Obstetrics in Family Medicine

A Practical Guide

PAUL LYONS, MD

HUMANA PRESS

Obstetrics in Family Medicine

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Obstetrics in Family Medicine

A Practical Guide

Paul Lyons, *MD*

Department of Family and Community Medicine
Temple University School of Medicine
Philadelphia, PA

HUMANA PRESS TOTOWA, NEW JERSEY

999 Riverview Drive, Suite 208
Totowa, New Jersey 07512

humanapress.com

This publication is printed on acid-free paper. ∞
ANSI Z39.48-1984 (American Standards Institute) Permanence of Paper for Printed Library Materials.

Production Editor: Robin B. Weisberg

Cover design by Patricia F. Cleary

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Printed in the United States of America. 10 9 8 7 6 5 4 3 2 1

eISBN 1-59745-142-8

Library of Congress Cataloging-in-Publication Data

Lyons, Paul, 1963-
Obstetrics in family medicine : a practical guide / Paul Lyons.
p. ; cm. -- (Current clinical practice)
Includes bibliographical references and index.
ISBN 1-58829-510-9 (alk. paper)
1. Obstetrics. 2. Family medicine. I. Title. II. Series.
[DNLM: 1. Obstetrics. 2. Family Medicine. 3. Pregnancy Complications. WQ 100 L991o 2006]
RG524.L99 2006
618.2--dc22 2005031535

Series Editor's Introduction

Obstetrics in Family Medicine: A Practical Guide, by Paul Lyons, MD, is an important book for the approximately 21,000 family physicians in the United States who regularly perform obstetrics, as well as the 7500 physicians currently in residency training for whom obstetrics is considered a core body of knowledge. This title should serve as an important addition to the literature in its scope and orientation.

Dr. Lyons' approach to the material is carefully organized and gives particular attention to the relevant aspects of prenatal and pregnancy care that family doctors need to know. He speaks with clarity of voice as an inner-city family physician who has done a great deal of obstetrics care and understands both the practical realities of the delivery rooms as well as the evidence base on which obstetrical decisions are made.

Obstetrics in Family Medicine: A Practical Guide is being published along with a PDA version (available separately at the publisher's website: www.humanapress.com) so that readers can use the book both to gain an understanding of the material, and as a reference. For the clinician interested in the handheld application, the PDA version can then be used as a point-of-care tool to look up information quickly when attending to patients or seeing pregnant patients in the office. *Obstetrics in Family Medicine: A Practical Guide* will find its place in the practices of family doctors who are doing obstetrics, in the offices of family doctors who may not practice obstetrics but desire to know more so that they can better understand what is happening to their pregnant patients, and as a useful resource for family medicine residents in training.

Neil Skolnik, *MD*
Associate Director
Family Medicine Residency Program
Abington Memorial Hospital
Abington, PA
Professor of Family and Community Medicine
Temple University School of Medicine
Philadelphia, PA

Preface

A few years ago, a medical student who was working with me was struck by a car while crossing the street during her lunch hour. Because she could not walk after the accident, she was taken to the emergency department for evaluation, which included an x-ray of her leg. I met her there just as the radiologist was informing her that she was pregnant. Our radiology department screens all women of childbearing age for pregnancy prior to radiological imaging.

Among the many areas of medical care, few are as potentially joyful as pregnancy. Ironically, it is also the area of medical care that produces more anxiety than almost any other for both patients and providers. As obstetrical care has become more complex and specialized, the care of pregnant women has become an area of concern for an increasingly well-trained and specialized group of providers. Anyone who cares for women, however, will eventually discover the joys and challenges of caring for pregnant women, even if only tangentially.

A significant number of providers are involved in the care of pregnant patients: nurse midwives, nurse practitioners, family physicians, and obstetricians. The list of those who will encounter pregnant patients in their practice is even longer: pediatricians, internists, surgeons, almost any provider who cares for women. An even larger number of future providers will spend some portion of their training in obstetrical settings. *Obstetrics in Family Medicine: A Practical Guide* is written for all providers who include women in their practice. It is particularly focused on the needs of primary care providers who provide preconception, prenatal, or labor and delivery care. It is also designed to be a concise but reasonably comprehensive resource for primary care providers who may not specifically provide such care but who often have need of such information as their patients ask for it.

No project of this scope can ever be the product of just one person. I would like to acknowledge and express my thanks to the many people who have contributed in countless ways to *Obstetrics in Family Medicine: A Practical Guide*, including my patients and their families who have graciously allowed me to be a part of the joys and occasional sorrows of their

obstetrical experience. I would also like to specifically acknowledge and thank my wife, Cindy, and my daughter and son, Devin and Dylan, for the countless hours—rightfully theirs—they have allowed me to devote to this project. Without their support this text would not exist.

Paul Lyons, *MD*

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I PRECONCEPTION AND PRENATAL CARE

1 Physiology

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KEY POINTS

1. The menstrual cycle can be considered a comprehensive physiological adaptation for potential pregnancy.
2. Normal menstrual cycles last 21–45 days (average 28 days), counted from the first day of menstrual bleeding.
3. Physiological adaptations of pregnancy affect most major organ systems including cardiac, renal, gastrointestinal, and endocrine systems.

BACKGROUND

Although most patients will not present to their providers with questions concerning the specifics of reproductive physiology, the care and management of pregnant patients begins with an understanding of the physiological environment in which pregnancy occurs (or in some instances, does not occur). Many women's health providers will face questions concerning menstrual function prior to caring for a patient's obstetrical needs. Conversely, routine gynecological care may provide an opportunity to begin discussions of pregnancy planning and preconception counseling. For many women, a "routine" gynecological examination is the primary point of contact with the health care system early in life. For this reason, all providers who care for women should have some understanding of normal reproductive physiological function. A brief overview of menstruation, fertility, and pregnancy follows.

From: *Current Clinical Practice: Obstetrics in Family Medicine: A Practical Guide*
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PHYSIOLOGY OF MENSTRUATION

Menstruation represents the cyclical physiological preparation for potential pregnancy, followed by removal of endometrial contents if pregnancy does not occur. Most women of reproductive age are familiar with menstruation. The average age of menarche in the United States is approximately 11.5 years. Most menstrual cycles are anovulatory in the first year following menarche (although women and providers should be aware that ovulation and/or pregnancy may occur). For the next four decades, most women will menstruate every 21 to 45 days (average 28 days). Bleeding is variable but generally lasts 3 to 5 days (1–7 days may be considered normal) and is of variable intensity (but generally less than 3 ounces or 90 cc).

Although generally considered an ovarian and uterine phenomenon, the normal menstrual cycle may be considered as a comprehensive physiological adaptation in preparation for possible pregnancy. In addition to the uterine and ovarian changes described here, changes can be noted in the cervix, vagina, breast, and core body temperature. The cervical mucus becomes thinner with increased pH to facilitate entry of sperm. Vaginal epithelial cells also undergo change. Mammary ducts proliferate under estrogen and progesterone stimulation, which may lead to breast swelling and tenderness. A small spike in basal body temperature can be seen at the time of ovulation. This observation has contributed to the use of basal body monitoring in fertility management.

Physiologically, bleeding represents the end of one cycle. From the perspective of the patient and the provider, however, bleeding is the most easily identified aspect of the menstrual cycle and is, therefore used to mark the beginning of each cycle. The first day of menstrual bleeding is day 1 with each day numbered sequentially through the last day prior to the reoccurrence of bleeding. Each menstrual cycle can be divided into two halves that differ in hormonal and physiological events. In a typical or average menstrual cycle, each half is approximately 14 days in duration.

The first half of each menstrual cycle is marked by endometrial proliferation and follicular development. In the first week of each menstrual cycle, multiple follicles enlarge. At approximately 1 week, a single follicle becomes dominant and the others involute, becoming atretic. The dominant follicle will, with appropriate hormonal regulation, continue to develop and will eventually rupture releasing an ovum for possible fertilization. With release of the ovum on day 14, the follicle undergoes a series of stereotypic changes filling with blood, granulose, and thecal cell proliferation and displacement of blood by luteal cells (corpus luteum). The luteal cells produce progesterone, which serves to stabilize the thickened endometrium through the second half of the menstrual cycle. The period of follicle development is referred to as the follicular phase. The period of luteal production of progesterone is referred to as the luteal phase.

