thus, the case for specialist referral in order to achieve optimal surgery and tumour bulk reduction is now irrefutable. Whilst the surgical gynaecological oncologist is the most important member of the multidisciplinary team, working closely with radiological and medical oncological colleagues is essential to determine (*a*) the most appropriate time for surgery to be carried out and (*b*) the most suitable chemotherapy for treatment of primary disease and for recurrence as and when it occurs.

Decision for Surgery or Neoadjuvant Chemotherapy

Surgical resection of tumour (cytoreduction) remains the cornerstone of current treatment for patients with advanced and early stage ovarian cancer. However, when there is widespread disseminated, often small volume, disease optimal resection of tumour may be impossible. Under those circumstances primary neoadjuvant chemotherapy may offer an advantage by removing extensive small volume disease, reducing the volume of ascites and then allowing an optimal 'cytoreduction' or resection of solid tumour mass prior to further chemotherapy being administered. It has been accepted for many years that the amount of residual disease remaining after primary surgery for epithelial ovarian cancer is inversely proportional to overall survival, i.e those patients in whom maximal, optimal or complete surgical resection has been possible have a considerably better survival rate than patients in whom large volumes of disease remain after their surgical procedure for tumour resection.[11] When extensive metastases and spread to the upper abdomen have occurred, optimal cytoreduction of tumour may include considerable upper abdominal surgical resection as well as pelvic clearance. Such surgery may include diaphragmatic resection, splenectomy, distal pancreatectomy and liver resection.[12] Serum tumour markers including CA125 should be estimated and if raised above a significant cut off level may indicate that optimal cytoreduction would be unlikely.[13–15]

Imaging Study

Whilst magnetic resonance imaging (MRI) is the most specific method of assessing and characterising a pelvic mass and ovarian malignancy,[16] computerised tomography is the most specific imaging modality for detecting peritoneal disease both in the upper abdomen and pelvis, and especially in the omentum. Either modality will assess retroperitoneal involvement. It is therefore possible to predict sub-optimal cytoreductive surgery[17] and to use a predictive index score based on radiographic criteria and performance status.[18]

Surgical Options for Treatment

Prior to undergoing surgery an assessment should be made as to whether the procedure is likely to be curative or palliative. The aim for all patients having primary surgery is cure, or at least optimal resection of tumour to allow a good response to chemotherapy. For some patients with advanced disease surgical resection may give palliative relief in situations such as obstruction, haemorrhage, perforation, or acute pain. The surgeon involved needs to be clear about the purpose of surgery and to explain this to the patient and her relatives.

LAPAROTOMY OR LAPAROSCOPY

Surgical staging of ovarian cancer can be achieved by both open laparotomy and minimal access laparoscopic surgery. Whilst a diagnostic assessment may be achieved successfully in the majority of cases by laparoscopy, resection of large bulky tumours safely is not always possible. Rupture resulting in tumour spillage[19] or possible port site metastases can occur.[20]

Complete surgical staging however can be achieved by laparoscopy with comparable operative time and less operative complications than laparotomy for selected patients with early stage and small volume disease.[21] A diagnostic procedure with sampling of small volume disease, biopsies and a retroperitoneal node dissection is a very different proposition from the resection of a large tumour mass from both the upper abdomen and pelvis. Laparotomy and traditional open surgery is always necessary for this type of disease.

PRIMARY SURGERY

The standard treatment for ovarian cancer is a surgical resection of the primary tumour with cytoreduction of metastatic disease. This may be optimal leaving behind no residual microscopic disease or sub-optimal. Prognosis is directly related to the amount of residual disease remaining after primary surgery.[11] Surgery is defined as sub-optimal when macroscopic inoperable disease remains and this is quantified as to whether individual nodules of greater or less than 1 cm remain. The aim of surgery should however be to remove all macroscopic disease unless it is truly inoperable due to its location, but not due to the inability of the surgeon carrying out the procedure. It is essential that the surgeon is trained in extensive abdominal surgical procedures to carry out these very extensive operations. The initial laparotomy therefore has two purposes. The first is to fully assess and stage the disease and the second, to carry out a therapeutic procedure, i.e. resection of the tumour.

Advanced disease or early stage disease with bulky enlarged ovarian masses necessitates a laparotomy through an extended midline incision. On opening the abdomen peritoneal washings should be taken using 300 cc of normal saline instilled into the abdominal cavity and pelvis. If there is no obvious evidence of peritoneal disease then blind biopsies should also be taken from the pelvis and paracolic gutters. Any suspicious nodules should be excised and biopsied and then appendicectomy carried out for mucinous tumours. The whole of the abdomen and pelvis is explored from the diaphragm to the pelvic floor. The retroperitoneum is also extensively assessed with the resection of bulky nodes from either the para-aortic region or the pelvis paracolic gutters. If the nodes are not enlarged a lymphadenectomy may still be required for staging, in particular if there is otherwise early stage (I or II) disease, as this would affect treatment and have a bearing on outcome and prognosis. This includes not only the pelvic nodes on the side of a primary tumour but also the para-aortic nodes up to and including the level of the renal vessels. Needless to say, the primary tumour is removed as part of the total abdominal hysterectomy and bilateral salpingo-oophorectomy, with an omentectomy and excision of any other peritoneal tumour from either the sub-diaphragmatic peritoneum or paracolic gutter. If there is involvement of the Pouch of Douglas with tumour extending onto the rectosigmoid an anterior resection of the rectum may be necessary. If at all possible, a primary re-anastomosis should be performed. This procedure of a retrograde extended hysterectomy as part of the radical oophorectomy procedure is well described by Hudson. Other metastatic disease involving the terminal ileum or other parts of the gastrointestinal tract should also be resected and any further bowel resection performed with a primary re-anastomosis.[22–24]

Liver metastases are rare in ovarian cancer but can occur and metastatectomy by a partial liver resection should be considered. This may be carried out as part of a primary procedure or during re-exploration for recurrent disease (Fig. 17.1). Similarly, sub-diaphragmatic peritoneum may be excised by mobilising the liver and transecting the falciform ligament in order to facilitate access. Tumour from the paracolic gutters may be

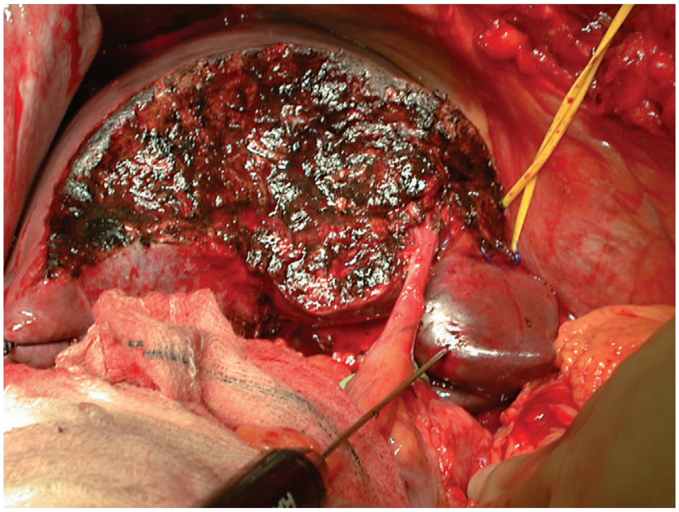

Fig. 17.1: Partial liver resection (metastatectomy) (by courtesy of Mr. S. Mudan).

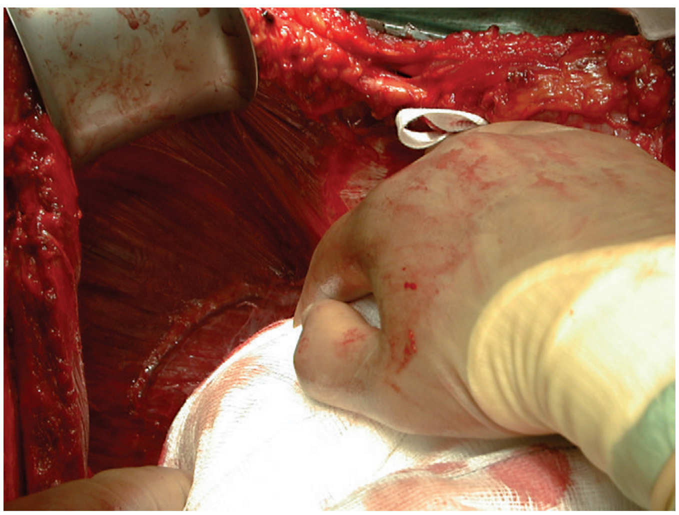

Fig. 17.2: Peritonectomy: excision of peritoneum with metastatic tumour from right hemi-diaphragm (by courtesy of Mr. S. Mudan).

excised by stripping the peritoneum (Fig. 17.2). If the disease has spread through into the diaphragmatic muscle, on occasion this may also be resected. The diaphragm may be closed with interrupted number 1 vicryl sutures having inserted a drain and ensuring adequate re-expansion of the lung. Small perforations or openings in the diaphragm may be closed without a drain.

This approach allows an accurate staging even if blind biopsies have been necessary with no obvious involvement of tumour outside the ovaries.[25] Whenever lymphadenectomy is required, i.e. with either bulky palpable nodes or in order to achieve a more accurate staging, systemic lymph node dissection in the aortic and pelvic areas is necessary. Isolated lymph node biopsies randomly are inappropriate.[26]

At the end of this primary surgical procedure, not only is the surgical stage determined accurately, but also the precise location of any residual disease. Thorough and extensive resection will have an impact on the success of adjuvant chemotherapy and determine whether early stage tumours require further treatment or not.[27] A recent Cochrane review has confirmed that this approach with complete surgical staging has improved survival.[28]

The question as to whether the effort for maximal surgical resection is necessary remains controversial with differences of opinion amongst various authorities. Early studies showed that patients in whom intestinal resection was necessary in order to achieve maximal possible cytoreduction did not fare as well as those patients in whom bowel resection was unnecessary.[29] Similarly, Potter et al.[30] found that peritoneal stripping with or without bowel resection did not improve overall survival. A subsequent study by Eisenkop et al.[31] found that ultra-radical surgery did not have a negative effect on survival. Their study demonstrated that it was possible to carry out maximal cytoreductive surgery and achieve optimal resection by employing techniques including posterior exenteration with anterior resection of the rectum, resection of the small bowel, stripping of the diaphragm, retroperitoneal node dissection and ablation of remaining peritoneal implants. A good overall median survival could be achieved (48 months) with a 47% 5-year survival. This was the first study to show by multivariate analysis that the most significant factor for survival was whether cytoreductive surgery led to zero residual disease. Other significant factors include age, the volume of ascites present if any, stage of disease, i.e. stage IIIC fared better than stage IV and the histological type.

More recent studies have confirmed that optimal, complete tumour surgical resection has a beneficial effect on survival and also response to chemotherapy.[7,12,32,33]

INTERVAL DEBULKING SURGERY

The concept of giving neoadjuvant chemotherapy prior to a planned surgical procedure was given credibility by van der Burg et al.[34] in her pivotal paper published in 1995. This indicated that interval debulking as a planned second surgical procedure after three courses of neoadjuvant chemotherapy and sub-optimal primary surgery had a major impact on survival. Secondary debulking after an initial sub-optimal procedure significantly lengthened the progression free and overall survival rate, reducing the risk of death by 1/3. The intention therefore is to increase the possibility of carrying out maximal tumour reduction, to make the surgery easier thereby reducing operative morbidity. Initially, primary chemotherapy was used in the treatment of elderly patients in relatively poor medical condition rather than submitting them to an aggressive surgical procedure. Stage IV patients with disease in the chest or liver were also treated in this way. Vergote et al.[35] demonstrated a significant survival advantage for patients thus managed, with a 3-year survival of 42% as opposed to 26% for those patients treated by standard primary surgery followed by chemotherapy. A later and larger series has shown that neoadjuvant chemotherapy followed by delayed primary surgery is not inferior to primary surgery followed by adjuvant chemotherapy.[36] The importance of this study is that for some women with advanced disease in whom the prospect of debulking is low, this approach appears preferable.[37]

SURGERY FOR RECURRENT DISEASE: SECONDARY CYTOREDUCTION

The place of surgery for recurrent ovarian carcinoma is probably the most difficult question to answer. If patients are symptomatic with progressive intestinal obstruction or acute pain then surgical re-exploration is clearly indicated.[38] Studies have demonstrated a survival benefit for patients undergoing optimal secondary cytoreductive surgery but the great majority of these are retrospective and non-randomised.[39–41] If optimal surgical resection can be achieved then a secondary surgical procedure may be indicated. Careful assessment of CT scans will demonstrate whether there is an isolated single recurrence or two or three areas that may be resected. If complete resection is possible then there is a survival advantage.[42] Surgery for recurrence in asymptomatic patients should therefore be reserved for those with either single site disease or two or three operable areas but is not appropriate for those with extensive widespread peritoneal recurrence.

PALLIATIVE SURGERY

The surgery for symptomatic control and therefore palliation is another matter. Most patients with progressive disease will develop some form of intestinal obstruction. The majority will have incomplete intestinal obstruction with diffuse serosal disease. If this is unremitting and not responding to conservative medical management and dietary control, surgery should be considered, as substantial palliation may be achieved. Criteria for selection are difficult to define but progressive obstructive symptoms with a risk of perforation clearly warrant surgical intervention. A single site of obstruction may be resected but on some occasions a stoma may be necessary for faecal diversion.[43] The reasons for carrying out palliative surgery are to relieve symptoms, when response to chemotherapy has ceased and hence improve the quality of the remaining months of life, or possibly to allow further chemotherapy to be given. The most frequent sites for obstruction to occur are the distal small intestine, i.e. the terminal ileum, or the rectosigmoid, within the pelvis.[44] Ideally, the obstructed area should be resected with a primary reanastomosis, but often a diversion with either an ileostomy or a colostomy is necessary. Such intervention will allow a significant number of patients to resume a normal or low-residue diet.[45] Opinions may differ as to whether and when to undertake palliative surgical procedures and each case must be judged individually.[43]

Special Circumstances for Surgical Consideration

ELDERLY PATIENTS

With an aging population, surgery in the elderly has to be considered with increasing frequency. Ovarian cancer is predominantly a disease of the post-menopausal woman and therefore a significant number of patients will be in their 70's and 80's at presentation. Most patients will present with advanced disease and a considered decision has to be taken as to how they should be treated, whether by neoadjuvant chemotherapy or primary surgery. When surgery is contemplated, careful assessment and pre-operative preparation is essential to minimise morbidity and indeed mortality. Age as well as performance status play a significant role in determining prognosis and survival.[46]

Postoperative complications following primary cytoreductive surgery in octogenarians are common and include cardiac or pulmonary compromise, prolonged ileus, wound complications and psychological or mental changes. Death prior to hospital discharge and within 60 days of surgery has a higher incidence than in younger patients, and many do not fulfil planned treatment with adjunctive chemotherapy.[47] Poor nutritional status as shown by a low-serum albumin compromises wound healing and postoperative recovery. This is especially so in patients with advanced disease and in particular stage IV.[48]

A full pre-operative medical evaluation highlighting co-morbidities needs to be carried out and a frank discussion held with the patient and her relatives regarding the benefits as well as the risks of surgery and/or chemotherapy. When surgery is decided upon, the intention and aims of surgery must be carefully defined and planned by an experienced surgeon and anaesthetist, so that the shortest, safest and most appropriate procedure can be performed. Postoperatively, careful monitoring and supervision on a critical care ward will be necessary.

The planned surgical procedure will depend not only on the frailty of the patient but also the extent of the disease and the operability of the tumour. An extensive 4–6 hour procedure with multiple bowel resections and excision of the subdiaphragmatic peritoneum will often not be appropriate. A more prudent approach would be to first resect the pelvic masses and then to relieve any obstruction.

FERTILITY-SPARING SURGERY

Conservative surgery for fertility-sparing purposes may be appropriate in some young patients with early stage disease. Preliminary radiology and tumour markers may have suggested a malignant tumour, in which conservative surgery could be appropriate. If at operation, the mass and tumour are confined to one ovary then unilateral salpingo-oophorectomy, conserving the uterus and contralateral ovary, may be performed after adequate and complete surgical staging. This is especially so with the rarer forms of either germ cell or gonadal stroma tumours, but may also be applicable for young women with early stage epithelial tumours. When an apparent early stage unilateral tumour is detected the contralateral ovary should be carefully inspected. The risk of missing a microscopic lesion within the stroma of the ovary is small, of the order of 2%.[49] Random bivalving of the ovary to take a wedge biopsy can cause adhesions and subsequent infertility.[50,51]

A particularly difficult operative situation that may be encountered is the unexpected finding in a young woman of an ovarian tumour with malignant appearance, which pre-operatively had been thought to be benign. This unwelcome finding may be at laparoscopy or laparotomy. If possible the advice of a gynaecological cancer specialist should be sought. Frozen section analysis of a solid tumour mass may help when there is a question as to whether a tumour is benign or malignant. If surgical staging confirms early stage disease and the patient is young, fertility-sparing surgery as above should be carried out. When in doubt as to what procedure should be performed, it is best to be conservative. Once the final histopathology is available, if necessary, subsequent re-exploration and definitive surgery can be carried out as for other patients.

Where fertility-sparing surgery has been feasible, initial assessment of the remaining ovary should be by MRI and then follow-up with transvaginal ultrasonography. A period of observation for 2 years is usually advised to ensure that there is no recurrence before a pregnancy is embarked upon.

Ovarian Cancer during Pregnancy

Ovarian cancer can occur during pregnancy and is the second most frequent gynaecological malignancy to do so with an incidence of 1%.[52] Ovarian cysts or masses in pregnancy are common: the majority are physiological enlarging functional cysts, usually the corpus luteum maintaining the early pregnancy. An ovarian cancer during pregnancy may present with acute pain from torsion, or during labour when a large impacted ovarian tumour may cause obstruction.[53] The frequency of ovarian cancer occurring during pregnancy has been estimated to be 1 in 18,000 pregnancies.[54] The majority present during the first trimester (44%), 17% during the second and 17% during the third trimester or at the time of a caesarean section. Twenty two per cent are detected during the puerperium. The majority of tumours are epithelial in origin with 17% being germ cell tumours and 13% gonadal stromal or granulosa cell tumours.[55] Most tumours are early stage (stage I, 75%). Pregnancy appears to have no negative effect on the prognosis or survival. Diagnosis early in pregnancy can be difficult and on occasions delayed because of the enlarging uterus and symptoms that can be mistaken for normal pregnancy events. However, with the widespread use of ultrasound for early diagnosis and dating, ovarian morphology is now more critically assessed and noticed. Serum tumour markers can be elevated during pregnancy physiologically and are therefore of limited value.[55,56]

SURGERY DURING PREGNANCY

Surgery is the primary treatment for ovarian cancer during pregnancy and will usually consist of a unilateral salpingo-oophorectomy once a suspicious solid ovarian mass is detected from ultrasound assessment, or because of acute abdominal pain necessitating further investigation. In more advanced disease, a careful decision needs to be taken as to whether aggressive surgical intervention is necessary or advisable, taking into account fetal viability and the patient's and her family's wishes. Complex and difficult discussions may need to be had regarding chemotherapy, and radical surgery that may include hysterectomy, with termination of the pregnancy. During the third trimester delivery of the fetus by caesarean section, followed by radical surgical resection with hysterectomy and pelvic clearance with full staging should be performed.[52] There is some evidence that after the seventh week of gestation, bilateral adnexectomy is compatible with continuation of the pregnancy as the majority of hormonal production is then derived from the trophoblast. Advanced disease after this time does therefore allow the option for removing bilateral malignant pelvic masses and other tumour whilst conserving the uterus.[57]

The question is often asked as to whether malignant cells can metastasise through the placenta to the fetus. This has been reported[58] and therefore following delivery of a patient with a malignancy, the placenta must be examined, particularly the intravillous spaces as well as the umbilical cord. Fetal metastases have also been reported with melanoma (22%) and breast cancer (15%) in pregnancies with placental involvement.[59]

CHEMOTHERAPY DURING PREGNANCY

Chemotherapy is contraindicated in the first trimester in view of a high abortion rate and instance of fetal developmental abnormality. This is reported as up to 10% for single agent and 25% for combination regimens.[52] Once the second or third trimester is entered, the risk for congenital malformation is negligible, and therefore advanced disease may be treated with neoadjuvant chemotherapy in order to postpone the need for radical surgery.

Borderline Ovarian Tumours

Low-grade or borderline ovarian tumours, also known as tumours of low potential malignancy, are a separate well-recognised diagnostic group of tumours, which are neither benign nor truly invasive high-grade epithelial tumours. They affect young women more often than the elderly and are usually diagnosed at an early stage. They are associated with an excellent prognosis and therefore fertility-sparing surgery by unilateral salpingo-oophorectomy with excision of peritoneal metastases may be undertaken. If the contralateral ovary is involved consideration of either a partial oophorectomy or excision of surface tumour may be performed. If there is extensive involvement of both ovaries then bilateral adnexectomy may be necessary. Pregnancy outcomes after fertility-sparing surgery are encouraging, with little impact on the disease even if there is remaining small volume tumour present. There is no evidence that treatment of infertility in patients after surgery for borderline tumours hastens recurrence or has impact on survival. Having such treatment however, when there is widespread active, albeit borderline, disease present should be approached with caution. If fertility-sparing surgery is not feasible due to extensive tumour spread, current advanced reproductive techniques such as IVF, the use of donor oocytes or surrogacy may be used.[60]

Recurrence of borderline tumour should also be dealt with surgically, as these tumours are not chemosensitive, although on occasions widespread small volume disease may be treated with combination chemotherapy. A small number of borderline low-potential malignant tumours may dedifferentiate and become more aggressive and hence the need for surgical resection of as much of the solid tumour as possible and for careful reassessment histologically. Higher grade disease will necessitate treatment with chemotherapy following surgery. Recurrence should be tackled surgically and may require radical resection as for the more invasive high-grade tumours, especially when there are isolated identifiable masses present.[61]

The further question to be addressed is whether patients treated conservatively with fertility-sparing surgery should have completion surgery with pelvic clearance, i.e. removal of the contralateral ovary and uterus at a later date. Whilst opinion has varied and changed over the years currently there is evidence to suggest that this is advisable, as indeed with patients who have undergone fertility-sparing surgery with early stage high-grade tumours.

Pseudomyxoma Peritonei

The majority of cases of pseudomyxomatosis peritonei are now considered to arise from the gastrointestinal tract – predominantly the appendix. These are mucinous tumours often associated with a rise in Ca 19-9. Spillage of mucin from ovarian mucinous tumours or appendicular mucoceles may lead to peritoneal mucinous deposits. When there is widespread peritoneal involvement, mucinous ascites may result and be very troublesome to control as it can originate from all peritoneal surfaces. Surgery for extensive disease includes a full pelvic clearance (TAH BSO with excision of pelvic peritoneum) appendicectomy peritoniectomy including the paracolic gutters and diaphragm, omentectomy, splenectomy and resection of any affected bowel. Heated intraperitoneal chemotherapy is often considered.[62] Referral to national or regional pseudomyxoma units specialising in the complex multidisciplinary treatment necessary should be considered.

Surgical Treatment for Epithelial Ovarian Cancer

The principles of a surgical approach have been outlined but the methodology of this surgery remains as has been well described in previous editions of this textbook. Small tumours without any risk of rupture may be dealt with by laparoscopy. Larger tumours, i.e. whenever there is a risk of rupture should be removed by open surgery. The cut off point with regard to size is questionable as although a tumour up to 8–10 cm may be placed in a laparoscopically inserted endo-catch bag, the risk of rupture and spillage of cells is not small. Tumours of up to 4–5 cm may be removed laparoscopically by widening the inferior suprapubic portal whilst at the same time carrying out a laparoscopic staging procedure. However, any tumours larger than this do run a significant risk of tumour spillage and rupture and it would be foolhardy to jeopardise the chance of cure in a patient for the sake of surgical incision and scar. Standard treatment therefore for a known malignant tumour diagnosed prior to surgery should be performed by open laparotomy. A midline incision should be employed for ready access to the whole of the abdominal and pelvic cavity.

Surgical management for the various stages of disease may be summarised as follows:

Stage IA: Unilateral salpingo-oophorectomy is the correct initial management in a pre-menopausal woman with a full-staging procedure including sampling of the para-aortic nodes up to the level of the renal vessels. Omentectomy with unilateral pelvic lymphadenectomy should also be carried out with a biopsy of the peritoneum. In a post-menopausal woman, hysterectomy with bilateral salpingo-oophorectomy should be performed and peritoneal washings are taken.

Stage IB, IC and IIA: Total abdominal hysterectomy with bilateral salpingo-oophorectomy would normally be carried out with a full-staging procedure as already described. If a stage II tumour is present with pelvic peritoneum adherent to the uterus, the hysterectomy should be carried out in a retrograde fashion as described by Dellepiane G.[63]

Stage IIB, IIC and IIIA: A radical oophorectomy procedure should be performed and this should be feasible in nearly all cases with a view to a complete macroscopic clearance. An infracolic omentectomy is carried out with para-aortic node extensive sampling. Any peritoneal nodules should be biopsied and other suspicious lesions also.

Stage IIIB and early IIIC: If there is no major or unresectable disease above the umbilicus then a radical oophorectomy procedure is applicable with total infracolic omentectomy. If there is extension of disease into the rectal mesentery or pelvic peritoneum then retrorectal mobilisation may be necessary to confirm operability.

Late stage III disease with widespread abdominal metastases, i.e. stage IIIC: Maximal cytoreductive surgery may be attempted in all cases. In the past, these cases would have been deemed inoperable and the abdomen closed with the biopsy alone or at most only the main ovarian mass removed.

The midline incision should be extended high into the epigastrium to allow access into the upper abdomen and diaphragm as well as The Pouch of Douglas. The infracolic omentum should be dissected off the transverse colon. If there is any question of supracolic involvement by tumour, this should also be removed. The mesocolon and particularly the middle colic artery must be preserved. When the supracolic omentum needs removal, the gastro-epiploic vessels and branches to the greater curvature of the stomach are divided right up to the hilum of the spleen, which itself occasionally requires removal also. Piecemeal removal of all other upper abdominal metastases should be undertaken. Whilst it used to be held that leaving small volume tumour up to 1 cm in size was permissible, if possible all tumour masses should be removed. If tumour bulk and widespread upper abdominal disease of greater than 1 cc remains behind, radical pelvic surgery disease is contraindicated. However if upper abdominal maximal and optimal cytoreduction has been achieved, a serious attempt at pelvic clearance and complete resection should be made. Positive inguinal or extra-pelvic lymph nodes should also be removed.

Stage IV disease: Pleural effusions as well as mediastinal lymphadenopathy or parenchymal lung disease constitute stage IV disease. Such cases may warrant neoadjuvant chemotherapy and if there is a good response after 3–4 courses, a radical surgical attempt at removing intra-abdominal disease should be considered. Again, the intention of abdominal surgery should be to resect all macroscopic disease. If this is not feasible then at least a maximal effort should be made to leave minimal residual tumour of less than 1 cc as described above.

Liver metastases also confine the patient to stage IV. At present in the author's department these patients will also receive neoadjuvant chemotherapy, but serious consideration should then be given to maximal resection of tumour including partial hepatectomy providing that there is not widespread multiple metastatic disease present. Isolated deposits of up to three or four metastases may be excised but again individualisation and careful review in conjunction with a hepatobiliary surgeon would be wise. At the same time, any sub-diaphragmatic peritoneal disease may be resected with peritoneal stripping not only beneath the diaphragms and along the falciform ligament but also the paracolic gutters.

Radical Oophorectomy

PRELIMINARY INVESTIGATIONS

As described in Chapter 4, the use of MRI scans of the pelvis to characterise masses and assess involvement of other organs including the rectosigmoid, bladder or pelvic side walls should be undertaken. Computed tomography scans will assess the upper abdomen and peritoneum. Paracentesis of pleural or ascitic fluid may be undertaken under ultrasound guidance and tumour markers including CA125 and CA19-9 estimated. Whilst a pleural effusion is not a contraindication to radical abdominal surgery, most patients who do have stage IV disease will receive neoadjuvant chemotherapy.

PRE-OPERATIVE PREPARATION

In many instances, the diagnosis of an ovarian malignancy will be tentative until a definitive laparotomy is carried out. Biopsies from any metastatic solid disease especially the omentum, may be obtained under ultrasound or CT control. Immunocytochemistry will help to differentiate a gastrointestinal and colonic primary from an ovarian primary tumour. Patients undergoing laparotomy for ovarian cancer should have full bowel preparation. In the author's experience up to 30% of patients with large pelvic masses associated with disseminated ovarian carcinoma will require a bowel resection. Whilst the aim should always be to restore gastrointestinal continuity and avoid a diverting stoma, 10% of patients may require this with approximately half (5%) requiring a permanent stoma and the other half only a temporary diversion, which may be closed at some stage over the subsequent months or even year. This should only be done after completion of chemotherapy, and will depend on disease response and whether there has been any early stage recurrence. Patients should always be prepared for this eventuality, but it should be emphasised that if at all possible a stoma will be avoided.

POSITIONING THE PATIENT

With a significant pelvic mass the operation is best carried out in the Lloyd-Davies position. This will allow adequate access both to the rectum and vagina enabling a perineal approach to be undertaken to aid a lower large bowel resection and re-anastomosis.

TECHNIQUE

A long vertical incision is used, a transverse incision being contraindicated. The diagnosis of a fixed ovarian tumour is confirmed without attempting mobilisation. The upper abdomen should then be explored to exclude a gastric or colonic primary and to identify upper abdominal metastases. Lymphadenectomy of the lumbar (para-aortic) lymph nodes in the presence of advanced disease is controversial but lymph node enlargement should certainly be documented and bulky nodes removed. Upper abdominal disease should be reduced to minimal size before attempting pelvic clearance.

PRINCIPLES OF THE RADICAL OOPHORECTOMY OPERATION

The objective of the operation is enucleation of a fixed ovarian tumour through elevation of the pelvic peritoneum as a false capsule, achieved by retrorectal mobilisation. The situation is shown diagrammatically in Fig. 17.3.[22]

PROCEDURE

The sigmoid-descending colon junction is elevated by an assistant and the white line where the mesocolon is reflected is incised (Fig. 17.4). The mesocolon is swept medially and the ureter identified well above the pelvic brim. This provides a guide to the ovarian vessels, which cross the ureter at this level. These vessels are doubly ligated some 7 or 8 cm from the ovary. The peritoneum on the lateral side of these vessels is then incised round the pelvic brim as far as the round ligament.

The colon is next displaced to the left to expose the sacral promontory and right side of the pelvic brim. If necessary the caecum and terminal ileum should be mobilised and elevated. The right ureter is identified and the right ovarian vessels likewise ligated above the pelvic brim. The peritoneum on the right side of the pelvic brim is incised as far as the round ligament (Fig. 17.5).

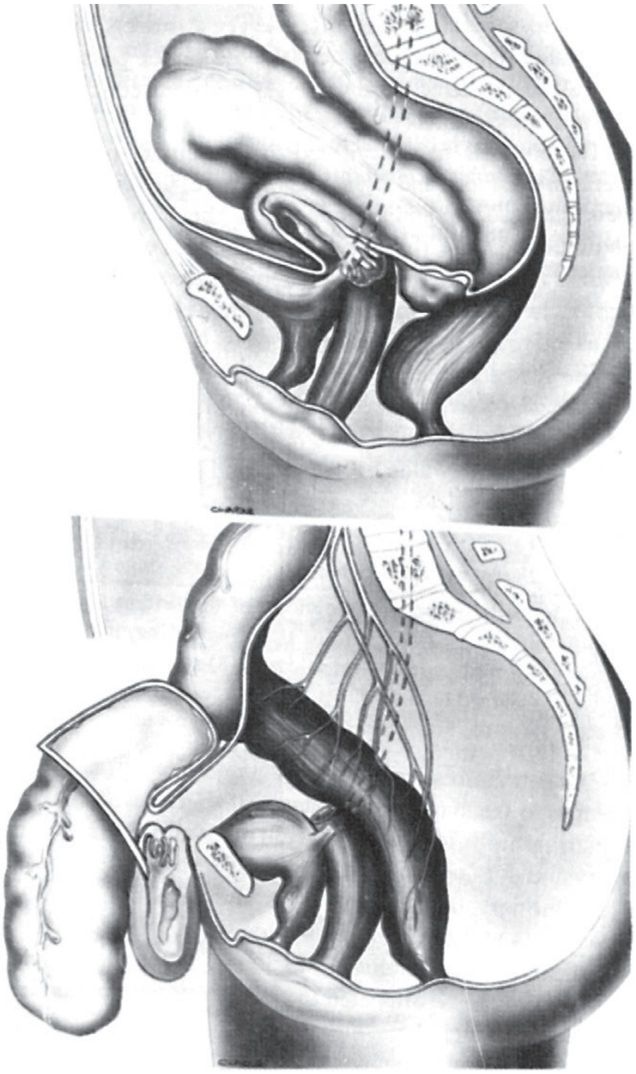

Fig. 17.3: Radical oophorectomy. Sagittal diagram to illustrate mobility achieved by elevation of the rectum from the sacral hollow.

Fig. 17.4: Radical oophorectomy. The plane behind the recto-sigmoid is being developed on the left. The ovarian vessels have been divided and the ureter visualised.

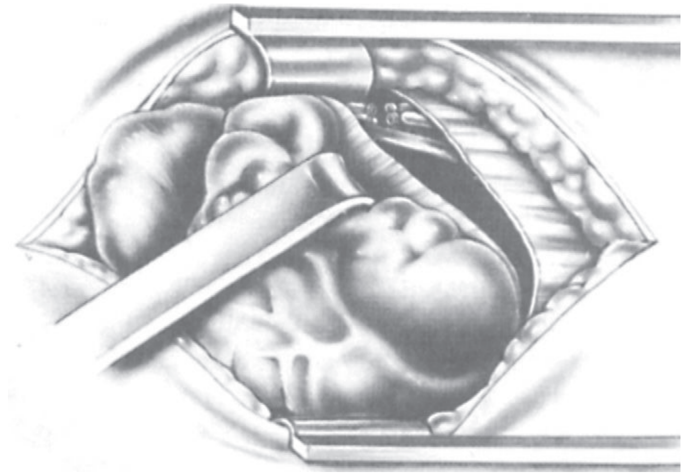

Fig. 17.5: Radical oophorectomy. An incision has been made round the brim of the pelvis to the right of the rectum. The right ovarian vessels and ureter have been exposed.

The rectosigmoid is then elevated and two fingers are inserted into the retrorectal space to allow air to enter with a sucking noise. This is a relatively avascular space in front of the pre-sacral (Waldeyer's) fascia and behind the superior haemorrhoidal vessels. The two paracolic dissections should now communicate behind the rectosigmoid and the first mobilisation of the tumour will have been achieved.

The round ligaments of both sides should now be divided between Howkin's clamps as in a radical hysterectomy. Attention is given to the uterovesical peritoneum. If this is involved an incision should be made well clear anteriorly and the peritoneum over the bladder stripped back to the uterovesical fold. It does not matter if a hole is made in the bladder and it may be necessary to make this deliberately. Below the peritoneal reflection the areolar tissue is divided in the usual way to expose the cervix and upper vagina.

The next move is separation of the ureter from the pelvic peritoneum and division of the uterine artery by the classical Wertheim technique (see Chapter 16). It may be helpful to enter the anterior fornix and circumcise the cervix first before dividing the uterine arteries and parametrium. This is the retrograde hysterectomy technique. A vulsellum is applied to the cervix, which is pulled up making division of the uterine artery easier, without hazard to the ureter (Fig. 17.6). The ureter should be freed from the peritoneum until it enters its tunnel in the cardinal ligament. The peritoneum attached as a 'false capsule' to the tumour must then be separated digitally from the side wall of the pelvis.

The uterus, still attached by the opposite uterine vessels and parametrium, must be pushed to that side. This allows digital development of the space between the peritoneum of the pouch of Douglas and the posterior vaginal fornix. This will be extended inferiorly into the rectovaginal space to assist mobilisation of the rectum. At this stage, the surgeon should return to the hollow of the sacrum and by digital dissection endeavour to free the rectum down to the anorectal junction at the level of

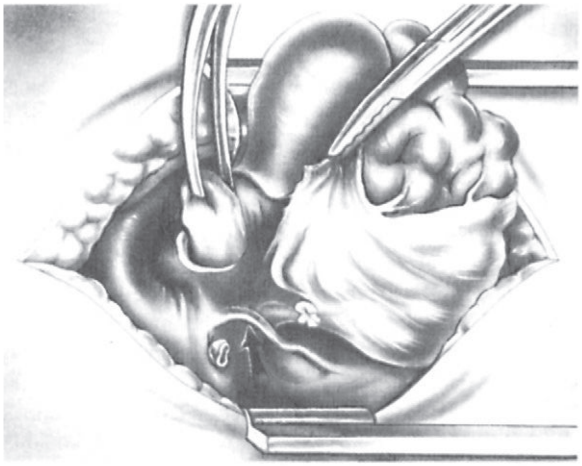

Fig. 17.6: Radical oophorectomy. Retrograde hysterectomy; the tumour with attached pelvic peritoneum has been mobilised on the left side, exposing the ureter. The left uterine vessels have been secured using the Bonney–Wertheim technique and the vault of the vagina incised in the anterior fornix

the levator ani (Fig. 17.7). Firm strands, particularly in the region of the uterosacral folds, will need division by scissors. Full mobilisation will not be achieved until the ipsilateral uterine artery of the main tumour mass has been divided. It is usually necessary to do this from the vaginal aspect and the vessels may have to be cut with scissors without clamps. This is safer than blind clamping and the object of this manoeuvre is to avoid ripping the tumour from the bed to which it is adherent. The ureter is inevitably at risk and, indeed, if it is adherent to the tumour at this point it should be cut without hesitation. Resection of a short length of ureter in this position can be readily dealt with by re-implantation once the tumour has been removed.

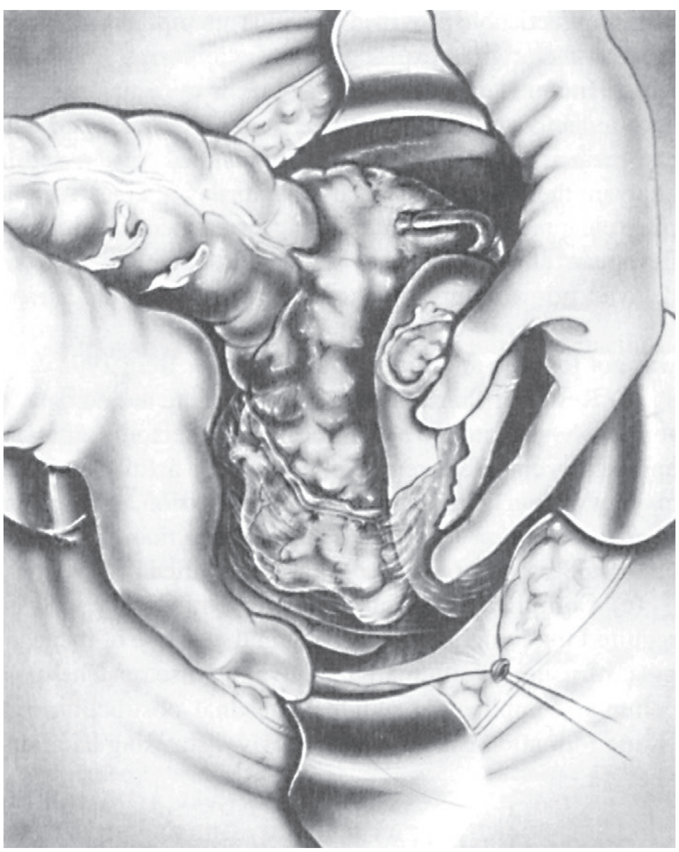

Fig. 17.7: Radical oophorectomy. Mobilisation of the rectum to the level of the anorectal ring allows the pelvic contents to be freed from the pre-sacral space and elevated for dissection under vision.

The next stage is full elevation of the rectosigmoid and pouch of Douglas with the uterus and tumour adherent within the peritoneal sac (Fig. 17.8). It is now possible to dissect the rectum free under direct vision. The peritoneum may strip from the anterior rectal wall in the outer longitudinal muscular layer aided by delicate scissor dissection (Fig. 17.9). Superficial nodules may be excised with the specimen in this way and sometimes a small disc of full thickness rectal wall may be excised and the hole sutured. If adhesion is extensive a short segment of upper rectum should be resected.[24]

TECHNIQUE OF ANTERIOR RECTAL RESECTION

A right-angle clamp should be placed across the infraperitoneal rectum. The middle haemorrhoidal vessels need to be secured at the apex of each lateral ligament of the rectum. The anal canal should be cleaned out by an assistant with normal saline or dilute betadine.

At the upper end of the adherent loop the mesentery should be transilluminated to choose a suitable area for division between vascular loops. First the superior haemorrhoidal vessels should be clamped and ligated with No. 2/O vicryl ties.

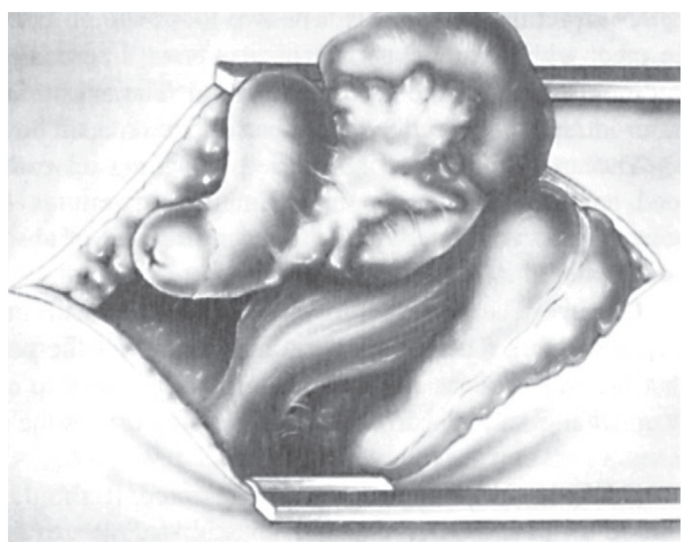

Fig. 17.8: Radical oophorectomy. The entire pouch of Douglas has been elevated by separation of the uterus from the vagina and mobilisation of the rectosigmoid down to the pelvic floor. The dissection can proceed under vision.

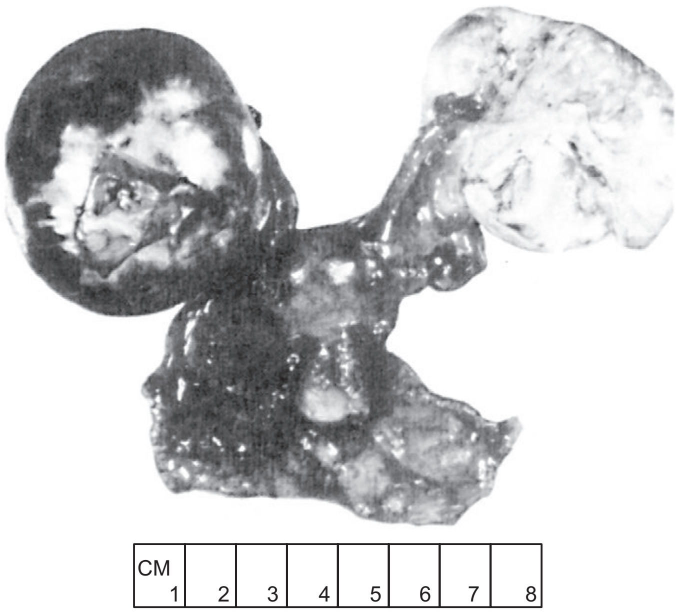

Fig. 17.9: Radical oophorectomy. Operation specimen; the pelvic peritoneum viewed from below contains multiple small metastases.

The length of adherent rectosigmoid will determine whether any sigmoid vessels need division. As the disease is not intrinsic to the bowel the least possible amount of mesentery and vascular pedicle should be taken. There should be no problem, therefore, with maintaining an adequate blood supply.

After division of the superior haemorrhoidal vessels, the mesentery should be divided between pairs of small artery forceps up to the point of division of the bowel. At this point the bowel should be divided between two crushing clamps.

COLORECTAL ANASTOMOSIS

The two loops should be able to meet without any tension. This can always be achieved by mobilisation of the descending colon. The anastomosis after intrapelvic resection is best performed on open bowel.

The anastomosis can be carried out using an end-to-end anastomosis staple gun or interrupted sutures. By hand a single layer of inverting sutures of absorbable material is commonly preferred.

URETERIC IMPLANTATION

If division and resection of part of the ureter is necessary this will be in the lower third close to the bladder. Re-implantation with a Psoas hitch or Baori flap should be feasible. A ureteric stent, usually double J, should be inserted and left for 4–6 weeks.

CLOSURE

The vaginal vault should be closed with interrupted sutures. There is no peritoneum to cover the pelvis but the stump of the round ligament may be fixed to each vaginal angle and absorbable cellulose placed over the raw area.

If the bladder has been partly resected it should be closed in two layers using absorbable sutures with a Foley catheter inserted. This will be left for 10 days. Consideration should be given to inserting a low-suction drain, i.e. a Robinson drain particularly if there has been any soiling. This may be removed after 5 days. The drain is brought out through a separate stab incision in the left iliac fossa. If a diverting stoma is necessary this may either be as a loop ileostomy in the right iliac fossa or on occasions an intubated caecostomy using a widebore Foley catheter also brought out in the right iliac fossa. This may be a useful and more temporary alternative. Finally anal dilatation may be carried out if there has been a large bowel resection in order to ensure adequate passage of any retained flatus in case of temporary paralysis of the anal sphincter.

CONCLUDING REMARKS

It is desirable that surgery for ovarian cancer should be carried out by a surgeon adequately trained to perform complete removal of disease with, if necessary, extra-genital resections. Nevertheless, the generalist gynaecologist cannot avoid occasional involvement with ovarian malignancy and also, incidentally, may be glad to use the retroperitoneal approach for certain other cases of benign pathology. This should therefore be within the competence of a well-trained generalist.

If faced with the need to resect a segment of bowel to achieve a complete operation, the generalist gynaecologist has two options:

(a) To recognise the situation, stage carefully, confirm the diagnosis histologically and close the abdomen without gross pelvic disturbance.

(b) To complete the extirpation with the attached loop of bowel; bring out the proximal sigmoid as an 'end' colostomy in the left iliac fossa; oversew the rectal stump with inverted sutures and tack it to the sacrum as high as possible (Hartmann's operation). Colorectal anastomosis can electively be performed by a specialist colorectal or gynae-oncological surgeon during a chemotherapy interval.

Either of these is preferable to 'sub-optimal debulking'.

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SECTION E

Aspects of Multidisciplinary Care in Gynaecology

SECTION OUTLINE

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Radiotherapy in Gynaecology

18

Melanie Powell, Millie Light

Introduction

Radiotherapy is the use of ionising radiation to treat disease. For a century, it has played a vital part in both the cure and palliation of all types of gynaecological malignancy.

The discovery of X-rays in 1895 by the German physicist, Röentgen, followed by the first therapeutic use of X-rays by Emil Grubbe in January 1896 to treat an advanced fungating breast tumour,[1] heralded a new era in the management of malignant tumours. But in gynaecology, it was the discovery of radium by Marie and Pierre Curie in 1903 that revolutionised the treatment of cervical cancer with both physicians and surgeons adopting the use of intracavitary radioactive treatment. Howard Atwood Kelly, a formative figure in the practice of Obstetrics and Gynaecology, was one of the first to establish its clinical use in gynaecological malignancies in the US, whilst in Europe, Louis Wickman first started using intracavitary radium to treat patients with carcinoma of the cervix in 1905.[2] In 1913, radium treatment was being widely used with over 1000 patients treated. By the early 1920s, the familiar combination of external beam radiotherapy and intracavitary brachytherapy had become the standard of care with reported 5 year survival rates of 45%.[3]

The modern day multidisciplinary approach to the management of gynaecological cancers involves a combination of specialities. Surgeon, clinical and medical oncologist along with nursing, radiological and histopathological colleagues work together to ensure individualised patient care and replace the traditional role of 'one doctor treats all'.

Treatment Delivery

Radiotherapy as a curative treatment modality is delivered primarily either by external beam (X-rays generated within the treatment machine and administered through the machine head placed at a set distance from the patient) or brachytherapy, 'brachy' being Greek for 'short' therapy (radioactive sources placed directly into the tissue or cavity to deliver a treatment dose in close proximity to the source dependent on the dwell time of the source in situ).

EXTERNAL BEAM

External beam radiotherapy is delivered using high-energy (megavoltage) photon beams. These are produced by either a linear accelerator (LINAC) that generates high-energy X-rays, by accelerating electrons towards a target, or by a machine that produces gamma rays by decay of a radioactive source such as cobalt or caesium.

In the developed world, LINACs are the predominant treatment machines. In developing countries, however, cobalt or caesium treatment units remain in widespread use. Although they may lack the high-tech capability of the LINAC, they are reliable and, once installed, require little upkeep.

Conventional external beam radiotherapy is the simplest method of radiation delivery and uses orthogonal X-ray images to show bony landmarks or radio-opaque markers from which the radiation field is defined. Treatment is then delivered using either anterior/posterior portals or planned with three or four radiation fields. Due to individual variation in both soft tissue and vascular anatomy, relying on bony anatomy can lead to missing either tumour or potential sites of tumour spread (for example lymph nodes). Nonetheless because of ease of use and lack of ready access to computed tomography (CT) or magnetic resonance (MR) scanning in some developing countries, such techniques continue to be widely used.

The integration of CT scanning into the radiotherapy planning process has allowed the prescribed radiation dose to be matched or conformed to the outline of the target. This shaping of fields is known as conformal radiotherapy and is the considered standard of care when treating pelvic tumours. It allows the intended dose to be delivered to the target with some sparing of normal tissues.

In preparation for conformal radiotherapy, patients are CT scanned in the radiotherapy treatment position and with similar preparation. For instance, the bladder is 'comfortably full' which allows small bowel to be pushed into the abdomen and away from the high-dose area. The oncologist then creates a three-dimensional target volume by delineating on each axial slice the area that needs to be treated. For a cervical cancer this would include the cervix and uterus as well as upper vagina, parametria and pelvic nodes. In addition, normal structures, such as bladder, rectum and small bowel are outlined (Fig. 18.1).

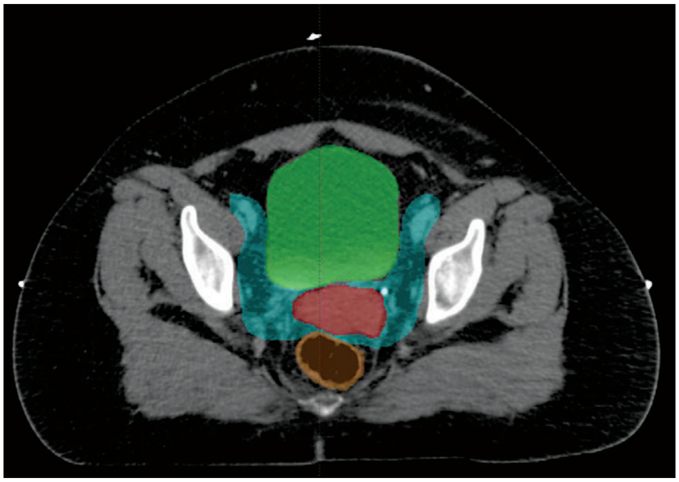

Fig. 18.1: Axial CT slice through the pelvis. Red and blue areas denote the 'target volume' tumour. Red outlines central cervix tumour, and blue outlines pelvic nodal areas. Bladder is outlined in green and rectum in brown.

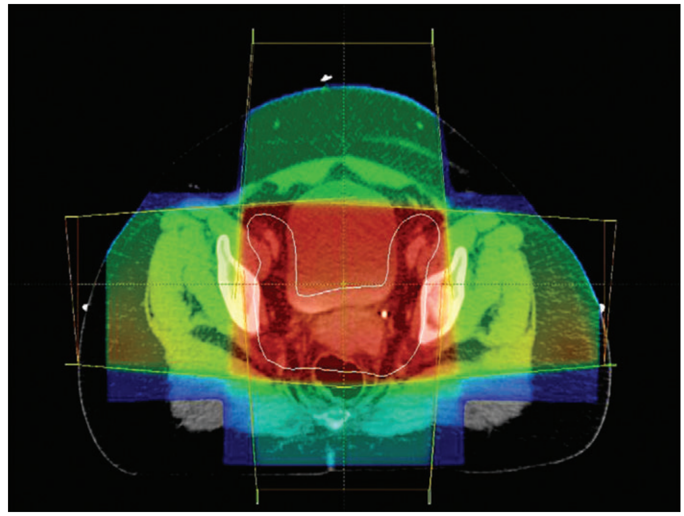

Fig. 18.2a: Colour wash to show distribution of radiation dose in standard pelvic radiotherapy field. Red, yellow, green and blue colours denote decreasing dose levels. Red is the highest dose (prescribed dose) and blue the lowest. The target (cervix and nodal area) is outlined in white.

Dosimetrists create plans of the radiation treatment aiming to treat the target volume to the prescribed dose whilst sparing as much normal tissue as possible. This often involves several radiation beams treating from differing directions with additional shielding.

Intensity modulated radiotherapy (IMRT) is an extension of the principle of conformal radiotherapy. Varying the intensity of an individual radiation beam enables more accurate beam shaping even around concave tumour shapes. Dynamic arc radiotherapy allows a similar high degree of conformity.[4]

In pelvic radiotherapy, where a dose/volume dependence for late toxicity exists, IMRT and dynamic arc treatment offer the potential to reduce doses to normal tissues, thereby lowering the incidence of side effects.

Theoretical radiotherapy planning studies comparing IMRT with conventional 'box' radiotherapy techniques have shown that the volume of small bowel, bladder and rectum irradiated to high dose can be reduced by between 20% and 50% (Fig. 18.2). In the clinical setting, single institution data comparing IMRT with historical controls treated with conventional radiotherapy seem to show that these reductions do indeed translate into clinical benefit with a reduction in both acute and late toxicity.[5]

BRACHYTHERAPY

Brachytherapy uses direct placement of radioactive sources or materials within tumours or within body cavities adjacent to or encasing tumours. It enables a high dose of radiation to be delivered to the tumour site with relatively little dose to surrounding tissues. Brachytherapy is an essential aspect of treatment of many gynaecological cancers, and in particular of cervical and uterine cancer.

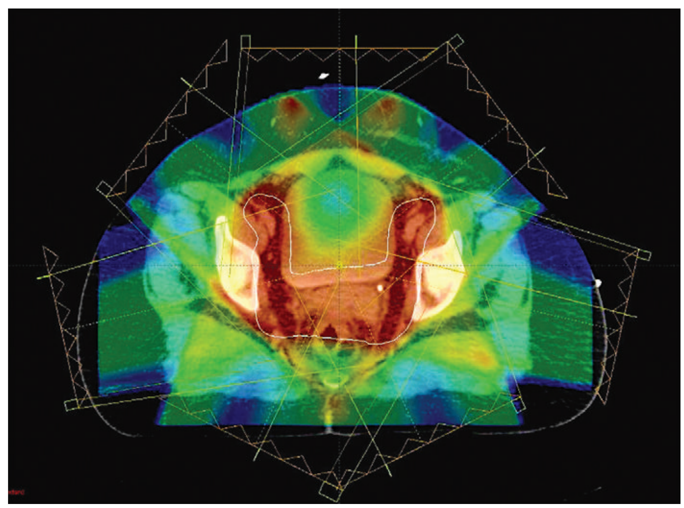

Fig. 18.2b: Colour wash showing distribution of radiation dose in intensity modulated radiotherapy plan. The high-dose (red) area is shaped around the target (outlined in white). Note the high-dose region is convex in shape, meaning the bladder receives lower doses than in the conventional plan.

Brachytherapy Treatment Delivery

In the early years, radium sources were used to deliver this treatment but radiation safety has led to the development of afterloading techniques where non-radioactive tubes or needles are positioned and later loaded with a radioactive source. High-dose rate after-loading machines, which contain a high-activity iridium source, allow treatment to be delivered over a period of minutes. Low or medium dose rate systems (LDR or MDR) with caesium or other sources are still used and means treatment may take many hours or days to deliver. This has the disadvantages of an inpatient stay, and greater patient discomfort and inconvenience.

Pulsed dose brachytherapy is similar to high-dose rate (HDR) system but treatment is delivered in short pulses over several hours requiring an inpatient stay, but the ability to interrupt treatment as required.

For primary cervical cancer or inoperable endometrial cancer the initial procedure needs to be carried out under either general or epidural anaesthetic. This is to allow careful examination together with dilatation of the cervical os and positioning of the radiotherapy applicators within the uterus and vagina.

The radiotherapy applicators traditionally comprise an intra-uterine tube and two vaginal ovoids or colpostats (Fig. 18.3). Vaginal packing or a spacer is used to push the rectal mucosa away from the high-dose region. Newer equipment involves the use of an intra-uterine tube and a hollow ring which, when used with three-dimensional imaging, allows for an individually tailored dose prescription.

Confirmation of correct positioning within the uterus is needed and this is best done with MR imaging. However, many centres do not have immediate access to MRI and use CT scanning as an alternative. Orthogonal films do not provide the soft tissue definition to provide accurate localisation of the brachytherapy applicators.

To facilitate calculation and description of intracavitary treatment various systems were developed. One of the most widely used is the Manchester system, developed in the 1930s to deliver brachytherapy for cervical cancer with radium and adapted in the 1970s for use with caesium. It is based on a single intra-uterine tube and two vaginal applicators. Two dose points were defined—'Point A', which is 2 cm lateral to the cervical canal and 2 cm superior to the lateral fornix; and 'Point B', which is 5 cm lateral and 2 cm superior to the cervical canal. This prescribing system remains in widespread use.

With increasing use of MR and CT imaging, together with high-dose rate afterloading systems, image-guided brachytherapy is now being undertaken.[5] This allows the treatment to be patient specific with the prescribed dose conforming to an individual's anatomy and tumour. This may lead not only to reduced toxicity, but also has the potential to increase tumour dose.[6]

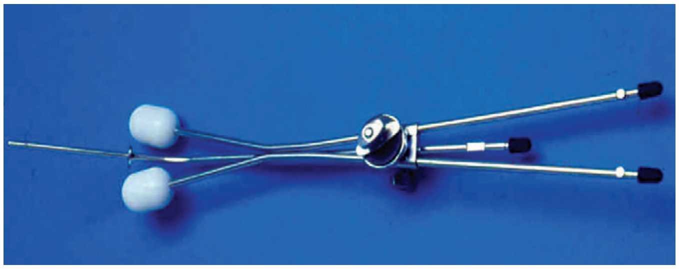

Fig. 18.3: High-dose rate brachytherapy applicators—'tube and ovoids'.

Where treatment is delivered to the vaginal vault, as with endometrial cancers, the brachytherapy procedure is more straightforward. A vaginal cylinder, the size of which can be determined by clinical examination, is placed in the vagina without the need for general anaesthetic. Treatment delivery is then given after image verification.

The dose is usually prescribed at a set distance from the surface of the applicator.

Toxicity

In any treatment it is important to ensure that the probability of benefit outweighs the probability of toxicity. It is inevitable that normal tissue will be irradiated in the course of radiotherapy delivery and therefore a degree of toxicity is to be expected. Careful planning prior to treatment aims to limit the exposure of normal tissue as far as possible in achieving the aim of treatment.

Risk factors that may predispose a patient to increased risk of treatment morbidity include diabetes, obesity, multiple surgical interventions and inflammatory bowel disease.

Adverse effects may be divided into early or acute, and late or chronic effects.

ACUTE SIDE EFFECTS

Acute effects are a result of rapidly dividing cells, such as those found in the skin or mucosal surface, being damaged during the phase of mitosis. These acute effects are common, rarely serious and usually self-limiting. They typically present 2–3 weeks into treatment and resolve within a few weeks of radiotherapy finishing (summary Table 18.1).

In the main, acute effects can be managed conservatively with skin care, dietary advice and medication as needed. Best practice involves the support not only of the medical team, but also specialist nurses and nutritionists.

LATE SIDE EFFECTS

These are radiotherapy-related problems that begin months or even years following treatment. Unlike acute side effects they tend to be permanent and progressive, with symptoms becoming

Table 18.1: Summary of acute radiation toxicity

Bowel	Increased bowel frequency
	Diarrhoea
	Passage of mucus or blood (rare)
	Nausea or vomiting
Urinary	Increased frequency
	Dysuria
Skin	Erythema or hair loss at treatment field site
	Dryness
	Desquamation
General	Fatigue

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Table 18.2: Summary of late radiation toxicity

Bowel	Increased frequency or diarrhoea
	Passage of blood or mucus
	Stricture
	Fistula
Bladder	Cystitis
	Contracture (reduced bladder volume)
	Haematuria
	Fistula
Vagina	Narrowing/shortening
	Stenosis
	Persistent dryness
Skin	Telangiectasia, decreased pigmentation, fibrosis
	Lymphoedema (particularly if inguinal area treated)
Others	Premature menopause
	Sexual dysfunction
	Sacral insufficiency fractures
	Second malignancy

worse over time. They are often due to damage to connective tissue, blood vessels or mucosal surfaces (summary Table 18.2).

Management of pelvic late radiation toxicity is often difficult and requires expert input from clinicians with a particular interest in these issues. Although medical management is often preferred, for severe bowel or bladder problems such as stricture, fistula or major haemorrhage surgical intervention may be required.

Site-Specific Radiotherapy

CERVIX

For women with FIGO IB2 disease and higher, chemoradiotherapy is the treatment of choice. A meta-analysis with data from 19 trials with 4580 patients showed a highly significant survival benefit with concomitant chemoradiation (hazard ratio = 0.71, $P < 0.00001$),[7] which represented a 12% absolute benefit in survival.

In order to overcome differences between the studies in 'standard' radiotherapy treatment, a re-analysis using individual patient data has been published.[8] This study of over 3000 women confirms the benefit of additional chemotherapy. The benefit, however, is not as great as originally thought, with an absolute improvement in survival of just 6%. Of note, non-platinum containing regimens, in particular those containing 5FU and/or mitomycin show similar benefit to cisplatin.

With advancing stage the risk of lymph node metastases increases and standard radiotherapy includes the external iliac, obturator, internal iliac and common iliac nodal groups. The para-aortic nodal chain is also irradiated if there is either evidence of gross disease within these nodes or where there are enlarged nodes within the common iliac group.

Typically radiotherapy is delivered on a daily basis (Monday to Friday) for between 5–6 weeks with cisplatin chemotherapy given weekly. Intracavitary brachytherapy is given in the latter part of external beam treatment or once it has been completed to allow for maximal tumour regression (Fig. 18.4).

After surgery for early cervix cancer certain histopathological features increase the risk of recurrence and reduce progression free survival.[9] These include positive pelvic lymph nodes, lymphovascular space invasion, parametrial involvement, positive margins and tumour size of greater than 4 cm. With one or more of these features the 5 year survival drops to between 50% and 70% and pelvic radiotherapy is usually recommended, although such combined modality treatment leads to increased morbidity.[10]

ENDOMETRIAL

Radiotherapy is used in endometrial cancer largely as an adjuvant treatment. Its role is determined based on risk factors that predict for disease recurrence. These include FIGO stage, grade of tumour, clear cell or serous sub-type and lymphovascular space invasion.

Low-risk endometrial cancer, which includes stage IA grade 1 and 2, where the risk of relapse is less than 10% need no additional treatment. Intermediate risk stage IA grade 3, Stage IB grade 1 and 2 may be treated with vaginal vault brachytherapy alone.

The adjuvant treatment of high-risk endometrial cancer is currently the subject of international debate. This group—which includes stag e IB high-grade tumours, stage II or III tumours and tumours with serous or clear cell histology—is generally offered pelvic radiotherapy, which reduces the

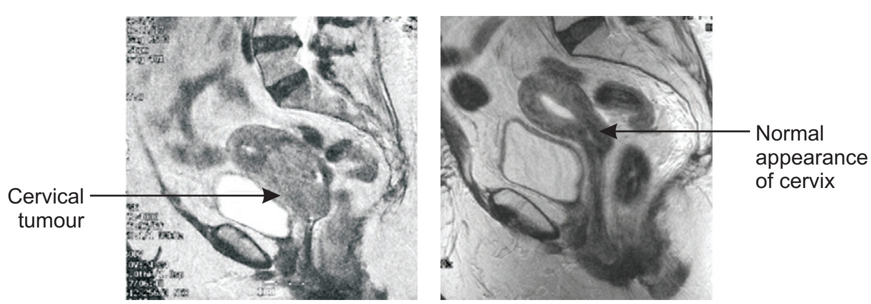

Fig. 18.4: MRI scan showing patient with stage IIB squamous cell cervix cancer before and 3 months after radiotherapy.

probability of loco-regional recurrence. Chemotherapy may also be considered in order to reduce the incidence of distant metastases.

Primary radiotherapy using a combination of external beam radiotherapy and intracavitary brachytherapy, similar to their use in cervical cancer, may be considered for patients not suitable for surgery.

VAGINA

As primary carcinoma of the vagina is a rare condition, treatment is often individualised with minimal evidence base. Radiotherapy, usually with concurrent cisplatin chemotherapy, is often the preferred modality, particularly in sexually active women. In all but the earliest of tumours there is a significant risk of microscopic nodal spread, and external beam treatment is given to pelvic and inguinal nodal regions. Depending on the size and site of disease, a boost dose is delivered using either external beam or brachytherapy.

VULVA

Vulval cancer is rare and tends to affect elderly women. This partly explains why there is very little data available to evaluate the role of radical radiotherapy in this disease. In addition most of the studies are from several decades ago and describe sub-standard radiotherapy techniques.

The standard primary treatment for most vulval cancer is surgical excision with node dissection. Adjuvant treatment is individualised depending on the extent of disease and well being of the patient. For tumours with resection margins of less than 8 mm, the risk of local recurrence is almost 50% and adjuvant radiotherapy is given, reducing the risk to below 20%.[11]

Primary radiotherapy, often with chemotherapy, may be used in locally advanced disease if the extent of tumour or patient fitness makes surgery less desirable. The treatment volume usually includes inguinal nodal areas as well as the vulva. The acute radiation toxicity is often problematical due to the severe skin reaction that may occur when irradiating the perineum to high dose. Given with care and to high dose, primary radiotherapy to the vulva can often be successful in achieving lasting disease control (Fig. 18.5).

Fig. 18.5: Carcinoma of the vulva before and 4 months post-primary chemoradiotherapy.

OVARY

Management of ovarian tumours is primarily with surgery in the curative, or debulking setting. Any adjuvant treatment considered is usually in the form of platinum-based chemotherapy, with the role of radiotherapy considered in the palliative setting or atypical histologies, for local symptom control.

UTERINE SARCOMA

The mainstay of treatment for uterine sarcomas is surgery. Postoperative radiotherapy reduces the risk of local failure but has no survival benefit. It is only recommended if tumour extends outside the uterine cavity or local excision is incomplete. Although patients remain at risk of distant metastases, as with other soft tissue sarcomas, there is no proven role for adjuvant chemotherapy.

Palliation

Radiotherapy remains a valuable treatment for patients unfit for radical treatment, with local recurrence or distant metastatic

Table 18.3: Role of palliative radiotherapy

• Pain
• Bleeding
• Obstruction (ureteric or bowel)
• Bone metastasis
• Cord compression
• Skin/soft tissue metastasis

disease (summary Table 18.3). Visits to hospital are minimised by using short fractionation schedules with the aim of treatment being symptom relief rather than long-term tumour control.

Summary

Radiotherapy, more than a century after it was first used continues to be at the forefront of treatment of gynaecological cancers. It has evolved into a sophisticated, ultra-high-tech treatment modality offering the potential to improve outcome with enhanced cure rates and reduction in morbidity.

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Medical Oncology in Gynaecology

19

Axel Walther, Martin Gore

Medical oncology is primarily concerned with the systemic treatment of malignancy, utilising predominantly chemotherapy. Hormonal therapy is occasionally used, and more recently, agents trying to exploit a particular aspect of tumour biology (targeted agents) have entered the armamentarium of the medical oncologist.

Principles of Chemotherapy

Chemotherapy is usually given as a cycle, with drug administration repeated at regular pre-defined intervals, e.g. 3 weeks for carboplatin and paclitaxel. Others are given every 4 weekly (e.g. liposomal doxorubicin), weekly (e.g. paclitaxel), or on the first day of a 3-weekly cycle then on day 8 and/or 15 (e.g. gemcitabine, when given with carboplatin). In addition, chemotherapy drugs are given at a standard dose usually according to surface area (based on a nomogram, which uses weight and height) or, in the case of carboplatin, the glomerular filtration rate of the patient. Dose reductions are made for the fitness of the patients, co-morbidities and the use of drugs in any combination. Most drugs are given intravenously, although capecitabine (the prodrug of 5-FU) is given orally as are a host of newer targeted agents. These later drugs tend to be administered daily without a break or for weeks at a time with short interruptions of a week or two.

FITNESS FOR CHEMOTHERAPY AND THE BALANCE OF BENEFIT

The primary determinant for the administration of systemic treatment is the fitness of the patient. Fitness is assessed on Eastern Cooperative Oncology Group (ECOG)* performance status on a scale from 0 to 4 and should generally be (Table 19.1). Toxicities encountered during any preceding cycle also need to be addressed. They are graded on a scale from 0 to 4 using the Common Terminology Criteria for Adverse Events (CTCAE, current version 4.0).[1] Depending on the type and severity of toxicity, dose reductions or interruptions may be instituted and adjunctive supportive therapies prescribed as necessary, e.g. anti-emetics see below. Generally, with optimal supportive therapy any toxicity should have resolved to grade 1 on the day of treatment before the next cycle is administered; therapy is interrupted if grade 2 or higher toxicities are still present. The occurrence of any grade 4 toxicity requires a dose reduction for all subsequent cycles, as does the second occurrence of a grade 3 toxicity. However, protocols vary and it is important to bear in mind the aim of treatment when deciding whether to reduce dose or interrupt chemotherapy. In patients who are being treated with curative intent, there is a higher threshold for dose reduction and interruption, whereas in patients treated with palliative intent, one of the main aims of chemotherapy is to improve the quality of life, and it is sensible to consider a dose reduction after the first occurrence of a grade 3 or even 2 toxicity.

Table 19.1: Eastern Cooperative Oncology Group (ECOG) performance status†

Grade	ECOG
0	Fully active, able to carry on all pre-disease performance without restriction
1	Restricted in physically strenuous activity but ambulatory and able to carry out work of a light or sedentary nature, e.g., light house work, office work
2	Ambulatory and capable of all self-care but unable to carry out any work activities. Up and about more than 50% of waking hours
3	Capable of only limited self-care, confined to bed or chair more than 50% of waking hours
4	Completely disabled. Cannot carry on any self-care. Totally confined to bed or chair

†Modified from Oken MM, Creech RH, Tormey DC, et al. Toxicity and response criteria of the Eastern Cooperative Oncology Group. *Am J Clin Oncol.* 1982;5:649–55.

In addition, haematological and biochemical indices need to be assessed, with particular attention to the neutrophil count. For most chemotherapy drugs, the threshold on day 1 is an absolute count of 1000/mm^3, for carboplatin it is 1500/mm^3. Depending on the metabolic pathway of the drugs used, renal and hepatic functions need to be checked because a decrease in function can to lead to unacceptably high plasma levels and subsequent serious toxicity. Lastly, an assessment of response to therapy must be made at regular intervals, if excessive toxicity occurs or there is clinical evidence of disease progression.

If a patient is in a clinical trial, then there are likely to be strict guidelines as to what should happen in response to side effects or toxicities including reporting the events to the trial sponsor and the regulatory authority.

*Oken MM, Creech RH, Tormey DC, et al. Toxicity and response criteria of the Eastern Cooperative Oncology Group. *Am J Clin Oncol.* 1982;5:649–55.

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MANAGEMENT OF SIDE EFFECTS

For most side effects (see Table 19.2), good supportive care is required and/or dose reduction along the lines detailed above. Oral mucositis often responds to good mouth care with a soft toothbrush, mouthwashes, aspirin mucilage, sucralfate and the avoidance of foods that increase mucosal blood flow (hot and/or spicy) for the first few days. Diarrhoea is often managed satisfactorily with loperamide taken with the first and every subsequent loose motion until they start to firm up. Codeine phosphate is a reasonable alternative or second line. Hair loss can be avoided by use of a cold cap to reduce delivery of chemotherapy to the scalp. Depending on the drug used and the infusion time, this strategy is successful in about 60% of patients but can be difficult to tolerate.[2]

Nausea and Vomiting

Nausea is an almost ubiquitous side effect of chemotherapy, and requires prophylactic anti-emetics. Prevention is better than treatment after the event and regular anti-emetics should be started before chemotherapy. First-line therapy for moderately to highly emetogenic drugs or combinations (carboplatin, doxorubicin and paclitaxel) consists of steroid (e.g. dexamethasone) and a $5HT_3$ antagonist (e.g. ondansetron) prior to administration, followed by 3 days of dexamethasone and 5 days of a D2 antagonist (e.g. metoclopramide). Failing this, addition of a $5HT_3$ antagonist for 5 days is indicated. Patients receiving cisplatin, who fail $5HT_3$ antagonist therapy, can be considered for prophylaxis with the neurokinin receptor antagonist, aprepitant.

When treating acute nausea, immediate, regular and as required doses should be prescribed, they should be given parenterally if the patient is unable to tolerate them by mouth. Potential contributory factors such as pain, anxiety, other drugs, or hypercalcaemia should be addressed if present. The optimal treatment at acute phase nausea is essential to preventing delayed phase nausea as well as anticipatory nausea; the latter often responds to a benzodiazepine, e.g. lorazepam.

Neutropaenia

Neutropaenia is common and predisposes to bacterial infections and bacteraemia. The risk is proportional to the degree of neutropaenia below $1000/mm^3$ as well as the duration of neutropaenia. The mortality can be as high as 10% in high-dose chemotherapy,[3] and patients with neutropaenia need to be treated aggressively with intravenous antibiotics if surrogate markers of infection are present (fever, hypotension and raised inflammatory markers) even in the absence of positive microbiology. Local protocols vary according to the prevailing microbiological environment, but a reasonable first line would be piperacillin/tazobactam and gentamicin. In highly selected low-risk cases, oral antibiotic therapy and early discharge can safely be contemplated[4] but usually only when infection is present without neutropaenia.

The routine use of prophylactic G-CSF is not indicated for low-risk neutropaenia, the threshold for its use being a 20% likelihood of developing febrile neutropaenia.[5] Prophylactic antibiotics can reduce the frequency of febrile neutropaenia, but do not appear to reduce mortality,[6] and their use must be weighed up against the likely incidence of neutropaenia and the associated costs and side effects.

Table 19.2: Common gynaecological chemotherapy agents and side effects

Drug	Side effect
Carboplatin	Myelosuppression, diarrhoea and lethargy
Cisplatin	Lethargy, neurotoxicity, ototoxicity, nephrotoxicity, hair loss and marked nausea
Paclitaxel	Neurotoxicity, lethargy, hair loss, myalgia, allergic reactions, nail changes, bradycardia and abnormal liver function tests
Doxorubicin	Myelosuppression, mucositis, cardiotoxicity, hair loss and photosensitivity
Liposomal doxorubicin	Myelosuppression, mucositis, hand and foot syndrome and photosensitivity
Ifosfamide	Bladder irritation, hair loss, nail changes and encephalopathy

The side effects listed are those more common or noteworthy; all drugs can lower blood counts and induce a degree of nausea.

Cancer of the Lower Genital Tract

The mainstay of treatment for localised and locally advanced cancers of the lower genital tract (cervix, vagina and vulva) is surgery for early stage disease, and radiotherapy for the remaining non-disseminated cases. These modalities are discussed in more detail in chapters 7 and 18. Concomitant chemotherapy may be used as a radiosensitiser, while chemotherapy as the only mode of therapy is reserved for disseminated disease at presentation or relapse and inoperable relapse in the radiation field.

CANCER OF THE CERVIX

Chemoradiotherapy utilising cisplatin as a radiosensitiser is effective treatment for patients presenting with locally invasive or locoregionally advanced cervical cancer (FIGO stages IB2 – IVA). In a meta-analysis of 3104 patients comparing radiotherapy with chemoradiotherapy, the latter improves the 5-year survival from cervical cancer by 6% (HR = 0.81, 95% CI 0.71–0.91, $p < 0.001$).[7] The addition of adjuvant chemotherapy following radiotherapy might further improve the survival benefit, but only very limited data are available on the benefit.[8] Likewise, neoadjuvant chemotherapy followed by surgery does not improve overall survival when compared to surgery alone in women with early-stage or locally advanced cervical cancer,[9] and no good data exist exploring neoadjuvant chemotherapy before chemoradiotherapy, although the latter is being investigated in the EORTC 55994 protocol.[10] Therefore, neither approach of additional chemotherapy before or after local therapy (chemoradiotherapy or surgery) can be considered standard at present.

Disseminated disease at presentation or locoregional relapse that is not amenable to salvage surgery or radiotherapy may be treated with systemic chemotherapy, although these patients are almost always incurable. The mainstay of chemotherapy is a platinum compound and several studies utilising single agent cisplatin have demonstrated its efficacy[11] with response rates of around 20%. Other agents have similar or lower response rates, e.g. irinotecan, paclitaxel and ifosfamide, although they are generally not effective once the patient has failed platinum-based therapy.[12]

Several trials have added a second active agent to cisplatin; in a randomised phase 3 study enrolling 264 patients to receive cisplatin with or without paclitaxel, the combination showed an increased response rate (36%) and a median progression-free survival gain of 2.0 months. This combination had a significant increase in myelotoxicity with over half the patients experiencing grade 3 or 4 myelotoxicity, but appeared to maintain the patients' quality of life.[13] In a randomised phase 3 study of 294 patients receiving cisplatin with or without topotecan, the combination again had a better response rate (27%), an improvement in median progression-free survival of 1.7 months, and a statistically significant improvement in overall survival of 2.9 months.[14] Again, myelotoxicity was much worse in the combination arm with 70% experiencing grade 3 or 4 events.

A trial comparing four cisplatin-based doublets (with paclitaxel, topotecan, gemcitabine and vinorelbine, respectively) was stopped early because it was not going to demonstrate superiority of any of the regimen over the others.[15] Therefore, a platinum compound (either cisplatin or carboplatin) in combination with paclitaxel is an acceptable standard of care for fit patients with stage IVB and recurrent cervical cancer requiring systemic therapy; platinum in combination with gemcitabine, topotecan or vinorelbine is also acceptable.[16]

Further lines of chemotherapy depend on the fitness and motivation of the patient, but data are limited to help choose the most appropriate therapy. If the response duration to platinum and paclitaxel is more than 6 months, rechallenge with platinum in combination with a known active agent may give good palliation again. Alternatively, treatment with a topoisomerase inhibitor (e.g. topotecan) can be considered. The preferred option in this setting is the offer of entry into a clinical trial.

CANCER OF THE VAGINA

Vaginal cancer is an uncommon disease, and the role of chemotherapy is not well established. Because risk factors, especially Human Papilloma Virus (HPV), histological subtype, usually squamous cell carcinoma and anatomical distribution are very similar to cervical carcinoma, cisplatin is the *de-facto* standard for patients with metastatic or recurrent disease. There are very few data to support this approach, but in the absence of other active agents, single agent cisplatin possibly in combination with paclitaxel can be considered, as should be entry into a clinical trial.

Cisplatin can also be used as part of a chemoradiotherapy approach for stage II to IVA disease and appears to yield superior results compared to radiotherapy alone.[17] Again, there are no large randomised studies to support this approach.

There are no large randomised studies that have evaluated adjuvant or neoadjuvant chemotherapy in relation to surgery or radiotherapy because of the poor efficacy of chemotherapy in advanced disease.

CANCER OF THE VULVA

Like carcinoma of the vagina, the mainstay of therapy for carcinoma of the vulva is based on effective local control. For stage IV disease, in patients who are not fit enough or do not wish to undergo radical vulvectomy and pelvic exenteration, the addition of either 5-FU ± cisplatin to radiotherapy may produce results similar to radical surgery,[18] although no prospective randomised data exist.

In a small study of 46 patients with unresectable disease based on N2/N3 lymph node status, pre-operative chemoradiotherapy with cisplatin/5-FU induced resectability in 83% of patients, and a complete pathological response in the lymph node specimen of 41% of per protocol patients.[19] This approach is now under investigation in a further phase 2 trial in unresectable primary disease (GOG protocol 205). Overall, however, a review of the Cochrane Collaborative concluded that at present 'neoadjuvant [chemoradio-] therapy is not justified in patients with tumours that can be adequately treated with radical vulvectomy and bilateral groin node dissection alone'.[20]

In primary or recurrent metastatic disease, chemotherapy again is based on those agents that have some activity in cervical carcinoma or squamous cell carcinoma at other sites (e.g. cisplatin and/or 5-FU) without a randomised evidence base for vulval carcinoma. The limited experience has generally produced disappointing results for systemic therapy,[21] and patients should be considered for clinical trials if at all possible.

GYNAECOLOGICAL MELANOMA

The management of loco-regional mucosal melanoma is surgical. Metastatic disease can be treated with dacarbazine or the CTLA4 antibody ipilimumab, the latter with more promising results.[22] Recently, c-kit mutations have been identified as driver mutations in around 15% of cases; the c-kit inhibitor imatinib has been used in small series with promising results[23] and c-kit inhibition is now being explored in prospective phase 2 trials.

FUTURE DIRECTIONS

Epidermal growth factor receptor (EGFR) overexpression is detected in up to 75% of cervical carcinoma and has been associated with a worse prognosis,[24] consequently anti-EGFR strategies are being evaluated, both with anti-EGFR antibodies (cetuximab and panitumumab) and small molecule inhibitors (gefitinib and erlotinib). To date, no results confirming useful activity of these agents have been published. The anti-vascular endothelial growth factor (VEGF) antibody bevacizumab has been studied in small phase 2 studies and shown reasonable activity as a single agent in patients relapsing after platinum therapy with an overall survival of over 7 months[25] and is now under investigation in a phase 3 trial. Small molecule tyrosine kinase inhibitors (sunitinib) have not shown significant activity in cervical carcinoma.[26]

Cancer of the Uterus

Cancers of the uterus generally are not particularly sensitive to chemotherapy, although in selected cases adjuvant chemotherapy may be indicated. Systemic therapy remains unsatisfactory, but some palliation can be achieved from chemotherapy in the metastatic setting.

ENDOMETRIAL ADENOCARCINOMA

Chemotherapy

The mainstay of treatment for carcinoma of the endometrium is a combination of surgery and radiotherapy. For early stage disease, the role for adjuvant chemotherapy has not been established.[27] For late stage disease, because of the high rate of abdominal relapse in patients with stage III and IV disease who have three or more extra-uterine sites of disease,[28] whole abdominal radiotherapy, rather than pelvic radiotherapy, has been advocated.[29] However, a randomised trial of stage IIIA and above compared postoperative whole abdominal radiotherapy with adjuvant doxorubicin and cisplatin-based chemotherapy (GOG-122) and showed a significant improvement in progression-free and overall survival at 5 years in the chemotherapy arm for the whole cohort, translating into an absolute improvement of 4%, and 11%, respectively. As would be suspected, the failure patterns varied slightly with a preponderance of local relapse in the chemotherapy arm and distant relapse in the radiotherapy arm,[30] and whole abdominal radiotherapy is not recommended.[31]

However, comparing adjuvant chemotherapy using doxorubicin, cisplatin and cyclophosphamide with pelvic radiotherapy did not show superiority of the chemotherapy arm.[32] Reasons may be that in GOG-122, patients had more advanced and aggressive disease, no parenchymal metastases and sites of disease had to be smaller than 2 cm, whereas in this trial of triplet chemotherapy, stage IV patients were excluded.

Trying to improve on the results of doxorubicin and cisplatin by replacing the latter with paclitaxel showed similar efficacy and toxicity profiles between the cisplatin and paclitaxel arms.[33]

Lastly, the experience from a single centre suggests that the combination of adjuvant radiotherapy with a variety of platinum-based chemotherapy regimens after surgery in optimally debulked patients may lead to marked improvement in overall survival when compared to either modality alone,[34] but this has not been prospectively validated in a randomised trial.

Taken together, these data support the use of adjuvant chemotherapy only in a relatively small group of stage IV patients with small volume residual disease and no liver or lung metastases at presentation.

Fit patients with disseminated recurrent disease should be offered systemic therapy. Several agents have shown useful activity in this setting (doxorubicin, cisplatin, paclitaxel and cyclophosphamide).[35] A trial in 281 patients comparing doxorubicin to doxorubicin with cisplatin showed improved response rates (42% vs. 25%) and prolonged progression-free survival HR = 0.736 (95% CI, 0.58–0.94; p = 0.014), translating in a median progression-free survival gain of 1.9 months for the combination. Overall survival was not significantly different between the treatment arms.[36] The results of this US trial were mirrored by those of the EORTC study in 177 chemotherapy naïve patients using the same chemotherapy arms.[37] There is some evidence for a modest (≤3 months) improvement in overall survival with a more intense 3-drug regimen, but at the cost of markedly increased toxicity, leading to 24% of patients discontinuing the experimental 3-drug arm.[38]

The familiarity of the carboplatin/paclitaxel combination, as well as its tolerability, has established this as the *de facto* standard of care for patients with disseminated endometrial carcinoma, without a strong randomised evidence base.[39] For second-line chemotherapy, response rates are disappointing, but doxorubicin, often in its pegylated liposomal form, is used with good palliation in some patients based on promising results in phase 2 trials in the first-line setting.[40] Pegylated liposomal doxorubicin can be combined with carboplatin in fit patients and this has also been used followed by carboplatin/paclitaxel with acceptable toxicity.[41]

Hormonal Therapy

For some patients, hormonal therapy, usually in the form of medroxyprogesterone or megestrol, can be tried either after the failure of chemotherapy or as primary therapy in disseminated disease in selected cases.

Patients who are particularly suited for this approach are those with oestrogen and/or progesterone receptor positive, histologically well-differentiated adenocarcinoma, with metastases to the lung. Response rates are in the order of 20–25% and progression-free and overall survival comparable to single-agent chemotherapy.[42] Also, it has been suggested that patients with a long treatment-free interval between the initial diagnosis and disease recurrence also appear to benefit more, and it is an attractive option for less fit patients because of its favourable toxicity profile and ease of administration compared to conventional chemotherapy.

Attempts to improve on the initial trials using dose-escalation did not show any benefit from higher doses of medroxyprogesterone but underlined the importance of progesterone receptor expression in the tumour.[43] Trials with tamoxifen showed similar survival but lower response rates.[44] It appears that an alternating regimen of medroxyprogesterone and tamoxifen to upregulate progesterone receptors may improve outcomes compared to medroxyprogesterone alone with response rates of 31% and a median overall survival of 14 months.[45] The results from a randomised phase 3 trial comparing chemotherapy with tamoxifen and megestrol in recurrent endometrial cancer (GOG-189) are awaited.

UTERINE SARCOMA

Uterine sarcoma comprises of three main types—carcinosarcoma (also known as mixed Müllerian tumour), leiomyosarcoma, endometrial stromal sarcoma; these are often grouped together when discussing treatment strategies for uterine sarcoma, although it is becoming clear that differences in chemosensitivity exist in metastatic disease. To date, no convincing evidence to support the use of adjuvant chemotherapy exists in any of the uterine sarcoma subtypes,[46] although patients should be considered for clinical trials if possible.

Carcinosarcoma

Some of the first evidence to suggest that carcinosarcoma are different from leiomyosarcoma came from a small study of cisplatin in uterine sarcoma that showed 19% and 3% response rates, respectively.[47] Subsequent small phase 2 trials established cisplatin and ifosfamide as the most active agents with paclitaxel showing lesser activity, leading to a randomised study of ifosfamide with or without cisplatin in 194 patients with advanced, persistent, or recurrent carcinosarcoma. The combination arm showed higher response rates (54% vs. 36%) and improved median progression-free survival from 4 to 6 months. There were no differences in overall survival and markedly higher toxicity in the combination arm, leading the authors to conclude that the combination was not warranted.[48] The addition of paclitaxel to ifosfamide leads to a similar improvement in response rates and median progression-free survival, but also improved median overall survival from 8.4 to 13.5 months. However, this was again at the cost of significantly increased toxicity.[49]

Carcinosarcoma is now considered to be an adenocarcinoma rather than a true biclonal malignancy despite the phenotypic appearances of sarcoma and carcinoma cells in the tumour.[50] This has lead to the evaluation of carboplatin/paclitaxel in view of the much higher tolerability and ease of administration than cisplatin plus ifosfamide. In a prospective population-based cohort study, carboplatin plus paclitaxel showed similar response rates to the combinations outlined above (58%) with a median progression-free survival of 12 and 16 months for primary metastatic and recurrent disease, respectively,[51] these data are supported by prospective phase 2 data showing response rates of 54% and median progression-free and overall survival of 7.6 and 14.7 months, respectively.[52] Carboplatin plus paclitaxel is now the standard of care for carcinosarcoma, although randomised data are lacking.

Leiomyosarcoma

Leiomyosarcoma is true sarcoma, and does not respond well to carboplatin and paclitaxel, but rather is treated with doxorubicin in the metastatic setting, producing response rates of about 25%, with a median overall survival of 12.1 months.[53] The addition of a second agent (e.g. dacarbazine, cyclophosphamide and ifosfamide) does not lead to a meaningful prolongation of progression-free or overall survival. Pegylated liposomal doxorubicin did not improve survival when compared to doxorubicin-treated historical controls.[54]

The combination of docetaxel and gemcitabine has shown some promise in a small phase 2 trial of 34 patients, with 16 patients who had progressed after prior doxorubicin chemotherapy. The response rate was 53% and the median progression-free survival 5.6 months.[55] In the first-line setting, this combination achieved a median overall survival of >16 months.[56] Further prospective evaluation is awaited.

Patients with indolent leiomyosarcoma may benefit from an aggressive surgical approach as well as hormonal therapy with medroxyprogesterone, aromatase inhibitors, or mifepristone, a progesterone antagonist. Hormonal manipulation of the progesterone pathway possibly results in the longer disease control compared to oestrogen pathway interference.[46] Trials using hormonal agents against expectant management are ongoing.

FUTURE DIRECTIONS

Research interest at present is focused on the use of the novel agents that have recently found their way into the management of other malignancies, such as agents targeting the VEGF pathway (bevacizumab), mTOR inhibitors (temsirolimus and everolimus), tyrosine kinase inhibitors (sunitinib) and EGFR inhibitors (gefitinib and erlotinib)[57]; the publication of results in peer-reviewed format are awaited for most of these. Despite some endometrial adenocarcinomas over-expressing HER2, trastuzumab did not exhibit significant activity as a single agent.[58] In uterine sarcoma, recent research activity has focussed on the promising activity of gemcitabine and docetaxel in leiomyosarcoma. Trabectedin, a novel anti-neoplastic agent derived from the marine organism *Ecteinascidia turbinata* has also generated interest.[59] Tyrosine kinase inhibitors such as imatinib, sunitinib and pazopanib have not shown significant activity in uterine sarcoma.[60,61]

Cancer of the Ovaries

Cancers of the ovary are chemotherapy sensitive and its role in the adjuvant and metastatic settings is well established. Fallopian tube and primary peritoneal carcinoma are treated as epithelial ovarian carcinoma.

EPITHELIAL MALIGNANCIES

Early Stage Disease

Even very early stage disease (stage IC or any stage I high grade tumour) has a high chance of disease recurrence.[62] The pivotal trials for the benefit of adjuvant chemotherapy in early stage disease were the MRC-ICON1 and EORTC-ACTION trials comparing platinum-based adjuvant chemotherapy to standard follow-up with treatment at progression.[63] In the combined analysis, the median progression-free survival at 5 years improved from 65% for standard follow-up to 76% for adjuvant chemotherapy (HR = 0.64, 95% CI 0.50–0.82, $p = 0.001$), while overall survival improved from 74% to 82%, respectively. Despite the criticism of these trials regarding the heterogeneity of chemotherapy regimen used, eligibility criteria and requirements for surgical staging, they nonetheless established platinum-based adjuvant chemotherapy as the standard of care for patients with the following: stage IB grade 2 and 3, stage IC, stage 2 and all stage I clear cell carcinomas.

Based on the findings in late stage disease, the addition of paclitaxel has become standard in many centres without a randomised evidence base. The GOG-157 compared 3 to 6 cycles of carboplatin plus paclitaxel with a suggestion that 3 cycles are associated with an inferior progression-free survival, while 6 cycles are associated with a marked increase in toxicity.[64] A patient who is not fit or unwilling to accept the toxicity of combination chemotherapy should therefore be offered six cycles of single agent carboplatin.

Late Stage Disease

Until the early 1990s, the standard of care for patients with late stage disease had been cisplatin and cyclophosphamide, given immediately after surgery.[65] The GOG-111 and OV-010 trials showed the superiority of cisplatin and paclitaxel over cisplatin and cyclophosphamide in terms of progression-free and overall survival.[66,67] The GOG trial showed an improvement in median progression-free survival from 13 to 18 months (HR = 0.7; 95% CI 0.5–0.8; $p < 0.001$) and overall survival from 24 to 38 months (HR = 0.6; 95% CI 0.5–0.8; $p < 0.001$).

Several trials have established the equivalence of carboplatin and cisplatin when used in combination with paclitaxel in terms of progression-free and overall survival. However, the carboplatin and paclitaxel combination was significantly better tolerated,[68,69] and it has been accepted as the standard of care in the first-line setting in patients fit enough for combination chemotherapy. A trial by the Japanese Gynaecologic Oncology Group (JGOG) showed that weekly, dose-dense paclitaxel in combination with carboplatin is superior to carboplatin and paclitaxel on a 3-weekly schedule, with an improvement in median progression-free survival from 17.2 to 28 months but reduced toxicity and this schedule should be considered for less fit patients.[70]

Carboplatin plus paclitaxel should also be offered to patients in whom primary surgery with optimal debulking is not possible with a re-assessment of the feasibility of debulking surgery after 3 cycles: the size of the residual tumour after the first surgical intervention (either primary or interval) remains the most important prognostic feature after surgery.[71] Secondary cytoreduction after sub-optimal debulking has not been shown to be effective in improving survival.[72] The results of the prospective EORTC 55971 trial comparing initial surgery followed by 6 cycles of carboplatin and paclitaxel with the same chemotherapy and surgery after 3 cycles show that optimal debulking mattered most while the timing of surgery did not. Postoperative complications were lower in the delayed surgery group.[73] Final results of the CHORUS trial investigating the same approach are awaited.

The GOG-182/ICON5 trial was a five-arm study that compared triple therapy carboplatin plus paclitaxel plus liposomal doxorubicin or gemcitabine, or sequential therapy with carboplatin plus topotecan or gemcitabine with carboplatin followed by carboplatin plus paclitaxel. The control arm was carboplatin plus paclitaxel.[74] None of the experimental arms produced significantly improved survival. The Italian MITO-2 trial compared carboplatin plus paclitaxel with carboplatin plus liposomal doxorubicin, with no survival or toxicity difference between the arms.[75]

GOG-218, a phase 3 study of carboplatin, paclitaxel, with or without the VEGF antibody bevacizumab in the adjuvant setting for stage III and IV patients showed that concurrent bevacizumab followed by 12 months bevacizumab maintenance was superior to carboplatin and paclitaxel alone with the median progression-free survival 14.1 and 10.3 months, respectively (HR = 0.72; 95% CI 0.63–0.82, $p < 0.0001$).[76] There appeared to be no benefit for concurrent bevacizumab plus carboplatin and paclitaxel without subsequent maintenance bevacizumab. The results of a similar study (ICON7) confirm the benefit for maintenance bevacizumab following induction chemotherapy.[77] Although neither study showed a significant overall survival benefit, maintenance bevacizumab is now licensed in stage 3 and 4 patients.

Intraperitoneal Chemotherapy

In stage III disease, by definition, no cancer is found outside the peritoneal cavity. Delivering a high dose of active drug intraperitoneally directly to the sites of potential residual disease is attractive as it could achieve high drug concentrations while sparing systemic side effects. Intraperitoneal (IP) chemotherapy penetrates only to a depth of some millimetres, with cisplatin having a higher penetration than carboplatin in animal models.[78]

Only two randomised trials compared the intraperitoneal and intravenous routes using paclitaxel in the intravenous arm.[79,80] Both trials enrolled patients with stage III disease who had been optimally debulked and randomised to either intravenous cisplatin and paclitaxel, or 2 cycles of high-dose carboplatin and paclitaxel, followed by intraperitoneal cisplatin (GOG-114) or intravenous paclitaxel on day 1 and 8 and intraperitoneal cisplatin on day 2 of a 21 day cycle (GOG-172). Both trials showed a significantly improved progression-free and overall survival, at the cost of markedly increased toxicity and catheter complications, with only 42% completing all 6 cycles of intraperitoneal chemotherapy in GOG-172.

Intraperitoneal chemotherapy has therefore not been widely adopted; its role remains the subject of much discussion. There is currently no role for intraperitoneal chemotherapy in stage IV, sub-optimally debulked or relapsed disease outside the context of a clinical trial.