Follicular development in the first half of each menstrual cycle is marked by follicular production of estrogen and endometrial proliferation in anticipation of possible implantation of a fertilized ovum. This generally occurs late in the first week and throughout the second week of the menstrual cycle. The first half of the menstrual cycle is, for this reason, sometimes referred to as the proliferative phase. With ovulation and luteal production of estrogen and progesterone, uterine glands become active, secreting clear fluid. This phase is referred to as the secretory phase. The endometrium will remain stable and secretory for as long as the progesterone stimulation continues.

If fertilization fails to occur, the corpus luteum will lose function beginning in the second half of the fourth week (corpus albicans). With the loss of hormonal support, endometrial thinning and localized necrosis leads to sloughing of the proliferative portion of the endometrial lining and the onset of menses. Until menopause, this cycle will repeat more or less regularly each month.

PHYSIOLOGY OF FERTILITY

The hormonal changes just described relate to preparation for release of the ovum and subsequent fertilization by sperm. As noted, however, these menstrual changes may occur in the absence of ovulation. In addition, under normal physiological conditions, pregnancy requires the presence of functional sperm in sufficient quantity to ensure fertilization of the released ovum.

In women, the release of an ovum is under the control of the hypothalamic–pituitary–ovarian endocrinological axis. Each of these components must function normally to ensure ovum release. Two pituitary hormones, in particular, are critical to normal ovulatory cycles—follicle stimulating hormone (FSH) and luteinizing hormone (LH).

Hypothalamic Function

Release of pituitary hormones depends on hypothalamic stimulation. The hypothalamus is responsible for stimulation of a variety of pituitary hormones and hypothalamic dysfunction may manifest with altered fertility or a variety of other endocrinological signs or symptoms. In addition to pituitary stimulation, the hypothalamus is responsible for direct release of oxytocin (of import at the time of labor).

In relation to fertility, hypothalamic release of gonadotropin-releasing hormone (GnRH) stimulates the anterior pituitary production of FSH and LH. GnRH is produced in the hypothalamus and released directly to the pituitary via local blood vessels. Release of GnRH is episodic in brief, timed bursts. Failure to maintain this episodic release will inhibit pituitary stimulation, probably secondary to downregulation of pituitary receptors. Disruption of the timing of the episodic release will also impair fertility by disrupting the appropriate

timing of FSH and LH stimulation of the ovary. In addition, appropriately episodic and timed GnRH stimulates pituitary GnRh receptors enhancing sensitivity at mid-cycle and facilitating a surge in LH at the time of ovulation.

Pituitary Function

As with the hypothalamus, the pituitary is responsible for the release of several hormones regulating a variety of physiological functions. In relation to fertility, the two key hormones are the gonadotropins, FSH and LH. These two agents are released cyclically and are responsible for stimulating ovarian hormonal secretion. LH fosters ovarian production of estrogen and progesterone from the corpus luteum. FSH, as the name implies, is responsible for stimulating early follicle development within the ovary. In conjunction with LH, FSH is also responsible for terminal maturation. At the point of maturation, a surge in LH levels precipitates follicular rupture and ovum release.

Ovulation

Early in the menstrual cycle, FSH levels are slightly elevated (stimulating follicular development) and LH levels are low. In this phase of the menstrual cycle, estrogen serves an inhibitory role on LH. GnRH stimulation of the pituitary continues and the sensitivity of the pituitary is enhanced. Approximately 2 days prior to ovulation, the estrogen inhibition is reversed, becoming stimulatory and a positive feedback loop is established. Approximately 8 to 10 hours prior to ovulation, LH levels reach a peak (LH surge). Ovulation then occurs. Following ovulation, estrogen once again becomes inhibitory and in conjunction with elevated progesterone levels serves to inhibit LH and FSH levels in the second half of the menstrual cycle.

PHYSIOLOGY OF PREGNANCY

The physiological changes associated with pregnancy are numerous and the full scope of such changes is beyond the scope of this text. Common physiological changes with pregnancy are summarized in Table 1. Recognition of normal physiological changes is necessary not only to understand normal function while pregnant but also to facilitate recognition of physiological abnormalities that lie outside the normal range.

Cardiovascular Changes

Pregnancy can be considered an adaptive high-volume, hyperdynamic cardiovascular state. Increased volume, a newly developed peripheral vascular bed, and anatomic changes associated with an enlarging uterus all serve to alter normal cardiovascular status. The heart, itself, enlarges and cardiac output increases by nearly 50%. This increased output is initially facilitated by an

Table 1
Physiological Changes of Pregnancy

Cardiovascular
Cardiac enlargement
Increased cardiac output
Systolic flow murmur
Decreased venous return
Decreased peripheral vascular resistance
Decreased blood pressure
Increased blood flow to uterus, kidneys, skin, breasts
Renal/Urinary
Increased urinary stasis
Increased urinary system volume
Kidney enlargement
Renal pelvis dilation
Ureteral elongation
Increased bladder capacity
Increased glomerular filtration rate
Elevation of rennin, aldosterone, angiotensin
Glucosuria
Gastrointestinal
Early satiety
Nausea, vomiting
Constipation
Gingival hypertrophy
Progression of periodontal disease
Decreased gastric emptying
Relaxation of lower esophageal sphincter
Hematological
Increased red blood cell volume
Anemia
Leukocytosis

increase in cardiac volume and subsequently by an increase in heart rate. The increase in output reaches a peak near the end of the second trimester and then remains stable until the end of pregnancy.

The increase in volume may lead to increased flow turbulence within the heart. This turbulence may be apparent clinically as a systolic ejection murmur. Such a murmur will manifest in 80–90% of all pregnant women. This murmur is a normal physiological finding and does not warrant further cardiovascular investigation.

Vascular changes are also common in pregnancy. With an increase in uterine size, venous return via the inferior vena cava may be directly impaired. Placing the patient in the left lateral recumbent position may alleviate the direct pressure

of the uterus on the vena cava and facilitate enhanced venous return. The direct compression of venous return from the lower extremities may lead to peripheral edema. Peripheral vascular resistance declines with pregnancy as maternal cardiac output increases. Compensatory venous response to rapid position changes may also be impaired in pregnancy causing lightheadedness or dizziness with rapid positional changes. Blood pressure often declines slightly (approximately 10 mmHg diastolic) with a nadir in the second trimester and a slight rise (to near pre-pregnant levels) near the end of pregnancy.

Blood flow is altered in pregnancy as well. The most obvious change is the increase in uterine blood flow with the development of the utero-placental vascular bed. Blood flow through this vascular bed is facilitated by vascular resistance that is low relative to the overall peripheral vascular resistance. In addition to increased blood flow to the uterus, maternal blood flow is increased to the kidneys, breast, and extremities (including increased flow to the skin). Although concern has been raised that exercise may divert blood flow from these key areas to muscles, this has generally not been found to be clinically significant except for women who significantly increase their activity level from their pre-pregnancy baseline. A reasonable recommendation would be that women may continue exercise through pregnancy at a level not to exceed their usual degree of exertion.

Renal/Urinary Changes

Pregnancy is marked by an increase in urinary stasis. The direct impingement of the uterus and fetus on the bladder contributes to this effect as do anatomic changes within the urinary tract. Kidneys enlarge, the renal pelvis dilates, and the course of the ureter elongates contributing to increased volume within the urinary tract. This increased volume in turn contributes to an increase in post-void residual urine within the tract and subsequent stasis.

Renal function is also changed in pregnancy. A combination of hormonal modulation with increased plasma volume leads to an increase of nearly 50% in the glomerular filtration rate. Renin, angiotensin, and aldosterone levels are all elevated in pregnancy. Despite this increase in glomerular filtration, urinary output is not increased during pregnancy. Although many patients will report increased urinary frequency, the total output volume remains similar to the pre-pregnancy levels. (The functional capacity of the bladder is, in fact, increased in pregnancy with a total capacity of approximately 1.5 L.) Aldosterone-mediated sodium resorption in turn leads to fluid resorption and maintenance of intravascular homeostasis. Increased renal filtration does lead to increased creatinine clearance and a concomitant reduction in serum creatinine levels (along with decreased blood urea nitrogen levels). Sporadic glucosuria is a common finding in pregnancy and may be an artifact of increased glomerular filtration.