Recurrent Disease

The aim at relapse shifts towards symptom control in this incurable setting, and the choice of therapy should take this into account. Therapy should be started when the disease becomes symptomatic or the presence of bulky disease on computed tomography (CT). A rise in CA125 demonstrates disease recurrence but is not an indication for chemotherapy.[81] Patients who require further chemotherapy within 6 months of carboplatin and paclitaxel are deemed platinum refractory and can expect response rates of at most 20% with subsequent, non-platinum containing therapy, e.g. weekly paclitaxel, gemcitabine, topotecan or etoposide. Of these, weekly paclitaxel is probably the most active and best tolerated. Response rates increase with increasing time from the last chemotherapy; for patients with a disease-free interval >6 months, re-challenge with carboplatin plus another active agent is considered reasonable.[82]

The CALYPSO trial comparing carboplatin plus pegylated liposomal doxorubicin (PLD, Caelyx®) to carboplatin plus paclitaxel in women who had relapsed more than 6 months after first- or second-line chemotherapy with carboplatin and paclitaxel reported an improvement in median progression-free survival from 9.4 months to 11.3 months in the carboplatin plus doxorubicin arm, with more gastrointestinal toxicity in the carboplatin plus PLD arm, but less myelo- and peripheral neurotoxicity.[83] It failed to show a significant overall survival benefit.[84] Several trials have shown that carboplatin plus another active agent is superior to single agent carboplatin at platinum sensitive relapse (>6 months), and single agent carboplatin should be avoided.[84,85]

The OCEANS trial compared carboplatin and gemcitabine with the same chemotherapy and bevacizumab, the latter until progression. There was a clear progression-free survival benefit for the bevacizumab containing arm (HR =0.48; 95% CI, 0.39–0.61; $p < 0.0001$) and a progression-free survival gain of 4.0 months, but no overall survival advantage to date.[86] A similar benefit was found in the AURELIA study of single agent chemotherapy in platinum resistant disease compared with chemotherapy and bevacizumab until progression, with a median progression free survival gain of 3.3 months.[87] In neither trial did patients receive bevacizumab in earlier lines of therapy, and it is not yet clear when the best time to use bevacizumab is.

Small studies have confirmed activity of bevacizumab in end-stage ovarian carcinoma, both by symptomatic improvement of the malignant ascites,[88] but also by demonstrating responses in measurable disease in 15–20% of patients.[89,90]

RARE GYNAECOLOGICAL MALIGNANCIES

Germ Cell Tumours

Germ cell tumours are rare but are exquisitely chemosensitive. Fertility-sparing surgery is the standard approach, all patients except those with stage IA dysgerminoma and stage I, grade 1 immature teratoma should be offered postoperative BEP (bleomycin, etoposide and cisplatin) chemotherapy.[91] In view of the known pulmonary toxicity of bleomycin, regimens without bleomycin have been trialled with no apparent loss of efficacy.[92] Even for advanced stage dysgerminomas, the intent is curative with cure rates approaching 100%.[93] The outcomes are slightly less good with non-dysgerminomas, and while the cure rate for early stage disease approaches 100%, for advanced stage is only around 75%.[94]

There is no standard therapy for relapsed disease and entry into a clinical trial should be offered if appropriate. Those with platinum-sensitive disease may be re-challenged with BEP, or if avoidance of bleomycin is desirable, VIP (etoposide, ifosfamide and cisplatin) although many regimens are recognised.[95] In platinum-resistant disease, therapy with VAC (vincristine, dactinomycin and cyclophosphamide) can be considered,[96] as can high-dose therapy with stem cell rescue.[94]

Ovarian Stromal Tumours

Ovarian stromal tumours are rare, but their prognosis is less good than for germ cell tumours, with 10-year survival between 20% and 30% for stage III and IV disease.[97] Consequently, patients with stage 2–4 disease are often offered adjuvant chemotherapy, the accepted standard in the absence of randomised data being BEP.[95] In addition, patients with stage I disease associated with high-risk feature should also be considered for BEP.[98] It is not clear if bleomycin adds to the efficacy, and the superiority of BEP over EP has not been demonstrated. Interest in carboplatin and paclitaxel is rising as this combination also shows good activity without the toxicity of BEP.[99]

There is no standard therapy for relapsed disease, and entry into a clinical trial should be offered if appropriate. Patients with recurrent disease can be considered for VAC (vincristine, dactinomycin and cyclophosphamide) or paclitaxel as single agent or in combination with carboplatin or ifosfamide. Hormonal agents and bevacizumab have a role in relapsed granulosa cell tumours.[95]

Gestational Trophoblastic Tumours

Gestational trophoblastic tumours are rare malignancies with an excellent outlook in specialist centres. They occur most commonly following a molar pregnancy (hydatidiform mole), although they can occur after normal pregnancy. Provided that β HCG levels fall to normal after evacuation of the hydatidiform mole, patients require careful follow-up only. Irrespective of the antecedent pregnancy, indications for chemotherapy are persistent or rising levels of β HCG post-partum or histological evidence of choriocarcinoma; this should be instigated as a matter of urgency.

Low-risk disease (stage I and metastatic disease with a prognostic score[100] less than 7) is usually treated with fertility-sparing intent. Single agent chemotherapy with methotrexate or actinomycin in methotrexate-resistant disease, is most commonly used with cure rates approaching 100%. For high-risk disease, dose intense chemotherapy with EMA-CO (alternating weekly etoposide, methotrexate, dactinomycin and vincristine, cyclophosphamide) is commonly used with substitution of vincristine and cyclophosphamide by further etoposide and cisplatin in relapsed disease.[101]

FUTURE DIRECTIONS

The incidence of ovarian carcinoma is increased in carriers of BRCA1 and BRCA2 mutations, and some sporadic ovarian carcinoma carry epigenetic silencing of the BRCA1 gene. In the absence of BRCA function, these cancers rely on the base excision repair pathway for repair of DNA damage, and drugs that inhibit the enzyme polyadenosine diphosphate-ribose polymerase (PARP) in this pathway are therefore an important research target.[102] Studies of the PARP inhibitor olaparib in BRCA mutation carriers have shown promising activity with response rates of around 40%,[103] and studies are underway to test olaparib and other PARP inhibitors in patients not known to be BRCA mutation positive.

Despite common expression of oestrogen receptors on ovarian cancer cells, neither tamoxifen[104] nor aromatase inhibitors[105] have produced the kind of clinical benefit seen with these agent in breast cancer, although their excellent tolerability makes them good targets to try prolonging the platinum-free interval in recurrent ovarian cancer.

In addition to bevacizumab, other agents targeting the VEGF pathway, e.g. VEGF trap, VEGF tyrosine kinase inhibitor, are being evaluated but have not yet been introduced into clinical practice despite some promising early phase activity. Drugs targeting the human epidermal growth factor receptor family (predominantly EGFR and HER2) have largely been disappointing in the phase 2 setting. Drugs targeting the folate receptor, overexpressed in 90% of ovarian cancers, as well as a whole host of other targeted agents are being trialled in ovarian cancer and no conclusive results are available yet.[106]

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Aspects of Anaesthesia and Critical Care for Gynaecological Surgery

20

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Introduction

The anaesthetic and critical care of patients undergoing gynaecological surgery may present particular challenges. They represent a diverse group often with complex co-existing medical illnesses. Although primarily an adult cohort, germ cell tumours may require surgical intervention in young children. These are best managed in specialist children's units. Procedures range from day cases to prolonged open pelvic surgery, and raise significant anaesthetic and critical care issues.

Pre-Operative Anaesthetic Considerations

Information from pre-operative assessment aids anticipation of potential peri-operative problems, helps predict any requirement for postoperative critical care management and permits optimisation of patient care.

Patient assessment must evaluate:

- Pre-existing co-morbidity and limitations on physiological reserve.
- Ongoing disease process and respiratory/cardiovascular/gastrointestinal compromise as a result of, for example, a pelvic mass, neoplastic metastases or paraneoplastic syndromes.
- Impact of other treatment modalities, such as radiotherapy or chemotherapy. Cardiac, gastrointestinal, haematological and hepatic toxicity have been associated with various chemotherapeutic agents, in particular, platinum-based agents and anthracyclines.

Investigations frequently required include blood biochemistry, blood counts and coagulation. Electrocardiogram (ECG) and chest radiographs may be requested where indicated during assessment. Further investigation may take the form of echocardiography, thallium scanning, lung function and cardiovascular physiology exercise testing (CPEX).[1]

Some or all of the results are used to guide optimal peri-operative care, indicate risk of morbidity/mortality and offer useful information for risk-benefit assessment and planning.

Special aspects of pre-operative assessment in this patient group concern (*i*) cardiovascular disease (*ii*) respiratory disease (*iii*) endocrine disease and (*iv*) obesity.

CARDIOVASCULAR DISEASE

Cardiovascular disease is the commonest significant risk factor for anaesthesia and surgery. Several risk indices have been developed attempting to correlate clinical characteristics with peri-operative cardiac mortality and morbidity. The Lee index, a modification of the original Goldman index (1977), is considered by many clinicians to be the best currently available cardiac risk prediction index in non-cardiac surgery. The Lee index contains five independent clinical determinants of major peri-operative cardiac events in patients having high-risk types of surgery: a history of ischaemic heart disease, a history of cerebrovascular disease, heart failure, insulin-dependent diabetes mellitus and impaired renal function. All factors contribute equally to the index (a point each), and the incidence of major cardiac complications is estimated at 0.4%, 0.9%, 7% and 11% in patients with an index of 0, 1, 2 and 3 points, respectively.[2]

Ischaemic heart disease, valvular heart disease, arrhythmias and hypertension may be established or incidental findings. A peri-operative plan of management, further investigation if necessary and a plan for medication in the lead up to surgery, need to be carefully considered. In general, medications are taken as normal on the day of surgery, but for angiotensin-converting enzyme inhibitors only after anaesthetic consultation. Anticoagulant therapy demands risk-benefit analysis and is only discontinued when haemostasis is an anticipated problem.

RESPIRATORY DISEASE

Patients with chronic pulmonary airway disease should be optimised pre-operatively. This may include a course of antibiotics, bronchodilators and physiotherapy. Asthmatic patients can be at risk during anaesthesia due to the increased irritability of the bronchial smooth muscle and it is important to ascertain precipitating factors, recent hospital admissions, the necessity for previous steroid control, current exercise tolerance and peak expiratory flow rate. Pre- and postoperative nebulised bronchodilators may be helpful. Smoking may complicate the effects of asthma and patients should be encouraged to stop smoking for at least 48 hours before surgery.

ENDOCRINE DISEASE

Diabetes and thyroid disease are the most common endocrine disorders with implications for anaesthesia. Diabetic patients on oral hypoglycaemic agents should stop their medication at the onset of pre-operative fasting, the last dose usually being 12–24 hours pre-operatively. They may then recommence medication with a normal diet after more minor operations. Insulin-dependent diabetics and those having major surgery must stop medication when normal oral intake ceases and the titration of intravenous short-acting insulin by a 'sliding scale' commenced to regulate blood sugar levels. Glycaemic control is an aspect of peri-operative management specifically addressed by the World Health Organisation (WHO) Surgical Safety Checklist.

Patients with established thyroid disease should have recent normal thyroid function tests and be clinically euthyroid prior to proceeding with elective surgery. A raised index of suspicion of undiagnosed thyroid disease must be maintained for those noted to be symptomatic, in particular, a new arrhythmia or change in weight.

OBESITY

Obesity is an increasingly common problem in many parts of the world. Patients who are morbidly obese (body mass index >35 kg/m^2) are high risk for anaesthesia as well as surgery. Problems include difficult airway management, poor venous access, an increased incidence of cardio-respiratory complications and an increased risk of regurgitation and aspiration. Sleep apnoea and postoperative hypoxaemia are common, and the patient may require a period of mechanical ventilation postoperatively and should be managed on the intensive care or high-dependency unit.

Patients who have had gastric banding to manage obesity may have a reduced rate of gastric emptying and a potentially raised risk of regurgitation.

WHERE AND WHEN TO PRE-ASSESS?

Pre-assessment is ideally undertaken in a pre-admission clinic offering phlebotomy and the facility to organise ECG or chest X-ray within a single session. Assessment is often by skilled, senior nurses employing a 'traffic-light' system for requesting investigations.[3]

Referral for anaesthetic assessment is made by a member of the surgical team or the pre-assessment clinic nurse where indicated.

Pre-assessment should occur at a time pre-operatively that allows sufficient time to arrange for further investigation or medical management. Equally, the timing should not be so far ahead that changes in the patient's condition may render the assessment obsolete.

Day Case/Minor Operations

Day case surgery continues to expand to include more complex patients and surgical procedures. The aim to achieve a pain-free, ambulant patient requires careful patient and procedure selection.

Gynaecological procedures such as dilatation and curettage, colposcopy, hysteroscopy and laparoscopy lend themselves well to the day surgical setting. The patient cohort, generally young ASA (American Society of Anaesthesiologists) grade 1 or 2, renders this safe and efficient. Conditions such as obesity and diabetes offer contention over management and institutions running day case units should have guidelines outlining policy. These may be subject to exception with consultant surgical and anaesthetic input.

Postoperative nausea and vomiting (PONV) represents a particular problem in this group of patients. Risk assessment is by an Apfel scoring system, or similar, awarding points for female gender, a history of PONV or motion sickness and non-smokers. Anaesthetic techniques to minimise PONV include the use of total intravenous anaesthesia (TIVA), avoiding nitrous oxide and gastric insufflation, adequate hydration and avoidance of prolonged starvation, minimising opioids and using prophylactic anti-emetics. Pharmacological agents used in managing PONV interact with multiple receptors. Ondansetron, a 5HT$_3$ antagonist, and cyclizine, with anti-histamine and antimuscarinic effects, are often used in conjunction for this purpose.[4]

Laparoscopic Procedures

Respiratory and cardiovascular compromise as a consequence of the pneumoperitoneum raises significant anaesthetic concerns.

Bradycardia after peritoneal insufflation is common, rarely progressing to asystole, so rapid deflation may be required if there is inadequate response to treatment with vagolytic agents such as glycopyrrolate or atropine. The increased intra-abdominal pressure may reduce systemic blood pressure by reducing venous return. Often however, no change in systolic blood pressure is observed as it is maintained by a compensatory increase in systemic vascular resistance.

The pneumoperitoneum acts as a 'splint' to the diaphragm, reducing lung compliance and functional residual capacity. Hypoventilation and high airway pressures must be anticipated and managed. Surgical emphysema as a result of an inadequately advanced Veress needle may be an additional cause of rising blood carbon dioxide level, requiring management with a period of prolonged ventilation under anaesthesia.[5]

Robotic-assisted laparoscopic surgical intervention is a more recent development. In offering the option of remote precise control of surgical instruments and reduced hospital stay, the process also presents new anaesthetic challenges.

Major Operations

These include abdominal hysterectomy, radical trachelectomy, lymph node dissection and major vulval surgery. Urological or plastic reconstructive surgical input may be required. In addition, major operations may be undertaken in stages or involve redo processes with incumbent surgical, anaesthetic and critical care implications.

General anaesthesia with tracheal intubation and ventilation is usually necessary to facilitate prolonged and possibly technically difficult surgery.

Regional anaesthesia can provide operative anaesthesia and intra/postoperative analgesia to minimise the need for intraoperative opioid, attenuate the stress response to surgery and offer other advantages, discussed later. A combination with other analgesic modalities such as intravenous paracetamol, non-steroidal anti-inflammatory drugs (NSAIDs), opioids, clonidine and ketamine is used with success.

Venous Thromboembolism

Venous thromboembolism (VTE) is an important cause of morbidity and mortality in the hospital population. The National Institute for Health and Clinical Excellence (NICE) has specified obesity, age over 60 years, use of hormone-replacement therapy or oestrogen-containing contraceptives, cancer, general anaesthesia and prolonged immobility peri-operatively as significant risk factors for VTE.[6]

Their clinical guideline offers best practice advice on assessing and reducing the risk of VTE in patients admitted to hospital. It identifies mechanical and pharmacological modalities of prophylaxis. Pharmacological options, in those who have a low risk of major bleeding, include low molecular weight heparin, fondaparinux (Factor Xa inhibitor) or unfractionated heparin. Mechanical options include anti-embolism stockings, foot impulse devices and intermittent pneumatic compression devices.

Patients on oestrogen-containing oral contraceptives or hormone-replacement therapy may be advised to consider stopping these 4 weeks before elective surgery. Regional anaesthesia carries a lower risk of VTE than general anaesthesia. If regional anaesthesia is used, planned timing of pharmacological VTE prophylaxis to minimise the risk of epidural haematoma is necessary.

Positioning

Most procedures are undertaken in the Lloyd-Davies or lithotomy positions. The lumbar spine, hip joints and common peroneal nerves are at risk and need special attention on positioning, with use of padding to avoid nerve injury. Arms need to be secured carefully to avoid displacement during operation. Because of its superficial course, the ulnar nerve is at special risk of injury. It too should be carefully padded. Head down tilt increases pressure of intra-abdominal contents on the thorax. Ventilation and venous drainage from the head is compromised in this position.

At the end of surgery, reversal of head-down tilt and lowering legs can suddenly reduce venous return. This must be anticipated with careful patient monitoring, and intravenous fluid and vasoconstrictors readily available.

Placement of cables and breathing circuits must be secured to prevent these being trapped by surgical clamps fixed to the operating table. These also need to be placed so as to avoid pressure damage to the patient, with special attention to infusion lines from the fluid warmer where there is the added risk of causing skin burns.

Haemorrhage and Haemostasis

Anaesthetic considerations involve pre-operative assessment of risk by surgical procedure and patient factors to include comorbidity and anticoagulant medication.

Anticipation of increased blood loss prompts preparation with cross-matched blood, adequate large-bore intravenous access and invasive monitoring to guide fluid balance as well as provide access for regular blood sampling of blood gases, blood counts and coagulation tests.[7] Replacement of packed red cells and fresh frozen plasma in equal ratios is recommended for acute major blood loss. Platelets, cryoprecipitate, recombinant clotting factors (Octaplex, Beriplex), vitamin K, calcium and Tranexamic acid must also be considered in the context of acute major blood loss. Temperature homeostasis is also important in avoiding coagulopathy in this circumstance.

Occasionally, anaesthesia and resuscitation may need to be undertaken whilst transferring the patient to a facility for interventional radiology and embolisation. Meticulous planning and preparation for safe patient transfer to and from this remote location must take into account monitoring, drugs/ infusions, emergency resuscitation equipment and skilled assistance.

Temperature Homeostasis

Patients who develop peri-operative hypothermia can experience a number of complications including increased peri-operative blood loss, longer post-anaesthetic recovery, morbid cardiac events, altered drug metabolism, surgical wound infection and delayed healing. Any of these may lead to a longer stay in hospital, patient distress and discomfort, and even death.

Forced air warming devices, warmed intravenous and irrigation fluids and regular temperature monitoring are advocated by NICE in an attempt to maintain peri-operative temperature above 36°C.[8]

Regional Anaesthesia

The role of local anaesthetics and regional anaesthesia in gynaecological surgery is significantly increasing. Improved techniques and new local anaesthetic agents such as ropivacaine and levo-bupivacaine, with improved cardiac and neurological safety profiles, have contributed to this.

Ultrasound guidance offering real-time visualisation of fascial planes, nerves and surrounding anatomy have afforded more accurate deposition of local anaesthetic.

Research on outcomes and long-term sequelae will determine whether the effectiveness and safety of regional anaesthesia has been improved by ultrasonography.[9] Regional anaesthesia techniques include:

1. Local infiltration
2. Epidural anaesthesia
3. Spinal anaesthesia
4. Combined spinal epidural
5. Caudal anaesthesia
6. Transversus abdominis plane block

LOCAL INFILTRATION

Abdominal Procedures

Laparoscopy and laparoscopic sterilisation are widely carried out under local anaesthesia.

Technique: The puncture sites are infiltrated with lignocaine 1% to include the parietal peritoneum. This should be injected in a radial fashion from the umbilicus to include the needle track and a fan-shaped area on either side. The Fallopian tubes may be anaesthetised by dropping 5 mL of 1% lignocaine through a long fine spray cannula, or pelvic instillation of ropivacaine 200 mg in 40 mL saline.[10]

Vaginal and Vulval Surgery

For minor surgery on the vulva or vagina, local infiltration with 1% lignocaine or 0.5% bupivacaine is effective.

For endocervical curettage, paracervical block is required. Eight to ten millilitres of local anaesthetic are injected into each lateral fornix; injection must be preceded by aspiration. Either lignocaine 1% or bupivacaine 0.25–0.5% can be used. By combining lignocaine with 1:200,000 of adrenaline the duration of action can be increased from one to up to 2 hours and the maximum safe dose increased from 3 to 7 mg/kg. The onset of action is rapid. There is no block of the vagina or perineum.

The onset of action of bupivacaine is less rapid than lignocaine but the duration of action of 6–8 hours is considerably longer. The addition of adrenaline does not significantly prolong the duration of action of bupivacaine.

Complications

Local anaesthetic-induced convulsions can occur requiring treatment with a benzodiazepine or thiopentone and which, if severe, can lead to cardiac arrest.

EPIDURAL ANAESTHESIA

The contraindications to epidural and spinal anaesthesia are summarised below:

- Sepsis/localised infection around puncture site
- Generalised infection (septicaemia, bacteraemia)
- Abnormal coagulation
- Hypotension/shock/hypovolaemia
- Raised intracranial pressure
- Cardiovascular disease, low-output conditions
- Diseases of the spinal column (metastases, tumour)
- Local anaesthetic drug sensitivity
- Patient refusal
- Technical difficulties, i.e. kyphoscoliosis, obesity
- Medico-legal implications
- Neurological disease

Contraindications to Epidural/Spinal Anaesthesia

If an epidural is planned as part of the anaesthetic technique, it is advisable to ensure that subcutaneous heparin, if used, is given latest 12 hours beforehand.

Most epidurals are now inserted, with the patient conscious and cooperative before general anaesthesia is induced. Local analgesia is used and occasionally small amounts of benzodiazepine sedation. The sitting position is often used to ensure a successful epidural siting. Full aseptic precautions should be observed and current practice is to insert a catheter through the epidural needle in order to prolong the block during surgery and to use the epidural for postoperative pain relief. Intraoperative boluses of local anaesthetic can be given, usually 5–10 mL of 0.25–0.5% bupivacaine which can be followed by an infusion of 0.125% bupivacaine for postoperative pain relief. Commonly the epidural local anaesthetic will include an infusion of the opioid fentanyl. Chirocaine or ropivacaine may be employed as the local anaesthetic.

Complications of Epidural Anaesthesia

- Respiratory depression
- Hypotension
- Dural tap and post-dural puncture headache
- Epidural haematoma Failure
- Nausea/vomiting
- Urinary retention
- Reaction to local anaesthetic
- Infection
- Total spinal

SPINAL ANAESTHESIA

Spinal anaesthesia is produced by the injection of a local anaesthetic solution into the cerebrospinal fluid (CSF) causing temporary axonal block. The injection is usually performed at L3-4 below the termination of the spinal cord at L1-2 to avoid damage to the cord. The technique is performed with the patient in the lateral or sitting position on a tipping trolley. Following venous access, monitoring of blood pressure, ECG and oxygen saturation should be established. Facilities for full resuscitation must be available.

Technique

Under strict aseptic precautions, the back is cleaned with antiseptic solution and the appropriate space located by palpation. The needle is inserted at right angles to both the horizontal and vertical planes. The needle is advanced through the skin and subcutaneous tissue until resistance is felt as it enters the supraspinous and inter-spinous ligament and then the ligamentum flavum. Further advance causes the needle to penetrate the dura. The stylet is removed and CSF will leak from the hub of the needle confirming correct placement. Subsequently, 0.5% heavy bupivacaine 2–4 mL is slowly injected. With spinal anaesthesia the smaller the bore of the needle, the less likely the patient is to develop post-dural puncture headache (PDPH),[11] a distressing and often prolonged complication. However the use of a small bore needle (25–29 G) may necessitate the use of an introducer to facilitate passage through the skin and ligaments. With the advent of small gauge spinal needles, and the increasingly common practice of performing Caesarean section under a spinal anaesthetic, more operations are now being performed under spinal anaesthesia in situations where general anaesthesia is not available. It is essential, however, to have facilities for assisted ventilation and resuscitation should the need arise.

Complications

Complications of spinal anaesthesia include total spinal anaesthesia resulting in apnoea and loss of consciousness, which may lead to cardiac arrest. Immediate treatment with tracheal intubation and ventilation with 100% oxygen should be instituted; cardiovascular support may be necessary. Other complications include hypotension, which should be treated with fluids and vasopressors (generally ephedrine in 3–6 mg increments), and rarely neurological damage. This includes haematoma formation, cord ischaemia, infection/aseptic meningitis and arachnoiditis. Anaphylactic reaction to local anaesthetic is extremely rare.

COMBINED SPINAL EPIDURAL

The combined spinal and epidural (CSE) is an increasingly popular technique, combining the advantages of the two techniques. The Tuohy needle is essentially used as an introducer for the spinal needle prior to its use for catheterisation of the epidural space. The speed of spinal anaesthesia is then available in conjunction with duration afforded by the epidural component. The CSE has a more widespread role in obstetric anaesthesia than for gynaecological surgery.

CAUDAL ANAESTHESIA

Caudal anaesthesia is technically easier to perform than an epidural but because of inconstant anatomy the success rate is not as high. It is a useful technique to augment anaesthesia for vaginal or perineal surgery.

The extra-dural space runs from the foramen magnum to the base of the sacrum where it is sealed off by the sacrococcygeal ligament. Generally, the dural sac ends at the inferior border of the second sacral vertebral and the spinal cord at the inferior border of the first lumbar vertebra. However, there is much variation.

Technique

The block is performed with the patient in the lateral position. The sacral cornua are palpated, the thumb is drawn cephalad until bone is felt in the midline. This is the apex of the triangle formed by the superior part of the sacro-coccygeal ligament. A 19 or 21 gauge needle is inserted, immediately caudad to the thumb at an angle of about 45°. Resistance is felt as the needle engages in the ligament and is followed by a loss of resistance as it enters the sacral extradural space. The angle is now changed to become parallel with the long axis of the sacrum and the needle advanced. If resistance is felt the needle has either passed beneath periosteum or is situated subcutaneously. Should this occur the needle should be removed and the procedure recommenced. After aspiration to ensure the absence of blood or CSF the local anaesthetic is then injected. Bupivacaine 0.25% or 0.5% in a dose of 20 mL is usually adequate for perineal procedures.

TRANSVERSUS ABDOMINIS PLANE (TAP) BLOCK

The TAP block aims to deliver local anaesthetic to the branches of the anterior rami of the spinal nerves supplying the anterior abdominal wall (T7-L1) as they traverse the plane between the transversus abdominis and internal oblique muscle layers.

The technique, initially described as a blind procedure within the lumbar triangle of Petit, has been the subject of recent renewed interest under ultrasound guidance.

The block offers the possibility of extensive sensory nerve block with minimal risks relative to the alternative central neuraxial blocks. Its uptake has been primarily as a single-shot technique, but may afford prolonged block if a catheter is tunneled into the space. Reports of liver trauma, intraperitoneal injection, bowel haematoma and transient femoral nerve palsy exist, but the block remains one of the safest techniques in experienced hands.[12,13]

Postoperative Pain Management

A multimodal approach is used where possible. Paracetamol and non-steroidal anti-inflammatory drugs (NSAIDs), where not contraindicated, are available for use in intravenous, oral and rectal preparations. These, in combination with regional anaesthetic techniques, may be used to minimise opioid use and facilitate rapid recovery postoperatively.

Morphine, oxycodone and oxynorm are the more commonly used opioids for postoperative analgesia. Morphine and fentanyl are used with great success in patient-controlled analgesia (PCA) pumps in order to optimise dosing whilst maintaining safety with a programmed maximum bolus and lockout time. Side-effects may be further minimised by using an opioid antagonist, such as methylnaltrexone to counter opioid-induced constipation acting peripherally within the gastrointestinal tract.

Input from a Pain Team is invaluable to ensure adequate management of postoperative analgesia after major surgery. This is particularly so where catheter techniques have been employed and where PCA or patient-controlled epidural analgesia (PCEA) devices are in use.

Patients with pre-existing chronic pain problems and patients with drug dependence or tolerance problems have much to gain from regular input and assessment by such specialist services.[14]

Enhanced Recovery

The UK Department of Health currently promotes enhanced recovery programmes in an attempt to promote evidence-based, multidisciplinary optimal patient management peri-operatively to improve outcomes and early discharge.[15] Elements of the pathway have been addressed earlier within this chapter.

Critical Care

The critical care unit is the hospital facility offering intensive staffing and organ support resources continuously. Led by a consultant intensivist with 24-hour resident medical staff and 1:1 or 1:2 nurse:patient ratio, critical care is able to offer maximal intensive therapy where indicated.

Admission may be elective or as an emergency, and is occasionally arranged pre-operatively for so called 'pre-operative physiological optimisation'.

Elective postoperative CCU admissions are triggered by the patient's history, pre-assessment findings and complexity of the surgical procedure. Severe cardiorespiratory disease, such as pulmonary hypertension, and neuromuscular disorders are examples of conditions predictably warranting postoperative intensive care for invasive monitoring and organ support. High-dependency nursing may be required in those with complex analgesia concerns, which may include the support of epidural infusions.

Haemorrhage and sepsis are the commonest causes of emergency admissions to the critical care unit following gynaecological surgery. Other indications include complications of a large pulmonary embolism, cardiac arrest and rarer serious untoward anaesthetic or surgical incidents.

RESPIRATORY SUPPORT

Respiratory failure after gynaecological surgery as a consequence of opiates, infection, pulmonary embolus, oedema, pneumothorax, lymphangitic spread of cancer, massive ascites or exacerbation of pre-existing lung disease may require more support than supplemental-inhaled oxygen available on the ward. Obesity and a history of obstructive sleep apnoea add to the risk of deterioration in respiratory function postoperatively.

Critical care is able to support ventilation non-invasively or invasively whilst definitive management of the underlying precipitant is managed by inter-costal drains, bronchodilators, anti-coagulants, antibiotics or steroids. Regular chest physiotherapy is a key component of optimal respiratory support. Usually the physiotherapist will have also assessed the patient pre-operatively and planned together the rehabilitation activity.

Invasive ventilatory modes via endotracheal tubes range from simple pressure or volume-controlled modes through to the more intensive high-frequency ventilatory modes utilising frequencies in the range of 3–10 Hz. Where significant disease impairs gas exchange to the extent that further escalation ventilatory mode is no longer possible, the use of nebulised prostacyclin/sildenafil or prone positioning to improve ventilation-perfusion mismatch may be considered prior to resorting to extra-corporeal membrane oxygenation (ECMO) via a bypass machine.

The aim is to successfully wean off invasive support in the shortest feasible time in order to avoid the complications of ventilator-induced lung injury (VILI) and ventilator-associated pneumonia (VAP). Long-term mechanical ventilation, where inevitable, in the awake patient is administered via a tracheostomy. The decision for this is based on predicted prolonged respiratory wean, or where the patient is unable to protect their own airway when self-ventilating. Percutaneous bedside tracheostomy is a procedure often performed by the intensivist using a Seldinger dilatation technique.

CARDIOVASCULAR SUPPORT

Cardiovascular support is required in patients at risk of circulatory instability as a result of haemorrhage, sepsis, or return of circulation after cardiac arrest in the peri-operative period.

A balance of fluid resuscitation and inotropic support is necessary to optimise tissue perfusion, whilst minimising damage to other organ systems from the initial insult and resuscitative measures. Pulmonary oedema, oedema or vasoconstriction at anastomoses, mesenteric hypoperfusion, cardiac and renal failure are all recognised complications of the management of shock. Monitoring clinical signs and symptoms and regular blood gases, together with a high index of suspicion, aids detection and early management of these sequelae.

Management of haemorrhage by means of massive blood transfusion, early correction of coagulopathy and reversal of the cause of blood loss has been discussed earlier. Large bore peripheral access (14G, 16G cannulae) or central access (8Fr Swann sheath introducer) facilitate rapid infusion of intravenous fluid where acute blood loss is the primary problem. Invasive central venous pressure monitoring via central venous catheter, central venous saturation, oesophageal Doppler monitoring, and further invasive monitoring via the arterial waveform and thermodilution or dye-dilution (PiCCO, LidCO), are all commonly used to monitor cardiac output and to guide fluid resuscitation.

Vasoactive drugs in the form of vasoconstrictors (norepinephrine, vasopressin) and inotropes (epinephrine, dobutamine) are selected and titrated to clinical parameters in conjunction with adequate management of hypovolaemia.

Vasopressor Therapy

The initial inotropic agent employed in patients with clinical signs of shock and hypotension not responsive to empiric fluid challenge is noradrenaline in order to support organ perfusion pressure. Pulmonary artery catheterisation to guide fluid and inotropic support is now reserved for the more complex patients. The vast majority of critically ill patients are monitored with the less invasive oesophageal Doppler and/or PiCCO or LidCO devices, as previously discussed. Epinephrine should be considered for refractory hypotension although adverse dysrhythmic effects are common. Vasopressin is commonly employed when the above measures have failed and may allow the reduction of toxic higher doses of noradrenaline.

In severe septic shock, adrenal output may be inhibited and corticosteroid administration may be helpful in some patients.[16]; However, its use is tempered with the knowledge of increased susceptibility to infection and also prolonged critical illness neuropathy/myopathy syndrome.

Inotropic Therapy

Dobutamine is the first choice for patients with a low cardiac index (<2.5 L/min/m^2) after fluid resuscitation and obtaining an adequate mean arterial pressure. Dobutamine may cause hypotension and/or tachycardia in some patients, especially those who are hypovolaemic. In patients with evidence of tissue hypoperfusion, the addition of dobutamine may be helpful to increase cardiac output and improve organ perfusion. A strategy of routinely trying to increase cardiac index to predefined 'supranormal' levels (>4.5 L/min/m^2) has not been shown to improve outcome in the postoperative period.

Bedside echocardiography by an experienced cardiologist can be a very useful and non-invasive examination to rule out cardiac tamponade, to look for vegetations on heart valves and to estimate left and right ventricular function.

CARDIAC ARREST

The management of cardiac arrest is governed by the European Resuscitation Council Guidelines for resuscitation and advanced life support. The protocol is reviewed regularly with the emphasis in recent years being on chest compressions with shock delivery in VF/VT as soon as possible.[17] Education of all team members of the algorithm, and regular updating of skills and knowledge is necessary for successful resuscitation. Intubation and mechanical ventilation, inotropic support, together with neuroprotective-controlled hypothermia to 34°C for 24 hours post-VF arrest, are the initial measures on admission to the unit following return of spontaneous circulation. Sadly, a significant proportion of such patients will die despite all efforts.

RENAL SUPPORT

Acute renal failure requiring critical care support in gynaecological surgery is most often the result of tissue oxygen deprivation secondary to reduced intravascular volume, or reduction in perfusion pressure. Obstruction or ureteric damage at surgery must be excluded as a cause of renal failure.

Once circulatory support has been optimised, infusion of a loop diuretic such as frusemide may be considered.

Indications for renal replacement therapy in the form of continuous veno-venous haemofiltration include hyperkalaemia, severe uraemia, acidaemia and fluid overload.

GASTROINTESTINAL SUPPORT

Maintenance of adequate nutrition and early enteral feeding are important features of critical care support. Enteral feeding orally, nasogastrically, nasojejunally, via feeding jejunostomy or percutaneous gastrostomy is preferable to the parenteral route.[18]

There is evidence for a reduction in bacterial translocation and sepsis from a gastrointestinal source with use of the enteral route, and the infective complications of parenteral nutrition are avoided.

Prolonged paralytic ileus is the commonest cause of CCU gynaecological surgical patients being unable to feed via the enteral route. Complications resulting in the formation of enterocutaneous fistulae may also prevent adequate enteral nutrition.

Dietary supplements such as glutamine are used in a critical care setting as there is evidence to show a reduction in frequency of pneumonia, sepsis and bacteraemia in patients who received glutamine-supplemented enteral nutrition. Other vitamin and calorie supplements are also used in some units. Input from a dietitian is invaluable in this setting.[19]

SEPSIS

Sepsis is a clinical syndrome that complicates severe infection and is characterised by systemic inflammation and widespread tissue injury. It is mediated by various cytokines-released systemically as a response to infection.

Patients on chemotherapeutic drugs, those with cancer, diabetes and invasive catheters or tubes (e.g. for ventilation) have impaired defense mechanisms and are at an increased risk of sepsis and multi-organ failure. The development of severe sepsis may be prevented by avoidance of invasive catheters, use of full aseptic techniques when siting them and removing them as soon as possible. Prophylactic antibiotics in the peri-operative phase may be beneficial.

Sepsis syndrome is recognised clinically by the presence of two or more of the following:

- Temperature greater than 38°C or less than 36°C.
- Heart rate greater than 90 beats/min.
- Respiratory rate greater than 20 breaths/min or a $PaCO_2$ in arterial gas less than 32 mmHg
- WBC count greater than 12,000 cells/µL or less than 4000 cells/µL.

Septic shock is sepsis with hypotension (systolic BP <90 mmHg or a reduction of 40 mmHg from baseline) despite adequate fluid resuscitation.

Key components of adequate management of sepsis include:

- Early recognition and resuscitation.[20]
- Early and appropriate antibiotic therapy: adequate sampling of possible sources for microbiology lab tests and initial empirical therapy with broad spectrum cover to include the more likely pathogens. This usually incorporates a single broad spectrum agent, with added anaerobic cover if a gastrointestinal source is suspected, added pseudomonal cover in neutropenic patients.

- Granulocyte colony-stimulating factor (G-CSF) in neutropenic patients to stimulate the production of white blood cells.
- Source control: this may include imaging for pelvic collection, image-guided drainage or return to theatre to remove an infective focus.
- Careful monitoring and support of respiratory, renal, gastrointestinal, neurological and cardiovascular systems to prevent multi-organ failure.
- Corticosteroids for refractory vasopressor-dependent shock.

Judicious use of antimicrobial agents is important to prevent the evolution of multiresistant strains of pathogens that make sepsis more difficult to manage. Regular advice from the microbiologist is crucial. Equally important in minimising morbidity and mortality from sepsis on a local scale, is careful isolation and hand-washing to reduce spread of infective organisms. Guidelines for care, education of healthcare professionals and data collection for audit and feedback are key measures in the management of sepsis on a global scale.[21]

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21 Gynaecology and the Urologist

Erik Mayer, Justin Vale

Introduction

Historically, the lower female urinary tract has been regarded as the proper province of the gynaecologist, both for disorders of continence and for the management of abnormal communications with the genital tract. This is because of the close aetiological association between these conditions and childbirth, or gynaecological surgery. Intrinsic pathology, such as bladder cancer, stones, and tuberculosis, is now entirely the responsibility of the urological surgeon.

In no area of gynaecology is early referral and close cooperative working with another specialist more important than when urological problems develop in association with either childbirth or gynaecological operations.

Not only will the patient be much better served by early involvement and the expertise of a urologist, but formal complaints and litigation are less likely, particularly if operative consent has included reference to urinary tract complications where relevant.

Diseases of the Urethra

PROLAPSE OF THE URETHRAL MUCOUS MEMBRANE

A minor degree of prolapse of the urethral mucous membrane is not uncommonly seen in adult women, though it is symptomless and necessitates no treatment. Severe degrees of prolapse are restricted to children and the aged. The condition is circumferential and in many ways comparable to prolapse of the mucous membrane of the rectum. In children there is usually a history of bronchitis or of worms, while a chronic cough may be an associated complaint in elderly patients. In addition to the factor of raised intra-abdominal pressure brought about by coughing, it must be assumed that the urethral tissues are lax so that the mucous membrane can separate from the muscle layer. The prolapsed mucous membrane becomes oedematous and congested and may cause severe local discomfort with frequency and urinary tenesmus. Rarely the prolapse becomes infarcted, causing pain and a blood-stained discharge. If the condition is not treated surgically, the prolapse will eventually slough.

Treatment: The simplest surgical procedure is to excise the prolapsed mucous membrane and to suture the healthy margin of the urethra to the skin by a series of interrupted fine (4/0) polyglactin sutures. Great care must be taken in placing the sutures accurately to prevent stenosis developing at the meatus. There is some risk of recurrence after this operation though the immediate results are satisfactory. Better results can be obtained if the prolapsed mucous membrane is excised with a diathermy knife. It seems that scar tissue that forms around the meatus after diathermy excision tends to prevent a recurrence, particularly if radial incisions are made in the skin of the adjacent vestibule (Fig. 21.1).

URETHRAL CARUNCLE

Urethral caruncle is a very common condition. It is defined as a small cherry-red protrusion arising from the posterior wall of the urethra and is most commonly seen in the elderly. Very often it is discovered on routine pelvic examination and causes no symptoms and requires no treatment. More rarely, however, a caruncle may be a source of pain, dysuria and frequency, and it may cause bleeding and discharge. It is one cause of dyspareunia. The pathological classification of caruncles is suggested as follows:

1. Granulomatous or chronic inflammatory, and associated with a chronic urethritis.
2. Papillomatous. The covering epithelium dips into the subjacent stroma where it forms nests of transitional cells with some resemblance to a transitional cell carcinoma. It is, however, a completely benign tumour.
3. *Angiomatous* and even adenomatous patterns are occasionally seen (haemangio-neurofibroma).

Treatment: The treatment of a urethral caruncle is to excise it with a diathermy knife. Caruncles are friable and are not easily grasped with dissecting forceps, yet it is essential to apply traction to the caruncle to display its base. Small Allis' forceps, or small sponge holders, should be used to grasp the caruncle. The diathermy knife should cut through the mucous membrane of the urethra wide of the base of the caruncle and bleeding from the raw surface should be treated by coagulation. The excised material must be sent for histological examination.[1] The pedicle of the caruncle often extends as much as 0.5 cm along the posterior wall of the urethra and when the caruncle is excised care must be taken to prevent the development of stenosis.

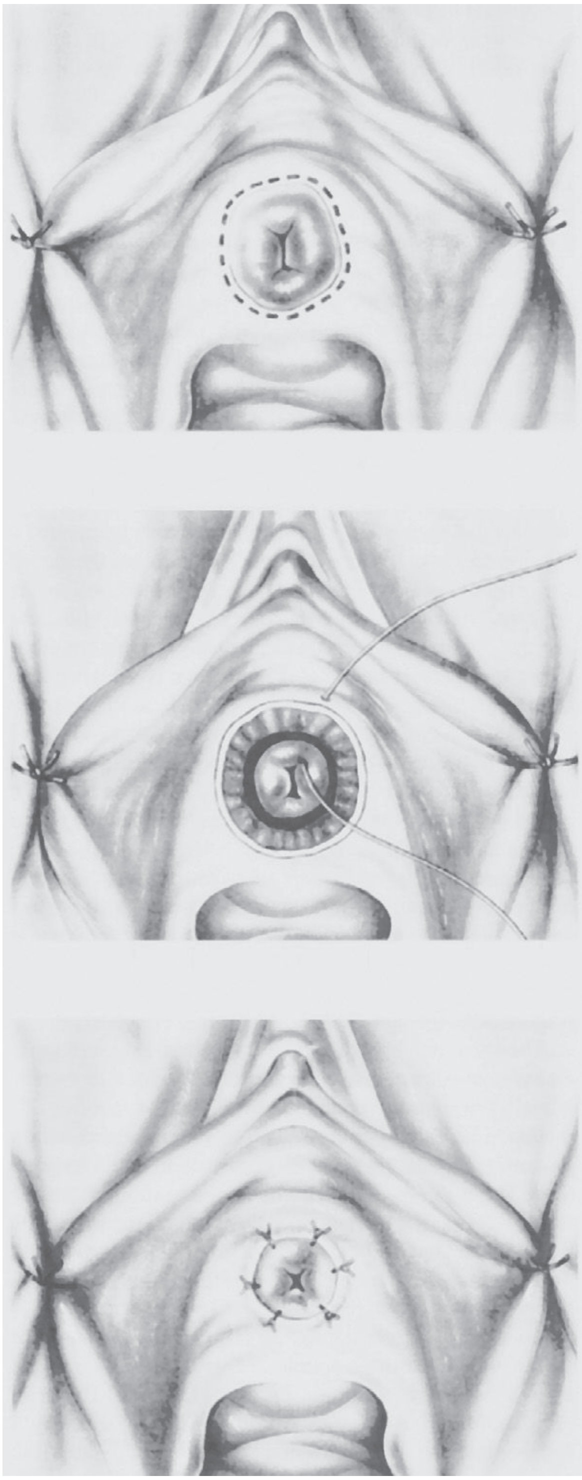

Fig. 21.1: Treatment of prolapse of the urethral mucous membrane. The redundant mucous membrane is first circumcised by a circular incision. It is then removed, preferably by a small sharp scalpel held on the flat or a diathermy needle. Subsequently, the raw area is closed by a series of interrupted fine polyglactin sutures.

Caruncles have an unpleasant tendency to recur. The treatment of the recurrent caruncle is more likely to be successful if a triangular piece of the posterior urethra from which the caruncle arises is completely excised with a fine diathermy needle. A soft catheter is first passed into the urethra, and this manoeuvre reduces the tendency to stenosis, which is an ever present risk of the operation. If stenosis does result, it should be treated by urethral dilatation with ordinary Hegar dilators up to size no. 6 or no. 7.

CYST OF SKENE'S TUBULES

These small cysts are very rarely seen and take the form of a small swelling to one or other side of the urethral meatus. The cyst can be excised and shelled out without much difficulty, and the edges of the wound drawn together with interrupted sutures.

DIVERTICULUM OF THE URETHRA

This condition is probably more common than is generally believed, with a reported incidence of 2–5%.[2,3] The aetiology is obscure, some being regarded as congenital, while others may result from the rupture of a peri-urethral abscess into the urethra, with the subsequent growth of transitional epithelium along the wall of the abscess to form a diverticulum. Patients complain of difficulty in emptying the bladder, or urgency, and often maintain that they have a feeling that the bladder has not been completely emptied at the end of the act of micturition. Furthermore, the diverticulum does not always produce a circumscribed swelling, as it is rare for the diverticulum to become distended with urine. For this reason the diverticulum is often mistaken for a urethrocoele and the exact nature of the condition is not recognised before operation. Nevertheless it is possible to diagnose the condition accurately with ultrasound or a magnetic resonance imaging (MRI) scan. An intravenous urogram (IVU) may well show a diverticulum on the post-micturition film and should always be performed if an ectopic ureterocoele is a possibility. If the aperture is large enough it should be possible to demonstrate the nature of the swelling by the passage of a urethral sound, and the opening in the urethra can sometimes be seen on urethroscopy. It is sometimes possible to demonstrate the escape of urine or pus from the urethra by pressure on the swelling from the vagina. A calculus may form in a diverticulum and be demonstrable by radiography.

The sac varies in size from a few millimetres to 5 cm in diameter and may extend to the bladder base or burrow laterally. It is sometimes saddle-shaped, straddling the urethra. The lining is transitional or squamous epithelium, or merely granulation tissue if it has been infected for some time. The wall consists of fibrous tissue; muscle fibres are rare or absent. The opening into the urethra is usually in the floor of the middle one-third but may be at the bladder neck; there may be multiple openings. The swelling is mobile if it is uninfected, but can become fixed if inflammation and pus are present.

Treatment: As a prelude to surgery, it is helpful to fill the diverticulum with a solution of methylene blue so that extensions and loculations may be identified. Treatment consists of incising the anterior vaginal wall by a longitudinal incision or inverted 'T' (Fig. 21.2).[4] The outer capsule of the diverticulum should be recognised without difficulty, and it is usually a

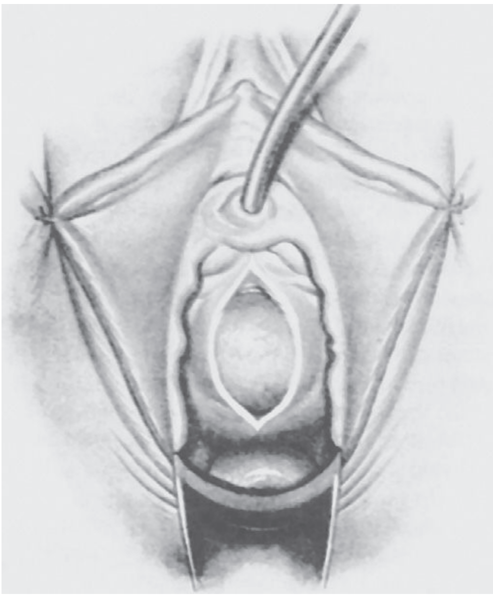

Fig. 21.2: Removal of a urethral diverticulum. A catheter has been placed into the bladder and the anterior vaginal wall exposed. A vertical incision has been made over the diverticulum. Alternatively an inverted 'U' incision may be used.