Gastrointestinal Changes

Gastrointestinal (GI) symptoms are among the most common complaints of pregnancy. Early in pregnancy nausea and vomiting are often reported. Later in pregnancy, early satiety and constipation are both commonly observed. Although these symptoms are generally not related to specific changes within the GI tract, some physiological alterations are noted with pregnancy. Gingival hypertrophy and worsening of gingival disease have both been reported. Some investigators have suggested a possible link between periodontal disease and an increased risk of preterm labor although the results are preliminary and inconclusive. GI motility is decreased, including a decrease in gastric emptying and increased transit time through the large intestine. Decreased gastric emptying combined with relaxation of the terminal portion of the esophagus may lead to an increase in reports of gastroesophageal reflux symptoms. This may be exacerbated late in pregnancy as the uterus increasingly displaces the stomach upward.

Hematological Changes

Pregnancy is associated with a variety of changes in hematological status. With an increase in intravascular volume, patients also experience an increase in red cell volume. This increase in red cell volume, in turn, increases the patient's need for iron. With inadequate dietary iron (either from food or supplementation), many pregnant patients will develop an iron deficiency anemia with the usual change in red cell indices (decreased mean corpuscular volume and decreased mean corpuscular hemoglobin content). An increase in blood leukocytes is common in pregnancy. Levels rise throughout pregnancy and peak during labor. Such a rise in white blood cells may make determination of infection more complicated.

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2 Preconception Counseling

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GETTING STARTED
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EDUCATION
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SOURCES

KEY POINTS

1. Preconception counseling is medical evaluation and intervention performed prior to conception with the expectation that the course and outcome of subsequent pregnancies will be improved.
2. Preconception counseling and intervention may occur only in the context of care for other medical conditions.
3. Preconception counseling consists of three primary activities: (a) risk identification/assessment, (b) patient education, and (c) risk intervention, when possible.
4. The postpartum period is often an ideal opportunity for preconception counseling for subsequent pregnancies.

BACKGROUND

Multiple independent factors impact the course and outcome of pregnancy. Figure 1 represents a schematic diagram of many of these factors and their interrelationship during the course of pregnancy. Prior to conception, a number of factors combine to provide the background environment in which subsequent pregnancies will develop. In particular, a complex interaction between the patient-related factors and environmentally related factors contribute to the likelihood of pregnancy, the prenatal course, pregnancy outcomes, and postpartum complications.

From: *Current Clinical Practice: Obstetrics in Family Medicine: A Practical Guide*
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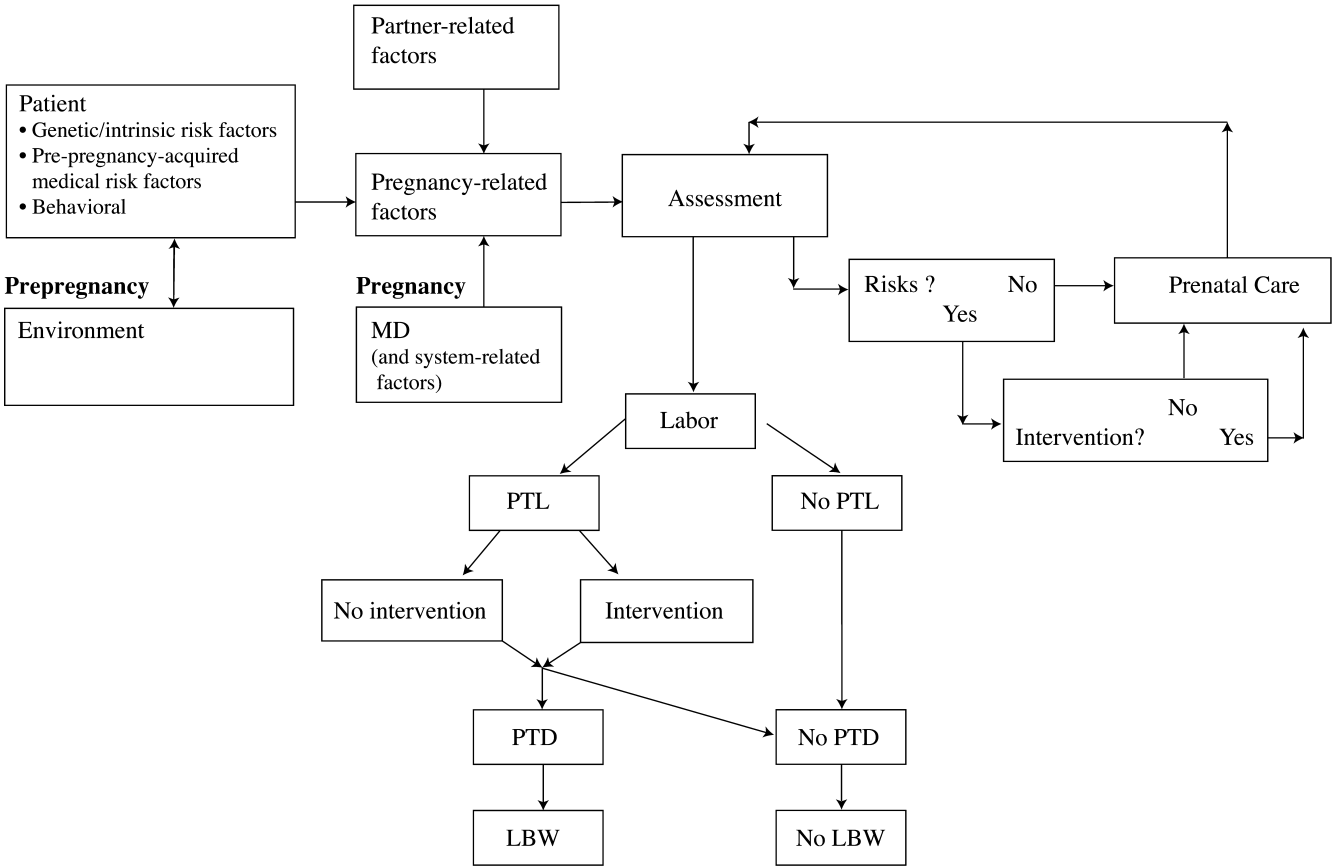

Fig. 1. Pregnancy outline.

The Patient

Any woman who becomes pregnant brings with her a variety of genetic and acquired factors that have the potential to impact the course of pregnancy. Genetic predisposition plays a significant role in obvious ways (e.g., sickle cell trait, Tay-Sachs, cystic fibrosis) or in more subtle manners (e.g., polymorphic tumor necrosis factor-α which may contribute to a predisposition to preterm labor). Anatomic factors may also contribute (e.g., congenital cervical incompetence, anomalous uterus). Physiological considerations such as the function of the hypothalamic–pituitary–ovarian axis (e.g., oligomenorrhea, anovulatory cycles) also play a role in becoming pregnant and in maintaining pregnancy.

Pregnancy is one potential medical event in the life of a woman, but it is by no means the only one. In addition to the genetic, anatomic, and physiological factors, many women will also acquire medical conditions that may impact the course or outcome of pregnancy. Such conditions as diabetes mellitus, hypertension, cardiac, renal, or thyroid disease all impact the course of subsequent pregnancies. Not only do underlying disease conditions have the potential to directly impact obstetrical outcomes, many of the medications and treatments for these conditions may also have obstetrical implications. Surgical interventions involving cervical, pelvic, or intra-abdominal manipulation may also have consequences in pregnancy.

A variety of behavioral issues have direct bearing on pregnancy. Nutritional status is critical and has been the focus of recent recommended interventions such as folate supplementation prior to pregnancy. Much work has focused on the detrimental effects that tobacco, alcohol, and other drug use may have during pregnancy. Intrauterine growth rates, congenital anomalies, infant addiction, and preterm complications—among others—have all been shown to be impacted by the use of these substances. Patient exercise, fitness, and activity levels may also contribute to pregnancy outcomes.

The Environment

Although potentially less obvious, the environment in which the woman lives may contribute significantly to obstetrical outcomes. For example, lower socioeconomic status is associated with higher complication rates and/or less good outcomes in a variety of obstetrical conditions such as preterm labor, pregnancy-induced hypertension, and others. Family and partner support for the pregnancy may impact the degree to which women access care during pregnancy.

All of these factors are present prior to conception providing the biopsychosocial environment in which the pregnancy will occur. Because these factors are all present—potentially identifiable and potentially modifiable—prior

to conception, it is helpful to consider pregnancy and prenatal care as beginning prior to conception as well.