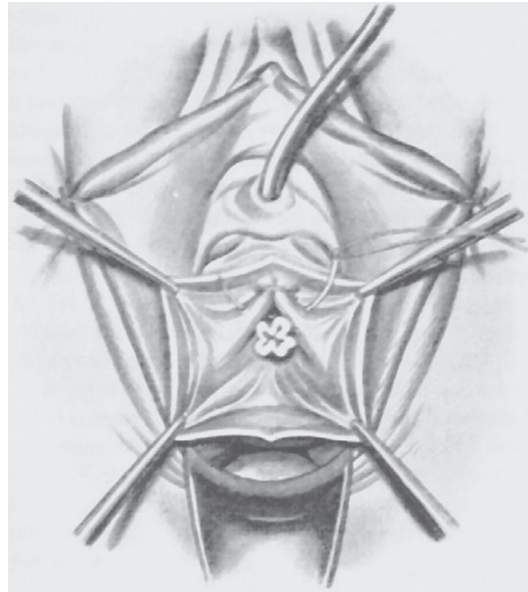

Fig. 21.4: Removal of a urethral diverticulum. The diverticulum has been excised and the sub-vaginal tissues are being brought together with interrupted sutures so that the cut base of the diverticulum is being covered.

simple matter to dissect it clear of the surrounding structures. In this way the diverticulum is mobilised and with the help of a urethral sound the communication with the urethra is identified. It is not necessary to open the sac, and it is convenient to dissect scar and fibrous tissue away from the circular communication with the urethra. The mucous membrane of the urethra is first closed by a series of interrupted 4/0 polyglactin sutures (Fig. 21.3). The neck of the sac should now be cut and the sac removed (Fig. 21.4). Subsequently a second layer of interrupted sutures is introduced through the muscle wall of the urethra and finally a third layer of sutures placed transversely should be introduced through the vagina (Fig. 21.5).

Sometimes the operation is of considerable difficulty when there is investment of the urethra by a complicated diverticulum. It is easy to injure the urethra during the dissection. As an alternative, excision of the posterior wall of the terminal

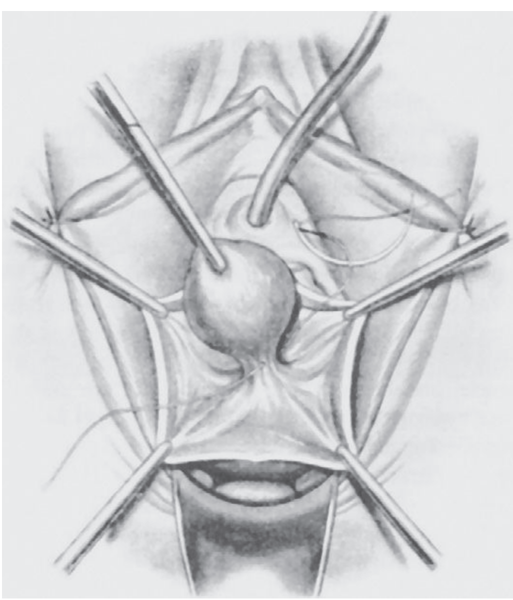

Fig. 21.3: Removal of a urethral diverticulum. The diverticulum has been dissected clear of the surrounding structures and the base of the diverticulum is being transfixed/ligated.

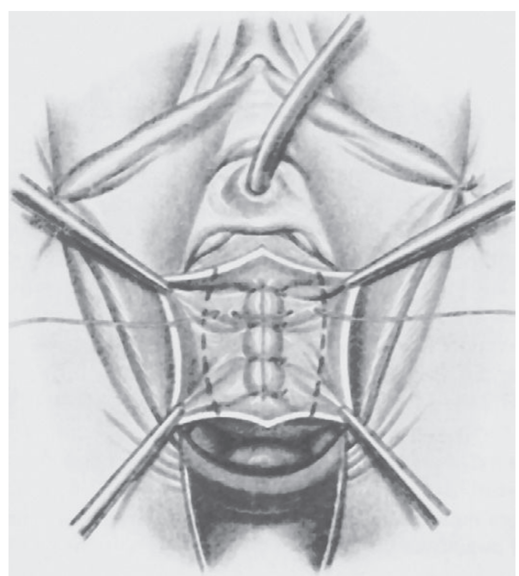

Fig. 21.5: Removal of a urethral diverticulum. A second layer of covering sutures has been introduced. The dotted line shows where the redundant vaginal wall is to be excised.

urethra has been advocated.[5] This effectively marsupialises upward extensions of the diverticulum.

Postoperatively, it is not necessary to leave an indwelling catheter. Most patients have no difficulty in passing urine, and the results obtained have been satisfactory.

ECTOPIC URETER AND ECTOPIC URETEROCOELE

In the female, an ectopic ureter may open into the urethra and if below the level of the sphincter can result in continuous urinary incontinence. If the condition is suspected, the distal urethra may be examined by using a child's nasal speculum (Fig. 21.6). The presence of an ectopic ureter is commonly associated with a duplex system and typically drains the upper pole that can either be dysplastic or hydronephrotic. Abnormal dilatation of the terminal ectopic ureter is referred to as a ureterocoele and may be detected as an anterior wall swelling on vaginal examination. This differential diagnosis needs to be considered with unusual anterior vaginal cysts. The treatment of an ectopic ureter is determined by the function and anatomy of the kidney that it is draining.

CARCINOMA OF THE URETHRA

The female urethra is an unusual location for primary carcinoma that can be either of squamous cell or transitional origin. Such growths are considered as urethral or vulvourethral, the prognosis for the latter being worse[6] and the incidence of lymph node metastases being higher.

Primary Urethral Carcinoma

Tumours arising at the bladder neck are commonly of transitional cell origin and cannot be separated surgically from that of the bladder. Treatment is exactly comparable to treatment of carcinoma of the bladder and in this instance usually requires cysto-urethrectomy with appropriate urinary diversion.

Tumours in the shaft of the urethra are usually squamous cell carcinoma. The symptoms from these may be misdiagnosed as ‘urethral syndrome’; the tumour may not be palpable. All patients with urethral symptoms should undergo urethroscopy.[7]

Treatment may be by brachytherapy with or without external beam radiotherapy, but wide local excision may be suitable for a small tumour. If the bladder neck can be conserved (see below), a tubular urethral conduit can be fashioned from a labial ‘island’ pedicle graft (see above).

Fig. 21.6: Urethroscopy. Small nasal speculum used for examination of the distal urethra.

Cases of adenocarcinoma are believed to arise from paraurethral glands and enter the differential diagnosis of suburethral metastasis (see below).

Vulvo-Urethral Carcinoma

The importance of this group lies in the fact that in early cases distinction has to be made from benign urethral caruncle, and the necessity of histological examination of biopsy material from such a source cannot be over-emphasised.[8] Treatment is by local irradiation using needle sources, often coupled with diathermy or local excision. Bilateral inguinal lymphadenectomy is sometimes indicated. If the tumour is at all advanced, radical urethrectomy is indicated, as external irradiation alone has little to offer.

Radical Urethrectomy This procedure is a modification of radical vulvectomy (described in Chapter 15). It is best carried out in the Lloyd-Davies position, which is suitable for a synchronous combined abdomino-perineal approach. The initial preparation is the same, except that if urinary diversion is contemplated the appropriate bowel preparation and other arrangements are necessary.

Incision A wide local excision of the urethra will include the clitoris, anterior two-thirds of the vulva and part of the mons veneris. It will include the full circumference of the lower vagina with the exception of a narrow strip of the posterior vaginal wall. Sometimes total colpectomy is necessary (see Chapter 15). The upper limit of the incision must be determined by pre-operative investigation and cysto-urethroscopy and should be a full 2 cm clear of visible growth. If such an excision encroaches well into the bladder, a complete cysto-urethrectomy or anterior exenteration may be necessary. In a community where diversion via a stoma is unacceptable, it is worth trying to fashion a ‘urethral spout’ even when total urethral ablation has been carried out. Surprisingly, an acceptable degree of continence may be obtained.

Involvement of Inferior Pubic Rami The lower urethra in the region of the triangular ligament is closely related to the inferior pubic ramus. If the growth is invading in this region, it is preferable that the inferior pubic ramus be removed in continuity with the urethra. For this purpose it is necessary to expose the obturator foramen through the vulvectomy incision and to pass a Gigli saw through it. When the other end of the saw is brought out into the perineum, the inferior pubic ramus can be divided. The saw is then re-inserted and taken across the retropubic space (Cave of Retzius) and brought out through the opposite obturator foramen. This will then divide the pubic arch transversely, leaving the pelvic girdle intact, but removing the arch and both inferior rami with the urethra (Figs. 21.7 and 21.8).

Lymphadenectomy Two linear extensions of the skin incision into the groin allow inguinal lymphadenectomy to be carried out in continuity. Occasionally, the intrapelvic nodes require excision as well.

Secondary Urethral Carcinoma

Transitional Cell Carcinoma

This may well be secondary to an unsuspected primary higher in the urinary tract. Full pre-operative investigation is indicated.

Sub-Urethral Metastases

The sub-urethral area is a relatively frequent site for deposits from primary carcinoma of the endometrium. If these ulcerate they may be mistaken for primary vulvo-urethral carcinoma. Carcinoma of the kidney (particularly left side) can rarely metastasise to this site, and secondary deposits from ovarian and colonic primaries that have invaded the uterus leading to metastasis in this site may also occur.

A sub-urethral metastasis is a classical complication of gestational choriocarcinoma. Occasionally emergency treatment is required for torrential haemorrhage, and it is most unwise to attempt to excise or biopsy such a deposit. Haemorrhage can only be secured by wide, under-running sutures, which reach healthy tissue on either side.

Genito-Urinary Fistulae

AETIOLOGY

In the developed world, the majority of cases of urinary fistula are of surgical origin.[9] Hysterectomy is the commonest antecedent operation, both for vesical and ureteric fistula, although some follow vaginal surgery.[10] More difficult are those that follow radiotherapy, especially if combined with surgery. Primary or recurrent cancer may cause or complicate genital fistula, and, of course, treatment of the malignancy is the prime concern. Very careful consideration is required before palliative intervention in such cases (see below).

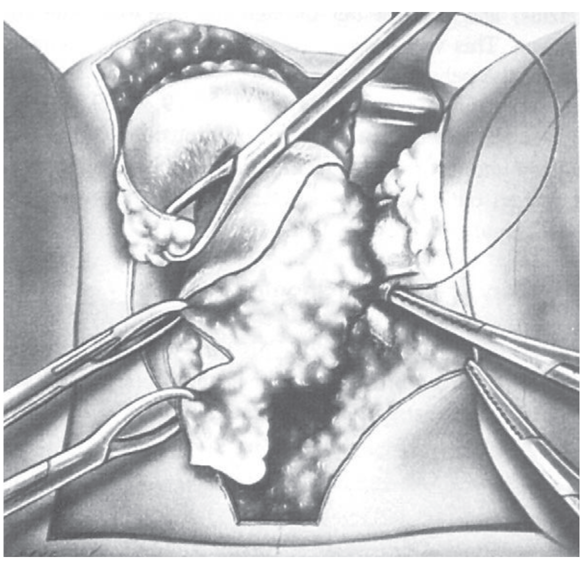

Fig. 21.7: Radical urethrectomy. A Gigli saw is passed behind the symphysis pubic traversing the obturator foramen on either side.

Intestinal fistula has a wider range of aetiology, inflammatory bowel disease being an important factor that may sometimes be overlooked. As with urinary fistula, more than one factor may be present (e.g. in addition to surgery). The possible association of infection (e.g. schistosomiasis, amoebiasis, tuberculosis, actinomycosis or lymphogranuloma venereum) needs to be borne in mind with urinary as well as intestinal fistula. Colorectal as well as gynaecological surgery is responsible for iatrogenic fistula, especially from low-stapled anastomoses.

In the developing world, in rural communities where maternity services are scarce or totally lacking, neglected obstructed labour is responsible for serious maternal genital injury, which provides a significant part of the workload of gynaecological services.[11] Most of these injuries are due to pressure necrosis and sloughing of the genital tract and adjacent organs. Vesicovaginal fistula is the most common and Harrison[12] gave a good review of the problem in West Africa. The sufferers are commonly little more than children and their misery is utter.[13] Permanently incontinent and smelling strongly of urine, the sufferer in a polygamous society is consigned to a matrimonial 'scrapheap'. The extent of the problem is certainly underestimated.[14]

In the worst obstetric cases there will be a double fistula producing both urinary and faecal incontinence. Furthermore the genital tract itself may have been so destroyed as to render future coitus impossible, let alone reproduction, even where the fistula can be closed.

Patient Support

Support is essential for the optimum management of fistula patients. With shattered morale and a poor state of health these individuals need counselling and care, both before and after surgery.

In a proportion of women repair of a fistula is at first unsuccessful and maintenance of morale in the face of such disappointment can be extremely difficult. Patient support groups run by successfully treated women are invaluable.[15]

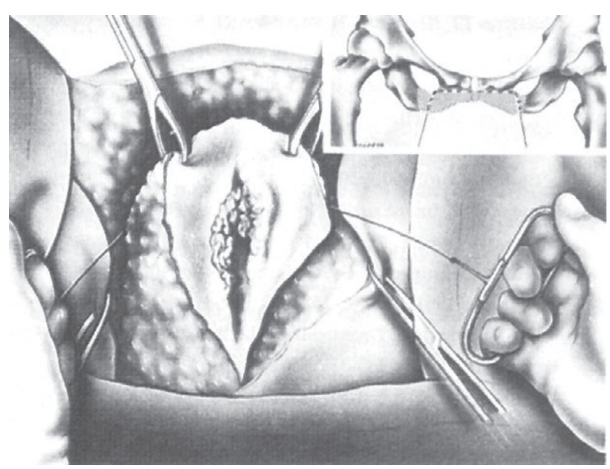

Fig. 21.8: Radical urethrectomy. The inferior pubic rami are divided at the level of the symphysis; a similar technique is used to divide them again nearer to the ischium (see inset).

INVESTIGATION AND DIAGNOSIS

A correct diagnosis and full functional evaluation are essential to the selection of appropriate treatment. For instance, although a post-surgical fistula may be the immediate problem, the indication for the original surgery may be very relevant and reflect an underlying disturbance of micturition or defaecation.

Urinary Fistula

Suspected Urinary Fistula

History alone can be misleading. Although the involuntary loss of small amounts of urine on stress or strain (stress urinary incontinence) may be due to a functional defect of the bladder neck closure mechanism, genuine stress incontinence or inappropriate activity of the detrusor muscle (detrusor overactivity), the symptom may also be due to a small vesico-vaginal fistula that only leaks when the bladder is partly distended.

Critical diagnosis requires determination of whether incontinent urine is leaked through the urethra or through some other aperture. Partial incontinence may involve simultaneous passage of urine through the normal (controlled) route and an abnormal aperture (see Table 21.1).

Examination When incontinence is incomplete and most urine is voided normally, the diagnosis of an abnormal communication with the vagina may be elusive. Painstaking examination is required with a good light, adequate exposure, a malleable probe and sometimes the assistance of dye tests. Direct observation during retrograde instillation of dye by catheter is required. If a ureteric leak is suspected, intravenous indigo-carmine may be used. The three sponge test[16] can sometimes be helpful in identifying the site of a small fistula that is not instantly apparent on examination under anaesthesia (EUA). In this simple test three small sponges are placed in the vagina and aqueous methylene blue is instilled into the bladder. After 20 minutes, the sponges are removed. If the lower sponge only is stained blue it suggests either a urethro-vaginal fistula or back-tracking of methylene blue from the urethra. If the lower sponges are dry but the top sponge is stained with clear urine it suggests a ureterovaginal fistula. If either the middle or the top sponge is stained blue it suggests a vesicovaginal fistula.

Cystoscopy Cystoscopy is relatively insensitive in the diagnosis of vesicovaginal fistula and is best combined with vaginal examination under anaesthesia. It is extremely difficult to identify a small bladder fistula among the folds of the bladder base, unless a probe can be passed from outside which is then diagnostic. Leakage of fluid into the vagina during filling may disclose a fistula from the vaginal aspect. If the fluid flows back through the cervix, this indicates a vesico-uterine fistula.

In the case of a larger fistula, of course, distension of the bladder with fluid for viewing is impossible unless the fistula can be occluded with a finger or some form of vaginal tampon to allow bladder distension.

The main indication for cystoscopy in the case of vesicovaginal fistula is to localise a fistula in relation to the ureteric orifices, using a probe or sound.

Ureteroscopy and Ureteric Catheterisation This has been used successfully in the management of ureterovaginal fistula[17] and is most likely to be helpful where the fistula is small and there is ureteric continuity. In that event it may be possible to pass a guide-wire retrogradely up the ureter beyond the fistula and insert a double pigtail (J-J stent). Four to six weeks of stenting should allow the ureter to heal, although the patient must be followed for a minimum of one year with serial Mag 3 renograms or intravenous urography to exclude late stenosis due to peri-ureteric fibrosis (see below).

In the case of a massive obstetric fistula the terminal ureters have commonly sloughed away together with the bladder base. The intramural ureters are often then left discharging directly into the fistula edge. Their location should be identified by careful examination under anaesthetic, preferably in the prone position, to look for the 'telltale' spurt of ureteric efflux. Direct ureteric catheterisation is then feasible.

Imaging Studies Imaging has an important role in the evaluation of fistula but is likewise of limited use in initial diagnosis. A positive diagnosis may be made by the visualisation of a leak of contrast from a viscus, but the absence of a leak cannot reliably exclude a fistula.

Excretion Urography This is essential on its own or in combination with axial tomography (CT urography) to define the anatomy, integrity and functional status of the upper renal tract. This is the case even if a vesicovaginal fistula has already been diagnosed because a ureter may also be involved as part of a complex fistula, and because knowledge of upper tract integrity is important at the time of surgery and may be valuable later if litigation is considered. A 'flare' around the distal ureter is very characteristic of a developing ureteric fistula (Fig. 21.9). After pelvic surgery the side showing hydronephrosis may not be the side of the fistula.

When congenital ectopic ureter is suspected, abnormal signs on the urogram may be elusive, because small pyelonephritic renal poles may not concentrate contrast. A skilled radiologist will compare the calyceal pattern on either side with the soft tissue shadow (Fig. 21.10), and of course CT scanning may be helpful.

Renal Ultrasound Renal ultrasound will demonstrate calyceal dilation and may show unopacified calyces and ureteric duplication in such cases.

Table 21.1: Extra-urethral incontinence

Sites		
(a) Congenital ectopic ureter*	–	vaginal cervical*
(b) Ureteric fistula	–	ureterovaginal
		uretero-uterine
(c) Vesicovaginal fistula	–	

*Congenital ectopic ureter may also open into the distal urethra below the sphincter apparatus.

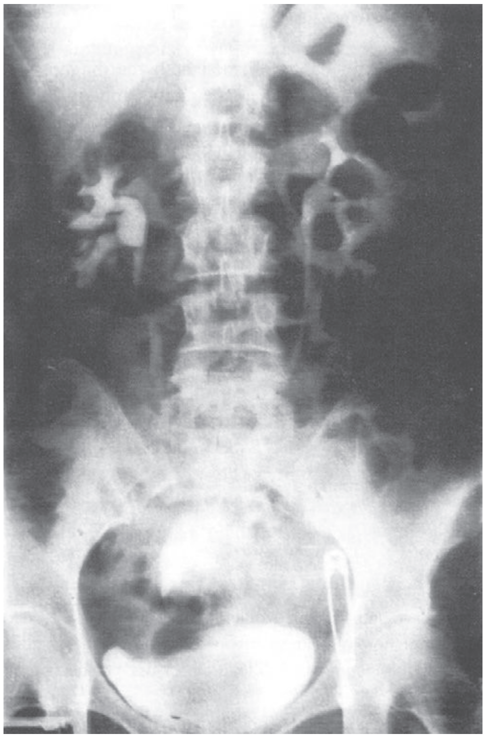

Fig. 21.9: IVU 'flare' from ureteric leak after pelvic surgery.

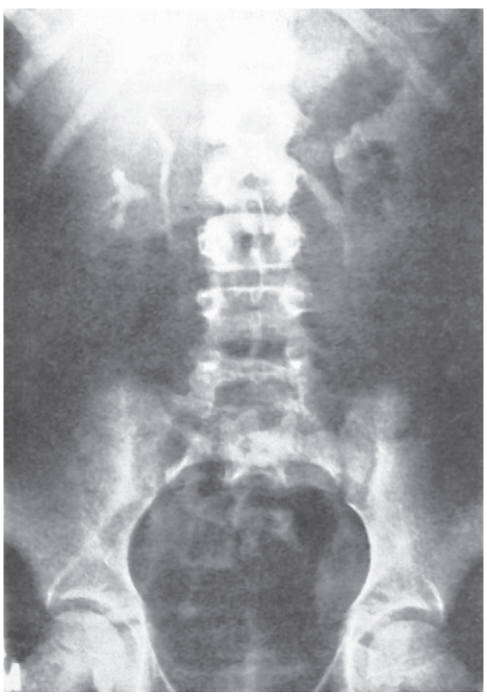

Fig. 21.10: Excretion urogram. Prior knowledge of re-duplication of any part of the urinary tract is of great value to the surgeon. In this case a separate ureter may be seen arising from the upper calyx on the right, but the distal portion is not opacified. There is lumbarisation of the 12th thoracic vertebra. Further studies would be necessary to determine whether the two ureters join before reaching the bladder and whether both enter the bladder or whether one is ectopic.

Transvaginal Ultrasound This technique is of limited value in bladder fistula but of more use in urethral fistula associated with a diverticulum.[18]

Magnetic Resonance Imaging (MRI) and Computerised Axial Tomography (CT) These modalities can display renal anatomy, and in the pelvis after surgery may delineate extravasation and associated abscess formation.[19,20] Magnetic resonance imaging is very sensitive in demonstrating established fistula tracts in the more chronic setting, particularly in relation to previous radiotherapy or failed surgical treatment.

Fistulography The insertion of a small Foley catheter or ureteric catheter into a sinus with retrograde injection of water-soluble contrast may be a critical examination when passage of a sound has failed to distinguish between a sinus and a fistula (Fig. 21.11). A complex fistula may show an intervening abscess cavity. This is more relevant to intestinal fistula (see below).

Cystography The principal use of this investigation is in cases of incontinence after Caesarean section, when uterine filling may be demonstrated on a lateral film in some cases of vesico-uterine fistula (Fig. 21.12).[21]

Hysterography When the only indication of a possible vesico-uterine fistula after Caesarean section is cyclical haematuria rather than incontinence, retrograde hysterography may demonstrate filling of the bladder.

Renography This has an important role in establishing split renal function when nephrectomy is being considered as definitive treatment for a large ureteric defect for which reconstruction is difficult.

Fig. 21.11: Barium enema: leak from surgical colovaginal fistula into a pericolic cavity.

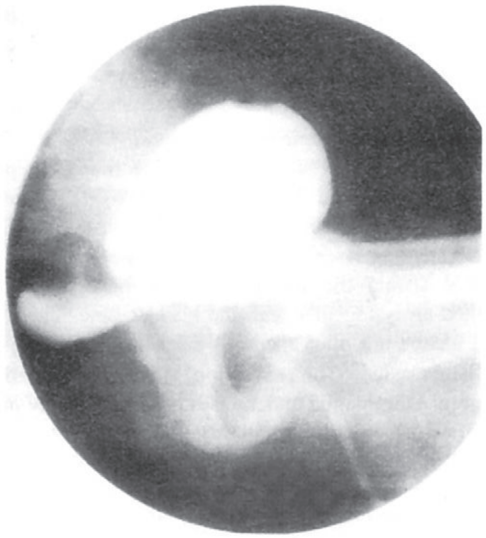

Fig. 21.12: Lateral cystogram; vesico-uterine fistula following Caesarean section.

TREATMENT PLANNING

Once investigation has confirmed both the diagnosis and the location of the fistula, a treatment strategy must be worked out (see Table 21.2).

The following factors need to be taken into consideration:

1. **Tissue condition.** The likelihood of successful closure and tissue healing is critically affected by prior irradiation, concomitant malignant disease, foreign bodies (e.g. calculus), infection, (e.g. schistosomiasis, lymphogranuloma venereum) and gross scarring (such as from prior surgery). Biopsy may be necessary.
2. **Tissue loss.** Obstetric fistula differs from most others in that tissue loss due to sloughing compounds the injury and poses its own problems for closure without tension.[22]

Table 21.2: Classification of vesicovaginal fistula

A. **High fistula** (a) Juxta-cervical (b) Vault (indirect vesico-uterine)
B. **Mid-vaginal fistula**
C. **Low fistula** (a) Juxta-urethral (b) Bladder neck (i) Urethra intact (ii) With urethral involvement – Segmental (partial bladder neck loss) – Circumferential vesico-urethral fistula (complete bladder neck loss)
D. **Urethrovaginal fistula.** A small fistula below the bladder neck does not normally cause incontinence unless the bladder neck is also incompetent. Total urethral loss may accompany C2
E. **Massive vaginal fistula** encompasses all three levels and often includes one or both ureters in addition.

3. **The presence of a double fistula.**
   (a) *Ureteric.* As stated above, with large obstetric fistula or those which are critically situated the terminal ureter may be involved and can indeed discharge into the very edge of the bladder fistula compromising mobilisation and being at risk of inclusion in a suture.

   Renal function may also be compromised and, if bilateral, this can be serious, even life-threatening. Preliminary relief by nephrostomy may be indicated, and, in any event, a plan for dealing with the ureter, either sequentially or simultaneously must be formulated.[23]

   (b) An associated intestinal fistula is important. Somewhat surprisingly this can sometimes be overlooked. A high-rectal fistula may be obscured by a 'horse-shoe'-shaped vaginal stricture so that its presence may not be suspected.

   Both components of a double fistula should only be repaired simultaneously if this can be achieved without tension. A bladder fistula heals better if not contaminated with faeces during recovery. If double repair is not feasible, preliminary loop ileostomy or transverse colostomy should be performed and then it is better to treat the urinary fistula first, as avoidance of suture line tension is essential. A trap for the unwary is the retroverted uterus, where an intestinal fistula can have access to the vagina through the anterior fornix and, if the connection is with small bowel, a faecal smell may be absent.

   In the presence of malignant disease with an offensive purulent discharge the concurrence of an intestinal fistula may be difficult to establish. Imaging and investigation of suspected intestinal fistula are discussed below.
4. **Scar formation.** This is characteristic of severe obstetric injury; where extravasated urine has collected before leakage, and prior unsuccessful surgery.
5. **Inter-current infections and parasite infestation.** They include skin ulceration (urinary excoriation) and urinary tract infection. These must be identified and treated.

Therapeutic Options

Urinary incontinence due to a fistula is a distressing symptom and, in general, only in extreme cases will a 'no-treatment' option be acceptable. This is so because only very occasionally, when other considerations virtually preclude surgery, will catheter drainage for a small high fistula prove to be acceptable or indeed effective. Tamponade and catheter drainage of the vagina itself is not usually successful as there is no balloon catheter made that will prevent the formation of a sump below the exit holes of the catheter. The sump is likely to leak as watertight occlusion of the lower vagina is virtually impossible to achieve. As temporary palliation, the use in the vagina of a sponge tampon, tucked into a length of Paul's tubing draining into a bag, may provide socially acceptable temporary continence. Every movement squeezes a small amount of urine out of the bottom of the sponge, hopefully within the lumen of the Paul's tubing.

'Non-surgical' Interventions

Both electrocautery and laser have been used for destruction of the epithelial lining of a very small fistula.[24] The endoscopic management of small fistulas has shown further promise with the use of new tissue adhesives and bioglues. These treatments, to date, have limited supporting evidence and remain experimental.[25] Unilateral ureteric fistula in the presence of advancing pelvic malignancy may be managed by antegrade intraluminal occlusion[26] and nephrostomy drainage.

SURGICAL TREATMENT

Timing of Intervention

This is one of the areas of greatest controversy in fistula management. Historical wisdom was that surgery should be delayed for a minimum of 3 months to allow the local tissue healing reaction to complete; the theory was that early surgery would be like operating on a sponge with very friable tissue and easy tissue breakdown. However in the situation of a 'surgical complication', the idea of leaving the patient with various drainage devices to control the situation for some months, or indeed incontinent for some months, has always been unsatisfactory. Whilst tissue necrosis, prior irradiation, infection or urinary extravasation all mandate delay before surgery (usually for three months), most re-constructive surgeons would now accept that a clean traumatic simple vesicovaginal fistula or ureteric fistula may be treated almost at once provided it is diagnosed within a week of surgery. Waaldijk[27] favours early suture and catheter drainage of simple fistula of obstetric origin.

Options

1. Surgical closure
2. External diversion
3. Internal diversion

Surgical Closure

Surgical closure is preferred, provided that the state of the tissues gives a reasonable prospect for success and if the compounding effect of two specific adverse factors can be assessed:

(a) **Grossly diminished bladder capacity with low compliance:** Intramural or perivesical fibrosis due to irradiation or inflammation can leave a bladder capacity insufficient to contain the renal output for even 1 hour, so that there is virtually no reservoir. In such cases, augmentation or substitution cystoplasty may be considered, but it has to be remembered that the conditions that have led to gross impairment of bladder volume and compliance may also have seriously compromised bladder neck closing function (see below).

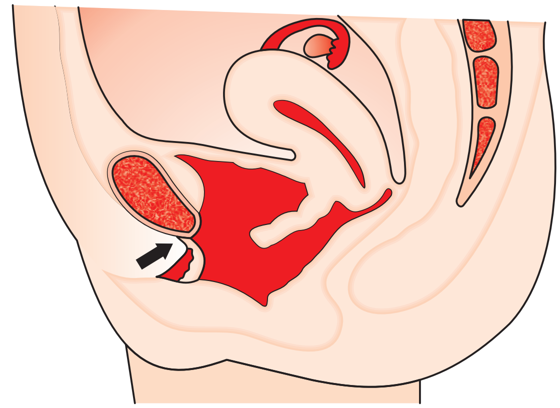

Fig. 21.13: Diagrammatical representation of circumferential bladder neck fistula, showing adhesion to pubic bone and obstruction of the distal urethra.

(b) **Urethrovesical incompetence:** If the bladder neck has been destroyed (circumferential fistula) (Fig. 21.13) or its function disrupted by fibrosis ('pipe-stem' urethra) the woman is likely to be as wet following closure of a vesicovaginal fistula by reason of continuous leakage through an incompetent urethra as she was hitherto through the vaginal fistula. It may be difficult to assess the extent of functional impairment of the bladder neck prior to closure of the vesicovaginal fistula but evidence of adherence to the inferior pubic-rami by a juxta-urethral fistula is highly suggestive.[28]

If incomplete bladder neck destruction is diagnosed (e.g. low obstetric fistula) the surgical treatment plan must include some form of bladder neck reconstruction often involving a pedicled graft[29] or the formation of a neo-urethra (see below). Bladder capacity and urethral function may have been significantly reduced or damaged so that even the successful closure of a fistula may go only part of the way to the relief of distressing symptoms.

External Urinary Diversion

External urinary diversion is certainly preferable to total urinary incontinence (either urethral or extra-urethral) or even to intolerable urinary frequency due to a poorly compliant bladder. The traditional method of external urinary diversion by ileal conduit is illustrated in Figs. 21.14–21.17. The use of an artificial sphincter is of limited application for the maintenance of female continence and must be virtually ruled out after the tissue destruction that has accompanied the formation of vesicovaginal fistula.

The creation of external urinary diversion is a specialist urological procedure, not normally undertaken by a generalist gynaecologist. The performance of such surgery is, however, not the most difficult part, but rather the decision on whether this measure is necessary in the case of major vesicovaginal fistula. The decision on whether urinary diversion is necessary is best taken by a urologist (or gynaecologist), experienced and

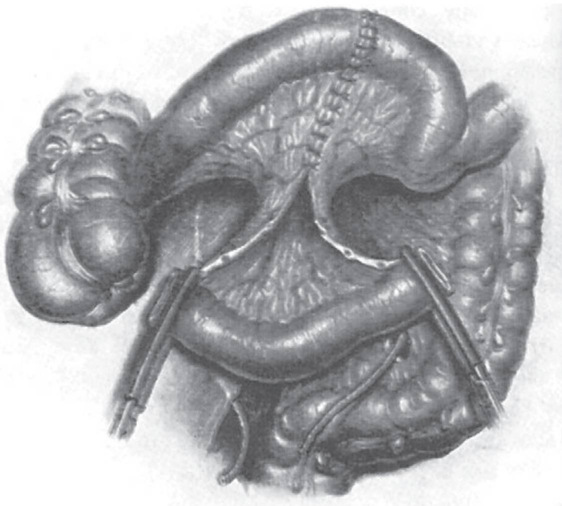

Fig. 21.14: Ileal conduit. End-to-end anastomosis has restored the continuity of the bowel and the mesenteric defect has been closed by interrupted sutures above the isolated loop.

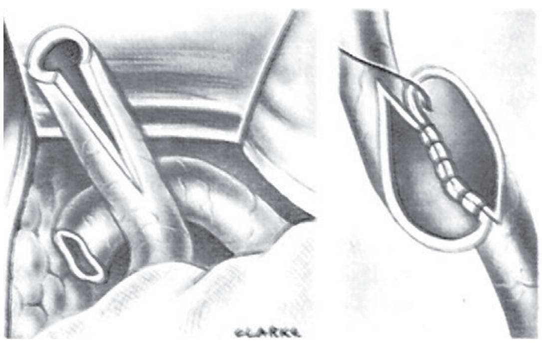

Fig. 21.15: Ileal conduit. The two ureters are spatulated and sewn together to produce a double-barrelled spout. This may be achieved either end-to-end (as shown) or in parallel according to the most satisfactory local anatomical configuration.

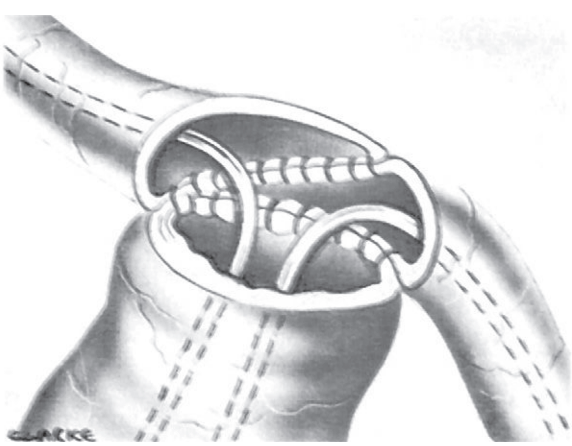

Fig. 21.16: Ileal conduit. The double-barrelled ostium is anastomosed end-to-end to the prepared loop of ileum. It is advisable to leave infant feeding tubes in the ureters for 7–10 days to minimise the risk of leakage and stricture.

skilled in the treatment of fistula who should be well versed in the likelihood of success of conservative and re-constructive fistula repair.

Internal Diversion

This involves urinary diversion into the intact bowel so that the rectum acts as a reservoir with continence under the control of the external anal sphincter. Integrity of the anal sphincter mechanism is a pre-requisite for such a procedure to be considered, as is the absence of an unsuspected rectovaginal fistula. There are broadly two types of internal diversion, namely uretero-intestinal and vesico-intestinal diversion.

(a) **Uretero-sigmoidostomy.** Historically, this was the first type of urinary diversion, carrying with it a significant immediate mortality and long-term morbidity—the latter quite often being life-limiting due to progressive renal destruction and recurrent infection. Nevertheless, in some cultures external urinary diversion is unacceptable and indeed co-incidental economic considerations may mean that collecting apparatus is simply not available.[30] Modern techniques of reflux preventing uretero-intestinal anastomosis (Fig. 21.18) have greatly reduced the complications of ureterocolic anastomosis. Dehiscence, stricture formation and leakage can further be reduced by utilising the retroperitoneal aspect of the rectum for anastomosis rather than the sigmoid loop, access for such a procedure being obtained through an anterior proctotomy. This is, however, not advisable if the rectum itself has been involved by the underlying pelvic condition (e.g. prior sepsis or irradiation). If the terminal ureters have been irradiated their viability after mobilisation for anastomosis must be regarded as questionable. The surgical technique is as described for uretero-neocystostomy.

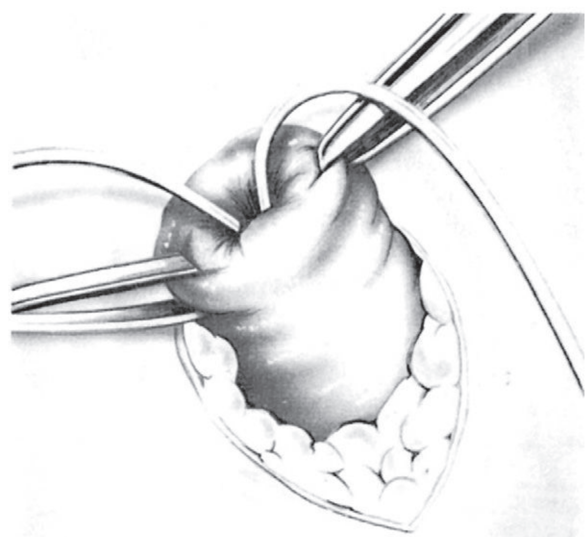

Fig. 21.17: Ileal conduit. The cutaneous ileostomy is brought out through a previously marked skin trephine. The distal end of the ileum is turned back over itself to produce a spout that may then be carefully tacked to the skin edge.

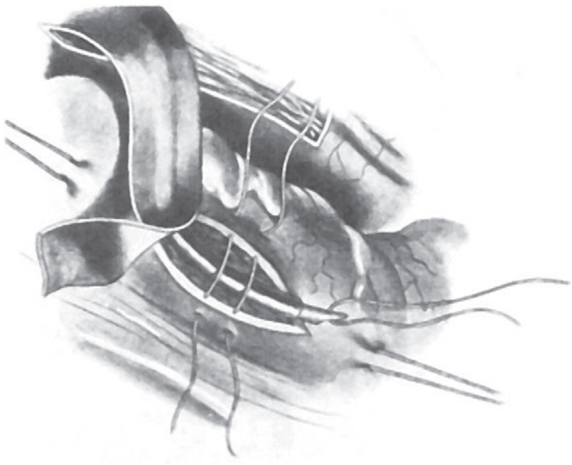

Fig. 21.18: Ureterosigmoidostomy. An incision in the seromuscular coat of the colon will enable a sub-mucous tunnel to be constructed. It is important that there should be sufficient room for the ureter to lie without constriction after the sutures have been inserted (after Leadbetter).

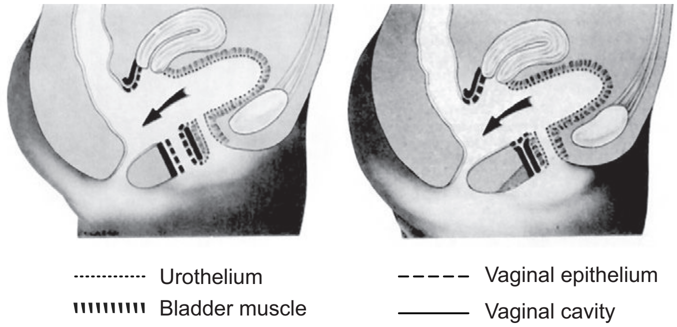

Fig. 21.19: Double fistula: vesicovaginal and rectovaginal. Diagrams of large post-irradiation fistula of the bladder and rectum into the vagina, before and after partial colpocleisis (note the gravity drainage of the bladder into the rectum) (after Blaikley).

(b) **Colpocleisis.** Internal urinary intestinal diversion may be achieved by colpocleisis in the presence of a double fistula (e.g. vesicovaginal and rectovaginal fistula). Colpocleisis is a procedure that is sometimes overlooked in the consideration of management options for otherwise inoperable vaginal fistula.[31] The technique and details of colpocleisis are discussed herewith.

Lower partial colpocleisis [in which the dead space may also have been filled by extrinsic tissue from the thigh (gracilis muscle) or vulva (bulbospongiosus graft)] will prevent vaginal leakage but permit discharge of urine from the bladder into the rectum through the resultant vesicorectal fistula. It is important that there should be free-dependent drainage from the bladder into the rectum itself otherwise bowel contents are likely to flow in the reverse direction (Fig. 21.19).

It is particularly important, therefore, to establish that the faecal fistula is not colonic. A colonic fistula into the posterior vaginal fornix is commonly associated with kinking and stricture of the distal rectosigmoid. Rectal fenestration, or end-to-side vaginorectal anastomosis, may be required.

CONSERVATIVE SURGERY

Once the above considerations have been addressed and the feasibility of conservative surgery determined, the questions of route and type of operation need to be resolved. Figure 21.20 illustrates some of the instruments suitable for fistula surgery—in particular the bistoury-bladed knife and the angled scissors.

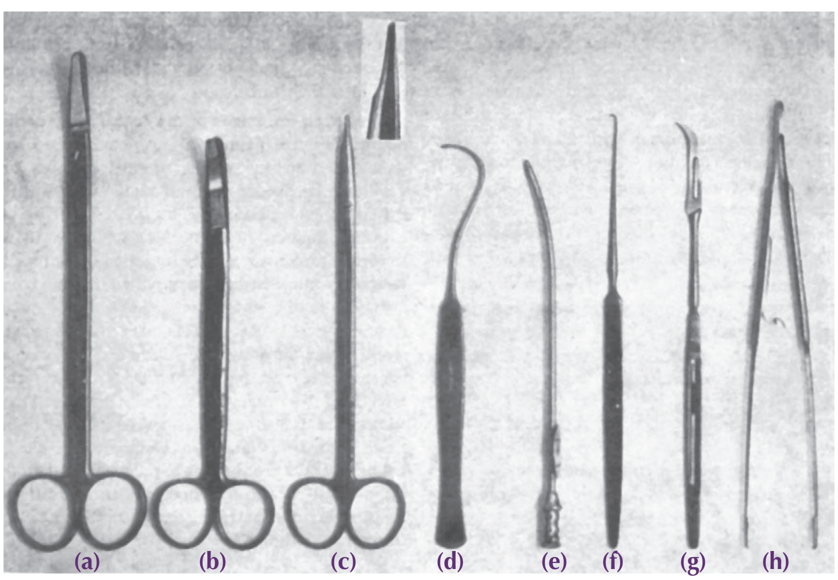

Fig. 21.20: Operations for genital fistula. Some instruments suitable for fistula repair: **(a)** Bonney's flat and angled scissors. **(b)** Right-angled scissors. **(c)** Milteck scissors (see inset). **(d)** Straight aneurysm needle. **(e)** Neuro-surgical sucker. **(f)** Nerve hook. **(g)** Bistoury-bladed knife. **(h)** Locking (cleft palate) forceps.

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In general, a **low (urethral and juxta-urethral) fistula** can only be treated by a vaginal approach as it is hidden from the view of an abdominal operator by the arch of the inferior pubic rami. Under such circumstances access using the face-down or 'jack-knife' position may be preferred. The alternative is to use a very steep Trendelenburg position.

If **circumferential loss of the bladder neck** has occurred and the anterior vesical wall is adherent to the back of the symphysis pubis (see Fig. 21.13) a combined abdominovaginal approach may be desirable in which case the lithotomy Trendelenburg position is mandatory (see below). In nearly all such cases the use of a Martius (bulbospongiosus) graft is required.

For **mid-vaginal fistula** (both vesical and rectal) a transvaginal approach is generally favoured by gynaecologists, although many urologists will prefer a suprapubic transvesical approach for a vesicovaginal fistula, which may be attractive if there is close proximity to a ureter. Rectal surgeons tend to favour a transperineal approach for a rectovaginal fistula.

For a **high vaginal fistula** (either into the vault after hysterectomy or in a juxta-cervical position) the surgeon should be prepared to use either the abdominal or the vaginal approach according to access and other intra-abdominal considerations. If the vagina is narrow and the uterus or vault is fixed high in the pelvis, the vaginal route should be avoided, unless, in the absence of the uterus, a major upper partial colpocleisis is to be utilised. This option should always be considered whenever subsequent coital function is unimportant.

Technique

Flap repairs are suitable for most cases of mid-vaginal fistula (rectal and vesical).

(a) *Exposure.* Relaxing incisions to bands and sometimes introital enlargement by episiotomy or Schuchardt's incision may be required. Exposure by adjacent traction sutures may be preferable to the application of tenaculum forceps. For a rectal fistula the rectum may be elevated by a finger in the rectum. For a small bladder fistula the insertion of a small Fogarty balloon can be useful if space is limited. Injection of a dilute solution (1:400,000) adrenaline in saline is helpful.

(b) *Incision.* The fistula margin is incised until clear of scar tissue in the para-vaginal space (Fig. 21.21). Care should be taken to avoid 'buttonholing' the bladder or rectum. Sufficient flap should be elevated to allow closure of the underlying viscus without tension. Scar tissue must be trimmed preserving as much as possible of the adjacent visceral wall. If a ureter is discharging into the fistula edge, the vaginal incision should skirt this sufficiently widely for vaginal skin to be turned over to protect the ureter.

(c) *Closure.* Interrupted Lembert sutures (00 polyglactin) are used. The line of closure should be that which apposes the edges most easily. Usually this is transverse except for a fistula in the region of the bladder neck or anal sphincters for which a vertical closure may be preferred (Fig. 21.22). A second layer of interrupted sutures should be inserted in the visceral wall (Fig. 21.23).

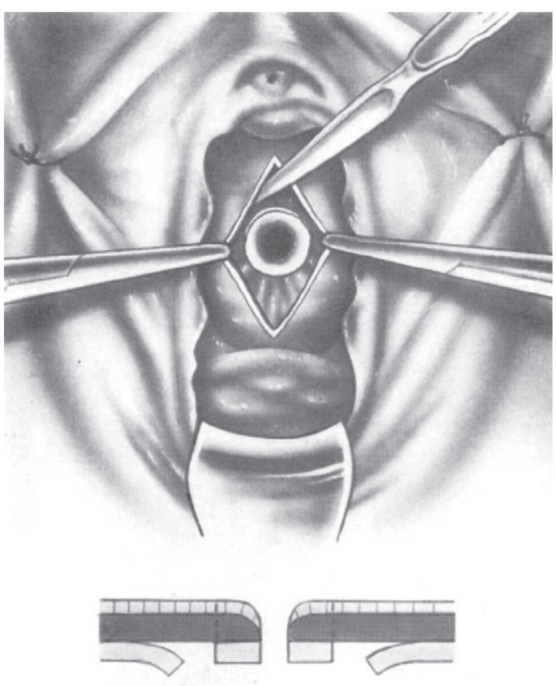

Fig. 21.21: Mid-vaginal fistula: flaps of vaginal wall are raised clear of scar tissue to allow closure without tension. Scar tissue around the fistula should be excised.

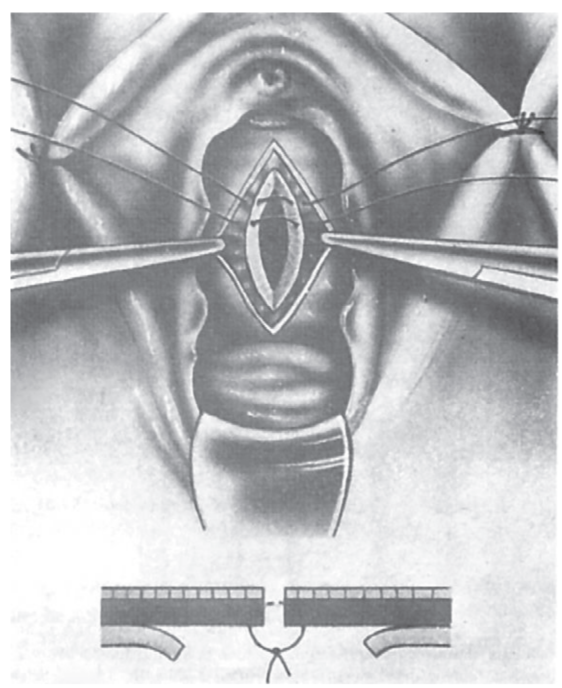

Fig. 21.22: Mid-vaginal fistula: bladder wall closed excluding urothelium.

For a bladder fistula these sutures should preferably pick up the deep aspect of the vagina to reduce tension and help to eliminate dead space in which a haematoma could form.

For an anorectal fistula the second layer of sutures should reconstitute the longitudinal and circular smooth muscle of the bowel wall.

The vagina is normally closed with similar polyglactin mattress sutures (Fig. 21.24). If nylon sutures are used in the vagina they should be removed at 21 days. Under no circumstances should non-absorbable sutures be left in close proximity to the bladder because of the risk of sinus and stone formation.

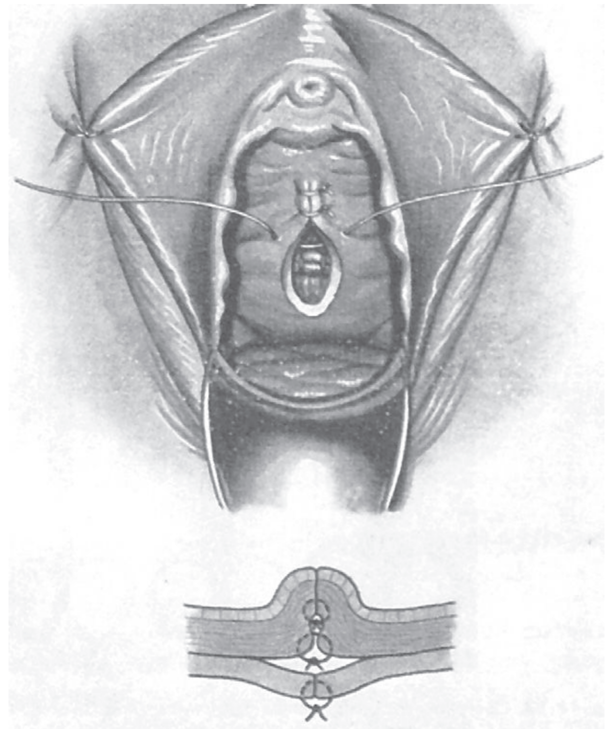

Fig. 21.24: Mid-vaginal fistula: closure of the vaginal wall.