Preconception counseling is medical evaluation and intervention performed prior to conception with the expectation that the course and outcome of subsequent pregnancies will be improved. Preconception counseling offers providers an opportunity to assess, document, and potentially alter many of the factors that influence pregnancy outcome. Many patients will present to their provider only after discovering they are pregnant. Under such circumstances, the opportunity to impact this potentially critical period is lost. For this reason, preconception counseling is of paramount importance for all providers who care for women of childbearing age. Prior to pregnancy, some women will only seek care for other medical problems. Preconception counseling and intervention, therefore, may need to occur only in the context of care for other medical conditions.

GETTING STARTED

Some women may raise the issue of planning for pregnancy providing the opportunity for the provider to begin the preconception assessment. For these women, providers can begin the process of risk identification/assessment, patient education, and risk intervention/reduction (when possible). Other women, however, may benefit from prompting by their provider. There are a number of ways in which to approach the issue and each provider will determine for him or herself the approach that works best. Because preconception counseling will often be initiated during visits for nonobstetrical care, providers should be prepared to raise the issue in these contexts. A review of menstrual history as part of a routine exam might be followed by open-ended questioning such as "Tell me about any plans you might have to become pregnant." Visits for chronic medical conditions might lead providers to raise the issue of "the impact of this condition should you choose to become pregnant." Routine gynecological visits provide another opportunity for beginning pre-pregnancy planning. Visits related to unprotected sex (sexually transmitted disease screening, late menses, pregnancy testing, etc.) provide an excellent and natural opportunity to discuss issues of importance prior to pregnancy. An often underutilized opportunity for preconception counseling is during routine postpartum care. Planning for subsequent pregnancies (or their prevention) can begin while the patient is still in the hospital and continue when she returns for routine outpatient postpartum care.

SCREENING

As noted in Table 1, preconception counseling should include screening for issues related to the patient and to her environment (including occupational,

Table 1
Content of Preconception Counseling

Patient-Related Factors
Psychosocial issues
Tobacco, alcohol, illicit drug use
Psychiatric illness
Literacy/language barriers
Medications
Prescription
Over-the-counter
Herbal, natural, and complementary/alternative therapeutics
Medical
Hypertension
Diabetes
Thyroid disease
Systemic lupus erythematosis
Renal disease
Cardiac disease
Thromboembolic disease
Sickle cell disease (or trait)
HIV/AIDS
Hepatitis
Measles (including immune status)
Varicella (including immune status)
Intra-abdominal or pelvic surgery
Obstetrics/gynecology
Pelvic anomalies
Pelvic inflammatory disease
Prior obstetrical history (all outcomes including full-term, preterm, spontaneous and elective abortions, living children)
Macrosomic infants
Fetal/neonatal death
Genetic (patient, patient's family and partner)
Down syndrome
Neural tube defects
Cystic fibrosis
Congenital anomalies
Multiple gestation
Environmental Factors
Psychosocial issues
Physical/sexual abuse
Partner/family support
Child care

Table 1 *(Continued)*

Transportation
Financial support
Insurance status
Occupational issues
High-risk occupations
Occupational exposures

financial, and family-related issues, among others). A variety of standardized prenatal care flow sheets exist that capture much of this data. Less formal screening may be appropriate under many circumstances. For patients who are seen regularly, screening may occur sequentially over time and should be updated periodically to ensure accuracy.

EDUCATION

An appropriate preconception history will allow providers to develop a list of important pregnancy-related concerns prior to conception. This list can form the focus of ongoing education designed to allow patients to make the best possible decisions concerning their health. Modifiable risk factors can be identified and addressed as noted here. For other issues, intervention or modification may be less important than education and discussion of the identified risk factors. Providers of preconception counseling can facilitate their patients' decisions concerning the desirability and timing of and preparation for pregnancy.

Genetic counseling may be beneficial for those patients at high risk for genetic complications during pregnancy. For patients with chronic medical conditions, the risks of pregnancy, optimal timing for pregnancy, contraception (if pregnancy is medically contraindicated), and prenatal management in the case of pregnancy should all be discussed.

INTERVENTION

A number of important interventions can be offered for women who are not yet pregnant. Patients should be counseled concerning the role of pre-pregnancy well-being including nutrition, exercise, and fitness. Patients should be counseled concerning the benefits of smoking cessation both for overall health and specifically related to pregnancy. Patients should be made aware of the effects of alcohol and the need to eliminate alcohol consumption prior to becoming pregnant. Use of illicit drugs should also be discouraged.

For those patients who do not plan to become pregnant for at least 3 months, review of the vaccination history may reveal the need for administration of MMR, Varicella and Hep B vaccines. For patients planning to become pregnant

in the near future, starting prenatal vitamins and/or folic acid supplementation should be recommended.

Patients' medical conditions and medications should be reviewed for potential complications in pregnancy. For patients who take medications contraindicated or relatively contraindicated in pregnancy, providers should discuss the risks and benefits of such medications in pregnancy. Consultation with a maternal–fetal medicine specialist may be beneficial in these circumstances.

Other issues such as language, financial or family support barriers can be discussed and problem solving can begin prior to rather than after conception. Patients for whom insurance or financial issues may be an issue should be made aware of insurance programs—available in most states—to provide insurance for pregnant patients.

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3 Prenatal Care

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KEY POINTS

1. Prenatal care is a process not an event.
2. Excellent prenatal care represents a partnership between the provider, the patient, and her family.
3. Key domains of intake information in prenatal care include pregnancy dating, baseline maternal health status, family health history, medical conditions impacted by pregnancy, medical conditions impacting pregnancy, and infection.
4. Key domains of information during follow-up visits include normal growth and development, medical and/or obstetrical complications of pregnancy, onset of labor.

BACKGROUND

Prenatal care is generally the most prolonged and sustained component of pregnancy care. Such care is often delivered by a single provider who will follow the course of the pregnancy with nearly as much interest as the pregnant patient. Although the prenatal period is often filled with anxiety, it is generally more relaxed and almost always less pressured than the labor and delivery setting. For these reasons, prenatal care provides patients with an opportunity to educate themselves and participate in the process of preparing for a new infant.

Prenatal care can best be thought of as a process rather than a specific event. For patients who received preconception counseling it is a continuation of the

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threefold process of education, risk identification, and risk reduction/intervention. For those patients who did not receive preconception counseling, it should be the beginning of such a process. Many prenatal care providers also participate in the delivery of their patients. In this regard, prenatal care provides an opportunity to establish or enhance a relationship that stretches from preconception through prenatal management to delivery. Excellent prenatal care represents a partnership between the provider and the pregnant patient (and her family) with ample opportunity for discussion, questions, and answers and active participation by each person involved.

Prenatal care is a cornerstone of modern obstetric care and has accompanied a reduction in the historic risk associated with pregnancy. Maternal mortality in 1935 was 582 per 100,000 pregnancies. By 1993, that figure had decreased to 7.5 per 100,000. Over approximately the same period infant mortality decreased from 47 per 1000 to 8 per 100,000. Although many factors unrelated to prenatal care have contributed to these reductions, prenatal care has directly contributed to improved outcomes in a variety of areas: (a) fetal organogenesis (folic acid supplementation, glycemic control in diabetes), (b) infectious disease detection/treatment (e.g., Chlamydia, bacteriuria), (c) infectious disease transmission prevention (e.g., syphilis, HIV), and (d) fetal growth (e.g., glycemic control in gestational diabetes).

Figure 1 in Chapter 2 provides a schematic outline for the interrelated factors involved in pregnancy. Factors present during the preconception period were reviewed in the prior chapter. With the advent of conception, additional factors come into play. Pregnancy itself introduces a variety of new conditions that can impact the health of both the mother and the infant. Although less well described, a variety of paternal factors can also affect the course and outcome of pregnancy. Although not specifically addressed in this chapter, there are a number of physician- and system-related factors that can, likewise, impact pregnancy. The process of prenatal care is cyclical and repetitive. Each visit allows providers to review what has already happened and to determine what has developed in the interval since the last visit. Each visit will focus on patient education, determination of normal growth and development, and compilation of critical information in a variety of important domains.

KEY DOMAINS OF PRENATAL INFORMATION

The first step in any prenatal assessment is to confirm that the patient is, in fact, pregnant. Many patients will arrive for a first prenatal visit with a confirmed positive pregnancy test result. Other patients will arrive for their first "prenatal" visit with a variety of less clear presentations. They may have missed their period but not have been tested. They may have self-tested but not trust the results (either positive or negative). Regardless of the nature of the uncertainty,

all patients with uncertain pregnancy status should have their status confirmed via urine or serum human chorionic gonadotropin (hCG) testing. Following confirmation of pregnancy, all patients should have the opportunity to consider what the most appropriate next step should be. When uncertain regarding the desirability of a confirmed pregnancy, providers should be cautious in their choice of language. In particular, providers should avoid the use of language that implies a specific outcome such as "Congratulations, you're pregnant!" or "We will need to get you started with prenatal care soon." The use of open-ended questions such as "The test confirms that you are pregnant. What do you think you would like to do at this point?" will allow patients to more easily express their thoughts concerning subsequent management.