Saucerisation: The original Marion Sims' technique may be used for a very small fistula, particularly for residual fistula after previous surgery. A bevelled cut through the vagina to the small visceral aperture should clear scar tissue to allow healthy tissues for apposition (Fig. 21.25). It is as well to remember that with a small residual fistula there may be more than one track.

Inversion and purse-string suture may also be used for a small fistula (Fig. 21.26). When used for a vesicovaginal fistula the purse-string should be removed once interrupted sutures have been placed.

A test of closure, using methylene blue or indigo-carmine, should be performed after closure of the viscus and before closing the vagina.

Postoperative Care

Catheter drainage should be maintained for a minimum of 10–14 days. Leakage, if it is going to occur, is usually around

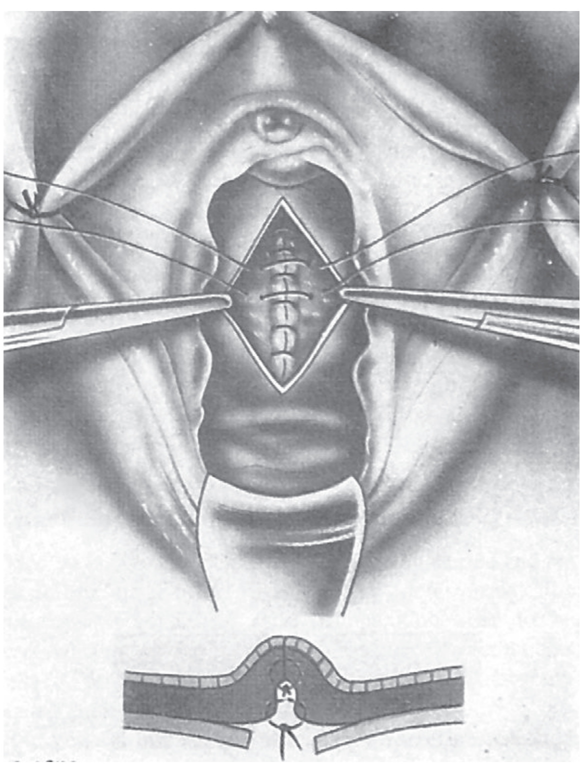

Fig. 21.23: Mid-vaginal fistula: inverting layer of Lembert sutures, obliterating, where possible, dead space.

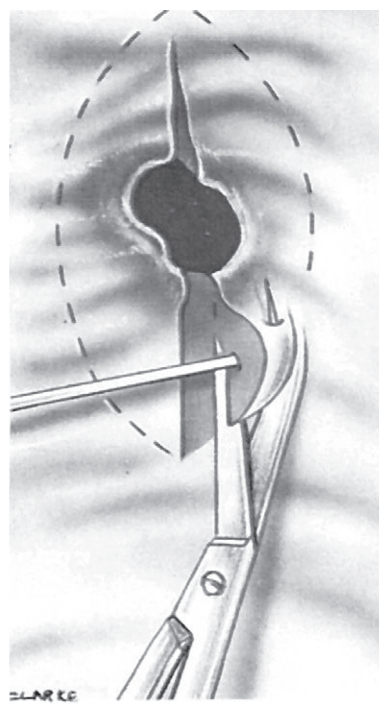

Fig. 21.25: Vesicovaginal fistula, saucerisation. An incision is made well above and well below the fistula. The vaginal wall is excised in a broad, bevelled cut down to, but not including, the bladder urothelium. All fibrous tissue is excised. A slight undercutting of the vaginal edge is sometimes preferable to wide excision (after Moir 1947).

7–10 days. If leakage occurs while the catheter is in place there is little point in maintaining drainage. If, however, leakage only occurs after removal of the catheter a further period of drainage may allow healing.

Choice of catheter: A Foley catheter is adequate except for a low vesicovaginal fistula or urethrovesical fistula repair, as in such cases the balloon will rest against the suture line. As an alternative, in the case of a low vesicovaginal fistula a 'double-wing' Malecot catheter or a catheter anchored using a suture through the abdominal wall and secured with a 'button' are options, but otherwise (and certainly for urethrovesical fistula) suprapubic catheterisation is preferable. Placement of the suprapubic catheter should be under cystoscopic control or using a Hey-Groves urethral sound to avoid extreme bladder distension and tension on a fresh suture line. The catheter should be at least 16 French as small catheters are easily blocked by blood clot with resulting retention and tension on a fresh suture line with a risk of disruption.

Exclusion of the urothelium from the actual suture line diminishes the risk of haematuria, but in some repairs haematuria is unavoidable. In such cases a combination of suprapubic and urethral drainage is preferred. The latter is preferably a Jacques or McCarthy 'whistletip' catheter, which will facilitate the evacuation of any clots that may form.

Gentle irrigation should be continued until the efflux is clear. Early diuresis, if necessary with frusemide or similar agent, is desirable. Catheter drainage should be into a closed system in which the hourly output can be measured and siphoned off.

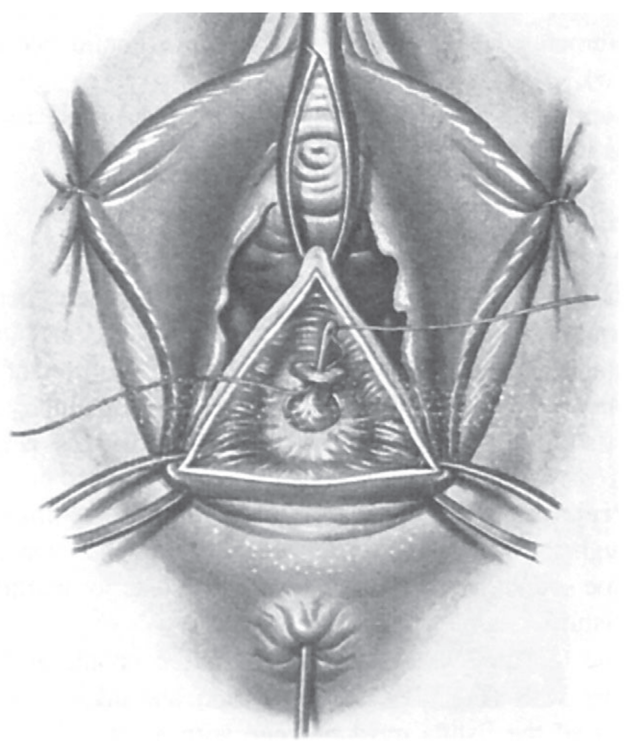

Fig. 21.26: Inversion of fistula. A small fistula tract is inverted through a purse-string using a probe (after Lawson 1967).

Nursing care: Meticulous recording of urinary output every hour while the catheter is in place, with instruction to seek assistance if it ever drops for more than an hour, is the only way to avoid obstruction leading to retention, which could cause dehiscence of the repair in the postoperative period. However, in this era of short-stay surgery it is unlikely the patient will be kept in hospital for the full period of catheterisation. If discharged with a catheter in situ, the patient should be advised to monitor her own output with clear instructions who to contact in the event of a catheter blockage. Some surgeons advocate the use of a 'covering' suprapubic catheter left on free drainage, to reduce the incidence of wound dehiscence if the urethral catheter blocks off.

Subsequent care: Catheter drainage should be maintained for at least 10 days, often longer. A test of closure, some 3 weeks from operation, with coloured dye should be carried out in complex fistula or if there is a concern about the integrity of a fistula repair. This should be performed in the lithotomy position with very careful inspection. Bladder capacity is almost certain to be reduced and early leak around the catheter may ensue, causing diagnostic confusion.

Sexual intercourse should be avoided until healing is complete and is unwise if vaginal stricture formation has occurred.

Special Situations

BLADDER NECK (JUXTA-URETHRAL) FISTULA

In bladder neck fistula, the aperture is often transverse with the corners firmly adherent to the back of the pubic bone. The distal urethral stump may be quite short. The incision should circumcise the fistula with a distal vertical tail over the proximal end of the urethral stump (racquet-handle). The corners of such a fistula must be separated by sharp dissection from the bone and mobilisation must be complete otherwise there will be no chance of refashioning an internal urethral meatus with a bore comparable to that of the residual urethral stump. A pedicled graft (see below) may aid subsequent continence (Figs. 21.27 and 21.28).

CIRCUMFERENTIAL FISTULA (SEE FIG. 21.13)

If there is circumferential loss with the anterior bladder wall completely adherent to the body of the pubis, a synchronous abdominovaginal approach may be the most successful.[32] The bladder must be completely freed from the bone and if necessary an advancement flap of anterior bladder wall fashioned.

In all such cases a pedicled graft is strongly recommended as an aid to postoperative continence (see below).

Suprapubic catheterisation (in preference to urethral catheterisation) is strongly recommended for all fistula cases involving the bladder neck (see above).

HIGH (JUXTA-CERVICAL) FISTULA

High fistula may be repaired by the vaginal route if there is reasonable access and some cervical descent. Quite commonly the anterior lip of the vaginal portion of the cervix has been

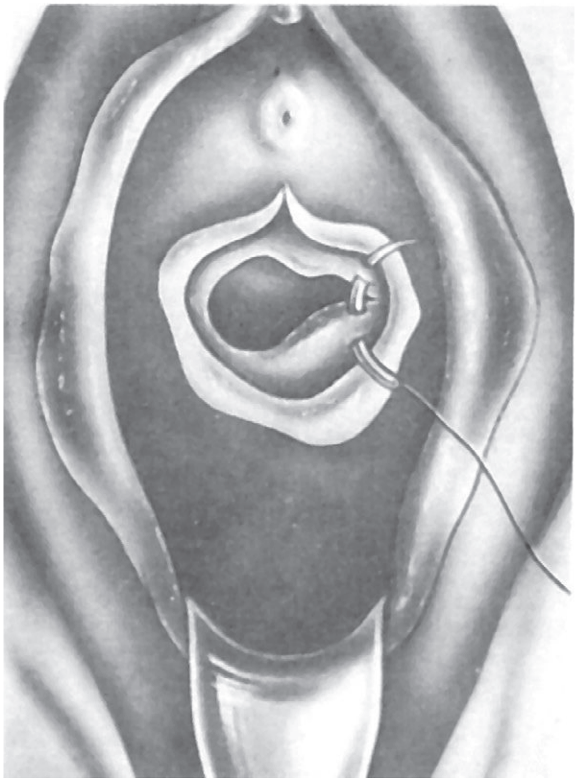

Fig. 21.27: Bladder-neck (juxta-urethral) fistula in prone position: the corners of the fistula may be adherent to bone (after Lawson, 1967).

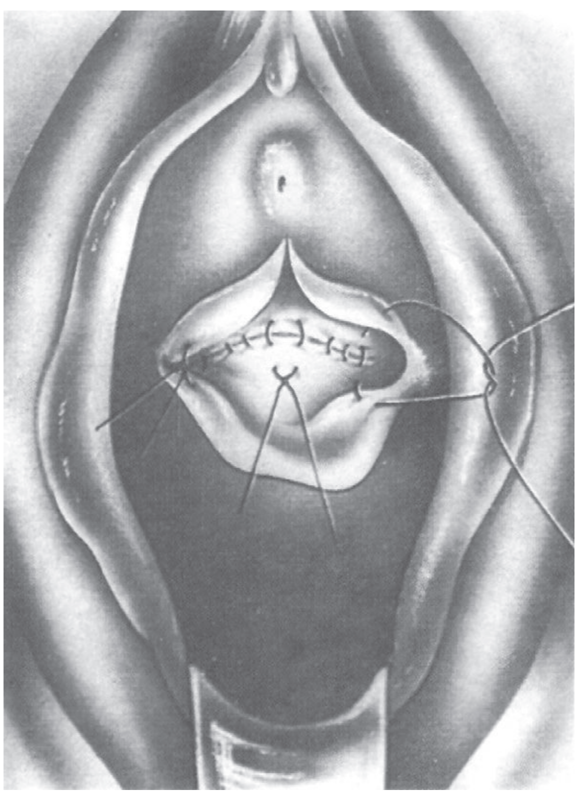

Fig. 21.28: Bladder neck fistula: the bladder aperture has been reduced to fit the urethral stump, with an additional fixation suture and space for a Martius graft (after Lawson 1967).

destroyed in the obstetric slough injury and the fistula may more correctly be described as vesico-cervico-vaginal.

Preparation: Traction sutures should be inserted through the residual posterior cervical lip. Insertion of a uterine sound may help to delineate the posterior margin of the fistula.

The incision will be triangular, based on the anterior uterine wall (Fig. 21.29). Dissection around the lateral angles of the fistula must proceed with great care as it is easy to get into the wrong layer and extend the bladder aperture cranially. The wall between the cervix and the bladder at this level may consist only of scar tissue (Fig. 21.30).

Closure: The bladder closure should be horizontal and preferably rolled against the anterior uterine wall (Fig. 21.31).

VAULT FISTULA

In the developed world, vesicovaginal fistula after hysterectomy is probably the most common presentation. Although urologists may prefer to treat such a fistula by an abdominal approach, many are accessible and treatable vaginally.[33]

Upper Partial Colpocleisis (after Latzko)

Preparation: If there has been an 'urinoma' or a pelvic abscess, all pelvic inflammation must be allowed to subside before reparative surgery is undertaken. The differential diagnosis

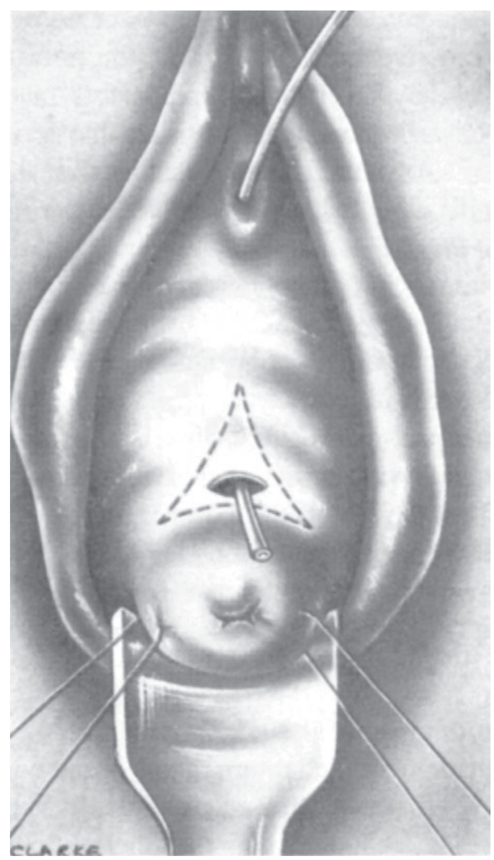

Fig. 21.29: High juxta-cervical fistula: incision to allow access to the vesicocervical space (after Lawson 1967).

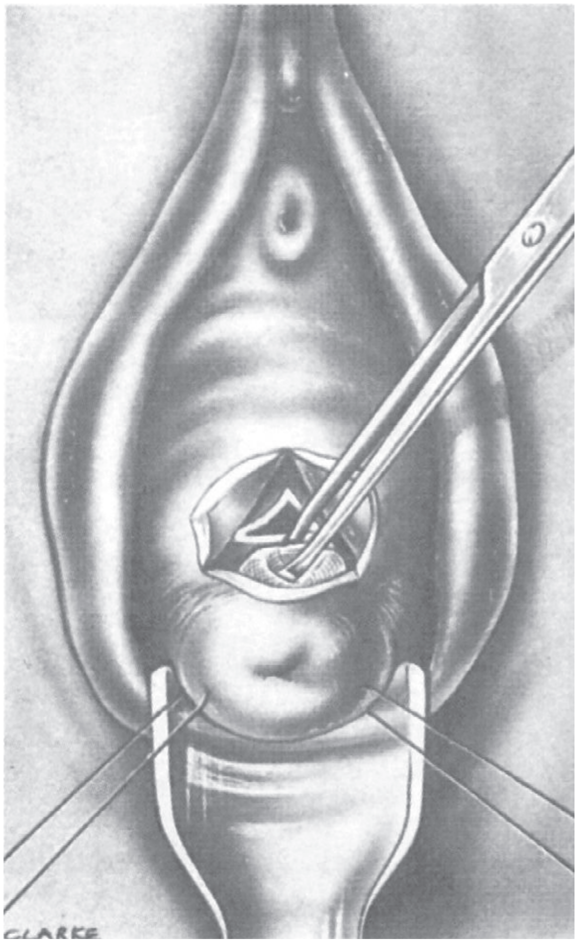

Fig. 21.30: High fistula: the vaginal wall has been freed; part of the cervix as well as bladder wall may have been lost, so that posteriorly there may be a bar of scar tissue.

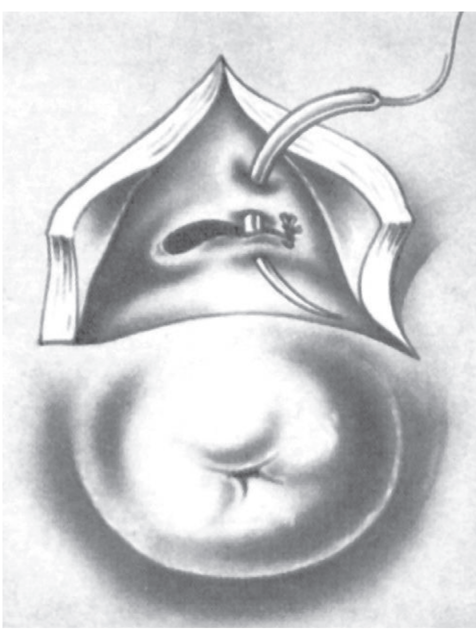

Fig. 21.31: High fistula: the bladder wall has been closed and rolled against the uterine isthmus (after Lawson 1967).

from ureterovaginal fistula must be secure and indeed the concurrence of both must not be overlooked. Cystoscopy with the fistula occluded by a finger may help to establish the relationship to the ureteric orifices.

Technique: The technique is similar to that of flap repair, except that mobilisation is extended to include the upper centimetre of the vaginal vault, which is removed as a cylinder allowing the bladder to be closed horizontally in two layers, with the vaginal vault also closed transversely below the bladder repair (Figs. 21.32 and 21.33).

Postoperative care: This is as for juxta-cervical fistula with Foley catheter drainage.

MASSIVE FISTULA

Prolapse of the bladder through such a fistula is quite common. For these cases, examination under anaesthesia in the prone position is most helpful. The ureteric orifices will probably be found in the fistula wall, the intramural portions of the ureters having sloughed with the original injury.

Ureteric catheters should be passed before commencing repair.

Occasionally, tension on the ureter will prevent closure of a very large bladder fistula, and the ureter may then have to be divided and re-implanted as a separate procedure. Prior intravenous urography is, of course, essential to delineate upper tract damage. If there is a serious shortage of vaginal skin, a full thickness skin flap may be left attached to a Martius graft.

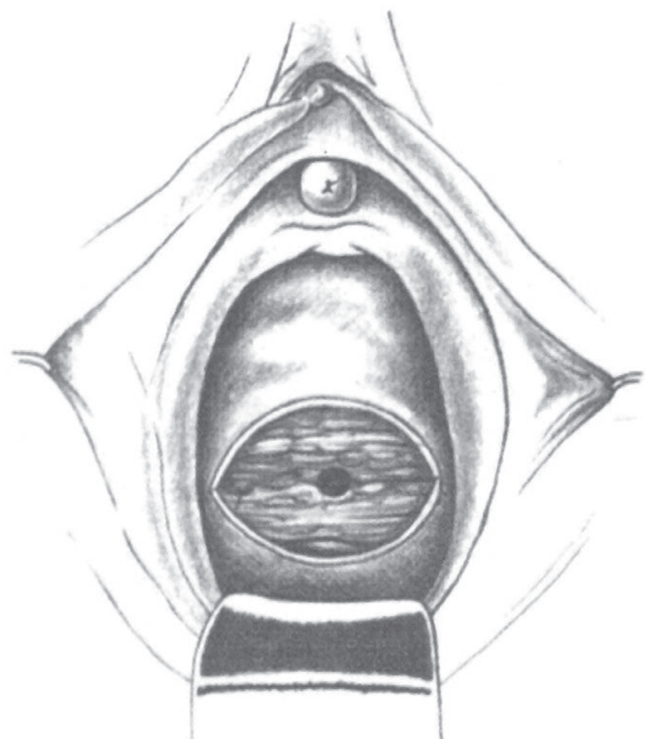

Fig. 21.32: Vault fistula: upper partial colpocleisis: after excision of a cylinder of vaginal vault the bladder wall defect is closed. It may be helpful to open the peritoneal cavity to reduce tension (after Latzko).

IRRADIATION FISTULA

Use of standard surgical procedures is almost always doomed to failure in such cases. Dissection in close proximity to irradiated tissue may lead to the unwelcome sequel of an additional fistula. This type of fistula is best repaired by the vaginal route with minimal local dissection and often with additional introduction of tissue with a fresh blood supply from outside the irradiated field. Although total colpocleisis (removal of the entire vaginal epithelium) can sometimes be utilised, the most appropriate procedure is usually lower partial colpocleisis. In the presence of anything other than a very small fistula, the upper vagina is converted into a diverticulum of the bladder, the fistula aperture being filled effectively by the full thickness of the opposite wall of the vagina.

Technique: A circumferential incision around the vagina is made below the level of the fistula in healthy tissue. Sufficient dissection of the upper sleeve is made to enable this to be closed with two layers of interrupted polyglactin sutures. The distal sleeve of vagina is then dissected and partly removed leaving sufficient flaps for the residual vagina to be closed just cranial to the external meatus (Fig. 21.34). The dead space is either closed by serial rows of sutures or preferably by interposition of a pedicle graft (see below).

PEDICLE GRAFT INTERPOSITION

(a) Bulbospongiosus fat pad. A vertical incision is made over the labium majus based posteriorly at the level of the posterior vaginal wall. Sub-cutaneous dissection (Fig. 21.35) enables a pedicle of fat, possibly also containing part of the bulbospongiosus muscle, to be mobilised on a posterior base. The blood supply is sufficiently good to permit an anteriorly based pedicle if desired.[10]

Dissection is made laterally from the dead space created by the removal of the sleeve of vagina. This tunnel must traverse the perineal membrane to communicate with the

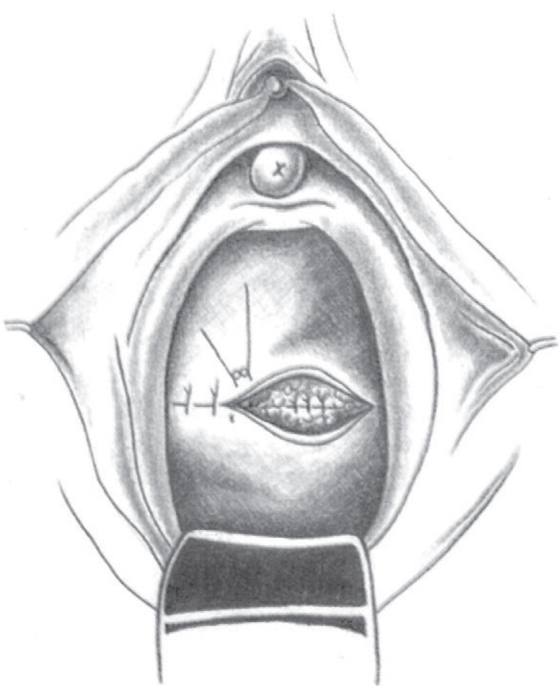

Fig. 21.33: Vault fistula: the wound is closed in layers (after Latzko).

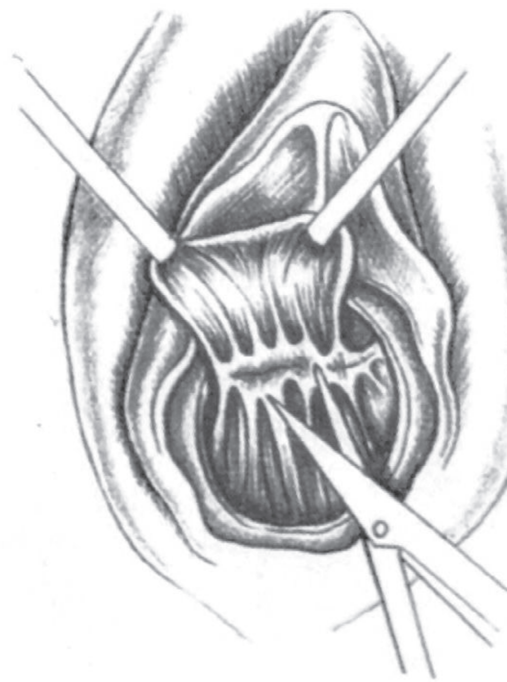

Fig. 21.34: Lower partial colpocleisis: excision of the distal vaginal sleeve.

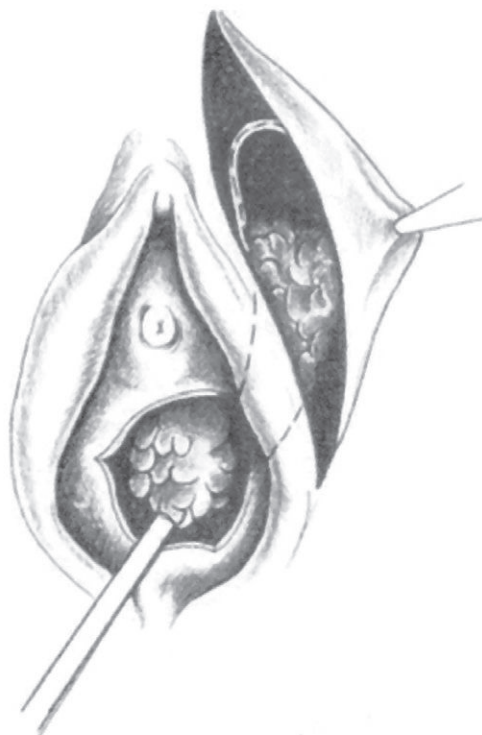

Fig. 21.35: Lower partial colpocleisis: mobilisation of a posteriorly based fat-pad pedicled graft (after Martius).

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sub-cutaneous tissue plane of the vulva, the tunnel being dilated with Hegar dilators to a size sufficient to transmit the fat pedicle without constriction.

A stay suture is inserted at the end of the graft, which is drawn through the tunnel and the graft stitched in place in the dead space beneath the bladder neck and urethra. The distal vaginal remnant is then closed (Fig. 21.36). Suction drainage through a separate stab incision above the groin passing down to the tunnel is advised. Leakage from the upper vaginal 'diverticulum' may occur through this drainage site, but does not usually persist.

(b) **Gracilis muscle graft** (Fig. 21.37). The gracilis muscle may be separated from its distal attachment on the medial aspect of the knee and folded up subcutaneously from the level of the superior perforating branch of the deep femoral artery. This is its main arterial supply at a level approximately one third the distance between the hip and the knee.[34]

Technique: The distal tendon of the gracilis muscle is divided as close to the knee as possible and doubled back on itself sub-cutaneously. It is necessary to divide the deep fascia carefully and identify one or more small perforating arteries two-thirds of the distance between the adductor tubercle and the knee (in 10% of cases, this is the main blood supply) and finally isolate the main neurovascular supply to the muscle in the upper part of the thigh that emerges adjacent to the adductor longus muscle (Fig. 21.38). A sub-cutaneous tunnel is developed as far as the labium majus with perforation or division of the deep fascia. At this point it is easier to make another incision, draw the muscle through and from there develop a tunnel through the perineal membrane to the site of the fistula (Fig. 21.39). A stay suture through the tendinous part of the gracilis muscle is drawn through and used to fix the tendon in the dead space beneath the closed off upper compartment of the vagina (Fig. 21.40). It is important to fix the muscle securely as intermittent contraction could withdraw this muscle into the thigh, if it were left unattached.

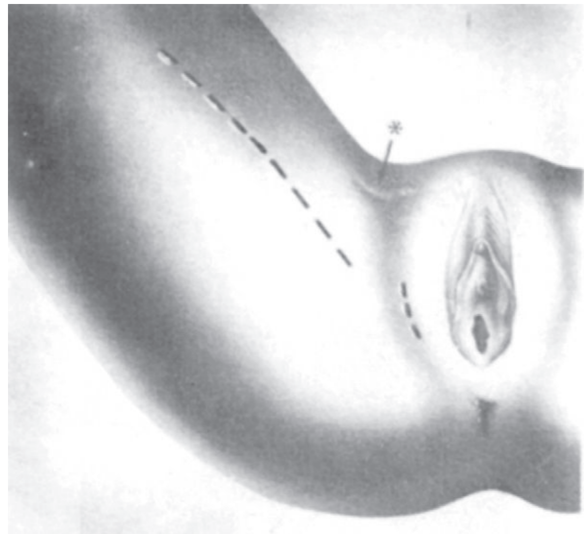

Fig. 21.37: Vesicovaginal fistula: gracilis muscle graft. The surface marking and incisions to be used for mobilisation of the gracilis muscle are indicated. The adductor tubercle is a most useful landmark.

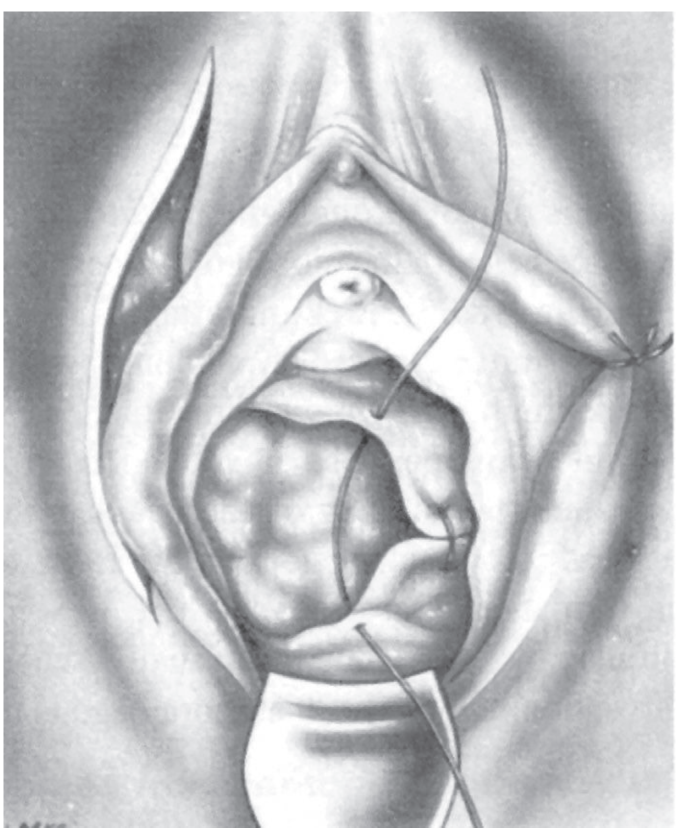

Fig. 21.36: Lower partial colpocleisis: after fixation of the graft the distal vaginal remnant is closed.

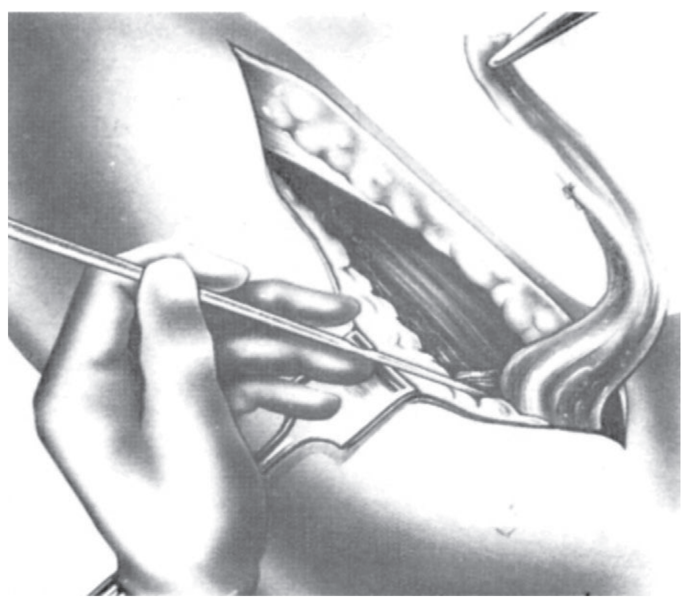

Fig. 21.38: Vesico-vaginal fistula: gracilis muscle graft. Elevation of the gracilis muscle—the probe points to the superior vascular pedicle.

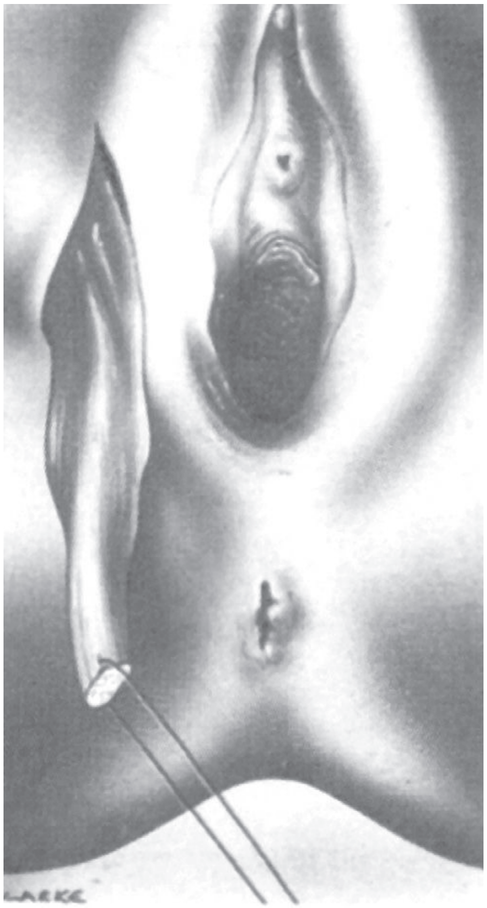

Fig. 21.39: Vesicovaginal fistula: gracilis muscle graft. The mobilised gracilis muscle is drawn through the groin incision.

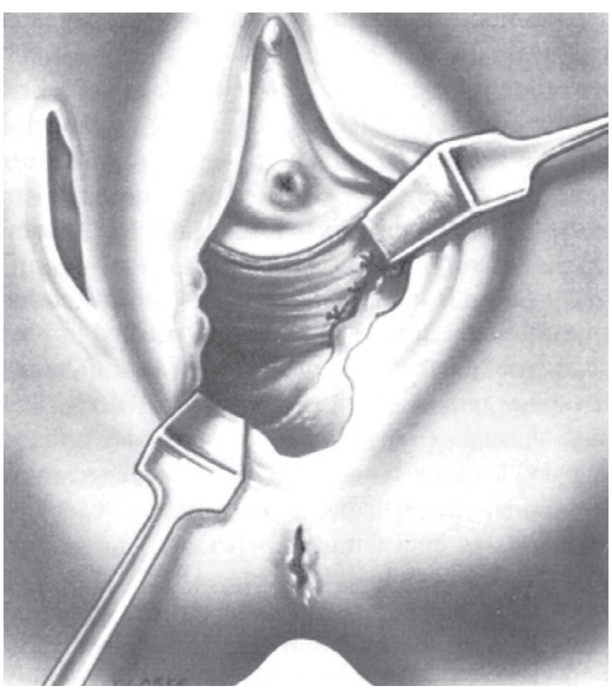

Fig. 21.40: Vesicovaginal fistula: gracilis muscle graft. The muscle is pulled through the tunnel and stitched in place.

Closure and drainage: A small suction drain is inserted through a separate stab in the groin and passed through into the fistula dead space alongside the muscle to prevent haematoma formation. Occasionally there is some urinary leakage through the drain but this usually settles without further intervention. Urethral catheter drainage is maintained for at least 14 days (Fig. 21.41).

Abdominal Repairs

VESICAL FISTULA

The abdominal approach, often preferred by urologists, is suitable, indeed essential, in certain cases. There are three alternative procedures:

Transvesical (Extra-Peritoneal) Repair

The bladder is opened extra-peritoneally by a standard retropubic cystotomy approach. The fistula may be elevated by the insertion of a tight intravaginal pack and further steadied by the insertion of a surgical hook. The remainder of the surgical procedure is exactly similar to that employed for a vaginal approach (Fig. 21.42) with circumcision of the fistula, excision of scar tissue and closure in layers. It may be necessary to insert a ureteric catheter to avoid inclusion of the intramural ureter if this is at risk.

Closure (Figs. 21.43–21.45). When operating through the bladder a continuous suture to the urothelium is acceptable.

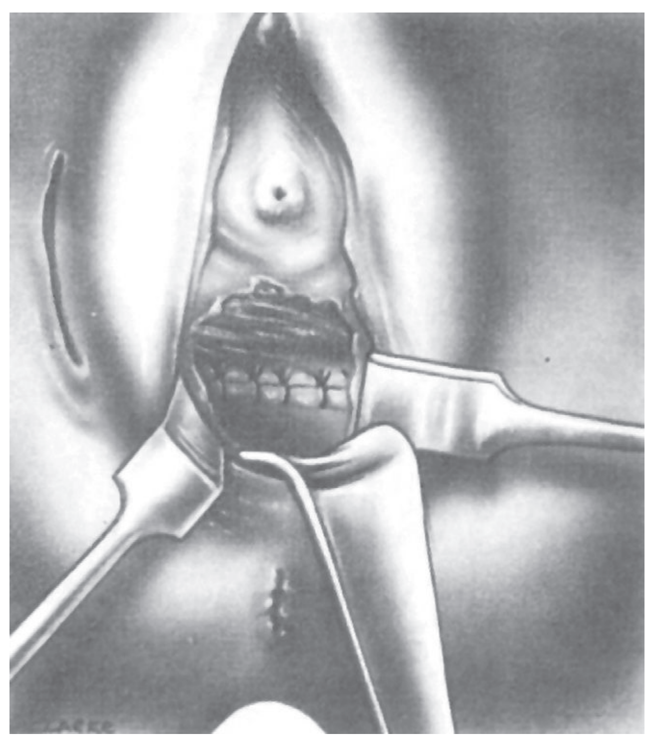

Fig. 21.41: Vesicovaginal fistula: gracilis muscle graft. The vaginal vault is closed.

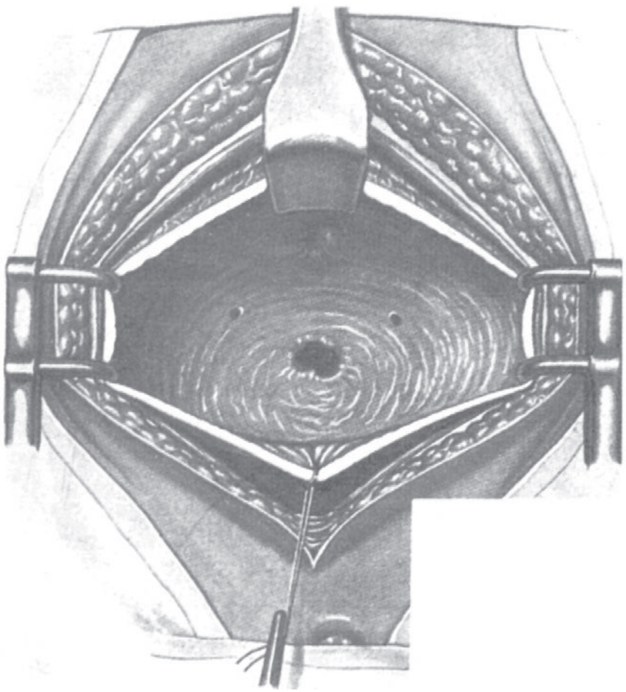

Fig. 21.42: High (vault) fistula: transvesical (retropubic) repair; anterior cystotomy.

This is rather more haemostatic, and it is important to avoid clot retention after surgery. Polyglactin sutures are used throughout both for the closure of the fistula and for closure of the cystotomy. Suprapubic drainage as well as urethral drainage should be established. Drainage should be maintained for 10–14 days.

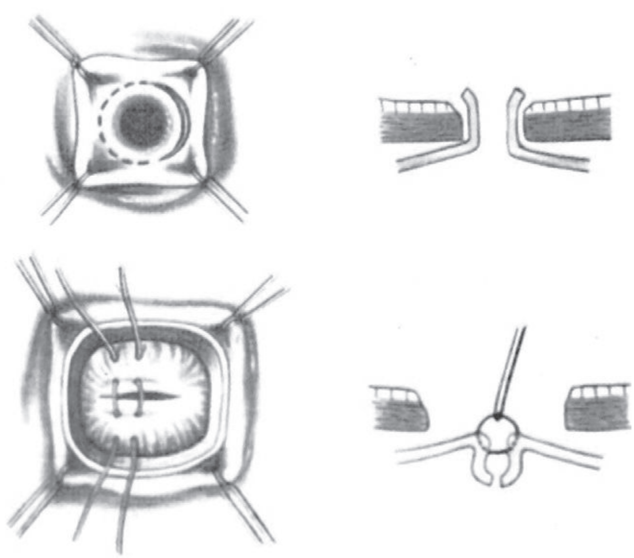

Fig. 21.43: High fistula: transvesical repair; elevation and dissection of the fistula; closure of the vagina.

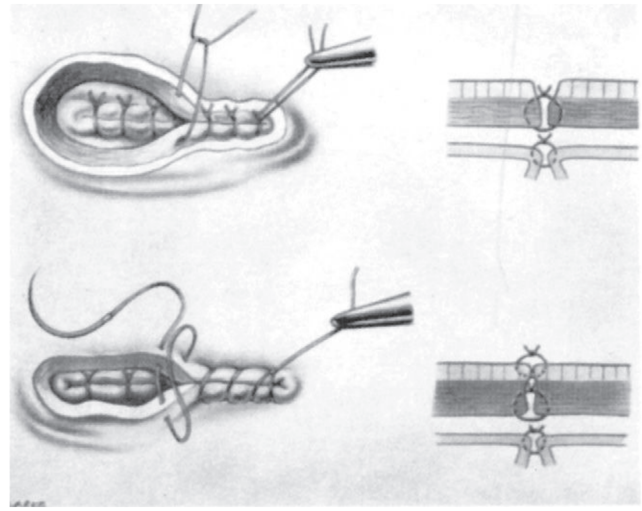

Fig. 21.44: High fistula: transvesical repair; closure in layers, using a continuous suture for the urothelium.

Transperitoneal Repair

In this technique the peritoneal cavity is opened and the plane between the bladder and vagina entered to expose the fistula track. In the presence of adhesions this route is not to be recommended as there is significant risk of further damage to the bladder outside the fistula when the anatomy is grossly distorted. This approach, however, can be combined with hysterectomy if appropriate (see vesico-uterine fistula) (Fig. 21.45).

Combined Transperitoneal Transvesical Approach (Swift-Joly)

This is probably the easiest technique to apply for a relatively straightforward post-hysterectomy fistula. The bladder is opened in the mid-line at the vault and bivalved in the median

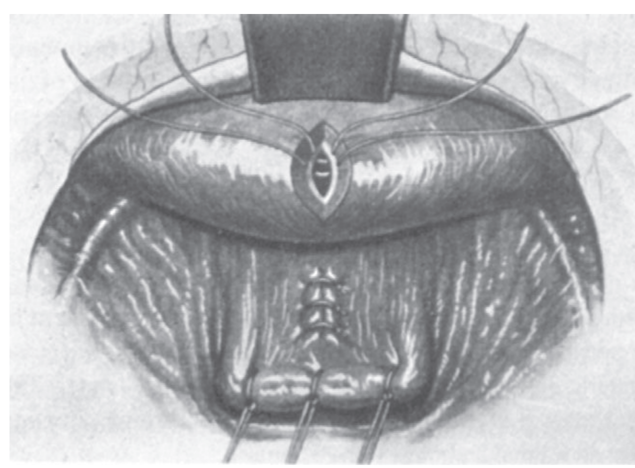

Fig. 21.45: Vesicovaginal fistula: transperitoneal repair. If the case is favourable the bladder may be closed without a cystotomy. If, however, mobilisation of the bladder is difficult a cystotomy should be performed.

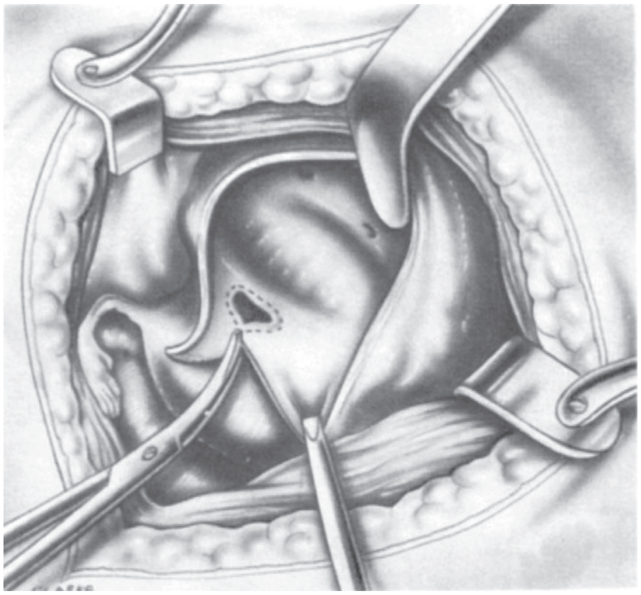

Fig. 21.46: Vesicovaginal fistula-transabdominal repair. Median cystotomy exposing a high fistula that will be excised (after Swift-Joly).

plane to the site of the fistula, which is then circumcised ('racquet handle' incision) (Fig. 21.46).[35]

The freshly incised bladder incision is then closed with two layers of polyglactin sutures and kept as separate as possible from the vaginal aperture (which need not of necessity to be closed). Suprapubic and transurethral drainage is maintained as above.

Omental Pedicle Interposition[36]

For a difficult fistula, particularly one in which there has been prior irradiation, interposition of a pedicled omental graft is to be recommended as a source of fresh blood supply and tissue. Even a relatively sparse omentum can be mobilised by careful dissection from its attachment to the transverse colon. The left gastro-epiploic artery is divided, together with short communicating vessels to the stomach, to allow mobilisation of the gastro-epiploic arcade based on the right gastro-epiploic artery (Fig. 21.47).

URETERIC FISTULA

In the acute phase ureteric 'stenting' should be attempted either antegradely via percutaneous nephrostomy or retrogradely, the latter with or without ureteroscopy. If a stent is successfully placed and left in situ for 4–6 weeks, this may be the only treatment required for a small ureteric fistula. The surgical management of ureteric fistula uses the techniques utilised for acute ureteric injury or deliberate resection.[37] In addition, in the chronic situation, two additional techniques may be used:

(a) Auto-transplantation
(b) Intestinal substitutions (including use of the vermiform appendix)

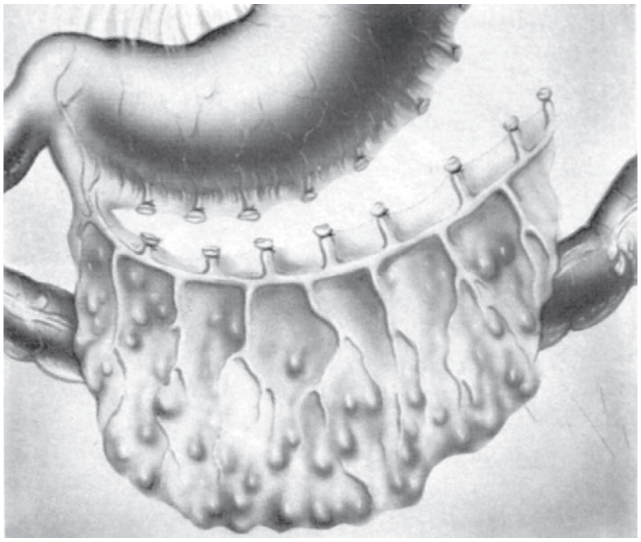

Fig. 21.47: Vesicovaginal fistula: transperitoneal repair using pedicled omental graft. Sufficient greater omentum can usually be mobilised to reach the pelvis if it can be detached from the anterior surface of the transverse colon and then separated in the supracolic portion from the greater curve of the stomach, following ligature and division of the left gastro-epiploic artery. A vascular pedicle based on the right gastro-epiploic artery remains to preserve viability.

These techniques fall within the sphere of the specialist urological surgeon.

URETHROVAGINAL FISTULA

A distal urethrovaginal fistula does not affect continence and is of minor significance. The technique of repair is identical to that of a small vesicovaginal fistula. A fistula that involves the bladder neck should be reinforced to preserve continence and the insertion of a Martius graft may be advantageous. Alternatively a bridge of vaginal skin may be used.[38]

Total Urethral Loss—Reconstruction

(a) **Dennis Browne (modified by Chassar Moir 1964):** If there is sufficient vaginal epithelium it may be possible to mobilise distal vaginal wall so as to bury a strip of epithelium as in the operation for male hypospadias. Suprapubic drainage must be maintained long enough to allow the epithelium to grow round to form a tube. The main difficulty is that there may be insufficient healthy distal vagina other than epithelium over scar tissue, from which to fashion the new urethra. A modified Martius graft largely overcomes this problem and may reduce the problem of stress incontinence (Figs. 21.48 and 21.49).