Initial evaluation during prenatal care is similar to the evaluation for preconception counseling. It is designed to focus on the patient's baseline condition and any development in the timeframe from last menstrual period (LMP) through the first prenatal visit. (This is a time period during which patients may not recognize that they are pregnant and may include significant exposures to infectious or toxic agents.) At intake prenatal screening provides important information in six key domains:

1. Baseline maternal health including prior obstetrical history, if any.
2. Family health (e.g., twins, Down syndrome, Tay-Sachs).
3. Medical conditions impacted by pregnancy (e.g., cardiac disease, renal disease).
4. Medical conditions impacting pregnancy (e.g., diabetes mellitus, hypertension, medications, toxic exposures).
5. Infection.
6. Pregnancy dating.

As discussed in the previous chapter, these domains of information can form the basis for patient education and intervention throughout the course of pregnancy (and beyond).

Following the initial prenatal screen, subsequent visits focus on interval developments and review of previously identified issues. It is often helpful to develop a prenatal problem list to organize ongoing issues under management. Such a list could include the problem, the date identified, interventions, if any, and the date resolved, if applicable. Follow-up prenatal care will focus on three key domains: (a) normal growth and development, (b) medical and/or obstetrical complications of pregnancy, and (c) onset of labor.

FREQUENCY OF PRENATAL VISITS

The frequency of visits during prenatal care is dependent on the complexity of the care being provided. For those patients with complex presentations, individualized decisions must be made concerning the frequency of prenatal

visits. For patients with uncomplicated pregnancies, the currently recommended frequency for visits is as follows:

First prenatal visit: in the first trimester
Follow-up visits: every 4 weeks until 30 weeks gestation, then
every 2 weeks until 36 weeks gestation, then
every week until delivery at term, or
twice weekly from 40 weeks for assessment of fetal well-being (*see* Chapter 18).

The First Prenatal Visit (see *Table 1*)

The first prenatal visit lays the groundwork for all subsequent visits and therefore includes the most comprehensive history, physical examination, and diagnostic testing. For patients who have had one or more preconception counseling visits, much of the information can be obtained from the records of those visits. Information subject to change will need to be updated and a brief review of all material should be performed to ensure accuracy and completeness. Many offices utilize one of the many standardized obstetrical health history and prenatal flow sheet forms that exist. In addition to providing a standardized method for recording necessary information, the flow sheets can serve as a prompt for providers throughout the course of pregnancy.

History

Menstrual History. The preconception history begins with the LMP. Information should include the date of the first day of bleeding and the duration. The certainty of this date is of considerable importance as this forms the first basis for predicting the estimated date of delivery (EDD; or confinement in some older references). Depending on a variety of factors, including regularity of menses, duration since LMP, and whether patients track menses regularly, patient recall of their LMP may be of variable reliability. Some notation of the patient's subjective "certainty" concerning the date should be recorded. First-trimester bleeding is a relatively common complaint and may mimic menstruation. For this reason, patients should be questioned concerning the timing and quantity of bleeding as well. A "period" that is abnormally light or heavy or fell out of the normal cycle may represent an event of pregnancy rather than the true LMP.

Prior Obstetrical History. Prior obstetrical history can significantly impact the current pregnancy. For this reason all prior pregnancies should be summarized in the prenatal record. For all prior pregnancies, documentation should include the date of the pregnancy, the outcome (full-term delivery, preterm delivery, spontaneous abortion, elective abortion) and the weeks of gestation completed. For those pregnancies that resulted in live delivery, additional key information would include date of delivery, gender and weight of the infant, duration of labor, delivery method and anesthesia use, or complications, if any.

Table 1
First Prenatal Visit

- Last menstrual period (LMP)
  - Duration, abnormalities, fertility treatment, contraceptive use, and prior pregnancies
- Prior obstetrical history: all prior pregnancies including elective and spontaneous abortions
  - All pregnancies: date, outcome, weeks of gestation
  - Deliveries: gender and weight of infant, duration of labor, delivery method, anesthesia, and complications, if any
- General medical history: including all pertinent medical conditions but focused on
  - Anesthesia history
  - Medications
  - Medication allergies
  - Toxic exposures (including tobacco, alcohol, and illicit drugs)
- History since LMP: events or exposures during early organogenesis
  - Drugs, medications, and radiation
  - Infectious diseases (cytomegalovirus, toxoplasmosis, tuberculosis)
  - Possible pregnancy-related symptoms (bleeding or discharge per vagina, abdominal pain, headache, visual complaints, emesis)
- Family history: comprehensive but with an emphasis on
  - Fetal deaths or abnormalities
  - Multiple gestations
  - Genetic history (cystic fibrosis, Down syndrome, thalessemia)
  - Chronic medical conditions with strong familial link (e.g., hypertension, diabetes mellitus, renal disease, substance abuse)

This information can be summarized in short-hand form as Gravida/Para figures. This notation takes the form of G_xP_{xxxx}. G(ravida) represents the total number of pregnancies regardless of outcome. P(ara) represents, in order from left to right, full-term deliveries, preterm deliveries, abortions (elective or spontaneous), and living children. Although it does not include all of the details of each pregnancy, this short-hand form provides a quick and convenient summary that is especially useful in oral or written presentations.

General Medical History. All pregnancies occur within the context of the patient's baseline health status. Many medical conditions may impact the course of pregnancy. At the same time, pregnancy may have a significant effect on a variety of pre-existing medical conditions. It should also be recognized that delivery is a surgical procedure in many instances with approximately one-fourth of all deliveries occurring via cesarean section. For this reason, a comprehensive review of the patients general medical history should be recorded. Special emphasis should be placed on chronic medical conditions, prior surgical

and anesthesia history, medications, medication allergies, and substance use including tobacco, alcohol, and illicit drug use.

History Since LMP. Particular attention should be paid to medical events between the LMP and the first prenatal period. This represents the critical period of organogenesis during which a variety of medical conditions and exposures may have significant impact on the developing fetus. In particular, note should be made concerning management and/or control of chronic medical conditions that may impact fetal development such as hypertension and diabetes mellitus. Exposure to a variety of toxic and infectious agents are also important during this time period. Note should be made of exposure to drugs, medications, live vaccine preparations, or radiation. Known or suspected exposure to infectious agents should also be documented including sexually transmitted disease, cytomegalovirus, toxoplasmosis, tuberculosis, HIV, rubella, or varicella.

In addition to exposures, this period of early pregnancy is also marked by a variety of potential complications of pregnancy such as abnormal implantation or hyperemesis gravidarum. Patients should be screened for possible pregnancy-related symptoms such as bleeding or abnormal discharge per vagina, abdominal pain, headache, visual complaints, and severe nausea or vomiting.

Family History. A number of familial conditions and events are of potential consequence in pregnancy. A family history should be obtained with an emphasis on fetal deaths or abnormalities, multiple gestations, gestational diabetes, large- or small-for-gestational-age infants, significant genetic history (e.g., cystic fibrosis, Down syndrome, thalessemia) and chronic medical conditions with a strong familial link such as hypertension, diabetes, renal disease, and substance abuse.

Physical Examination

All patients should receive a comprehensive physical examination. The purpose of the examination is threefold:

1. Diagnostic or supportive evidence of underlying medical conditions.
2. Notation of normal physical changes often associated with pregnancy.
3. Evaluation of the uterus and bony pelvis.

A variety of physical changes can be noted during pregnancy. Although underlying medical conditions must be excluded, these findings generally represent benign changes and should be noted primarily for reference in case of change. Such findings include split S1 and/or a systolic ejection murmur on cardiac examination, mild thyroid enlargement, skin changes including malar rash and striae gravidarum, and accentuated lordosis noted on musculoskeletal examination.