(b) **Bladder wall advancement:** A urethral tube may be manufactured from the anterior bladder wall, or from the trigone; the latter requires bilateral ureterovesical reimplantation.

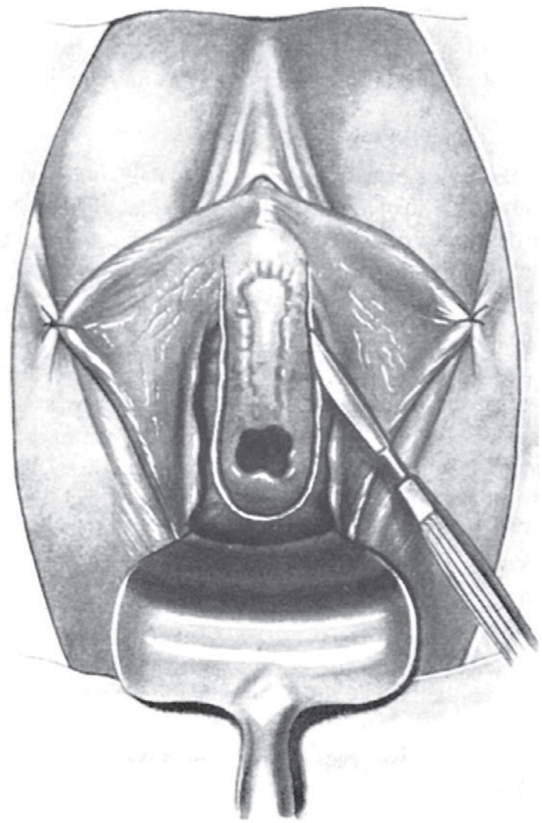

Fig. 21.48: Vesicovaginal fistula with loss of urethra. A simple method of dealing with this type of case. A U-shaped incision is made and the tissues on each side of the incision carefully mobilised.

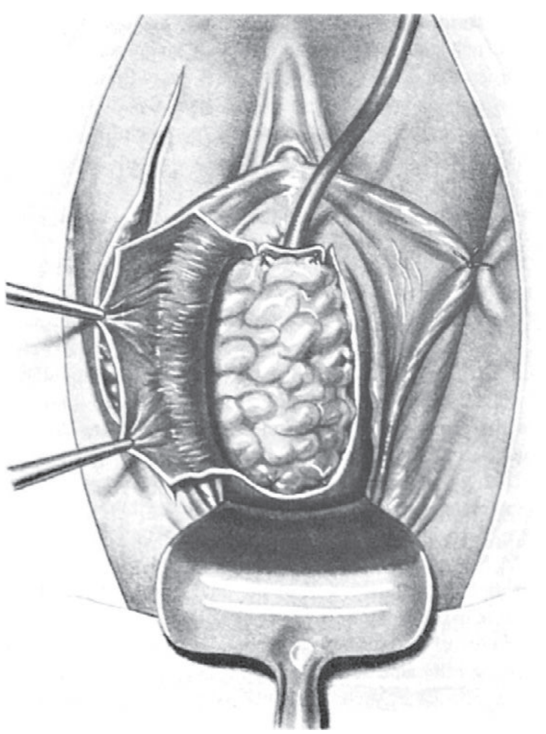

Fig. 21.49: Vesicovaginal fistula with loss of urethra: the strip is buried over a catheter covered by a Martius graft, either with a separate labial flap or with an attached island of skin.

(c) **Bladder 'spout':** In some cases where major surgery is not feasible (e.g. lymphogranuloma venereum), the mere creation of a urethral 'spout' may provide an acceptable measure of continence.[28]

VESICO-UTERINE FISTULA

A uterine fistula can arise after bladder injury or incorporation of bladder wall in the uterine repair at the time of lower segment Caesarean section. Quite commonly the history is of cyclical haematuria rather than incontinence. Repair is best achieved by the abdominal route—the Swift Joly combined approach is appropriate (see above). It may be necessary to dilate the cervix from below if granulations from the posterior uterine wall are occluding the cervical canal.[21]

Complications of Urinary Fistula Surgery

Vaginal stricture: Genital fistula surgery may result in considerable reduction in vaginal bore with subsequent impact on coital ability. Distal vaginal reconstruction may be required (see Chapter 7).

Operative mortality is uncommon but associated with Gram-negative septicaemia, especially in immunocompromised patients. Intra-operative haemorrhage may arise when operating in 'cartilaginous' scar tissue, particularly on the side wall of the pelvis.

Inadvertent fistula enlargement can complicate closure, and just occasionally a fresh injury may be perpetrated. Both these events are liable to result in surgical failure, as will failure to recognise a 'watering can' fistula. Failure may also be associated with non-recognition of intrinsic pathology, associated abscess or foreign body (e.g. suture, stone).

The ureter is at risk from inclusion in a suture when in close proximity to a fistula. Occasionally the extra-vesical ureter limits the mobility required for closure of a massive fistula. In such cases the ureter must be divided and re-implanted per abdomen. If ureteric occlusion occurs antegrade stenting under ultrasound control should be attempted.[39] If unsuccessful a nephrostomy tube should be inserted—a successful repair of bladder fistula should not be jeopardised.

Successful surgical closure of a fistula might be considered a 'Pyrrhic victory' if the patient remains wet via the urethra thereafter. The conditions that determine this distressing outcome are outlined above.

In spite of the difficulties, the successful relief of fistula remains one of the most rewarding procedures in surgical gynaecology. There is little doubt that the best results are achieved by training and experience, with the most difficult cases being sent to tertiary referral centre. There is a 'law of diminishing returns' from repeated attempts at closure.

Surgical Injury to Bladder and Ureter

Avoidance of damage to the urinary tract depends on a thorough understanding of the pelvic anatomy of the ureters and bladder, congenital variations that may occur, and changes in the anatomy that may occur as a result of benign or malignant disease, or from previous surgery or adhesions. Trainers in surgical technique have a duty to demonstrate the care, attention and patience that are required to identify the course of the ureter in every single case, whether the surgery is open or laparoscopic in order to minimise the risk of traumatic injury to the urinary tract. In modern practice, any suspicion of damage warrants calling for experienced senior advice, and wherever possible the immediate involvement of a urologist. This is not only important to obtain the best care for the patient, but to minimise the possibility of litigation. The act of causing urinary damage may be forgivable, but delay in recognition or inadequate treatment in the first instance is more likely to result in an expensive lawsuit.

REPAIR OF THE BLADDER AND URETER

Bladder closure with two layers of absorbable material (such as 3/0 polyglactin) is usually successful. Bladder drainage should be maintained for 10 days. If there is haematuria and risk of catheter blockage, suprapubic as well as urethral catheterisation may be desirable.

URETERIC INJURY

The availability of 'double pig-tail' (J-J) stents[40] has enabled a more conservative approach to partial ureteric injuries, with insertion of a stent across the partially injured ureter often being adequate management. Direct end-to-end anastomosis of the ureter has had a poor reputation in the past; with catgut sutures there was a significant risk of stricture formation and obstructive uropathy. The availability of fine (4/0) polyglactin sutures has overcome this issue to some extent, and provided there is enough ureteric length to allow spatulation and tension-free anastomosis, end-to-end uretero-ureterostomy is sometimes an option (Figs. 21.50 and 21.51). However below the pelvic brim where most gynaecological ureteric injuries are likely to occur, or if there has been segmental loss of ureter (gap problem), direct anastomosis is seldom the most appropriate technique. In this situation, the preferred procedure is uretero-neocystostomy using the 'psoas hitch' procedure (see below) and, if necessary a Boari flap. An alternative procedure is a retroperitoneal end-to-side transuretero-ureteral anastomosis, but this can only be considered if the integrity and patency of the uninjured ureter (Fig. 21.52) has been confirmed pre-operatively (IVU or retrograde pyelogram) and even then, some urologists are wary of potentially jeopardising the uninjured ureter by virtue of the anastomosis. This should be regarded as the procedure of last resort.

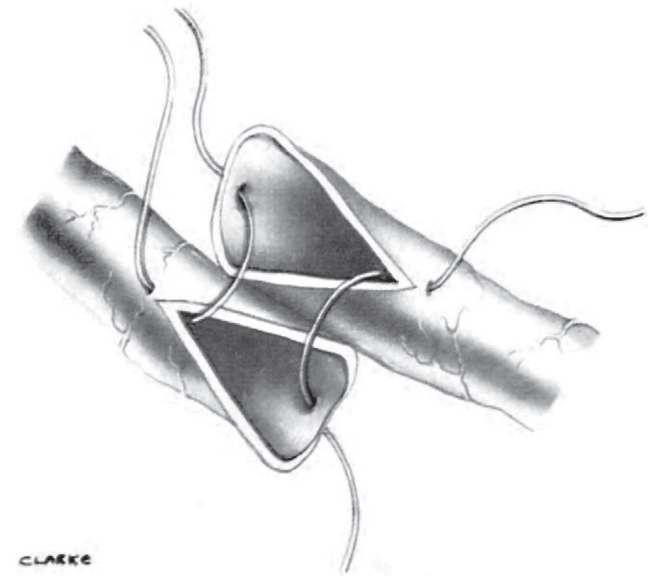

Fig. 21.50: Ureteric anastomosis. Longitudinal incisions have been made to enlarge the aperture (spatulation) and produce an oblique anastomosis; the corners having been rounded and stay sutures inserted. 4/0 polyglactin suture material is appropriate.

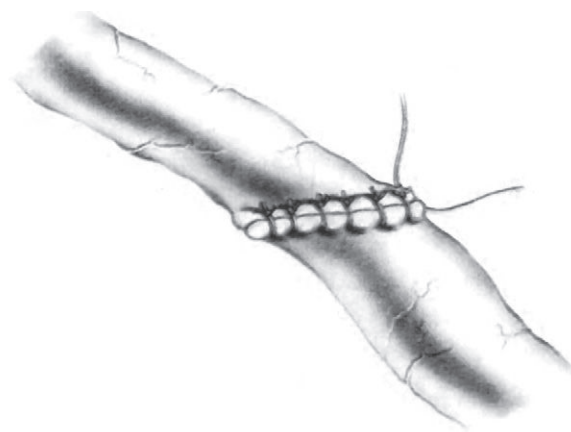

Fig. 21.51: Ureteric anastomosis. The anastomosis completed. A stent is typically left in situ for 4–6 weeks, and it should have a number of perforations otherwise it may act as an obstruction to urine flow which is then forced down the outside of the tube by ureteric peristalsis, thus causing over-distension of the anastomotic suture line.

URETEROVESICAL IMPLANTATION (URETERO-NEOCYSTOSTOMY)

If the ureter has been divided near to the bladder, the upper cut end of the ureter should be transplanted into the bladder. The lower cut end of the ureter is tied off.

Techniques of Ureterovesical Implantation

In clean operations, and in the absence of extensive injury, the implantation of the ureter into the bladder is a simple procedure, giving excellent results if the correct technique is employed. At the completion of the operation there should be no tension near the implantation site, otherwise the ureter will tend to pull out of the bladder and/or its blood supply may be disturbed. To obtain sufficient laxity it is necessary to mobilise the bladder freely on both sides so that it may be drawn across towards the severed ureter. As an elective procedure an extra-peritoneal approach using an oblique muscle cutting incision is recommended. The bladder should be fixed by several sutures to the fascial sheath of the psoas muscle ('psoas hitch') (Fig. 21.53). Bladder function is not significantly impaired by this distortion. Subsequently the site of anastomosis may be covered with peritoneum or omentum. Afterwards drainage should be employed to keep the bladder empty.

The mobilisation of the ureter requires judgement, since if it is mobilised so freely that it hangs like a cord across the pelvic cavity it is unlikely that its extreme lower end will have an adequate blood supply. The implantation, however, cannot be expected to be successful unless the ureter is free of tension at the completion of the operation.

Two techniques are presented here. The first is relatively simple and quick to perform, but does not attempt to create an anti-reflux mechanism. This is not an issue in most women, as reflux is frequently asymptomatic and in a normal-pressure bladder with no cystitis, there are unlikely to be any long-term implications for renal function. However if time and expertise permit, the latter technique (based on the Leadbetter–Politano method of re-implantation) creates an anti-reflux mechanism and is therefore advantageous.

Simple technique: After appropriate mobilisation of the bladder and the upper ureter, small incisions about 0.5 cm long are made by means of small sharp scissors on each side of the terminal part of the ureter, passing through both the muscle coat and the mucous membrane; a fine polyglactin suture is then passed through each of the two lips so fashioned. Some surgeons prefer to insert a stent into the ureter.

The surgeon opens the vault of the bladder and presses a pair of blunt-nosed forceps against the bladder wall to tent it towards the cut end of the ureter (Fig. 21.54). The best position for the re-implantation is the nearest segment of bladder wall and therefore, at the apex of this 'tent'. The surgeon then passes guiding sutures on each side of this point through the muscle wall of the bladder and cuts down upon the point of the forceps with a scalpel until the bladder is opened. In this way a small

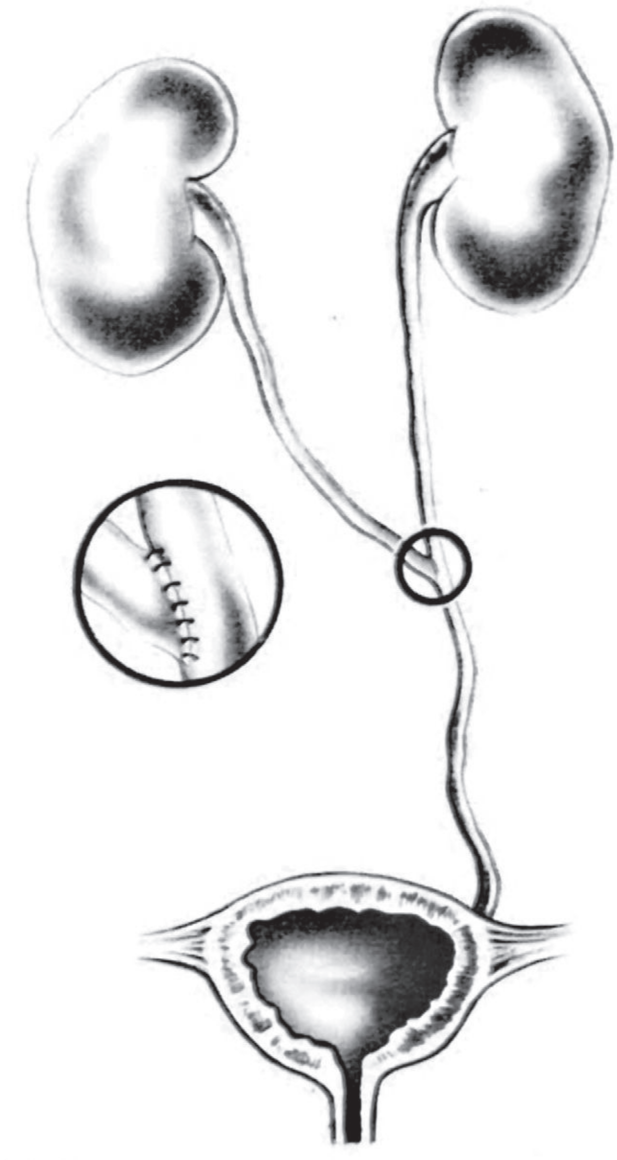

Fig. 21.52: Transuretero-ureterostomy. If direct anastomosis is inappropriate because the gap between the ends to be united is excessive, retroperitoneal transposition of the proximal segment of the damaged ureter for end-to-side anastomosis with the intact contralateral ureter is an acceptable manoeuvre. The inset illustrates the technical detail of such anastomosis. Ideally a stent should be placed in both ureters, but if this is not possible it is most important to guarantee the integrity of the uninjured ureter by stenting.

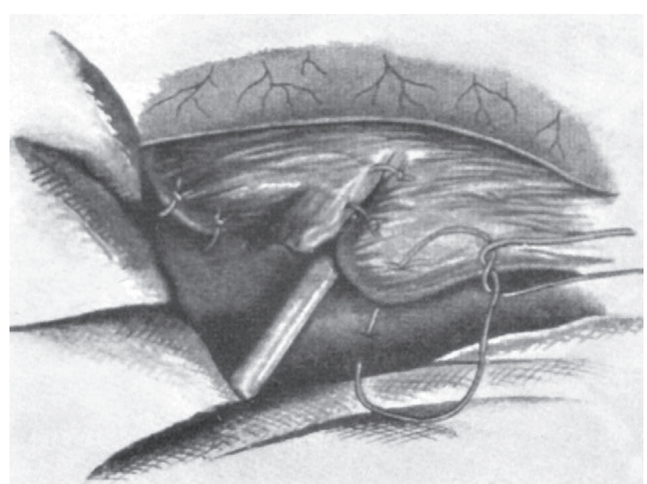

Fig. 21.53: Ureterovesical implantation – psoas hitch procedure. The final step. Stitches (for example No.1 PDS) are passed through the bladder wall into the fascia of the psoas tendon, which is easily visualised (psoas hitch), to ensure the anastomosis is tension free.

aperture is formed in the bladder. The sutures placed on the ureter previously are then pulled through into the bladder dragging the ureter with them, and then sutured to the bladder wall to fix the ureter securely in the bladder. Next, on one side a suture is passed through the muscle wall of the bladder and then through the connective tissue and muscle sheath of the adjacent part of the ureter. A similar suture is passed immediately opposite. The four sutures enable the ureter to be fixed firmly to the bladder. 3/0 polyglactin material is used for this suture. Two further stitches are introduced through the bladder wall and not through the ureter to obtain additional support. These sutures do not pass through the ureter, but take the form of Lembert's sutures through the muscle wall of the bladder (Fig. 21.55). Great care must be exercised when placing these sutures not to constrict the new ureterovesical junction (Fig. 21.56). It is always wise to drain the site of a ureterovesical anastomosis for 24–48 hours with a tube drain such as a Robinson's drain.

This method of implantation suffers from two potential complications:

1. The lower end of the ureter may become oedematous, so that the flow of urine is obstructed. This obstruction may only be transient.
2. The possible occurrence of ureteric reflux. As mentioned earlier this may not matter, but in elective ureteric reimplantation and when there is no 'gap' problem, the Leadbetter–Politano technique creates an anti-reflux mechanism.

Leadbetter–Politano Technique: An extra 1 cm length of ureter is drawn into the bladder through an open cystotomy incision. A sub-mucosal tunnel is constructed by injecting normal saline to raise a blister, nicking the roof of this bleb and drawing the ureter through. A mucosa to mucosa anastomosis

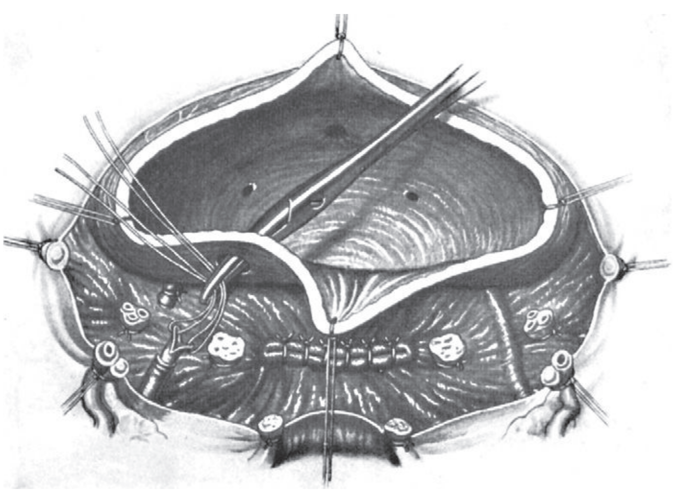

Fig. 21.54: Ureterovesical implantation. The end of the ureter has been incised below the level of the ureteric sheath and an opening made into the bladder through which the ureter is drawn. The position of this opening should be where the bladder may be 'tented' as close to the cut ureter as possible.

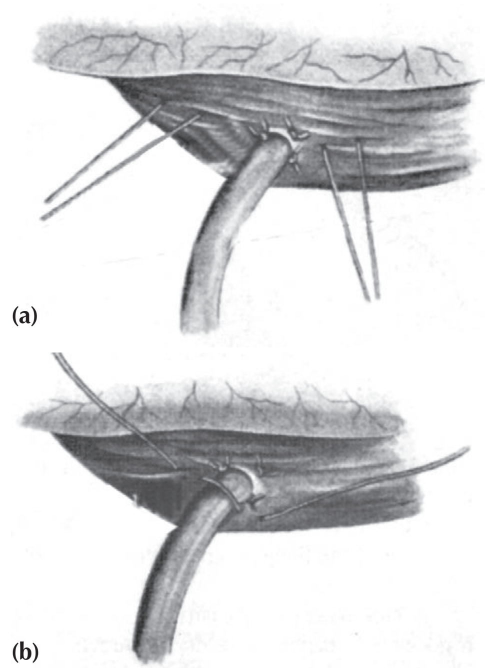

Fig. 21.55: Ureterovesical implantation. **(a)** Shows the position of the new ureterovesical anastomosis after the anchoring sutures in the ureteric sheath and bladder wall have been tied. **(b)** A Lembert suture not including the ureteric sheath draws the bladder muscle over the new ureterovesical junction as an additional protection.

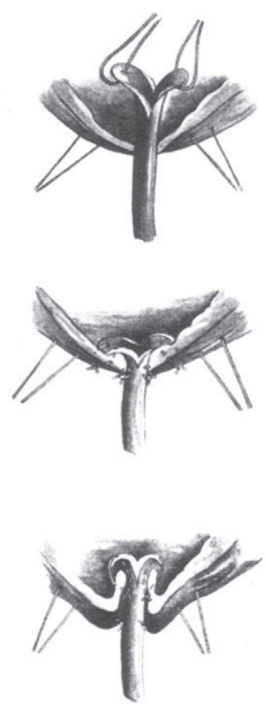

Fig. 21.56: Ureterovesical implantation. *Top*. The sutures in the end of the ureter are pulled through into the bladder with the ureter and then secured with a big bite into urothelium and the underlying detrusor muscle. *Middle*. When these sutures are tied they anchor the ureteric lips to the bladder. *Bottom*. Further anchoring sutures are passed through the ureteric sheath and the bladder muscle proximal to the first anchoring sutures.

should be performed (Figs. 21.57–21.59). Most urologists insert a ureteric stent that is removed after 4–6 weeks at cystoscopy. The bladder is closed completely and drainage obtained by an indwelling urethral catheter. It is usually unnecessary to employ suprapubic cystotomy drainage. The urethral catheter is connected in the theatre to a closed circuit drainage system.

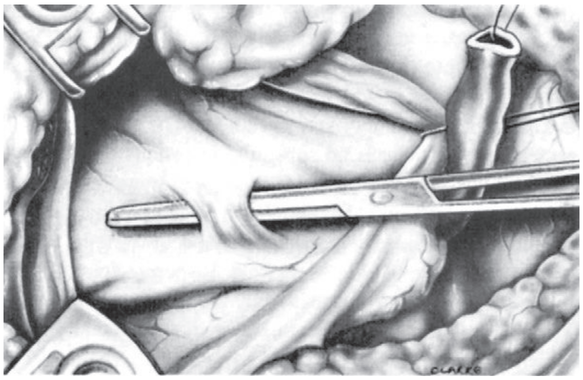

Fig. 21.57: Ureteric implantation using a submucosal tunnel. A pair of artery forceps has been inserted to develop the submucosal tunnel.

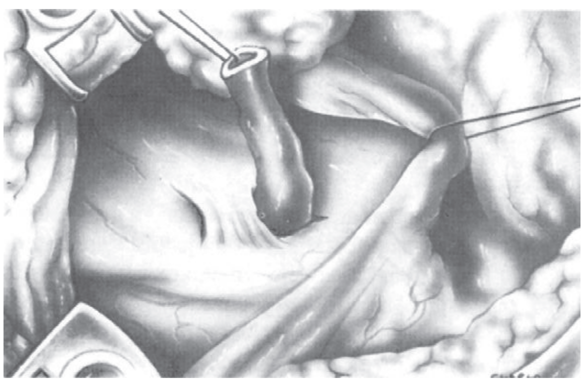

Fig. 21.58: Ureteric implantation using a submucosal tunnel. An adequate length of ureter has been drawn through the bladder wall.

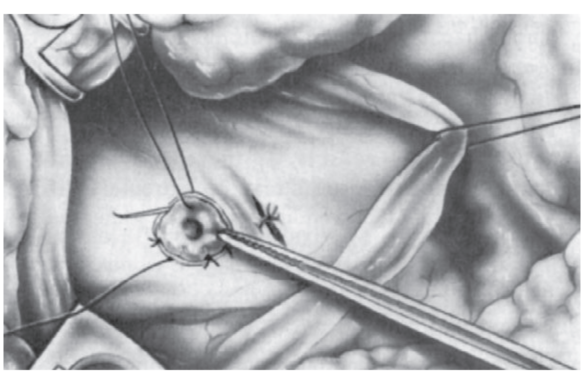

Fig. 21.59: Ureteric implantation using a submucosal tunnel. The ureter has been drawn through the submucosal tunnel and fixed by interrupted 4/0 polyglactin mucosa to mucosa sutures.

Alternative Procedures

While it is generally recognised that ureterovesical implantation is the most graceful recovery from an awkward surgical predicament and that of all ureteric anastomoses it is the least likely to lead to subsequent obstruction, the operation is only feasible if the ureter and the bladder can each be mobilised for union without tension. A position is eventually reached where the operation is no longer feasible because the point of ureteric section is too far from the bladder.

1. If it is essential to preserve function in the kidney on the side of the ureteric injury because the other is inadequate or absent, the gap between ureter and bladder may be bridged by two methods—one simple and the other elaborate:
   (a) **Boari flap operation:** A tube flap is fashioned from the bladder and with ingenuity 5–8 cm can thus be gained. The ureterovesical anastomosis at the end of the flap is performed over a stent and the defect in the bladder repaired by interrupted suture (Fig. 21.60). Ockerblad[41] reported the first success in a human female on whom he operated in 1936. Ten years later, the intravenous urogram was grossly normal and the bladder flap resembled a slightly dilated but otherwise normal ureter. Ockerblad's flap was 10 cm long and 4 cm wide at its base. He emphasised the importance of a generous width of flap in order to minimise the risk of subsequent stenosis. Blandy and Anderson[42] reported good results from 35 cases. It may be necessary to divide the contralateral superior vesical pedicle to adequately mobilise the bladder.
   (b) **Ileal replacement:** An isolated portion of ileum is used to replace the widely excised or damaged part of the ureter.
2. **Intubated ureterostomy:** If an inexperienced operator is unhappy with these measures, the best 'first aid' procedure is to tie an infant feeding tube (or large bore ureteric catheter) into the ureter without disturbing it from its bed, bringing the other end out through a separate stab incision. Neither cutaneous ureterostomy nor unilateral ureterocolic anastomosis are recommended.

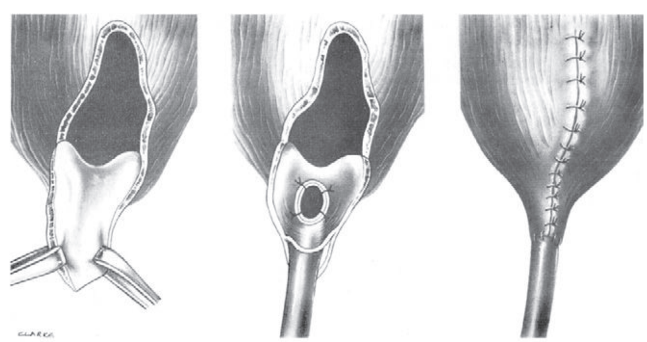

Fig. 21.60: Ureterovesical implantation using bladder flap. Boari–Ockerblad operation. A, Elevation of bladder flap. B, Anastomosis with ureter using submucosal tunnel to prevent reflux. C, Completion of bladder wall tube.

3. **'Autotransplantation'** of the kidney and upper ureter to the pelvic brim has occasionally been employed, a procedure for the experienced urologist.
4. **Nephrectomy**, provided that the other kidney is functionally and anatomically normal. This may well be the treatment of choice if the patient is elderly or has malignant disease with a poor prognosis. However in general, the authors disapprove of this sacrifice of a functioning organ that may become more valuable as the patient ages or if renally excreted chemotherapy is required in the future.

URETERIC OBSTRUCTION

Occasionally a gynaecologist is presented with the problem of complete ureteric obstruction on one side (rarely on both sides) after an operation. If re-exploration of the operation site is contraindicated a drainage procedure will be necessary. Percutaneous nephrostomy may be carried out under ultrasound control (see Chapter 4).[43] 'Stenting', either retrograde or antegrade, is the preferred option for ureteric injury if feasible.

Conclusion

There is no place for a gynaecologist to carry out occasional fistula surgery or repair of operative damage to the urinary tract. Good uroradiological services and an experienced urogynaecologist are required, often in conjunction with a urologist.

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Gynaecology and the GI Surgeon

22

Bhavna Gami, Paul Ziprin

Introduction

Fifty years ago, the majority of gynaecologists were trained first as general surgeons; hence, many of them had considerable experience and expertise in intestinal surgery. Current training will include an understanding of conditions that relate to both the gastrointestinal (GI) and gynaecological organs, but in practical terms the gynaecologist is likely to lack the skills necessary to deal with many conditions that a previous generation might have had.

There are many situations where a joint collaboration between surgeon and gynaecologist has great advantages for optimum care of the patient. Examples include patients with endometriosis who have colonic involvement or deep rectovaginal disease (see Chapter 11), and patients presenting with acute right iliac fossa pain, where the differential diagnosis may lie between tubo-ovarian pathology, appendicitis or other intestinal disorders. Diagnosis of pelvic pathology can often be confusing, because of the close anatomical proximity of bowel and gynaecological organs, particularly in the presence of an abscess or a malignant disease. Both surgeon and gynaecologist may need each other's help in the diagnosis and operative care of such patients.

In addition, there are occasions where surgical complications follow gynaecological surgery or obstetric procedures. In these circumstances, it may be appropriate for a general surgeon to manage the complication, as they may have more experience of the operative and postoperative requirements.

Other areas of collaboration may involve the management of patients with long-term sphincter injuries and rectovaginal fistulas. The World Health Organisation (WHO), in conjunction with the International Society of Obstetric Fistula Surgeons, has developed guidelines on 'fixing fistulas', including the repair of obstetric fistulae, to ensure high standards of practice around the world.

This chapter attempts to bring together the skills of GI specialist surgeons and gynaecologists to provide the best care for patients in unusual but often difficult clinical situations.

Non-Gynaecological Conditions

Recognition of pathology outside the female genital tract is crucial, and the gynaecologist who discovers a non-gynaecological condition during surgery should seek assistance if available; if not, the minimal procedure to contain the situation should be performed to avoid compromising definitive intervention later.

APPENDICITIS

From time to time, appendicitis presents to a gynaecologist, particularly during pregnancy. Acute appendicitis occurs in 1 in 2000 pregnancies and is the most common cause of non-obstetric surgery during pregnancy. It is associated with an increased risk of premature labour and maternal death. Although fetal loss can occur in 3–5% of pregnancies complicated by appendicitis without perforation, the risk increases to up to 36% of cases with a perforated appendix.

During pregnancy, appendicitis can be undertaken laparoscopically (if the size of the gravid uterus allows) or open. There are no data to suggest laparoscopic surgery is more harmful to the fetus. The usual technique for removal of the appendix should be followed, and no specific measures are necessary unless an abscess cavity surrounds the inflamed appendix (Figs. 22.1–22.3).

An appendix abscess may form in the right iliac fossa from an acute infection of a retrocaecal or para-ileal appendix. An abscess in this site is not likely to be mistaken for a tubo-ovarian abscess as it is fixed and localised within the right iliac fossa and tenderness on rectal or vaginal examination is not often or easily elicited. An abscess that forms around a pelvic appendix is not so easily felt on abdominal examination and always gives rise to considerable tenderness on vaginal examination. It is in this site that its differentiation from tubo-ovarian abscess may be

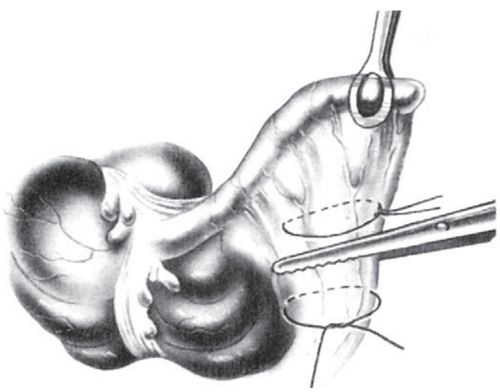

Fig. 22.1: Appendicectomy. Ligature and division of the mesentery.

extremely difficult and be the reason for a diagnostic laparoscopy. The association with caecal carcinoma in the elderly should be remembered.[1] Simple drainage of a pelvic appendicular abscess is usually undertaken under CT or ultrasound guidance. If the abscess is drained, an interval appendicectomy can be undertaken at a later date. Surgery may be required acutely if there is evidence of peritonitis at the time the abscess is drained and appendicectomy completed. This can be undertaken laparoscopically, but when sepsis is severe a formal laparotomy may be required. Rarely, the abscess is drained rectally or vaginally with the availability of interventional radiology.

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Sometimes the Fallopian tube and ovary on the right side are affected by the inflammation so that they are swollen and covered by adhesions. Often the ovary is enlarged, surrounded by adhesions and possibly containing fluid-filled follicular cysts. It is not usually necessary to remove either the Fallopian tube or the ovary, since they return to normal after the inflammation has subsided. On the other hand, adhesions around the fimbrial ends of the tube may lead to the right Fallopian tube becoming occluded. An effort should therefore be made to free the fimbriae and distal tube from adhesions, and to place the tube and its fimbriae well away from the abscess cavity before the abdomen is closed.

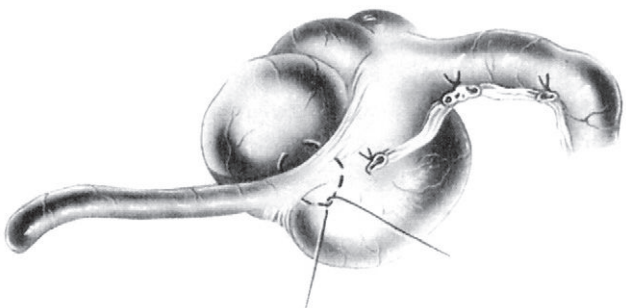

Fig. 22.2: Appendicectomy. 'Purse-string' suture.

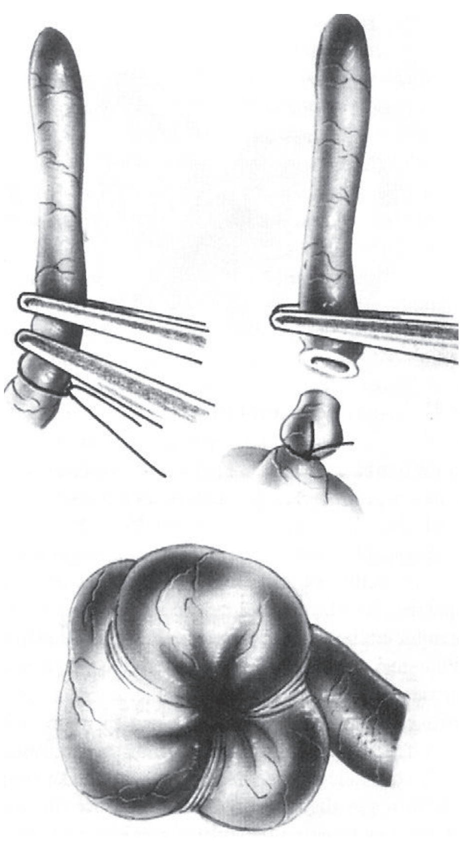

Fig. 22.3: Appendicectomy. Excision of the appendix and burial of the stump.

APPENDICECTOMY DURING GYNAECOLOGICAL OPERATIONS

Opening the bowel for this procedure will add a small risk of postoperative peritonitis to any laparotomy in which there is a possibility that a collection of blood may form in the pelvis. An infected haematoma is more serious than one that remains sterile.

The appendix should always be inspected. Only if there are adhesions or other evidence of disease should the appendix be removed; otherwise the rare complications of appendicectomy can occasionally turn a straightforward gynaecological operation into a disaster. In particular, appendicectomy should be avoided after any operation in which pelvic oozing is likely, such as myomectomy or operations for endometriosis.

MECKEL'S DIVERTICULUM

An incidental Meckel's diverticulum may be left in situ but if involved with the disease process or obviously inflamed, it should generally be removed by diverticulectomy or by formal small bowel resection.

DIVERTICULAR DISEASE OF THE COLON

The diagnosis of diverticular disease can be made at laparotomy or laparoscopy. If the colon is found to be indurated, fixed and surrounded by adhesions but there is no evidence of abscess formation, perforation or obstruction, the abdomen should be closed and the patient treated with broad-spectrum antibiotics including anaerobic cover. If there is evidence of abscess formation or perforation, peritoneal lavage and the placement of a large drain to the area of affected bowel can avoid the need for a Hartmann's procedure. No attempt should be made to close the perforation. A colostomy may be established to defunction the pelvic colon. If in doubt or if there is severe faecal contamination, local excision of the affected loop, with elevation of an end colostomy and over-sewing of the distal rectosigmoid (Hartmann's operation) is the best option with lowest mortality.

Obstruction should not be mistaken for a gynaecological disorder, but if it is discovered, a right transverse colostomy or loop ileostomy can be performed especially if the patient is acutely unwell at presentation and definitive surgery can be undertaken later when she has recovered. Primary excision with on-table colonic lavage and primary anastomosis with or without a defunctioning stoma is favoured now if the patient is stable physiologically. Otherwise colonic stenting can be used to decompress the obstruction prior to surgical resection, so avoiding a stoma.

The distinction between diverticular disease and carcinoma may be quite difficult. It may be possible to pass a sigmoidoscope or colonoscope while the abdomen is open to view a suspicious lesion. The abdominal operator may be able to guide the sigmoidoscope to view a lesion not normally within range. However, the use of acute imaging, in particular contrast CT, will aid in the diagnosis prior to surgery.

If any definitive surgical procedure is carried out for an unexpected colonic lesion, immediate broad-spectrum antibiotic therapy (including gram negative and anaerobic cover) is recommended. Drainage is important, and postoperative intravenous infusion and nasogastric suction may be required for several days.

CARCINOMA OF THE COLON

Apart from misdiagnosis, the gynaecologist may unexpectedly encounter carcinoma of the colon in two classic situations. In the first, there is a symptomless, and commonly quite small, mass that may only be detected as an incidental finding (Fig. 22.4); in the second, an intestinal primary is found in a case of carcinomatosis hitherto suspected as being of ovarian origin. In the latter instance, palliative local resection is all that is required, but for the former an adequate resection and anastomosis should be performed. This will involve sigmoid colectomy or left hemicolectomy. The technique of sigmoid resection has been described in Chapter 17. A colorectal surgeon should be involved in this situation, as outcomes from colorectal cancer surgery is improved in specialist centres.

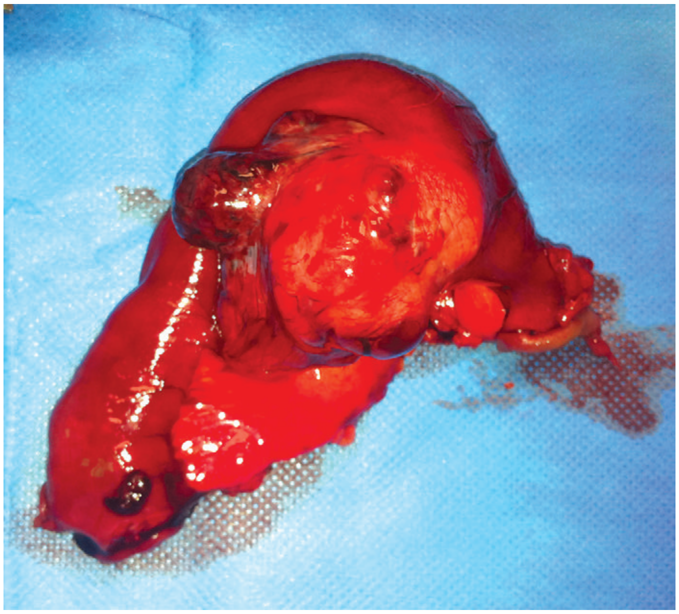

Fig. 22.4: Carcinoma of the ileum. This tumour was found in a patient who presented with a right adnexal mass that was presumed to be an ovarian tumour.

With greater availability of acute radiological imaging, in particular CT and ultrasound, unexpected findings as described above are rare. In pregnancy, ultrasound and MRI will aid in excluding appendicitis, but a combined multidisciplinary approach is invaluable.

INTRAPERITONEAL HAEMORRHAGE

It is very rare for a gynaecologist to be faced with diffuse intraperitoneal haemorrhage from a source other than a ruptured ectopic or possibly a ruptured corpus luteum. In pregnancy, rupture of a splenic artery aneurysm is a very rare cause of maternal death. Spontaneous rupture of the spleen can occur without an obvious history of trauma, particularly in parts of the world where splenomegaly is common due to tropical anaemia. If the gynaecologist discovers this through a lower midline incision, they should extend the incision cranially, and if it is not possible to achieve adequate exposure for splenectomy, the incision can be extended subcostally to the left as in a rooftop incision. Difficulty will arise from possible adhesions to the inferior aspect of the diaphragm and thoracic cage if there has been any preceding perisplenitis. Other structures at hazard are the colon and the tail of the pancreas, which is closely related to the splenic vessels and may be adherent to the hilum of the spleen. Any injury to the pancreas here will inevitably produce a pancreatic fistula; thus closure of the wound with unabsorbable suture material and drainage of the splenic bed is advisable (Figs. 22.5–22.7).

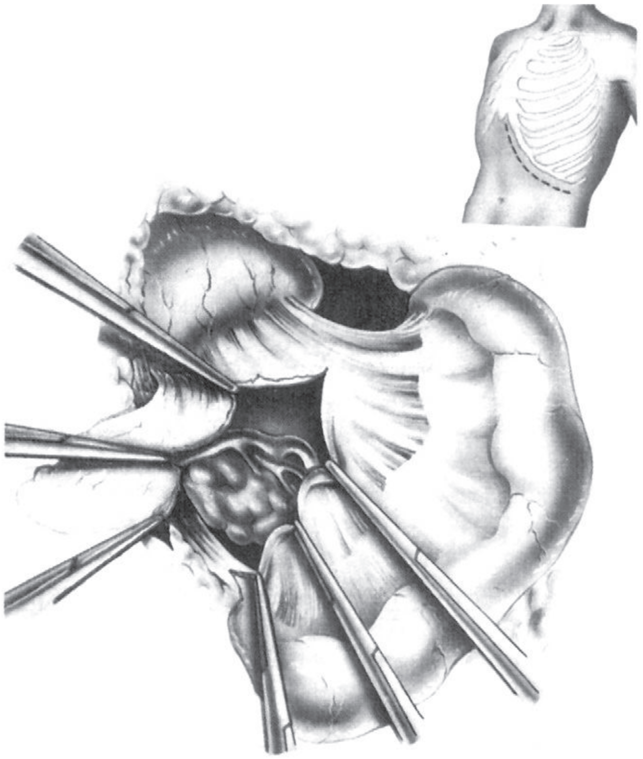

Fig. 22.5: Splenectomy. Anterior approach to the mesentery of the spleen.

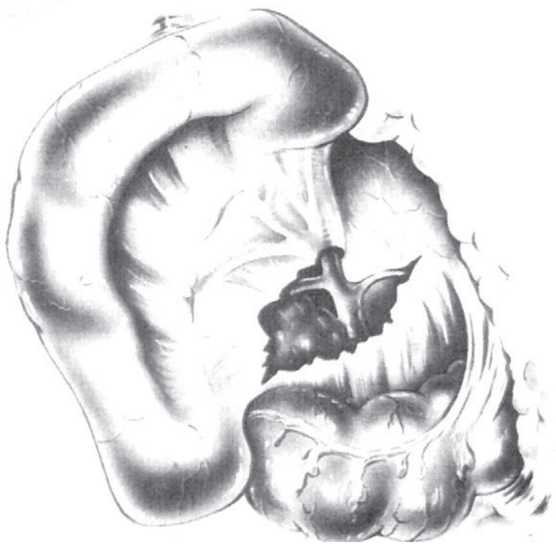

Fig. 22.6: Splenectomy. Posterior approach.

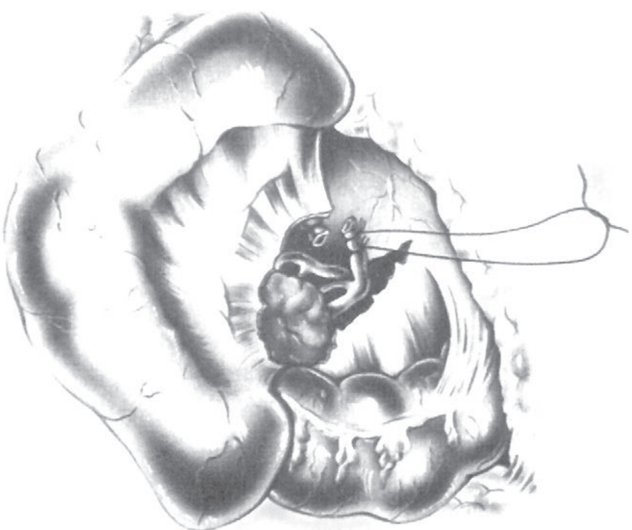

Fig. 22.7: Splenectomy. Division of the hilar vessels. It is important to avoid damage to the tail of the pancreas.

Other causes of diffuse intraperitoneal haemorrhage are very rare conditions such as a haemangioma of the liver and tumours of the sympathetic nerve chain (ganglioneuroma). Ruptured aneurysms of other vessels do not usually enter the differential diagnosis of ectopic pregnancy.

Haemorrhage that is difficult to control may occur during pelvic dissection, where the presacral veins are at risk of injury. The pelvis should be packed and after a period of time the bleeding site inspected. Packing may be enough to stop the bleeding but if bleeding continues, suturing may help, although commonly it does not stop the bleeding. Other strategies include the use of newer haemostatic agents (e.g. Floseal™, Baxter International Inc.) or tackers, which can tamponade the bleeding. If in these circumstances, the bleeding is not controllable, the pelvis should then be packed, the abdomen closed and the patient transferred to ITU where the patient can be stabilised and any coagulopathy corrected. The pelvis is then re-examined the following day, by which time the bleeding invariably has stopped.

OTHER ABDOMINAL WALL SWELLINGS

A mass arising in the anterior abdominal wall may occasionally be confused with one that takes origin within the peritoneal cavity. The physical sign of determining whether a swelling can still be felt once the patient's head is elevated and the rectus abdominis muscles have been put on stretch is useful. Both secondary deposits and endometriosis are conditions of the abdominal wall that may be encountered in gynaecological practice. The rare 'desmoid' tumour or low-grade fibrosarcoma of the anterior rectus sheath is a source of diagnostic confusion; it is seemingly confined to parous women. A major resection of involved muscles is required to cure this condition; local excisions are almost always followed by recurrence.

Surgical Complications of Gynaecological Procedures

BOWEL INJURY

Bowel injury during abdominal surgery is best avoided using the principle of gentle traction during separation of structures. The two occasions of greatest risk of bowel injury are entry to the peritoneal cavity, especially in the presence of adhesions from previous surgery, and freeing a loop of adherent bowel in the depths of the pelvis. The deep pelvis may be more surgically accessible by an experienced laparoscopic surgeon. Bowel may also be incarcerated in an extra-peritoneal space (e.g. the "dead space" of a transverse incision or ventral hernia). Finally, bowel may be trapped or punctured during suturing of the abdominal wall.

The bowel may be completely transfixed during blind insertion of a trocar and cannula or Veress' needle ("kebab" injury; see Chapter 3). This is particularly dangerous as the injured loop is outside the field of vision and may not leak until the instrument is withdrawn. The practice of removing the cannula under vision with the telescope partly withdrawn is the only method of detection (in addition to inspecting and sniffing the cannula sheath after removal). The risk of this type of injury might be reduced by using open blunt port insertion or Hasson technique. Bowel injury has also been reported after uterine perforation during hysteroscopy and biopsy.

During vaginal surgery, the anorectum is at risk during dissection of the perineal body and the rectovaginal space, and during penetration of the rectal pillar during sacrospinous-colpo-fixation. During vaginal surgery, the rectum is also at risk from inadvertent inclusion in a suture during closure of the vagina, or during reconstruction of the perineal body. It is always prudent to carry out a digital rectal examination at the conclusion of every surgical procedure on the posterior vaginal wall.

If a suture has been placed in close proximity to (rather than through) the rectal mucosa, the distinction may be quite difficult to determine by digital examination alone, and if necessary proctoscopy should be performed. Although primary suture of an injury to the bowel will commonly heal by first intention, it would seem that inadvertent inclusion of part of the bowel wall in an external suture is more prone to leak as a result of traction and pressure necrosis.

It is important to remember that:

- Intestinal injury may be overlooked at the time of occurrence.
- A transient faecal aroma should always arouse suspicion.
- 'Milking' the bowel to produce local distention may disclose the leak.
- Small bowel contents do not ordinarily smell, but the colour of the discharge is usually diagnostic.

Small Bowel Injury

Although puncture of internal organs by 'skinny' needles is usually without sequel, the same is not true for puncture by a Veress' needle. Injury to the ileum can often be managed by primary sutured repair avoiding constriction of the lumen or tension by closing in the transverse plane (Figs. 22.8, 22.9). If

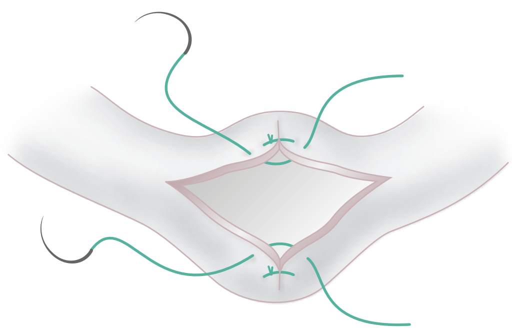

Fig. 22.8: Repair of injury to the small intestine. A longitudinal injury is closed transversely to avoid stenosis at the anastomosis site.

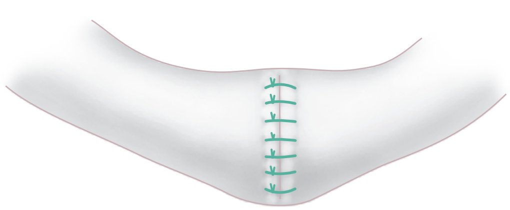

Fig. 22.9: Repair of injury to the small intestine. The injury has been closed transversely leaving a wider rather than narrower lumen. Seromuscular interrupted sutures are recommended by the Royal College of Surgeons, England.

the mesentery is injured, viability may be compromised. Local resection and anastomosis is preferable to a dubious repair (Fig. 22.10) using a single layer hand-sewn sutured anastomosis or stapled anastomosis.

Large Bowel Injury

Large bowel injury does not normally require faecal diversion unless there has been significant soiling. With peritonitis, copious lavage with warm saline is required. If recognised early at the time of surgery, this can be repaired as with small bowel injury. If there is a delay in diagnosis and there is widespread faecal contamination, exteriorisation of the damaged bowel loop as a stoma is the simplest procedure to avoid the high risk of an anastomotic leak. This can be reversed 8–12 weeks later. If the injury is too low to exteriorise or too extensive, Hartmann's operation may have to be considered. This is resection of the damaged segment, with elevation of an end colostomy. The rectal stump may be closed and tacked to the sacral promontory to facilitate subsequent reanastomosis. It is preferable, however, if there is sufficient distal bowel to bring it out as a mucous fistula at the lower end of the wound.

RECTAL INJURY DURING VAGINAL SURGERY

If the rectum is injured during transvaginal surgery, there is no alternative to immediate repair. It is of extreme importance to recognise that an injury caused in this way has usually been produced by shaving or stripping, and that it is only the central portion of a wider weakened area that has given way. Part of the visceral wall that should have been separated from adjacent tissue, such as the vagina, is probably still attached and an attempt merely to suture the hole that has been produced will be utilising thinned and weakened tissues.

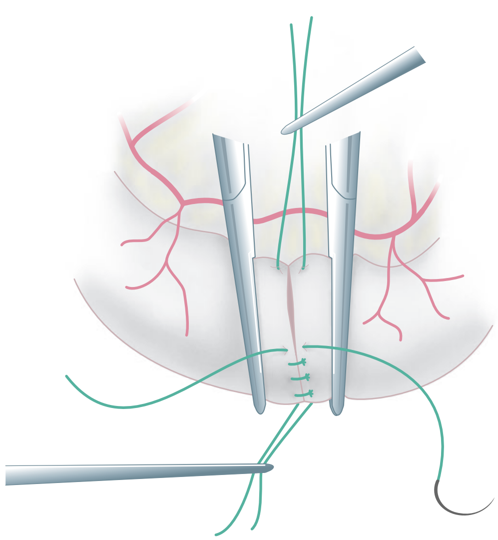

Fig. 22.10: Intestinal resection. End-to-end anastomosis using single layer interrupted seromuscular sutures.

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Obstetric Injuries

SEPTAL DEFECTS AND COMPLETE PERINEAL TEARS

Anal continence is maintained at the anorectal junction, characterised by the puborectalis sling of the levator ani muscle. The anal canal is normally empty, save immediately before defaecation. Injuries of the anorectal region are classified as high or low, according to whether they extend above the puborectalis sling. This is a critical level for gross control of faecal evacuation.[2] Most childbirth injuries are simple perineal tears and do not extend high up the posterior vaginal wall. Acute injuries occurring in gynaecological practice are usually due either to falls astride or sexual assault. Penetrating injuries can occur through the posterior fornix at or above the level of the peritoneal reflection. These may occasionally result from unskilled attempts at abortion. High, complete perineal injuries are rare, and involve complete loss of the perineal body and rectovaginal septum. These are almost always childbirth slough injuries, involving pressure necrosis from obstructed labour compounded by operative injury during delivery. They are thus not suitable for primary repair, and a suitable interval must be allowed to elapse (see Fig. 22.11).

Chronic unhealed high rectovaginal septal defects, although rare, involve considerable loss of tissue, and the repair is as difficult as that of a large fistula. Any lesion (either fistula or septal defect) extending above the puborectalis produces total faecal incontinence.

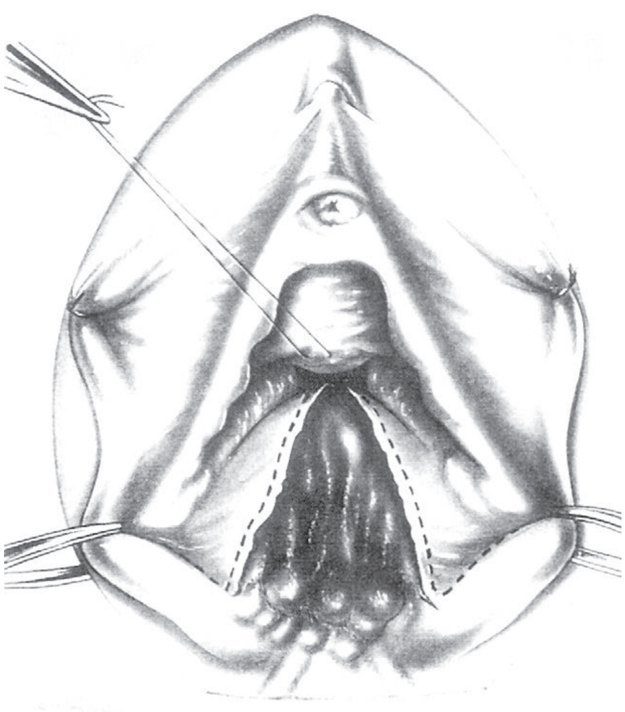

Fig. 22.11: Complete rectovaginal septal defect. The scarred junction between vagina and rectum is shown.

Otherwise, the immediate management of an acute perineal laceration is repair in layers. The functional results of immediate repair are less than perfect,[3,4] and such repairs should always be undertaken by the most experienced operator available. The technique of repair is similar to that described below, except that undercutting of the perineal skin is not required as there has not been chronic contracture and retraction of the severed external anal sphincter ends. Likewise, there is no tip of scar tissue on the severed ends to hold a double bank of sutures in the overlapping technique. Careful apposition of the freshly severed ends is important using fine high polymer sutures. Although formal pubococcygeus approximation is not required, accurate reconstruction of the perineal body anterior and superior to the anal sphincter is very important for the protection of the anal sphincter repair.

Wounds of the rectum appearing during vaginal surgery should be treated by immediate suture. It may be necessary to enlarge and excise the hole if the adjacent bowel wall has been damaged. Immediate postoperative broad-spectrum antibiotic cover is advised, as an infected haematoma is likely to lead to failure of the repair.

COMPLETE PERINEAL TEARS

For lesions below the puborectalis, the degree of disability and symptoms are extremely variable depending on personal fastidiousness, normal stool consistency and the ability of the levator ani muscle to hypertrophy and compensate.

Sometimes, the laceration in the bowel wall heals from above downwards, apparently completely, but the cut ends of the external sphincter have separated either from inaccurate primary suture or due to secondary breakdown. In such cases, there may be an arc of scar tissue between the cut ends if the perineal body has completely dehisced. This arc of scar tissue may be all that separates the vestibule from the anal verge. At other times, there may be a full sheet of skin between the introitus and the anus, but this is little more than a flap of skin and scar, there being no underlying perineal body and only a scarred gap in the external sphincter. The appearance is quite characteristic as this arc of skin lacks any corrugations, while those over the anal sphincter form a "horseshoe". Sphincter mapping with four quadrant electric stimulation can demonstrate the functional defect. Digital examination may reveal an extremely foreshortened anterior anal canal wall. This means that the lower part of the inverted "v" of the original laceration has opened up to become flush with the perineal skin. Further contraction of the scar may cause the anal aperture to be drawn into the vestibule. With or without a small associated rectovaginal fistula, the complexity of these lesions makes a more formidable procedure. Careful elucidation of the anatomy before commencing a repair is essential, and endo-anal ultrasound is especially useful.

Preliminary Preparation

Mechanical preparation of the lower bowel is essential. There is no good evidence that preliminary colostomy enhances the success rate for uncomplicated third-degree lesions,[5] although this may be considered for complex problems (e.g. a double fistula, a septal defect with significant tissue loss) and perhaps for prior surgical failure.

Technique of Repair

The repair is performed in layers. Three tissue forceps are attached in the usual way. One is fixed to the posterior vaginal wall about 5 cm above the level of the rectal mucous membrane, while two lateral forceps are placed symmetrically on each side near the end of the labium minus. A midline vertical incision is made in the posterior vaginal wall, extending downwards from the tissue forceps applied to the vagina to the junction of the posterior vaginal wall with the rectal mucosa. From the lower end of this vertical incision two transverse incisions are made on the vaginal side of the line of junction between the posterior vaginal wall and the mucous membrane of the bowel. The two vaginal flaps so outlined are then dissected clear of the underlying scar tissue. The dissection is made with the cutting edge of a scalpel, and great care must be taken to avoid injury to the wall of the bowel. Inferiorly the dissection is continued laterally on each side beyond the torn edges of the external sphincter (Fig. 22.12).

If there is a perineal skin flap and the anterior anal canal wall is largely intact, the skin incision is made in the middle of the perineum with a gentle concavity towards the anus. The shallow curve of this incision should take it well lateral to any muscle

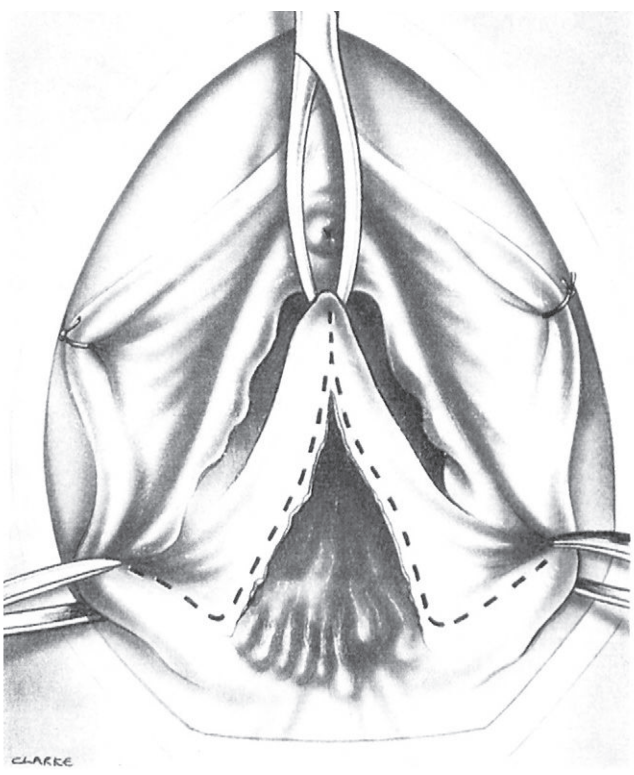

Fig. 22.12: Operation for secondary repair of a complete perineal tear. The lines of incisions are shown.

fibres of the subcutaneous anal sphincter to avoid damage to the neurovascular bundles supplying the sphincter muscle, which reach the muscle posterolaterally.

Sometimes dense white scar tissue replaces the skin near the cut edge of the sphincter; this scarred skin should be excised. Similarly, any scar tissue that lies in front of the anal canal and the lower part of the rectum is excised, and by means of incisions made with a scalpel on each side of the anal canal the bowel is mobilised. The midline incision in the posterior vaginal wall must be continued upwards and the rectovaginal space exposed. If the rectum is drawn up by scar tissue, this scar tissue is divided until the rectum is sufficiently mobilised. At the apex of a defect that extends to the cervix, sufficient mobility can only be obtained by opening the pouch of Douglas in a manner similar to that employed for high rectovaginal fistula.[6] Even with relaxing incisions, it may not be possible to close the upper part of the vaginal defect, but this does not mean that the repair will necessarily fail, only that there will be gross narrowing subsequently.

Repair of the Bowel Wall: The wall of the bowel is now repaired. A suture is placed in the muscle layer of the anal canal or rectum about 1 cm above the line of junction of the vaginal and rectal wall. The ends should be left long, artery forceps attached and the suture drawn upwards by an assistant. The next step is to excise from the line of junction of the vaginal wall and rectal mucous membrane all fibrous tissue and any vaginal wall that remains. Fine scissors, such as Milteck's, with a serrated edge, should be used, and the redundant tissue must be removed to such an extent that the cut edges consist of healthy mobile rectal membrane. The operation is likely to fail unless all scar tissue is excised from this area and unless the rectal mucous membrane is completely free of adhesions.

Suture of the Bowel Wall: The wound in the bowel wall is closed by a series of interrupted number 0 polyglycolic sutures mounted on a small round-bodied atraumatic needle. The ends and knots must lie within the lumen of the bowel, and it is a mistake to tie the sutures too tightly (Fig. 22.13).

At the level of the dentate line, the bowel mucous membrane becomes continuous with squamous epithelium and a similar series of sutures must be placed in the edges of this squamous epithelium, which is likewise continuous with the skin of the perineum. A second series of sutures must now be placed in the muscle of the anterior wall of the rectum and anal canal, preferably interrupted Lembert sutures. This layer of sutures cannot be introduced efficiently unless the anal canal and rectum have been sufficiently mobilised (Fig. 22.14). They are instrumental in repairing the torn internal sphincter, which extends cranially above the anterior external sphincter ring.

Identification and Repair of the External Anal Sphincter: A careful anterolateral approach will identify contractile external anal sphincter joined to its fellow by an arc of scar tissue (Fig. 22.15). The arc of scar tissue must be excised, leaving a cap of scar tissue attached to each end of the sphincter muscle. This is to provide a secure hold for the coapting sutures.

Reconstruction of the Perineal Body: The deep part of the perineal body should be reconstructed before the anal sphincter repair is completed. It is usual to perform a pubococcygeus repair (Fig. 22.16) as this will add length to the anal canal and

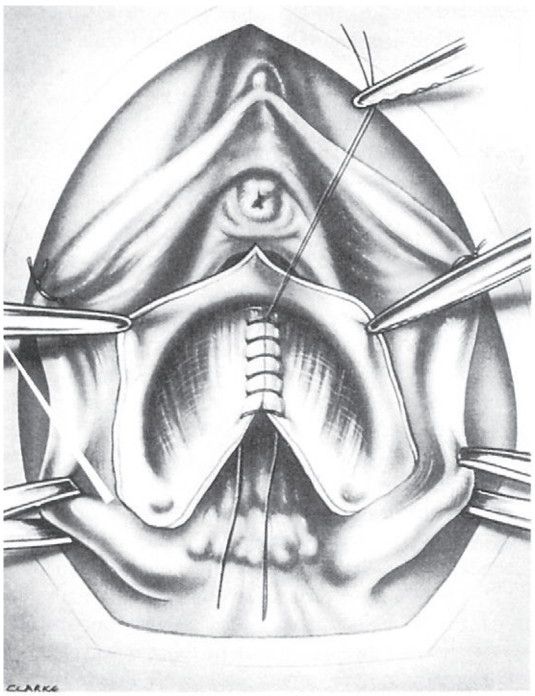

Fig. 22.13: Operation for secondary repair of a complete perineal tear. The rectum is now repaired by means of interrupted sutures. The upper end is left long and acts as a retractor.

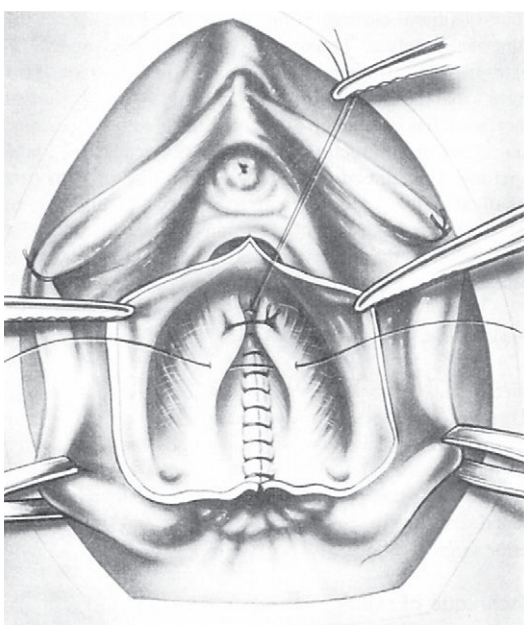

Fig. 22.14: Operation for secondary repair of a complete perineal tear. A second layer of interrupted Lembert sutures is now introduced through the muscle wall of the rectum, this repairs the internal sphincter.

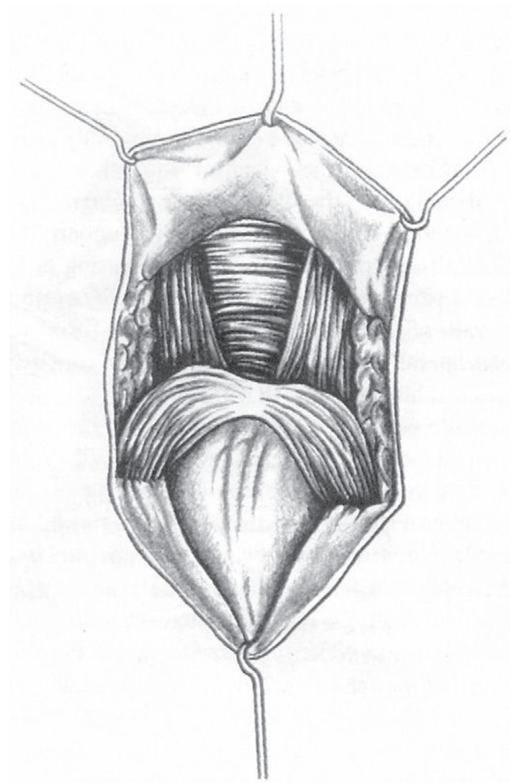

Fig. 22.15: Anal sphincter repair: arc of scar tissue displayed; a "cap" of scar must be left on each muscle end to prevent sutures cutting out.

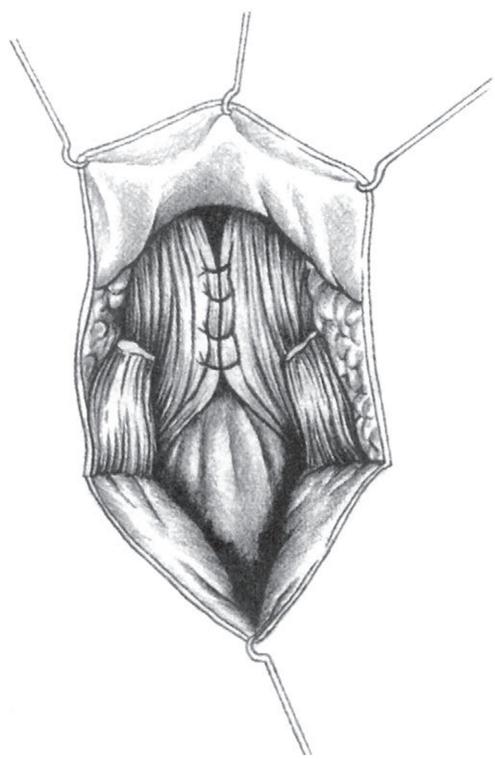

Fig. 22.16: Anal sphincter repair: the pubococcygeus muscles are approximated before sphincter reconstruction; the ends of the divided external sphincter are mobilised to allow union without tension.

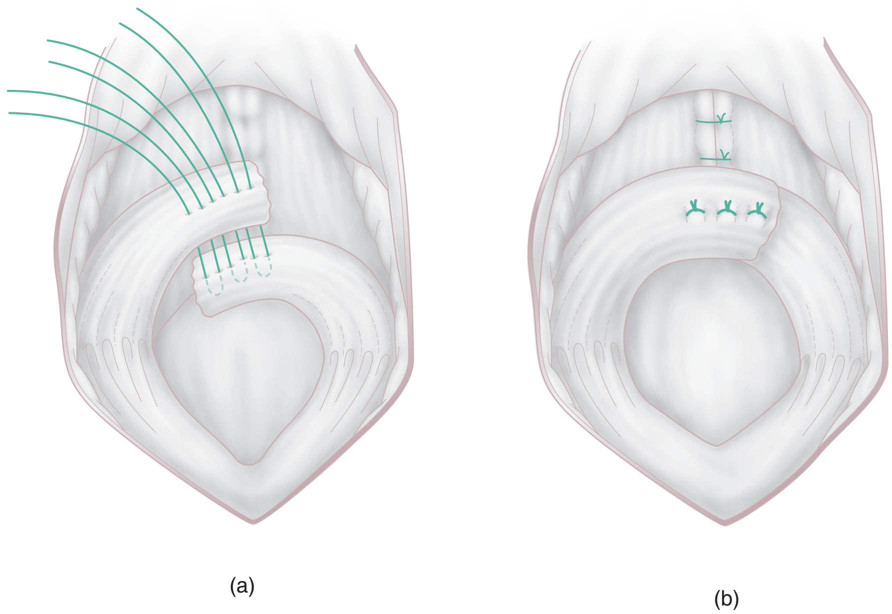

Fig. 22.17: Anal sphincter repair with the overlapping technique. The remainder of the perineal body must then be built up for support: **(a)** front tier of sutures, **(b)** overlap secured.

help to reconstitute a deep part of the external sphincter, which is normally continuous with the puborectalis sling.[7,8] The apex of the wedge of the perineal body is then reconstituted, which will help to take some of the strain off the sphincter muscles when they are approximated. It is important not to leave a gap between the united pubococcygeus muscles and the cranial end of the reconstituted anal sphincter.

An overlapping repair of the external sphincter is then carried out with six interrupted sutures in two banks (Fig. 22.17). This has been shown to be superior to juxtaposition repair. High polymer sutures (i.e. vicryl) are probably adequate, although many colorectal surgeons will use PDS or unabsorbable material. The remainder of the perineal body is then reconstituted. At this stage, the original skin incision over the perineum may be so distorted that it will not marry up for closure. This is of no great importance as any raw area will granulate and epithelialise. Some surgeons will employ drainage to the area, and a soft tube through the anus may help prevent the build-up of gaseous pressure. If the reconstituted anus is extremely tight, the tension may be relieved by a posterolateral sub-cutaneous sphincterotomy, which ordinarily heals well without leaving a functional defect. However, instinctively one would prefer to avoid this.

Postoperative Management

In order to prevent disruption of the suture line by hard faecal masses, the faeces must be kept soft. This is in contrast to the former teaching that the bowels should be confined for 5 days. When a preliminary colostomy has been raised, hard faecal masses must be removed from the descending loop before operation for the same reason. Liquid paraffin is better avoided as it tends to "creep" along the sutures. Routine use of a defunctioning stoma has been shown to be of no benefit.[9]

Intestinal Fistulae

Rectovaginal fistula and perineal trauma due to obstetric injury were formerly dealt with by gynaecologists, although intestinal fistulas due to other causes have largely been the remit of colorectal or general surgeons.[5] Increasingly, joint teams deal with both obstetric and gynaecology related fistula.

Intestinal fistula has a wide range of aetiology; inflammatory bowel disease being an important factor that may sometimes be overlooked. As with urinary fistula, other factors may be present in addition to surgery. The possible association of infection (e.g. schistosomiasis, amoebiasis, tuberculosis, actinomycosis or lymphogranuloma venereum) needs to be borne in mind with intestinal fistula. Colorectal as well as gynaecological surgery is responsible for iatrogenic fistula, especially from low-stapled anastomoses.

In the developing world, in rural communities where maternity services are scarce or totally lacking, neglected obstructed labour is responsible for serious maternal genital injury, which provides a significant part of the workload of gynaecological services.[10,11] Most of these injuries are due to pressure necrosis and sloughing of the genital tract and adjacent organs. Vesicovaginal fistula is the most common; Harrison gave a good review of the problem in West Africa.[12] The sufferers are commonly little more than children, and their misery is utter.[13] Permanently incontinent and smelling strongly of urine, the sufferer in a polygamous society is consigned to a matrimonial "scrapheap". The extent of the problem is certainly underestimated.[14]

In the worst obstetric cases, there will be a double fistula producing both urinary and faecal incontinence. Furthermore, the genital tract itself may have been so destroyed as to render future coitus impossible, let alone reproduction, even where the fistula can be closed.[15]

PATIENT SUPPORT

Support is essential for the optimum management of fistula patients. The close involvement of clinical nurse specialists is important; in some cases (particularly in the acute setting), a defunctioning stoma may be required prior to definitive surgery. The expertise of a stoma nurse specialist will therefore be required. With shattered morale and a poor state of health, these individuals need counselling and care, both before and after surgery.

In a proportion of women, repair of a fistula is at first unsuccessful and maintenance of morale in the face of such disappointment can be extremely difficult. Patient support groups run by successfully treated women are invaluable.[16]

DIAGNOSIS AND ASSESSMENT

A correct diagnosis and full functional evaluation are essential to the selection of appropriate treatment. For instance, although a post-surgical fistula may be the immediate problem, the indication for the original surgery may be very relevant and reflect an underlying disturbance of micturition or defaecation. Although, as an obstetric complication, intestinal fistula is much less common than urinary tract fistula; abnormal communications between the bowel and the genital tract show a wide range of complexity and aetiology.

Treatment of enterocutaneous fistula should concentrate initially on correction of fluid and electrolyte imbalances, drainage of collections, treatment of sepsis and control of fistula output. Malnutrition is common, and nutritional assessment and provision are essential as used in the management of patients with intestinal failure.[17]

Investigation and Imaging

Because of the range of possible sites and potential for complicated para-intestinal abscess cavities and intrinsic intestinal pathology, prior investigation by imaging, endoscopy, examination under anaesthesia with probes and, where relevant, tissue biopsy is essential. Inflammatory bowel disease is a very important factor in several types of intestinal fistula and may be a contributory factor in fistula attributable to surgery or even radiotherapy. Assessment prior to repair may include:

(a) Examination under anaesthesia—the most accurate diagnostic measure for anorectal fistula.
(b) Magnetic resonance imaging and computed tomography (CT) to delineate fistula tracts, abscess cavities and fibrotic extension rather better than ultrasound, particularly those with complex or recurrent disease.
(c) Flexible endoscopy or CT colonography, which has largely replaced double contrast barium enema, are important when there is a need to exclude significant colorectal pathology, e.g. neoplasms, diverticular disease and inflammatory bowel disease.
(d) Retrograde colpography is sometimes helpful with the vagina occluded by a balloon catheter.
(e) Contrast radiological follow-through studies on the small bowel may be helpful when irradiation enteritis, Crohn's disease or other small bowel pathology is suspected. This is primarily to assess the status of the bowel, and when appropriate to detect stricture or subacute obstruction. In the acute situation, this has been replaced on the whole by CT with oral water-soluble contrast (in particular when a perforation or anastomotic leak is suspected) and MR small bowel enteroclysis (Fig. 22.19) in the elective setting. Endo-anal ultrasound has been regarded as the gold standard imaging modality for the evaluation and classification of peri-anal fistulas in Crohn's disease.[18]

Identification of Fistula Site

Genital fistula from the intestine may involve the Fallopian tube, uterus or vagina (either directly or across an abscess cavity in the pouch of Douglas, which has drained through the posterior fornix). Within the peritoneal cavity, any mobile loop of bowel may be involved, particularly terminal ileum or sigmoid colon. The rectum may be involved at or below the peritoneal reflection of the floor of the pouch of Douglas.

A **high rectal fistula** is situated above the level of the puborectalis muscle and is almost invariably associated with incontinence (Fig. 22.18).

A **low rectal fistula** is technically anovaginal, but in practice the anterior wall of the anal canal in females is so much shorter than in the male that a fistula here is conveniently described as low rectovaginal unless it traverses the anal sphincter in the intersphincteric space, in which case such a fistula is referred to as anovestibular or anovulvar. A low fistula of inflammatory origin is merely an example of the common condition of fistula-in-ano, in which orifices may open around the circumference of the anus, but usually in the midline.

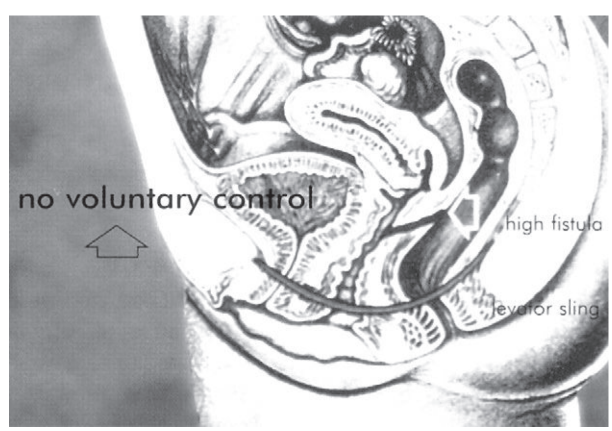

Fig. 22.18: High rectovaginal fistula: a diagram of the relationship to the puborectalis muscle.

INFLAMMATORY FISTULA

Ulcerative Colitis

A low rectovaginal fistula may be associated with ulcerative colitis. This is essentially non-specific and may be seen with any chronic diarrhoeal state. The treatment cannot be separated from that of the whole colonic disease, and local treatment is only appropriate during a quiescent phase.

Crohn's Disease

Anal fistulae, as well as those from the small bowel, are common in Crohn's disease (Fig. 22.19). Specific histological changes of Crohn's disease will often be found in the anal canal and fistula track. Such a fistula may heal occasionally with medical treatment for the Crohn's disease (for example anti-TNF alpha monoclonal antibodies and topical metronidazole[19]) provided any acute sepsis is drained. Early surgical treatment of suppurative perineal conditions has been found to reduce the risk of subsequent complications requiring proctectomy.[20] Attempts at surgical repair of rectovaginal fistula will continue to be unsuccessful if there is any evidence of local disease activity. Recent developments including the use of fibrin glue and anal fistula plugs have had limited benefit despite initial promising results.[21] Active anal Crohn's disease is very painful and a cause of severe dyspareunia, and even apareunia. Abdomino-perineal excision of the rectum may occasionally be required, but there are often problems with healing. This is particularly the case if there is any surgical or inflammatory involvement of the vaginal epithelium. Crohn's granulations can, of course, affect the vulva producing a chronic vulvitis. The appearance of a postoperative fistula may even be the first overt manifestation of hitherto occult Crohn's disease.

It is important that these patients are managed in conjunction with a gastroenterologist and surgeon with a special interest in inflammatory bowel disease.

Lymphogranuloma Venereum

Rectovaginal fistulae are quite commonly associated with the severe anorectal strictures of this disorder, curiously often below the stricture. Even if there is sufficient bowel lumen to allow faeces to pass were the fistula to be closed, there is often such severe fibrosis and damage to the sphincter that continence has been lost. There may then be no realistic alternative to diversion, often with abdominoperineal excision of the rectum.[22,23] Impairment of local blood supply with this condition renders the success of surgical treatment of fistulae extremely low. There is commonly an associated urethral loss with a characteristic sub-urethral 'hood' (Fig. 22.20).

Tuberculosis

Most cases of intestinal fistula associated with tuberculosis result from surgery on chronic adnexal tuberculosis with gross adhesions; often without the true nature of the infection having been appreciated. Prior treatment with antituberculosis therapy is essential before surgery is undertaken. Urinary fistula due to

Fig. 22.19: Contrast small bowel MRI of a patient with Crohn's disease with terminal ileal stricturing.

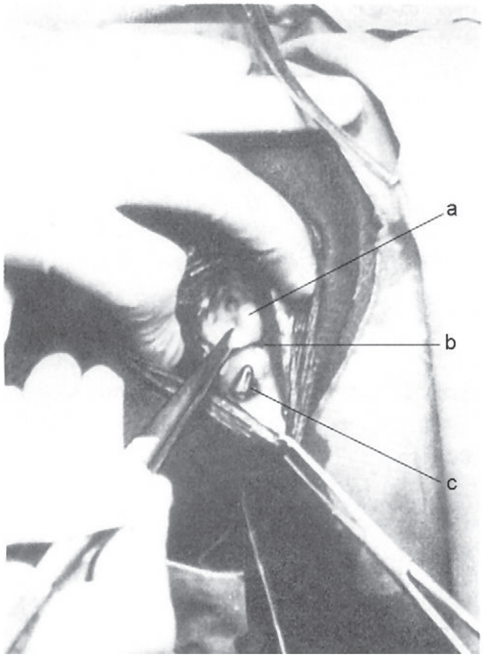

Fig. 22.20. Lymphogranuloma venereum with rectovaginal fistula. Urethral destruction with formation of a suburethral "hood" (a) urethra with sub-urethral hood, (b) vagina, (c) rectovaginal fistula.

tuberculosis is rare and usually secondary to tuberculous cystitis.[24,25]

Actinomycosis

Fistula from this rare infection has become rather more common as a result of an association with the use of intrauterine contraceptive devices. The occurrence of unilateral tubo-ovarian abscess in a patient with an intra-uterine device is highly suggestive of actinomycosis.

A complicated fistula between loops of bowel, rectum, oviduct and posterior vaginal fornix may be present. Even if culture is negative, the appearance of 'sulphur granules' in the pus may be diagnostic.

The occurrence of a faecal fistula following appendicectomy may suggest the presence of this infection in the ileocaecal region.

Amoebiasis

Rectovaginal fistula has been described and may heal spontaneously with medical treatment.[26]

Diverticular Disease

A peri-colic abscess, arising from diverticular disease of the sigmoid colon adherent within the pelvis, can perforate the posterior vaginal fornix. More commonly, however, it is seen fistulating into the vaginal vault after hysterectomy presenting as a colovaginal fistula (Fig. 22.21a). This can occur in the elderly with minimal constitutional disturbance and the resulting incontinence attributed to senility. When the perineum is soiled with faeces, it requires an astute observer to realise that the faeces are accumulating in the vagina from above rather than from below. Once the benign nature of the underlying condition has been established, resection of the diverticular segment and anastomosis ordinarily gives good results.[27]

Colo-Uterine Fistula

If a sigmoid loop is densely adherent to the back of the uterus, a peri-colic abscess may form within the myometrium and discharge into the endometrial cavity. This possibility should always be considered if there is a strong clinical suspicion of a faecal vaginal fistula without even a small sinus high in the posterior fornix.

MALIGNANT FISTULA

Malignant fistula arising from primary cancer of the cervix or vagina must be managed as part of the treatment of the malignancy. For an intestinal fistula, colostomy may be considered palliative; often there is an associated urinary fistula, which colostomy will not relieve. Even an advanced carcinoma of the cervix may, however, respond to radiotherapy with local control of the disease, in which case the management appropriate to an irradiation fistula can be applied (see below). For malignant fistula of intestinal origin, posterior exenteration may be justified even for palliation.

In the terminal stages of pelvic cancer, a malignant fistula is extremely distressing. Aside from the local perineal skin irritation, the sufferer is acutely aware of an offensive smell. This causes acute distress not only to herself but impacts on her loved ones and visitors.[28] Colostomy may benefit patients but consideration should be given to the possibility of palliative lower partial colpocleisis. If the intestinal fistula is colonic, there is commonly a stricture at the apex of the sigmoid colon. It may be appropriate in some cases to fenestrate the anterior

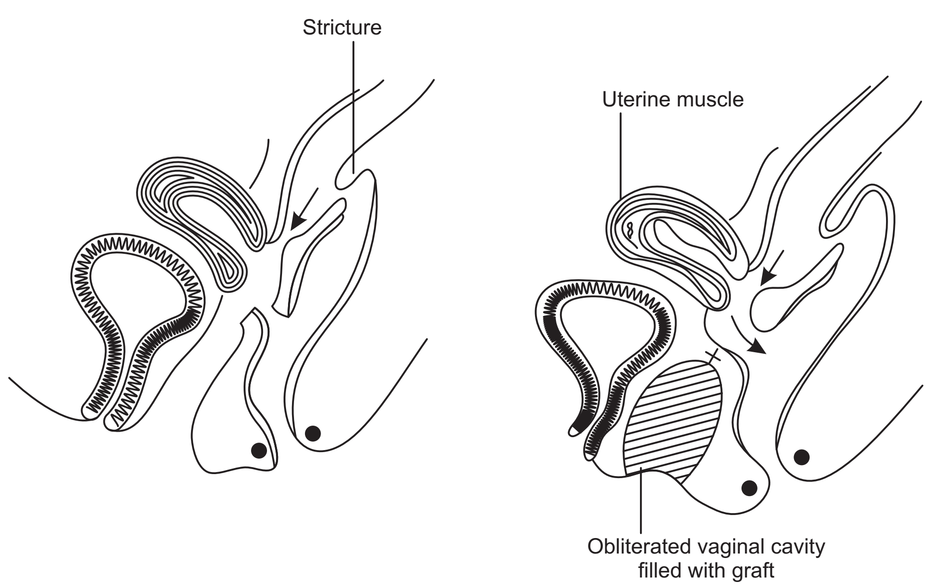

Fig. 22.21: **(a)** Colovaginal fistula: there is often obstruction distal to the fistula; **(b)** diagram of lower partial colpocleisis with by-pass by rectal fenestration shown.

rectal wall to allow the matter from the upper vagina to discharge into the rectum (Fig. 22.21b). If feasible, this measure can improve the quality of life for a few weeks in the terminal stage. In the presence of active malignancy close to the vaginal closure, early break down is quite common, but sufferers may still opt for an attempt.

Radiation Fistula

A small bowel fistula will sometimes respond to nonoperative management, provided there is no distal obstruction and low output. However, those with high output fistula may need the support of a unit specialising in intestinal failure.[17]

Colpocleisis with an interposition graft (gracilis or bulbospongiosus) is the treatment of choice for irradiated rectovaginal fistula. This is much less of an undertaking than complex abdominal repair with a pedicled omental graft (see above).

The fistula must be reachable by a finger inserted per rectum. If this is not so, the faecal source is almost certainly the apex of the sigmoid loop and colpocleisis will lead to an accumulation of faeces in the upper compartment, which will inevitably break down. Sigmoid resection should be considered in the form of a Hartmann's procedure with end colostomy, as anastomosis of poor tissue will inevitably lead to anastomotic breakdown. Some cases may be treated by an additional rectal fenestration which, in effect, anastomoses the upper vagina end-to-side to the anterior rectum.

CONGENITAL FISTULA

Congenital abnormalities of the proctodeum can range from a minor forward displacement of the anus through to complete agenesis of the rectum.[29] In female infants, such anomalies are quite often associated with a track from the distal proctodeum to the vagina. The obstetrician and gynaecologist may well be the first specialist involved in consultation when a female neonate is discovered to have no visible anus. An immediate search should be made for a fleck of meconium at the introitus and pressure on the perineum may well expel a further bead. Various conditions need to be distinguished, and it is important that over-treatment at this stage should be avoided. Specialist imaging assistance should be requested.

(a) **Covered anus:** In this condition, there is a normally situated anal canal and sphincters. The surface is, however, covered by a flap of skin that extends via a tract to the vulval introitus. A probe inserted into the orifice will be directed immediately posteriorly by the subcutaneous plane.
This is the only situation suitable for an early 'cut-back' procedure.

(b) **Vestibular (ectopic) anus:** In this condition, there is a small anus distal to the hymen but within the confines of the navicular fossa. This anomaly needs no intervention other than digital dilatation, which the mother can be taught to perform. An operation for reposition of the anus may be carried out in adolescence if the condition is socially embarrassing.

(c) **Imperforate anus with low rectovaginal fistula:** In this anomaly, the distal anal canal is imperforate but the anal sphincters may be within the normal anatomical site. A low rectovaginal fistula is situated within the puborectalis sling and under no circumstances should be cut back as this may destroy any sphincter muscle that is potentially usable (Fig. 22.22). Dilatation may be all that is required in the first instance, but at a later stage sphincter mapping and relocation of the orifice may be required.

(d) **High fistula associated with rectal agenesis** constitutes a relative emergency, and colostomy is required. The puborectalis muscle in such cases is actually pubovaginalis and should certainly not be damaged by any attempt at perineal surgery. At a later date, an abdominal approach to identify the levator sling and to bring down distal bowel within its embrace may be carried out.

These are highly technical and specialised paediatric procedures, and the generalist gynaecologist would be wise to refer. It is well to remember that rectovaginal fistula in the newborn may be secondary to maternal infection with human immunodeficiency virus (HIV).[30,31]

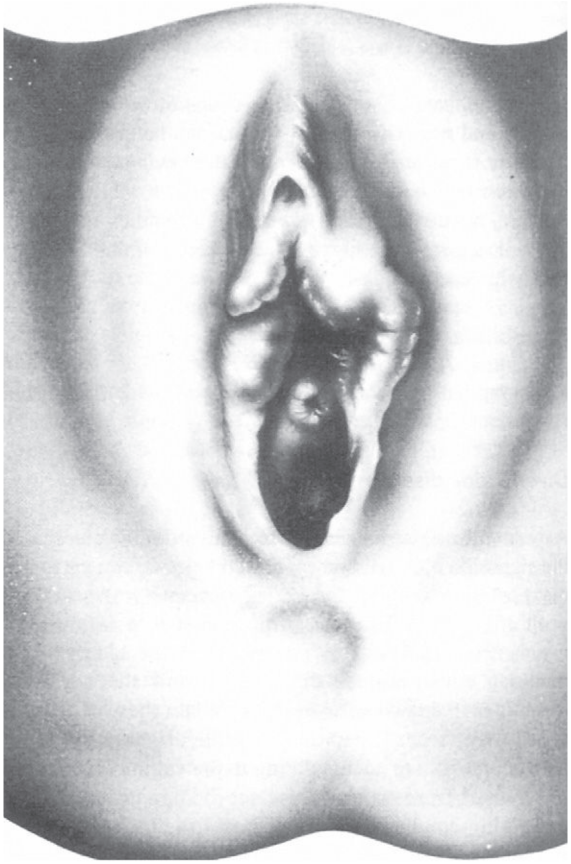

Fig. 22.22: Congenital imperforate anus. This patient had a persisting rectovaginal fistula following surgery for congenital imperforate anus on the second day of life.

TRAUMATIC AND OBSTETRIC FISTULA REPAIR

Preparation

Once a diagnostic work-up has been completed and the site, complexity and aetiology of the fistula determined, conservative surgery may be considered for traumatic or obstetric fistula. An experimental alternative to surgery in certain cases is the use of autologous fibrin glue.[32]

A good mechanical bowel preparation is essential, and may be preceded by a short period of residue reduction with an elemental diet. In some cases, parenteral nutrition may be indicated. Faecal diversion may be indicated for difficult or recurrent fistula (see below). Mechanical bowel preparation is required even if faecal diversion has been carried out.

It is well to remember that in the elderly, severe purging can produce dangerous dehydration.

Abdominal Route for Repair

Ileal or Colonic Fistula

A fistula involving free loops of bowel adherent within the pelvis is best treated by resection and anastomosis. In this way, the blood supply and integrity of the tissues may be assured. Attempts to excise the track and close the aperture may place the lateral ends of the wound under excess tension and compromise the lumen by the inversion of "dog ears".

High Rectovaginal Fistula

When centrally placed, such a fistula may be repaired by separation of the bowel and vagina, excision of scar tissue and closure in layers. Commonly, however, such a high obstetric fistula is adherent posterolaterally in the pelvis. Retro-rectal mobilisation (as in radical oophorectomy, see Chapter 17) may be helpful to expose the fistula and allow repair[33] (Fig. 22.23). Alternatively hysterectomy has long been recognised as aiding access to the inferior margin of the fistula, which is always difficult in such cases. Even this, however, can be difficult and dangerous after a major obstetric slough injury in which the pelvis has become a cartilaginous sheet of scar tissue. Under such circumstances,[2] sub-total hysterectomy is advocated, followed by median sagittal fissure of the cervix, which gives access to the upper vagina without endangering the structures in the fornices (Figs. 22.24, 22.25). This approach may be particularly suitable in those cases with traumatic amenorrhoea in which most of the substance of the uterus has been lost and there is only a median bar of scar tissue without endometrial cavity. The possibility of hysterectomy should always have been discussed in advance, and may not be acceptable. There have been technical advances, whereby repairing high rectovaginal fistula has been proven to be feasible, once tissue planes are identified.[8]

High Rectovaginal Fistula with Distal Circumferential Rectal Loss

If the distal anorectal stump is completely sealed off, anterior rectal resection of the damaged section with colo-anal anastomosis is required either using a circular stapler or, for very low lesions, a hand sewn colo-anal anastomosis. Resection and anastomosis using bowel from outside the treatment field may be suitable for post-irradiation rectal fistula (see also below).

Vaginal Route for Repair

High Fistula

Provided there is reasonable access from below, and if the fistula is not adherent to bone, a rectovaginal fistula high in the posterior fornix should be repaired by the vaginal route. Dissection should be continued between the rectum and the posterior uterine wall until the pouch of Douglas is reached

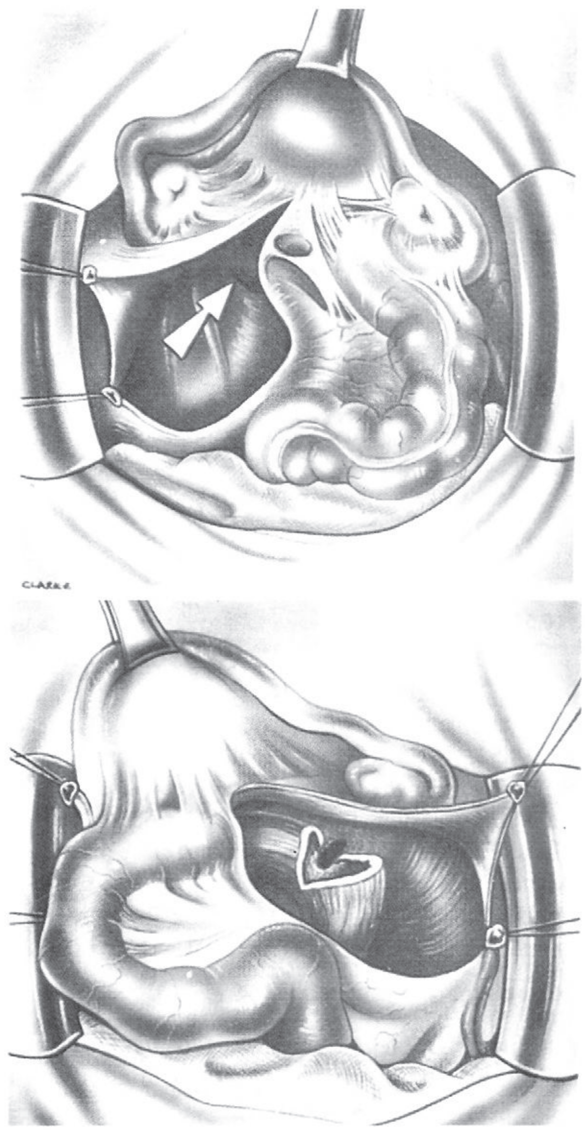

Fig. 22.23: High rectovaginal fistula: transabdominal repair. Access for the abdominal repair of certain high rectovaginal fistulae may be achieved by mobilisation of the rectum from the hollow of the sacrum and the vagina anteriorly, an approach similar to that used in radical oophorectomy (see Chapter 17).