Evaluation of uterine size is helpful in confirming the gestational age. At 6 weeks gestation, the uterus has enlarged beyond its pre-pregnant dimensions

and is described as the size of an orange. By 8 to 10 weeks, the uterus is described as grapefruit-sized. At 10 to 12 weeks, the uterus is palpable on abdominal examination at the symphysis pubis. Once the uterus is palpable from the abdomen, measurement is made of the fundal height. This measurement represents the distance from the symphysis pubis to the top of the uterine fundus. By 20 weeks gestation, the uterine fundus should normally be found at the level of the umbilicus. From 20 to 34 weeks gestation, measurement of the fundal height (in centimeters) should be equivalent to the gestational age (in weeks). For example, at 28 weeks gestation the fundal height should be approximately 28 cm from symphysis to the top of the uterine fundus (± 2 cm). Any significant deviation from these expected measurements should prompt the provider to reassess the gestational age and/or fetal development.

Assessment of the bony pelvic configuration (clinical pelvimetry) is often performed early in pregnancy to determine potential structural impediments to successful delivery. Abnormal findings do not rule out the possibility of a trial of labor and successful vaginal delivery but added caution may be warranted at the time of delivery. Notation should be made of the diagonal conjugate (distance from symphysis pubis to sacral promontory), ischial spines (blunt, prominent) sacrum (concave, straight), coccyx (fixed, mobile) and the pubic arch (normal, wide, narrow).

Laboratory and Diagnostic Testing

As previously noted, all patients for whom pregnancy status is uncertain should have a confirmatory pregnancy test. This may take the form of either a urine or serum test for hCG. The urine hCG test is generally positive beginning at the time of the first missed period (approximately 4 weeks gestation). The serum test is generally positive at the time of implantation.

For all prenatal patients routine obstetrical laboratory screening should include complete blood count with platelets, blood type (ABO and Rh), rapid plasma reagin, rubella titer, hepatitis B surface antigen (to detect active disease), HIV antibody, papanicolaou smear (if not performed within the preceding 3 months), gonorrhea and chlamydia screen, and a routine urine analysis with culture.

Selected patients may also benefit from screening for the following conditions: sickle cell disease (via routine screen or hemoglobin electrophoresis), Tay-Sachs, toxoplasmosis, cytomegalovirus, elevated serum lead, elevated glucose, substance use, and/or herpes simplex virus.

These screening tests are recommended at the first prenatal visit, which should routinely occur in the first trimester. For those patients who present for a first prenatal visit later in pregnancy, laboratory and diagnostic testing should include those tests just mentioned as well as all tests appropriate to their estimated gestational age at the time of presentation. These additional tests are described later.

Estimating Gestational Age

At the conclusion of the first prenatal visit a clinical assessment of gestational age and estimated date of delivery should be established. If the available information is incomplete or contradictory a tentative date may be assigned with arrangements for acquisition of more definitive data.

The available data that may contribute to establishment of the gestational age includes the following:

1. LMP: If the menstrual history is certain, an accurate calculation can be made based on the first day of the LMP. Obstetrical calendars (often referred to as an "OB wheel") are available (both in hard copy and online) that allow such calculation. In the absence of such a wheel, the EDD can be calculated by subtracting 3 months and adding 1 week to the LMP. For example, if the first day of the LMP was April 14, subtracting 3 months would yield January 14 and adding 1 week would then yield January 21 of the following year as the EDD.
2. Physical examination: As noted previously, uterine size can be used to give a clinical estimate of gestational age. When this data is congruent with the LMP it is generally accurate to within 1 week.
3. Developmental milestones: The fetal heart beat should be detectable with a handheld Doppler at approximately 10 weeks of gestation and with a fetoscope at 18–20 weeks. Fetal quickening (fetal movement) should be reported by the mother at 18–20 weeks gestation.
4. Ultrasound: An obstetric ultrasound obtained early in pregnancy (first trimester or early second trimester) is accurate to within 1 week of gestation. The accuracy of ultrasound dating diminishes with advancing fetal age. In the third trimester, fetal ultrasound is accurate to within 2 weeks up to 36 weeks gestation and to within 3 weeks thereafter.

Laboratory Testing

Levels of hCG obtained via quantitative testing are not considered accurate for dating purposes as significant variability is noted at any given gestational age.

As a general rule, the first gestational age/EDD assigned should remain unchanged throughout the pregnancy unless significant doubt exists concerning the data used to establish that date. Caution should be exercised when "correcting" an EDD based on later data.

Treatment and Follow-Up

All patients not already taking prenatal vitamins should be given a prescription and encouraged to immediately begin taking one vitamin per day. In addition, iron supplementation should be considered for those patients with documented anemia.

At the first prenatal visit, patients should be given an overview of the course of prenatal care, a general caution concerning warning symptoms that should prompt early follow-up, and arrangements should be made for an appropriate

follow-up visit. Patients should be given the opportunity to ask questions and to clarify any areas of uncertainty. It may be helpful to suggest that patients keep a list of written questions between visits to help ensure that all important concerns are addressed at each visit.

Follow-Up Prenatal Visits

Follow-up visits are designed to meet four purposes: to track the progress of the pregnancy; early identification of complications, if any; completion of testing/evaluation at specific gestational age milestones; and patient education/anticipatory guidance.

Follow-up visits provide the opportunity to elicit patient questions and concerns and to provide education and counseling. Topics for review include nutritional status, activity and exercise in pregnancy, and symptoms consistent with preterm labor. Plans for delivery, such as when to contact the provider and when to go to the hospital should be addressed. Also discussed should be issues related to delivery and the postpartum period, including use of anesthesia, breastfeeding, circumcision, and the duration of the postpartum stay.

Follow-up intervals noted here are for uncomplicated pregnancies. Follow-up must be arranged as indicated should abnormalities present at any point.

Interval History and Physical Exam

The interval history should focus primarily on events and developments in the time period from the last visit to the current visit. Review of unresolved or ongoing concerns should also occur. Aspects of the history that should be addressed at every visit would include fetal movement (presence or absence and quantity), uterine contractions, pelvic pain or pressure, abdominal or back pain, and discharge or bleeding per vagina.

The physical examination contributes to assessment of fetal development and may also provide clues to the detection of pregnancy-related complications. The core elements of the physical examination include blood pressure, notation of edema, and weight. Assessments of fetal development include measurement of fundal height and documentation of the fetal heart rate.

Appropriate weight gain in pregnancy is a very common concern for pregnant patients. In population studies, optimal outcomes have been associated with maternal weight gain of 20–25 pounds during pregnancy. Current recommendations for weight gain during pregnancy suggest 25–35 pounds for a woman of average weight at the onset of pregnancy. Decreased weight gain can be associated with inadequate nutritional intake, inaccurate dating, intrauterine growth retardation, oligohydramnios and fetal demise. Increased weight gain can be associated with excessive caloric intake, inaccurate dating, macrosomia, multiple gestation, and polyhydramnios. Abnormal weight gain should prompt review of the prenatal course, eating patterns, and fetal well-being surveillance.

Interval Laboratory and Diagnostic Studies

Each pregnancy will require individualization of appropriate interval laboratory and diagnostic studies. For most pregnancies, however, a variety of interval studies should be considered. These include the following:

1. At 15–20 weeks gestation, patients should be offered α-fetoprotein (AFP) or maternal triple screen (hCG, AFP, and estriol) as a screen for developmental abnormalities. In addition, an obstetrical ultrasound is often ordered in this time period although it may be ordered earlier or later for specific indications. Indications for obstetrical ultrasound include uncertain gestational age, termination of pregnancy, induction, scheduled repeat cesarean section, fetal growth evaluation, suspected multiple gestation, size–date discrepancy, adjunctive to amniocentesis or chorionic villus sampling, suspected hydatidiform mole, suspected ectopic pregnancy, suspected fetal demise, suspected poly-/oligohydramnios, bleeding per vagina, maternal pelvic mass, uterine abnormality/uterine scar assessment, ovarian follicle surveillance, fetal biophysical assessment, placenta localization, past history of fetal congenital anomaly, or late initiation of prenatal care.
2. At 24–28 weeks gestation, patients should undergo glucose challenge testing for gestational diabetes, repeat hemoglobin (28 weeks), and antibody screen (28 weeks).
3. At 36 weeks, RPR, Hep B sAg, HIV, GC/Chlamydia, Group B strep are all indicated.

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4 Medications in Pregnancy

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KEY POINTS

1. All medications should be viewed with caution in pregnancy.
2. Management of medication use in pregnancy ideally begins with adequate preconception counseling and pre-pregnancy planning.
3. Medications used in pregnancy require clear identification of indication for use, duration of treatment, expected outcome, and signs or symptoms requiring early termination of their use.
4. When in doubt consultation with an expert in maternal–fetal medicine is strongly recommended.

BACKGROUND

With the exception of prenatal vitamins and possibly iron supplementation, all medications should be used with caution during pregnancy. Although clinical experience with many medications in pregnancy is quite extensive and the safety and efficacy is reasonably established, pregnancy represents a unique challenge in medication assessment. It would not be ethical, under most circumstances, to randomize pregnant patients to receive increasing doses of medications to assess safety and efficacy of a medication known to produce or suspected of producing harm in pregnancy. This limits the degree to which safety can be categorically stated for the use of any medication in pregnancy. Many medications once thought to be safe in pregnancy have subsequently been shown to be harmful. Other medications originally thought to be harmful have

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been shown to have beneficial effects when used for specific medically indicated purposes.

Many medications can and should be used in pregnancy for a variety of legitimate medical indications. Although it is beyond the scope of this chapter to discuss in detail the use of all medications in pregnancy, a few general guidelines can be offered. Texts exist that detail the risks and benefits of many available medications. Such a text should be a routine part of every obstetrical provider's library. When doubt exists concerning the indications for or the safety or efficacy of any medication, consultation with an expert in maternal fetal medicine is strongly recommended.

GENERAL PRINCIPLES OF MEDICATION USE IN PREGNANCY

The three general principles are as follow:

1. Chronic medications should be reviewed to assess safety and efficacy.
2. The risk of not treating (or treating less effectively) an identified disease (acute or chronic) should be weighed against the risks of the proposed treatment.
3. All medications used in pregnancy require clear identification of indication for use, duration of treatment, expected outcomes, and signs or symptoms that require early termination of use.

Chronic Medical Conditions

Some patients have chronic medical conditions that predate pregnancy. The management of many of these conditions will include the use of medication. Although it is always important to consider safety and efficacy when using medications, with the onset of pregnancy these considerations become considerably more complex. Ideally, a consideration of the impact of pregnancy on the medical condition as well as the impact of the medical condition on pregnancy would occur prior to pregnancy. For some patients, this lead to a recommendation to delay pregnancy until the medical condition can be more adequately controlled. In other circumstances, it may lead to a recommendation to avoid pregnancy altogether.

Under many circumstances (both planned and unplanned), however, management of pregnancy will overlap with management of chronic medical conditions and their associated medications. The first consideration should be for the safety of the mother. Disease processes that are life-threatening to the mother may require continuation of treatment even if the pregnancy is continued. The provider should explore treatment alternatives with equal efficacy and better established safety profiles when possible. When safer alternatives are not available, providers should discuss with patients the potential risks of continuing the pregnancy while simultaneously continuing the use of the

required medication versus the potential risks of terminating medication use for the duration of pregnancy. Patients must be given sufficient information to make an informed decision concerning their health and the health of their developing fetus, especially during the critical period of organogenesis early in pregnancy. In all circumstances providers and patients must make individualized treatment decisions based on the medical conditions of the specific patient.

Acute Medical Conditions

Pregnant patients are vulnerable to all the acute medical conditions of nonpregnant patients. Medical decisions concerning the treatment of acute medical conditions that arise during pregnancy must follow the same general guidelines as those for chronic conditions. Will the medical condition adversely affect the pregnancy? Will treatment of the condition ameliorate or eliminate these potential effects? Will the proposed treatment adversely affect the pregnancy? Are there safer or more well-established alternative treatment options? What are the *likely* consequences of not treating the medical condition? What are the *potential* consequences of not treating the medical condition?

As with the treatment of chronic medical conditions it is critical that both providers and patients have sufficient information concerning the risks and benefits of treatment options to make informed, individualized decisions. When providers cannot adequately answer these questions, patients should be referred to a provider with sufficient expertise to provide more complete information.

Acute Obstetrical Conditions

Pregnancy may be accompanied by a variety of complications that require consideration of medication use. The same general principles apply and the same questions must be answered. When these complications are relatively common, much established data may exist to guide providers and patients in their decision-making process. When the complications are less common, consultation may be required.

Therapeutic Categories and Considerations

Any drug used during pregnancy should be checked for safety prior to use. Keeping in mind the general considerations just given, the following recommendations may be considered:

1. When antibiotics are indicated consider penicillin, cephalosporins (except cefotetan), clindamycin, and macrolides. Avoid sulfa drugs (contraindicated in first and third trimester), quinolones, tetracyclines, and aminoglycosides (ototoxic; may be indicated for severe Gram-negative infections).

Table 1
Medication Safety Ratings in Pregnancy

Category A: Controlled human studies have demonstrated no increased risk of fetal harm.
Category B: No controlled human studies suggest increased risk; probably safe in pregnancy when use is indicated.
Category C: No evidence in human studies of increased risk but animal studies show possible increased risk.
Category D: Evidence in human studies suggest increased risk but benefits of treatment may outweigh risk.
Category X: Clear evidence of teratogenic effects exists; contraindicated in pregnancy.

2. When analgesics are indicated consider acetaminophen and narcotic analgesia (consult reference for specific agents). Narcotic analgesics do cross the placenta and may affect the fetus transiently. Long-term narcotic analgesia use (or abuse) during pregnancy can be associated with withdrawal symptoms in the newborn. Narcotic analgesia at or near delivery has been associated with respiratory depression in newborns, which can be reversed, if necessary, with narcan. Avoid aspirin (in analgesic doses) and nonsteroidal anti-inflammatory drugs (NSAIDs; contraindicated in late pregnancy).
3. For treatment of hypertension, consider labetalol (individual β-blockers should be reviewed prior to use as some β-blockers have been associated with adverse effects on uteroplacental and fetal hemodynamics and fetal growth), methyldopa, and hydralazine. Avoid angiotensin-converting enzymes (and angiotensin receptor blockade agents).
4. For patients with diabetes, consider insulin, regular and intermediate acting agents; but avoid oral hypoglycemics (recent data suggests that some oral hypoglycemics may be safely used in pregnancy but experience is limited and individual agents should be reviewed prior to use).
5. For patients suffering from nausea, consider using diclectin (doxylamine/pyridoxine) or chlorpromazine.
6. In cases of gastritis/peptic ulcer disease, consider magnesium hydroxide, aluminum hydroxide, calcium carbonate, and bismuth subsalicylate.

PROVEN HUMAN TERATOGENS

Some agents have proven teratogenic potential. These agents are summarized in Table 2. Although the effects of such agents are potentially variable and predictable, their use should be very limited or avoided during pregnancy. Category D agents have proven teratogenic potential but may, under certain circumstances, be indicated. Prior to using any category D agent, providers should perform a careful review of indications, duration of therapy, all potential

Table 2
Proven Human Teratogens

Category D
Cyclophosphamide
Lithium
Paramethadione
Phenytoin
Barbiturates
Benzodiazepines
Systemic retinoids
Tetracycline
Trimethodione
Valproic acid
Warfarin
Category X
Thalidomide
Danazol
Misoprostil
Diethylstilbesterol

effects, and all potential alternatives to the proposed therapy. In addition, patients should be informed of these considerations, allowing for informed consent to the proposed therapy. Category X medications have proven teratogenic potential and use should be avoided in pregnancy.

SPECIAL CONSIDERATIONS

In addition to the use of medications in pregnancy, a variety of other exposures may occur with possible effects on pregnancy. These might include occupational exposures, legal and illegal drugs or nonpharmacological items such as exercising, lifting, or other activities. As previously noted, most such exposures will be subject to limited data concerning possible pregnancy effects. For this reason, the same general principles should apply that apply to medication use:

1. Is there any data available to guide the decision?
2. Is there a specific and compelling reason for the exposure?
3. Do safer alternatives exist?
4. Can potential adverse effects be monitored?
5. Can exposure be limited or modified in such a way as to minimize potential risks?

Although a full discussion of all such exposures is the work of an entire text in its own right, three common and frequently encountered exposures deserve attention.

Tobacco

Tobacco is associated with a variety of adverse outcomes including low birthweight, increased risk of fetal demise, abruptio placentae, and placenta previa. Although the absolute risk associated with tobacco use is not clearly defined, the outcomes are potentially quite severe. As tobacco has no known benefits in pregnancy, every effort should be made to reduce or eliminate tobacco exposure during pregnancy.