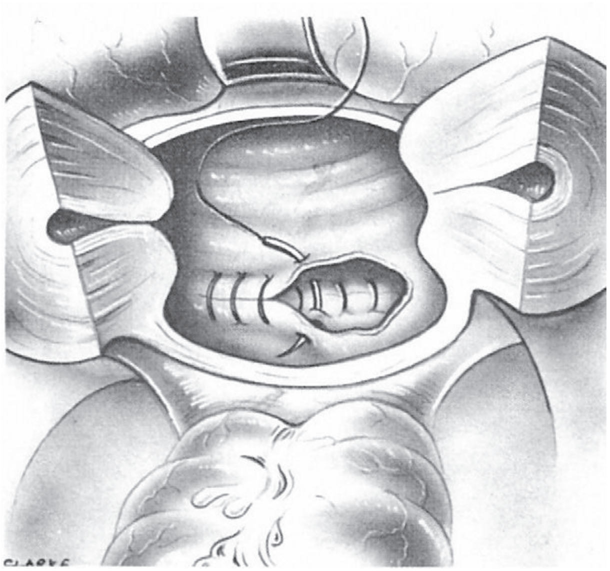

Fig. 22.24: High rectovaginal fistula: splitting the cervix after sub-total hysterectomy exposes the fistula (after Lawson[2]).

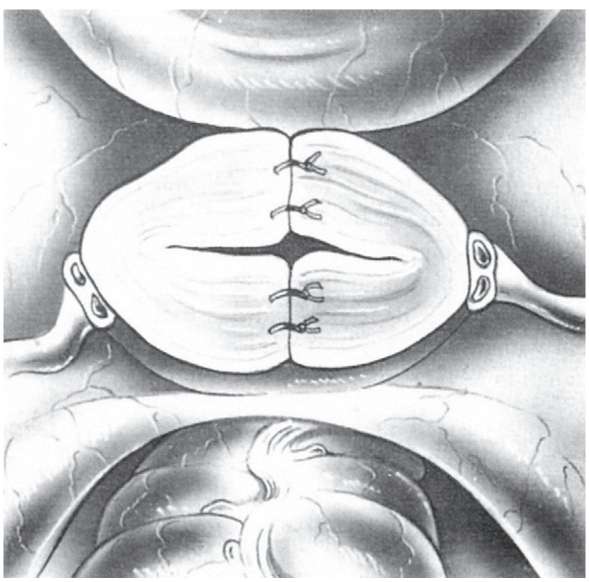

Fig. 22.25: High rectovaginal fistula: the cervix may be re-united after closure of the fistula.

(Figs. 22.26, 22.27). This will allow peritoneum-covered rectum to be brought down for transverse closure of the fistula without tension. The serosa of the front of the rectum may be tacked to the back of the cervix to close off the pouch of Douglas. It is commonly impossible to close the vaginal defect, but this does not matter as peritoneum-covered rectum will rapidly undergo squamous metaplasia (Fig. 22.28).

Mid-Vaginal Fistula

The technique of repair with flaps is identical to that described for vesicovaginal fistula (see Chapter 21). During the initial

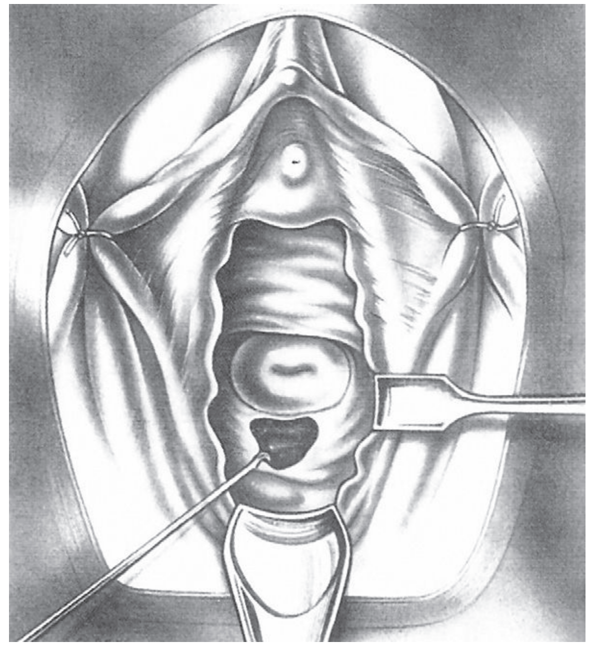

Fig. 22.26: High rectovaginal fistula. Traction on the inferior margin demonstrates a fistula high in the posterior fornix.

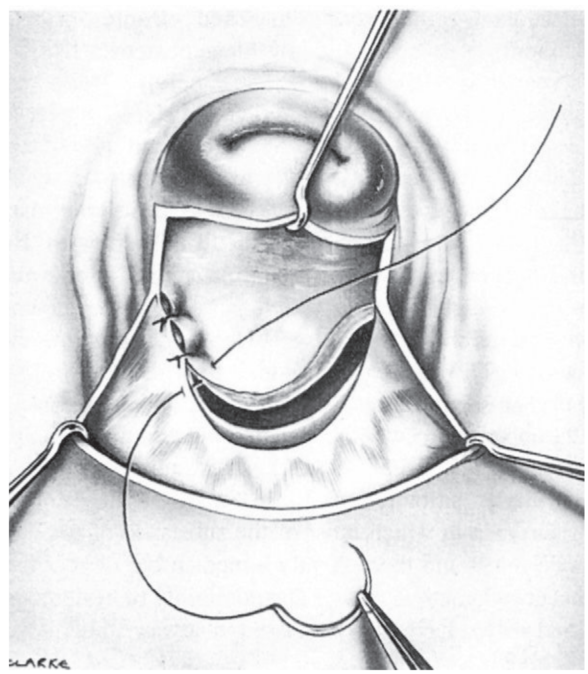

Fig. 22.27: High rectovaginal fistula. After opening the pouch of Douglas, peritoneum-covered bowel wall is brought down to close the rectal defect. Fat tags are not usually visible (after Lawson[2]).

dissection, elevation of the fistula by a finger in the rectum can be very helpful.

Trans-anal Approach

In the presence of severe gynaetresia such as may occur after a successful closure of a vesicovaginal fistula, a per-anal approach

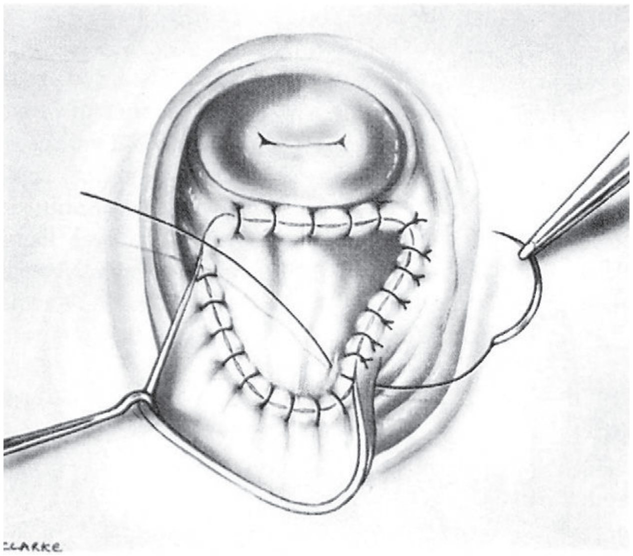

Fig. 22.28: High rectovaginal fistula. As there is insufficient vaginal wall to close the defect, the serous coat of the bowel forms a new posterior fornix (after Lawson[2]).

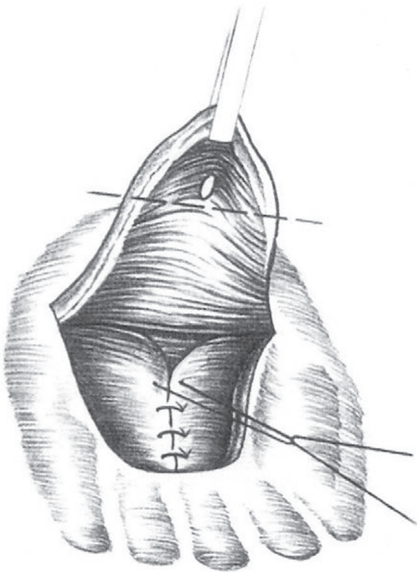

Fig. 22.30: Rectovaginal fistula: transrectal advancement flap; the muscle layer must be closed.

may be considered. The operation is performed in the face-down or 'jack-knife' position, using a flap-advancement technique via a Parks' or Eisenhammer speculum. A "U" shaped incision creates a superiorly based flap of full thickness bowel wall, which includes the fistula at its tip. The fistula is excised, a separate closure of the muscle layer carried out and a flap of healthy bowel wall is advanced to replace the damaged area (Figs. 22.29, 22.30, 22.31), leaving a suture line which is no longer in apposition to the vaginal aperture that is left unclosed. There is a tendency to leak from the angles. This method is not recommended for a recurrent fistula[34,35] and is not suitable for

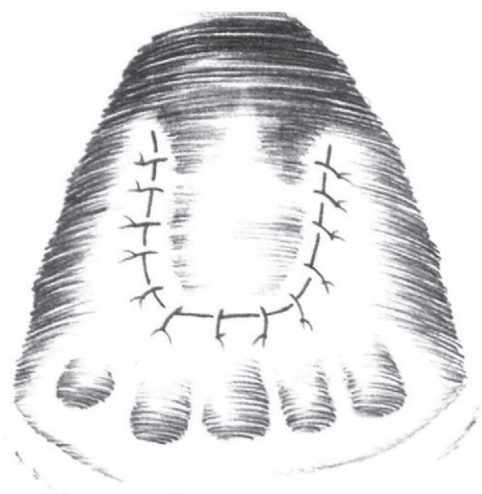

Fig. 22.31: Rectovaginal fistula: mucous membrane closure after excision of the fistula.

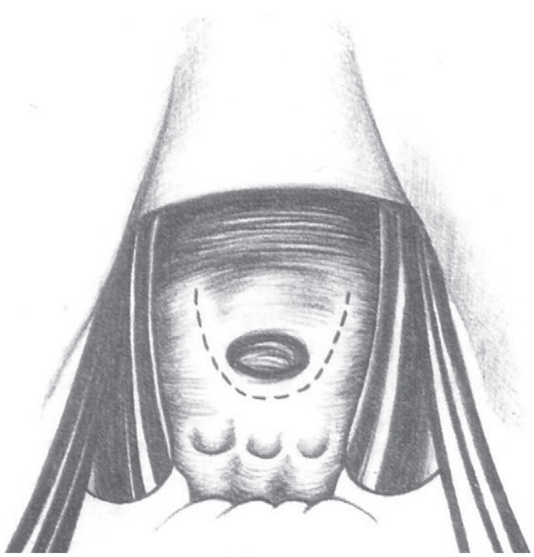

Fig. 22.29: Rectovaginal fistula: per-anal view in "face-down" position.

a fistula at or below the dentate line as there is a risk of creating a "wet anus".[36] A trans-sphincteric approach has been utilised by York Mason,[37] in which a posterolateral radial incision of the anus is utilised for access and subsequently repaired. This may, however, be undesirable in the presence of obstetric damage to the perineal body and anal sphincters in that region.

Low Fistula

A small low fistula is often associated with incomplete healing of perineal lacerations and sphincter damage. Sometimes, the perineal body may be represented by no more than a bridge of scar tissue. Under such circumstances, the bridge and fistula track should be excised and cut back to healthy tissue on either side so that a formal complete perineal tear repair may be carried out (see below including external sphincter reconstruction). It is often an advantage in such cases to add, where possible, a pubococcygeus approximation between the vagina and the repaired anorectum.

A small fistula may be approached directly through the vagina, or through the skin of the perineum entering the fistula in mid-track. It is important that all granulations and abscess cavities should be excised. Small tracks may be inverted into the rectum using a purse-string suture.

A small very low fistula may be laid open and allowed to heal. If continence is already impaired and a fistula is associated with an external anal sphincter injury, laying open of the fistula tract can be combined with a formal sphincter repair.

FAECAL DIVERSION

Diverting operations are the last resort when conservative surgery for fistula is impossible or fails.

Temporary Faecal Diversion

Faecal diversion by temporary loop ileostomy or colostomy is often advocated prior to complex proctological procedures. There is little evidence, however, that it adds to the success of vaginal repair of rectovaginal fistula, sphincter repairs or even of abdominal repairs in the absence of diseased bowel or some other complicating factor. The main exception to this view must be the presence of a double fistula of obstetric origin. Diversion of faeces from the vagina prior to repair of the urinary fistula is recommended. Simultaneous repair should only be undertaken if it is quite apparent that no undue tension will be put upon suture lines. Transverse colostomy has been advocated prior to the abdominal repair of a complex irradiation fistula.[9,38,39] Left iliac colostomy may inhibit mobility and access for subsequent pelvic surgery.

Inflammatory bowel fistulae may sometimes be amenable to local surgery if the disease is in full remission, particularly after prior diversion (including ileostomy).

Temporary Colostomy or Ileostomy

This should ideally be situated in the sigmoid colon or terminal ileum. Transverse colostomies are associated with increased prolapse rates and other stomal complications that affect patient quality of life and should be avoided if possible.

Laparoscopic approach affords the optimal view to ensure suitable bowel is identified and orientated appropriately. It can also be undertaken as a trephine through a small open incision. The site of the stoma should be marked by a suitably trained specialist such as a stoma nurse specialist after appropriate counselling. The site will vary dependent on previous scars, body habitus and type of stoma. This is undertaken with the patient standing and sitting to ensure that it is not sited in skin creases and not below the apron of the abdomen in more obese patients so that the stoma cannot be seen.

Sigmoid or Transverse Colostomy

After the appropriate loop is identified, the skin at the marked stoma site is incised and dissection continued down to the anterior rectus sheath. The anterior rectus sheath should be incised using a cruciate incision before the muscle is split in the line of its fibres. The relevant loop is delivered and supported over a stoma bridge (Fig. 22.32).

In forming a transverse colostomy, the part of the greater omentum attached to the exposed portion of the colon should be excised, or stripped off the colon and returned to the peritoneal cavity. A transverse incision should be made across the colon and the intestinal wall everted and sutured with interrupted vicryl to the skin (Fig. 22.33). Some surgeons use a longitudinal incision. The patency of the bowel must be checked by digital examination.

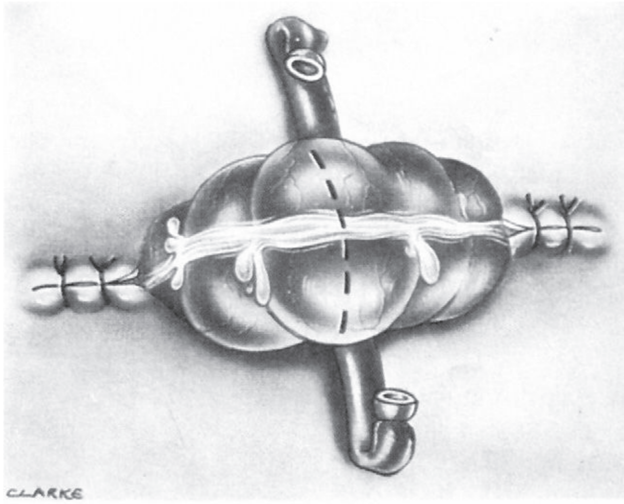

Fig. 22.32: Colostomy formed over a stoma bridge prior to transverse incision.

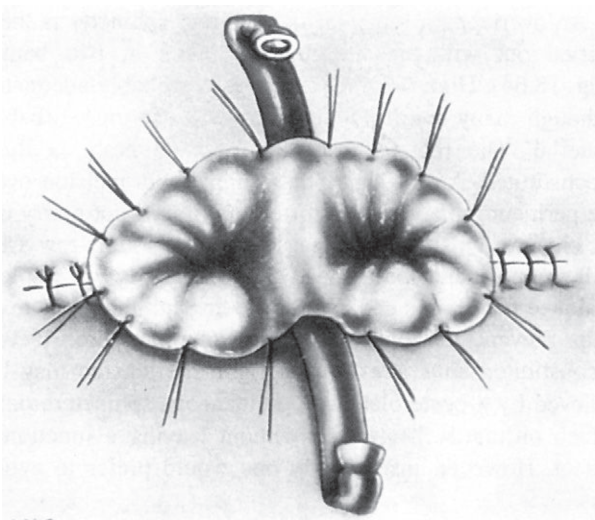

Fig. 22.33: Colostomy. After a transverse incision, the bowel is sutured to the skin using full thickness interrupted sutures.

Closure of Temporary Colostomy

The edge of the bowel must be separated from the skin and the deeper part of the wound through the rectus sheath into the peritoneal cavity. Stay sutures should be inserted through the mucocutaneous junction to act as holders to aid retraction during the mobilisation of the colostomy. The edges are freshened and then closed, using interrupted single layer seromuscular vicryl sutures. A second layer is not required. The rectus sheath is closed using PDS or Nylon. The wound in the abdominal wall is closed in the usual primary manner, or partially closed using a subcuticular prolene purse-string. This latter technique may improve cosmesis and reduce wound sepsis rates but will require daily dressings until healed.

Permanent Colostomy

A single-barrelled sigmoid or descending colostomy will be necessary as a permanent diversion whenever posterior exenteration is carried out. It is also a feature of Hartmann's operation. A disc of skin should be excised and beneath it a disc of external oblique aponeurosis. The divided end of sigmoid should be drawn through to skin level, and the bowel wall should be sutured to the skin with interrupted absorbable sutures (Fig. 22.34).

Perioperative Antibiotic Prophylaxis

One dose of broad-spectrum antibiotic prophylaxis including anaerobic cover is required perioperatively.

Care of the Stoma

The management of a stoma requires devotion and skill on the part of the nursing team, which should include a stoma nurse specialist. The institution of the career grade of "stoma therapist" reflects an appropriate emphasis on this aspect. Not the least of the problems to be dealt with is the psychological reaction of the patient, but this is much less of a problem when the stoma is only temporary.

A detailed description of stoma care is beyond the scope of this work,[40] but the reader is reminded that a stoma is amenable to digital examination and this avenue should not be neglected whenever diagnostic problems arise in such patients.

Defaecation

Constipation is to be avoided, as is early purging. It is better that a soft formed stool be passed a few days after the operation. Liquid paraffin is better avoided because of an alleged tendency to "creep" along sutures. Stools should be kept loose for 2 weeks if a sphincter repair has been carried out.

Postoperative Pain Relief

Prescribed opiate analgesia should be pethidine rather than morphine, as the latter increases the risk of constipation, which in turn increases intraluminal tension and may strain suture lines.

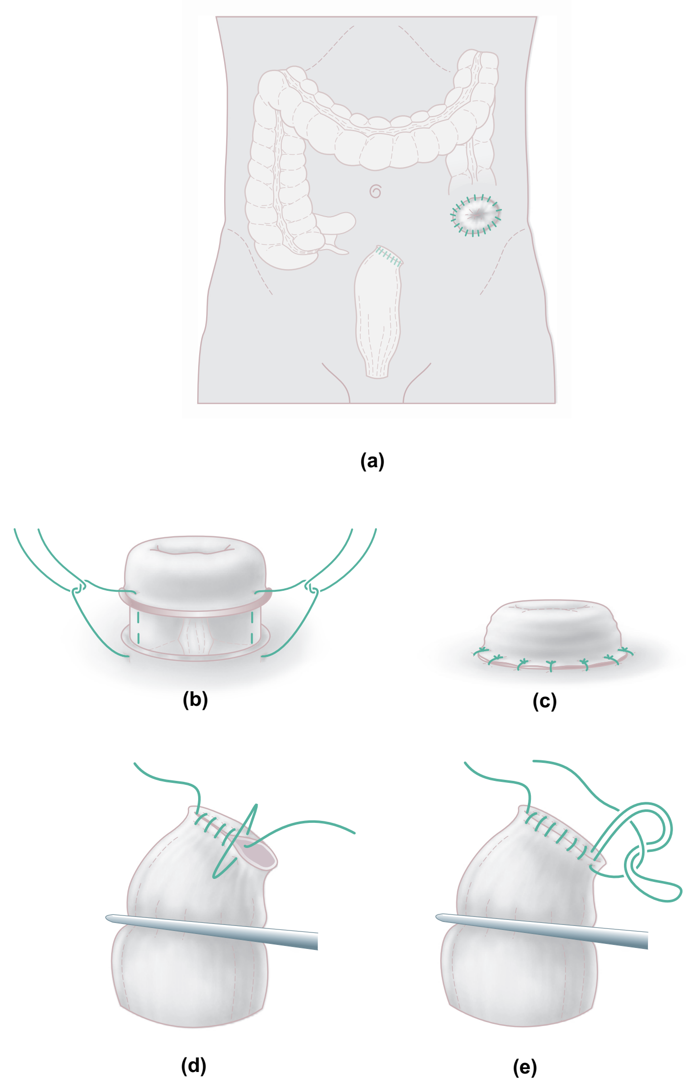

Fig. 22.34: Hartmann's procedure with an end colostomy (a,b,c). Following the stoma formation, the distal rectal stump can be oversewn (d,e) and left in the pelvis. If the stump is long enough, it can be brought out as a mucous fistula.

Test of Closure

A test of closure should be performed before any colostomy is closed, and reconstructive surgery on anal sphincters may be necessary in some cases.

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Consent to Treatment—A Personal View

A Pre-surgical Formality or the Crux of Doctor–Patient Relationship?

23

Bertie Leigh

The Direction of Travel

It is almost a century since an American Judge uttered the words that were unremarked by English observers at the time but which have since proved to be of seminal importance:

> 'Every human being of adult years and sound mind has a right to determine what shall be done with his own body; and a surgeon who performs an operation without his patient's consent commits an assault, for which he is liable in damages'[1]

These words point to two issues that have evolved over the years. The first is that a patient's autonomy is fundamental. Second and more broadly, not only are doctors not above the law but there are no special laws for doctors. In this chapter I want to use the development of the law of consent to treatment to explore the relationship between the doctor and the patient, and the role of the doctor in the patient's life as it is still evolving today. Law is closely bound up with other aspects of society. In the last 100 years we have seen a revolution in the safety and predictability of medicine and so our expectations of our doctors. We have also seen a transformation in the understanding of medicine by the laity. The role of the doctor and the expectations of the patient have naturally evolved to fit these changed circumstances.

The narrow right to bodily integrity has developed as a feature of English law from the ancient law of assault, or trespass to person. In the celebrated case of the conjoined twins in which the English Court of Appeal had to decide whether it was lawful to undertake an operation which it was known would inevitably cause the death of one of the patients, Lord Justice Robert Walker said:

> 'Every human beings right to life carries with it, as an intrinsic part of it, rights of bodily integrity and autonomy – the right to have ones body whole and intact (on reaching an age of understanding) to take decisions about one's own body.'[2]

However, the vast majority of the problems that doctors encounter in this area now arise in the tort of negligence. This is because the doctor seeking the patient's consent incurs a duty to give advice about all of the implications of the decision. The law of negligence demands that the doctor will mention any risk that a reasonable doctor in their position would mention. In English law, this principle was laid down in the case of Sidaway in 1985.[3] There it was said:

> 'The doctor cannot set out to educate the patient to his own standard of medical knowledge of all the relevant factors involved. He may take the view, certainly with some patients that the very act of his volunteering, without being asked, information of some remote risk involved in the treatment proposed, even though he described it as remote, may lead to that risk assuming an undue significance in the patient's calculations.
>
> It is a matter of clinical judgment to determine what degree of disclosure of risks is best suited to suit a particular patient to make a rational choice as to whether or not to undergo particular treatment.
>
> Whether or not failure to disclose a risk or cluster of risks in a particular case constitutes a breach of the doctor's duty is a matter to be decided principally on the basis of expert medical evidence. Having heard the evidence it is for the Judge to decide whether a responsible body of medical opinion would have approved of non disclosure in the circumstances of the case.'

The House of Lords found that a surgeon was justified in not warning Mrs Sidaway that she might be paralysed as a result of her spinal surgery. She was aged 63 and was to undergo a re-operation on her cervical spine. Her pathology was complex, involving a congenital fusion of C2/C3, a C5/6 stenosis which had been surgically fused in 1960 and now in 1974 she was to have a C4 laminectomy and a C4/5 facetectomy. The only imaging available was a myelogram. It was said that the risk of paralysis was 1%, which sounds optimistic.

Twenty years later, Miss Chester sued Mr Afshar in respect of the poor result from her spinal operation. By 1994, her risks must have been much lower than those contemplated by Mrs Sidaway: she was 10 years younger; she had not undergone previous surgery; the lesion in her lumbar spine was confined to the discs. The intervening 20 years had brought a revolution in imaging with the introduction of MRI and the risks had been further reduced as a result of advances in surgery and anaesthesia.

By any objective view the danger of paraplegia must have been greatly reduced. Yet, the defence did not even venture to argue the defence that succeeded 20 years earlier, namely that her surgeon was justified in failing to mention the risk of paralysis. Miss Chester's case was important for another reason. The expert evidence was that the risks of conservative management of her acute prolapse were greater than those involved in surgery. It was highly unlikely that she or any reasonable patient in her position would have refused to undergo surgery if she had taken a second opinion.

Miss Chester said she did not know what she would have done if she had been told of the risk. She was an educated woman and so must have known that there was a risk even if she underestimated its extent as a result of the advice of her surgeon. He was reported to have said '*I have never crippled anyone yet.*'

In theory, the Court still follows the *Bolam* test.[4] They have not followed the Australian High Court which found in *Rogers vs. Whitaker* that it simply did not matter what the expert evidence was.[5] Ms Rogers was a monocular woman whose non-functioning eye was causing her pain. She asked whether there was any risk to her good eye of having the non-functioning eye removed and the surgeon failed to mention the 1 in 14,000 risk of sympathetic endophthalmitis that is an auto-immune reaction to the surgery whereby the body destroys the remaining eye. The risk may be so rare that it had never happened to another patient in Australia and therefore no surgeon would mention it but in Australian law that is no defence. Here matters are slightly different. In *Bolitho,* the Courts reserved the right to reject expert evidence which does not stand up to analysis on the grounds that it cannot be respectable, but the test for breach of duty is still the *Bolam* test: a doctor acting in accord with a responsible body of opinion will not be negligent.[6]

Before the House of Lords, Miss Chester hoped the Courts would follow an Australian law which found in a case called *Chappel vs. Hart* that a patient who said she would have consulted other doctors would have been less likely to get her complication.[7] The House of Lords declined to follow this tenuous chain of causation. In reality, Miss Chester had to accept this risk sooner or later and it would have been about the same whenever she underwent her operation.

Nevertheless, the House of Lords said Miss Chester's autonomy was so precious that the surgeon who failed to mention that which should be mentioned became the insurer of the unmentioned risk. It was not necessary for the patient to prove that the failure to mention the risk had made any difference to the subsequent course of events. The Court simply would not explore the issues of causation.

Chester vs. Afshar has been widely criticised and if the matter were ever re-litigated it might well be over ruled or found to have been confined to its own facts.[8] Certainly, it has been found not to apply to advice given by barristers. By a remarkable coincidence, Miss Chester's own barrister turned up before the House of Lords as a litigant herself in the period between the oral hearing of Miss Chester's case and handing down the Judgment. Miss Jacqueline Perry had chosen not to mention a 50% risk that an application she proposed to make would fail, with catastrophic consequences for her client's case. The House of Lords said that there was still a respectable school of thought that believed a client paid a barrister for his advice rather than for his doubts, a remarkable difference in the attitude of the law to that exhibited to medicine.

However, even assuming the decision in Miss Chester's case was correct in England, it seems unlikely that it would ever be followed in Sub-Saharan Africa for a number of reasons and it is worth exploring those in trying to understand the difference in attitude to medicine in different countries.

First there is a much wider gulf between the knowledge of most patients and their doctors. In the rich countries of Europe, North America and Australasia, the playing field of knowledge between patients and their doctors has become much more level. Certainly there are arcane issues that have to be explained carefully to the most sophisticated patient, just as the modern gynaecologist has to be guided with care through the shoals and rocks concealed by the opaque waters of 'immunobabble', gene arrays and 'metabolomics'. But the educated woman of the West demands that her doctor apply the skills necessary to explain the relevant issues that will enable her to make a decision for herself. The ability to explain gynaecology to a patient is as much a part of the basic skill of the gynaecologist as the ability of the investigative specialist to explain the consequences of their research to their colleagues. In Africa, circumstances are very different: education in the rudiments of medical science is often as hard to acquire as effective medical care. However, I want to suggest that the structure of the obligation is similar, even if the details are different.

There are of course exceptions to these generalisations. Many people in England still lack access to the web and we have a significant illiteracy rate. Many lack the competence or inclination to understand the issues raised by their medical conditions. In Western Europe, the European Court of Human Rights has been asked to interfere in the affairs of countries where they have widely different attitudes to abortion. It has declined to do so, maintaining that the European Convention of Human Rights which has to balance both the right to life and the right to respect for private and family life, affords '*a margin of appreciation*'. In practical terms, this means that the Catholic countries of Southern Europe can ban abortion, whilst the Northern countries may permit it.

Similar problems were vividly illustrated by the widely different results of apparently similar interventions in predominately Hindu Orissa and similarly disadvantaged Islamic Bangladesh.[9] In both cases, a modest educational intervention in parturition aimed at reducing the perinatal mortality rate was introduced by teams led by Professor Anthony Costello from the Institute of Child Health in London. In the forests of Orissa there was a significant benefit as there had previously been in Nepal. By contrast, in the wetlands of Bangladesh, not only was there no benefit, but the intervention appeared to be positively disadvantageous. The precise reason for this discrepancy is not entirely clear but one view is that it is the consequence of the different nature of the patriarchal structure in both societies. It was less acceptable to the Islamic men of Bangladesh to have outside birth attendants advising their wives about parturition. If this explanation proves simplistic, the episode underlines the importance of shaping the intervention in order to suit the society. Whatever the expectations of the society in which you operate, the modern gynaecologist must recognise that the obligation to explain is a vital part of the armamentarium of the surgeon. The Sub-Saharan African woman needs knowledge if she has to survive the multiple threats posed by HIV and TB as well as obstructed labour. The doctor's obligation is to find ways of communicating with her effectively just as it is the obligation of the services to shape themselves so that they are fit for the purpose of meeting her needs, complicated as these will often be by practical difficulties created by illiteracy and a depleted transport infrastructure.

The obligation of the Western doctor is just as great. Too many doctors still think that '*consenting a patient*' is a brief exercise delegable to another on the day the patient is admitted as a day case. This overlooks the cardinal fact that except cancer the vast majority of gynaecological surgery is undertaken to remove symptoms that are uncomfortable and embarrassing rather than life threatening. A surgeon cannot experience a purely subjective symptom and has to rely on the description given by the patient; the patient is likely to weight her description of the symptoms according to her own enthusiasm for the surgery.

It is conventionally decreed by the English NHS that patients undergoing an operation should be counselled on the occasion when they sign the consent form by the surgeon or by somebody who is capable of performing the operation themselves. Personally, I think this is a mistaken view which devalues the importance of communicating with patients, which we should recognise is a speciality in itself often requiring specific techniques and aids. Those contemplating surgery may be challenged by extremes of age, intellect or disease-related difficulties. They may be illiterate and medically ignorant. They may speak a different language from the doctor. They may have different religious views, such as Jehovah's Witnesses whose refusal to accept blood transfusions can be very complicated and who may well be assisted in reaching their own decision if another witness is involved as a mediator or advisor.[10]

All these problems support the basic contention that communicating with people is a sophisticated business and the specialists in our society are often found in the advertising and teaching professions. Within medicine those trained as counsellors may be better at explaining what is involved to patients, even if they need the guidance of the surgeon in order to understand risks or aspects of the case which are specific to the individual patient.

The environment and the circumstances in which consent is sought are also important. Commonly the NHS patients are asked to sign a consent form for surgery on the day when they are admitted and today most people are admitted to hospital on the day when they are to undergo surgery, even if they are not to be treated as a day case. If they are not asked to sign a consent form on that occasion then it happens in the out-patient clinic when they decide to have the operation. A brief moment's reflection will demonstrate that this is not an optimal environment in which to take such a decision. First and foremost it is not always easy for the modern woman, at least in the English NHS to get to see a gynaecologist at all. She has to get an appointment with her GP, which is not always easy, especially if she has a job. She has to persuade her GP to make a referral to a specialist. She has to find time off work again, in order to keep the appointment. She may have to wait for several hours in the out-patient clinic. Inevitably the encounter with the gynaecologist seems to be a precious opportunity. In an insurance-based system the woman may feel that the operation is her right because she has paid for it in her insurance premiums. Her insurer may refuse to pay for her to have a second opinion or to come back at an interval to discuss the matter on a second occasion with her gynaecologist. The doctor may well have been running behind the clock by the time the interview takes place and there may be precious little time. Thus, the discussion often takes place when there are pressures to reach a decision swiftly. The doctor very often has a limited clinical armamentarium from which to choose. There may be a choice of surgical modalities to offer but ultimately, the surgeon has to decide whether to agree to perform the operation that the patient will already have discussed with her GP, her partner and her friends or to persuade her that it is not indicated. It is an on/off switch. Take for example, fibroid-related complaints which now account for 20% of appointments in benign gynaecology clinics. The surgeon usually only has a limited number of operative procedures to offer. Patients may have multiple symptoms and fail to appreciate that no procedure will address all the items on their list. He does not know how serious her symptoms are, save from what she tells him. If she has come determined to get the operation she is likely to describe those symptoms in emphatic if not exaggerated terms. If she wishes to avoid surgery, she may under-present her symptoms. The crux is that the dice are loaded in favour of the woman getting the specific surgical procedure appropriate to the symptoms that she describes.

In cases that I am instructed to defend, the doctors are often criticised for a failure to mention a risk that would have led the patient to choose not to undergo the operation. The implication is that the doctor has a vested interest in performing the procedure. In a publically funded service, such as the NHS it is difficult to understand this allegation: there is no financial reward associated with performing an operation as was identified by George Bernard Shaw in the polemical preface to his *Doctor's Dilemma*:

> 'That any sane nation, having observed that you could provide for the supply of bread by giving bakers a pecuniary interest in baking for you, should go on to give a surgeon a pecuniary interest in cutting off your leg, is enough to make one despair of political humanity. But that is precisely what we have done. And the more appalling the mutilation, the more the mutilator is paid. He who corrects the in growing toe-nail receives a few shillings: he who cuts your inside out receives hundreds of guineas, except when he does it to a poor person for practice.
>
> Scandalised voices murmur that these operations are necessary. They may be. It may also be necessary to hang a man or pull down a house. But we take good care not to make the hangman and the housebreaker the judges of that. If we did, no man's neck would be safe and no man's house stable. But we do make the doctor the judge, and fine him anything from sixpence to several hundred guineas if he decides in our favour. I cannot knock my shins severely without forcing on some surgeon the difficult question, "Could I not make a better use of a pocketful of guineas than this man is making of his leg? Could he not write as well—or even better—on one leg than on two? And the

guineas would make all the difference in the world to me just now. My wife—my pretty ones—the leg may mortify—it is always safer to operate—he will be well in a fortnight—artificial legs are now so well made that they are really better than natural ones—evolution is towards motors and leglessness, etc. etc., etc.'

Today rather the suggestion is that the surgeon has a limited imagination. That he has the sort of single minded determination exhibited in the YouTube comic video *Orthopaedics vs. Anaesthesia* where the surgeon monotonously repeats '*there is a fracture I must fix it*' oblivious of the fact that his 97-year-old patient has died. The reality is quite the reverse: many of the patients who attend a gynaecology out-patient clinic have come determined to get the operation that they have already decided is their right.

The GMC View

In England, the General Medical Council's advice to doctors in this area is headed '*Consent to Treatment Patients and Doctors: Making Decisions Together*'.[11] Doctors are told:

> 'You must work in partnership with your patients. You should discuss with them their condition and treatment options in a way they can understand and respect their right to make decisions about their care. You should see getting their consent as an important part of the process of discussion and decision making, rather than something that happens in isolation.'

The GMC's title rather begs the question what should happen when doctor and patient disagree. Plainly, if a patient decides not to undergo a procedure that she has been offered that will be an end of the matter and it may well be a thoroughly good thing. In the case of a benign condition, such as fibroids, endometriosis or urinary stress incontinence, such a decision may well be no more than the result of re-assessing her own symptomatology in the light of the information that she has been given by the doctor about the realistic prospects of a complete relief of her symptoms as a result of surgery. It may be that the symptoms have in fact previously been over presented. The doctor must always remember that it is implicit in respect for a patient's autonomy that sometimes patients will take decisions that the doctors believe are mistaken. The patient is entitled to refuse to consent to treatment in the words of Lord Donaldson for good reason, bad reason or no reason and it will behoves a doctor who has not experienced the symptoms of which this patient complains to seek to second guess her decision.[12]

A refusal to agree to the investigation of symptoms that suggest a malignancy is not governed by different rules although it does raise other issues. A refusal to accept a therapeutic intervention when there are excellent prospects of a cure is likely to puzzle the gynaecological oncologist where the negative decision appears to be fraught with far more hazard. However, it is plain that in English law at least the patient's autonomy is paramount. The doctor's obligation is to ensure that the substance of the advice has been understood even if it has been rejected. In self-defence, the doctor must make the clearest clinical record of the advice and it will be sensible to record the substance of that advice and the reasons for it in a letter to the patient, offering to see her again when and if she changes her mind. It is important to remember that the fact that the doctor and the patient have disagreed about the appropriate way forward does not in itself terminate the clinical relationship and the doctor's duty of care towards the patient continues. Indeed in the case of gynaecological oncology, a refusal to accept a radical surgical solution is not likely to diminish the need for medical advice. The surgeon should offer to refer the patient to the medical oncologists just as would have happened if they had previously undergone surgery.

Capacity

It may be that the doctor has doubts about the patient's capacity to take decisions. Capacity does not depend upon the patient acting as her doctor expects. A patient will have capacity if she is able to understand the information she is given and to handle that information so as to be able to take her own decision. The doctor's duty under the Mental Capacity Act is to maximise her capacity so she is capable of taking her own decision and only when it is clear that this will not resolve the problem should the doctor resort to other expedience. In English law this involves considering whether the patient has granted someone a lasting Power of Attorney to take decisions on her behalf and, if that is not the case making enquiries of members of the family or others to ascertain what her wishes would be likely to be, before acting as he sees would be in her best interests.

Demands for Positive Intervention

Sometimes the patient demands a positive intervention that the doctor believes not to be in her best interests. The doctor's duty here will depend upon the circumstances including the extent of the disagreement. In marginal cases, the doctor may decide to defer to the patient and respect her determination. However, if the positions become entrenched and the doctor is clear in his view it may be harder to resolve. No doctor should ever perform an operation that they believe is contrary to their patient's best interests. The Court will not order a surgeon to perform an operation that he does not believe is in her best interests. It is no answer to a suit in negligence after an adverse result that the doctor did not think the operation was appropriate.

Conventional advice is that the doctor faced with an irreconcilable disagreement with a patient should offer to refer her to somebody else who may take a different view.

In a structure, such as the NHS where a patient's entitlement to a procedure depends upon her need, the request also raises issues about the demand for scarce resources. A home delivery may demand twice as much midwifery time when there is a chronic national shortage of midwives. In the 20 years since *Changing Childbirth,*[13] when it was promised that women should be provided with one-to-one midwifery care during labour and delivery, this has never been achieved and now looks further off than ever. The extra costs of a Caesarean section will obviously vary with the environment but will always be substantial.

It must be recognised that we now have permanent inadequate financing of healthcare in every country. In 2006, the Boston-based Institute for Economic Affairs published its comparison of the growth in public healthcare expenditure in 10 OECD countries under the title "*Whose Going Broke?*"[14] It found that healthcare expenditure was increasing by 2% more than GDP everywhere and noted that this was unsustainable. It said that the crunch would come first in America. Indeed it may have been proved right already: the 2008 economic collapse was triggered by the collapse in property values in Detroit, which is dominated by the motor industry. The deficits in the funds from which healthcare was provided to pensioners of the motor industry were greater than the assets of the industry. The link between an unaffordable healthcare industry and economic collapse is closer than people realise. The idea that any other country will be able to afford this pattern of healthcare seems to be misconceived and the modern gynaecologist has to recognise that they are part of a system in which scarce resources have to be distributed.

In the 40 years since the philosophers first suggested that doctors had a duty in taking ethical decisions to balance four principles, beneficence, non-maleficence, respect for autonomy and a duty to act justly, much has changed. *Chester vs. Afshar* suggests that respect for autonomy has grown like a cuckoo in the nest to upset the balance with the other considerations. The victim obligation, which is overdue to fight back may be the duty to act justly. When the obstetrician delivers a fetus at 23 weeks gestation he knows that that baby is unlikely to survive, and if he is familiar with the EPICure data, he will also be aware that if it does survive, it will be highly likely to be significantly disabled. What he is less likely to consider is the fact that it may also occupy a neonatal intensive care cot for 6 months, during which time perhaps 20 other babies in need of intensive care will be denied access to the facility, some of whom may have to put up with 80 years of disability in consequence. The fact that these patients are not visible or represented when the decision is made does not alter their need.

The obligation to maximise the patient's capacity to take a decision underlines a more general obligation. Whatever the patient's underlying capacity or attitude to a procedure it is their doctor's obligation to make available the best information possible in the best way and at the best time. In the US, there has been a dramatic increase in interest in Shared Decision Making (SDM) and the use of decision aids to help them play their part. Over the last 10 years, these have been shown to reduce costs because well-informed patients increasingly decide against procedures. They also seem to reduce claims against doctors. The idea is that patients are encouraged to use multimedia sources of data before they meet a doctor.

The advantage of decision aids is that they enable patients to access information relevant to them and in a fashion that suits them. They seem to enhance understanding and facilitate SDM. However I suggest that they should trigger something close to a revolution in the profession's attitude to counselling patients, not only before surgery but at other times as well. It has become something of a cliché amongst good doctors' writings in the last 5 years that it should be a key part of their role that they empower patients to take control of their own destiny and to look after themselves more effectively. It is now more clearly understood that maintaining good health is a continuous active life-long process. The medical profession interact with patients infrequently. In the case of secondary and tertiary centres, they may only meet patients once or twice in their lives. This means that it is fundamental that specialists recognise that their role is to educate and assist their patients to look after themselves. It is well established that one crucial threat to the elderly comes from the loss of autonomy associated with acute periods of illness. One of the major threats facing the little old lady who fractures her hip is that she may never recover the ability to live autonomously again[15]: the surgeon who fixes the hip without restoring her to active autonomous life has only filled part of the role.

The same principles apply in a different way to a younger patient irrespective of whether she is considering surgery. The role of the healthcare services is to educate and empower her. Not only should she be encouraged to look after herself, she should be encouraged to access information which she needs in order to take a decision about her health. Plainly the nature of this role will depend upon the patient's knowledge of medicine, her level of education and her access to information technology as well as the complexity of the decision that she is being asked to take and the unusual features of her own condition. The problems posed by a need to communicate with a woman living in Chad where the maternal mortality is currently one in six are entirely different from those posed by the affluent resident of Chelsea in West London, where the life expectancy of a girl born in 2011 is in excess of 100 years if projected health improvements continue. However if the problems posed by the desire to empower, such diverse women are as different as their other medical needs may be, there is no doubt that the rewards for successful communication are equally glittering in either setting.

The lesson of cases, such as *Chester vs. Afshar* and the seemingly novel expectations of the medical professions that they reveal is that the obligations of the doctor in the eyes of society extend far beyond the competent performance of investigations and surgical procedures. Another advantage of a Decision Aid is that it can enable patients to absorb factual information at home. They can take as much time as they like to read and compare it with other pieces of information. For most people this is infinitely preferable to trying to take on board what a doctor is saying in the pressurised environment of the outpatient clinic. It is well established that patients in a hospital setting do not lay down memory.[16] The medical profession has seen research, such as that reviewed by Lemaire, as being a shield with which lawyers should be able to defend them against allegations that they failed to mention a risk, since Lemaire showed us that patient's parole evidence of what they were told is thoroughly unreliable. However it may also be that this insight is a sword pointed against the profession as well. It demonstrates that the doctor who relies upon the outpatient clinic as the forum in which to advise a patient is in fact choosing something which he knows or should realise is sub-optimal for the task.

I suggest that the doctor's role as an advisor has much in common with the role of a teacher at undergraduate level. The doctor should be there to clear up misunderstandings and help to resolve obscurities that the patient has encountered in doing her homework. The role of the doctor should not be to remedy deficiencies in the patient's own preparation for her decision taking. It should not be to help her to come to terms with points she has not understood and to resolve uncertainties. It should not be to furnish her with large quantities of elementary data that she can and should access for herself. Certainly the system should assist her by providing her with a reading list and appropriate web links. The guidelines of NICE like the green tops of the RCOG are written in language that is nowadays accessible to the majority of lay people. Patients should be encouraged to use them and told that in doing so they are playing their own active part in deciding what treatment they should receive.

Where Do We Go From Here?

One of the disadvantages of medical texts books in an era of instantaneous communication is that the science is apt to be out of date by the time the book is in the reader's hands. As far as the law is concerned, we have an analogous problem: not only do things move on in the period between my writing these words and you reading them, but it may take many years before a case arising at the time that you read these words to come to trial. In Mrs Sidaway's case, judgment was given by the House of Lords 11 years after she underwent her surgery and in Miss Chester's case, it took 10 years. Attitudes shift enormously over that sort of period and I am trying to predict changes in the future. The words I have quoted from Sidaway's case, in which the court recognised that the doctor might be justified in failing to mention a risk because it would take on an exaggerated importance in the patient's mind, seem obsolete today. The present algorithm was described by Lord Phillips MR in the case of *Burke* in 2005:

> 'So far as the general position is concerned, we would endorse the following simple propositions advanced by the GMC.
>
> (1) A doctor exercising his professional clinical judgement decides what treatment options are clinically indicated (i.e. will provide overall clinical benefit) for his patient.
> (2) He then offers those treatment options to the patient, in the course of which he explains to him/her the risks, benefits, side effects, etc. involved in each of the treatment options.
> (3) The patient then decides whether he wishes to accept any of those treatment options and, if so, which one. In the vast majority of cases, he will, of course, decide which treatment options he considers to be in his best interest and in doing so, he will or may take into account other non-clinical factors. However, he can, if he wishes, decide to accept (or refuse) the treatment option on the basis of reasons which are irrational or for no reasons at all.
> (4) If he chooses one of the treatment options offered to him, the doctor will then proceed to provide it.
> (5) If, however, he refuses all of the treatment options offered to him and instead informs the doctor that he wants a form of treatment which the doctor has not offered him the doctor will, no doubt, discuss that form of treatment with him (assuming it is a form of treatment known to him), but if the doctor concludes that this treatment is not clinically indicated he is not required (i.e. he is under no legal obligation) to provide it to the patient, although he should offer a second opinion.
>
> The relationship between doctor and patient usually begins with diagnosis and advice. The doctor will describe the treatment that he recommends or, if there are a number of alternative treatments he would be prepared to administer in the interests of the patient, the choices available, their implications and his recommended opinion. In such circumstances, the right to refuse a proposed treatment gives the patient what appears to be a positive option to refuse an alternative. In truth, the right to choose is no more than a reflection of the fact that it is the doctor's duty to provide the treatment that he considers to be in the best interest of the patient and the patient is prepared to accept.'[17]

I think that within the next 10 years, doctors will be accused of negligence, not only because of the risks they have failed to mention, but also because of the way in which they have presented the information. It is the doctor's role to help the patient to learn. As with a teacher, he must approach that task professionally. I suggest that the law will expect far more from both doctor and patient. In the first place, whilst the interaction between the doctor and the patient may be a one-off encounter, matters have to be seen in the context of the patient's ongoing management of their own condition. First and foremost, the obligation of the doctor will be to help the patient to maximise their own healthcare gain. It is to act as a teacher and guide, and to make available information in a way that the patient will find acceptable and useful. This will include reading lists and decision aids that the patient can utilise at home. If a competent patient turns up at an outpatient clinic without having done their homework, I suggest that the doctor should be entitled to give them a fresh appointment on the grounds that they are not in a fit state to be advised today. The patient is their own primary therapist and it is the doctor's obligation to enable them to discharge this role effectively. Of course the doctor must continue to look after patients, whether they be feckless, incompetent or even auto-destructive. These may be part and parcel of the problems that the patient places before the doctor. But within the limits imposed by the patient's condition and difficulty, the doctor should be entitled to expect the patient to do their best to play their part. Indeed, there may ultimately be cases in which patients complain that their eventual disability is attributable to a lack of firm, clear guidance that would have enabled them to achieve an optimal result.

We are moving into a new era in which the landscape has altered. This has come about partly because patients are now enormously varied in their knowledge and sophistication about medical matters, and partly because we now appreciate that the achievement of good health is an active process conducted primarily by the patient. Twenty years ago we realised that the consultant could not continue with the arrogant assumptions of Sir Lancelot Spratt; now we realise that the doctor cannot take on the responsibility that goes with those assumptions because the achievement of good health is continuing process in which a surgical procedure is a brief intervention. Good medicine is about so much more than surgery and most of it is a responsibility that the patient cannot share with anyone else.

Declaration of Interests: The author is an FRCOG AdEundem who has spent 38 years defending doctors under fire at Hempsons. He is also Chair of NCEPOD.

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