Alcohol

Fetal alcohol syndrome (FAS) is a constellation of developmental and physical findings in neonates born to mothers who consumed large quantities of alcohol during pregnancy. FAS is associated with growth retardation, microcephaly, microphthalmia, and central nervous system deficiencies. The use of alcohol is quite prevalent and a significant number of pregnant mothers will have consumed alcohol prior to becoming pregnant. The question frequently arises whether alcohol can be safely used in any quantity during pregnancy. Although data is limited, there is no established safe level of alcohol use in pregnancy. For this reason, patients should be encouraged to eliminate or significantly limit alcohol use during pregnancy.

Illicit Drugs

A variety of illicit drugs are associated with adverse pregnancy outcomes. Each drug should be reviewed individually for specific concerns. In addition to the medical considerations, all such drugs are, by definition, illegal and carry with them significant social risk. All pregnant patients should be screened by history for illicit drug use and when present, counseled concerning the desirability of reduction or elimination. This screening and counseling should be approached in a nonjudgmental and nonthreatening manner. A threatening or legalistic approach to patients is likely to reduce patient reporting and therefore limit providers' ability to effectively intervene.

OVER-THE-COUNTER MEDICATIONS

Questions concerning the use of over-the-counter (OTC) medications arise frequently during the course of pregnancy. The general considerations for use are the same as for prescription medications. The ease of access combined with the frequency with which OTC medications are used makes recommendations in pregnancy particularly challenging. It is estimated that more than half of all medication use in the United States is OTC. Approximately 75% of all pregnant patients will use one or more OTC medication during the course of pregnancy.

Although providers can control access to prescription medications, OTC medications are, by definition, available to patients without the necessity of a

prescription. In addition, the safety of OTC medications may vary with the time in pregnancy when they are used. For example, OTC NSAIDs that may be safely used early in pregnancy are generally contraindicated in the third trimester. For this reason, providers must be able to discuss in detail the appropriate uses and precautions that patients musts keep in mind when deciding whether to use OTC medications during pregnancy.

Food and Drug Aministration (FDA) pregnancy safety ratings are available for all OTC medications and should be reviewed prior to their use. It should be noted that supplements such as herbal and/or natural preparations are not subject. FDA oversight and information concerning safety in pregnancy may be very limited. The breadth of OTC medications available make a comprehensive review beyond the scope of this text; however, two common categories of medications warrant consideration: pain medications and cough/cold/allergy medications.

OTC Pain Medications

Pain is among the most common of medical complaints and although the frequency of pain in pregnancy may not be higher than in the non-pregnant state, it is certainly not any less common. For this reason, patients will often seek advice from their providers on OTC pain medication options.

Acetaminophen

Acetaminophen is widely used in pregnancy and early childhood. Although randomized, controlled trials concerning the safety of acetaminophen in pregnancy are lacking, the extensive experience combined with few reports of complications makes the use of acetaminophen a safe choice in pregnancy. Acetaminophen is a category B drug in all stages of pregnancy.

Aspirin

Use of aspirin has been associated with a variety of potential pregnancy complications, including prolonged gestation and decreased birthweight. In addition, aspirin has potent antiplatelet activity that may predispose patients to bleeding. The use of aspirin in pregnancy has been associated with neonatal hemorrhage. Aspirin is a category D drug in all stages of pregnancy and its use as an OTC medication should be discouraged during pregnancy.

Nonsteroidal Anti-Inflammatory Drugs

Although NSAIDs are often combined as a single class, significant differences may exist in their use during pregnancy. Indomethacin (a prescription NSAID) has been used in pregnancy for preterm labor (*see* Chapter 7) but has been associated with significant complications and should only be used with caution and for specific indications. OTC NSAIDs, including ibuprofen and naproxen, are category B drugs in early pregnancy but category D drugs in the

third trimester. In the absence of a compelling indication for the use of NSAIDs in pregnancy, their use as an OTC medication should probably be limited.

OTC Cough/Cold/Allergy Medications

Given the duration of pregnancy, the likelihood of experiencing symptoms of allergies or viral respiratory infections is quite high. A wide variety of OTC medications are available to treat the various symptoms of viral respiratory infections and allergies and their use is quite common in pregnancy.

ANTIHISTAMINES

Chlorpheniramine is a commonly used antihistamine in a variety of allergy and cold formulations. Chlorpheniramine is a category B drug and is probably safe for use during pregnancy. Diphenhydramine is the second commonly used antihistamine and is also a category B medication. It should, however, be used with caution as it has been shown to cross the placenta, may have oxytocin-like effects at high doses, and may interact with other drugs in pregnancy.

DECONGESTANTS

Pseudoephedrine has been the subject of animal studies and has had widespread human use in pregnancy. Pseudoephedrine is a category B medication and its use in pregnancy is probably safe. Because it has been associated with a possible increase in the risk of gastroschisis, its use in the first trimester of pregnancy should probably be avoided when possible.

COUGH MEDICATIONS

Cough medications fall into two broad categories: antitussive medications and expectorants. Both categories of medication are available in a wide variety of OTC formulations. Guaifenesin, a common expectorant, is a category C drug. Its use in the first trimester of pregnancy has been associated with a possible increased risk of neural tube defects but data is limited. It is probably safest to avoid the use of guaifenesin in the first trimester of pregnancy when possible. Dextromethorphan is also a category C drug. Animal studies have shown an association between dextromethorphan exposure and birth defects. Human data has not found a similar association.

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II Complications of Pregnancy

5 Dysmorphic Growth and Genetic Abnormalities

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KEY POINTS

1. Growth and development represent a complex interaction between genetic predisposition and environmental exposure.
2. Screening for genetic risk factors ideally begins in the preconception period.

BACKGROUND

Most fetuses are free from identifiable genetic abnormalities. Their pattern of growth and development falls within the range of normal parameters. Under some circumstances physical growth is restricted (intrauterine growth restriction). This is discussed in Chapter 6. Under other circumstances, however, genetic abnormalities lead to abnormalities in growth, development, or both. These abnormalities may be relatively minor (e.g., color blindness) or they might be more significant (e.g., muscular dystrophy). Primary care providers must be familiar with common abnormalities and available screening options to identify these conditions when they arise.

Genetic inheritance is a complex interaction of maternal and paternal genotypic predisposition with a variety of environmental factors. The resulting phenotypic expression represents final outcome of these two factors. A review of both familial genetic predisposition as well as environmental risk factors will

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allow providers to discuss with expectant parents the developmental risks, if any, associated with a particular pregnancy.

HISTORY

Ideally genetic screening by history would begin in the preconception period. If that is not possible it should begin as early in the prenatal period as possible. A variety of standardized screening tools exist to assist providers with the evaluation of maternal and paternal genetic risk factors. Table 1 provides a selected list of conditions commonly screened for in pregnancy. Common medical conditions with a strong genetic predisposition should be reviewed, including congenital abnormalities, cystic fibrosis, Down syndrome, hemophilia, sickle cell disease, neural tube defects, Tay-Sachs disease, and muscular dystrophy, among others. Although these standardized screening tools are helpful as a starting point, providers should be aware that additional detail may be required for some high-risk patients. If the primary care provider does not feel adequately prepared to complete such a genetic screening referral should be made to a genetics counselor or a maternal fetal medicine specialist.

In addition to a thorough family history, a history of recurrent early spontaneous abortions should be noted if present. Approximately 50% of early spontaneous abortions are estimated to demonstrate genetic abnormalities. The age of the mother should be noted, as fetal genetic abnormalities increase with increasing maternal age. The prevalence of such disorders ranges from approximately 2 per 1000 live births at a maternal age of 25 years to approximately 150 per 1000 by maternal age 50.

PHYSICAL EXAMINATION

Although a physical examination may, rarely, uncover a genetic abnormality not discovered through careful history-taking, in general the physical examination contributes little to the assessment of risk for genetic abnormalities.

DIAGNOSIS

Although careful historical screening will identify many patients at risk for genetic and/or developmental abnormalities, adjunctive diagnostic testing is available and should be offered during the course of prenatal care. A wide variety of screening options are available and patients requiring specialized testing should be managed in conjunction with a genetics counselor and an experienced maternal fetal medicine specialist. Three such tests (obstetrical triple screen, amniocentesis, chorionic villus sampling [CVS]), however, are offered with sufficient frequency that all primary care providers should be familiar with their basic function.

Table 1
Selected Congenital Conditions Screened for in Preconception/Prenatal Care

Endocrine disease
Autoimmune disease
Congenital abnormalities
Cleft lip/palate
Congenital heart disease
Cystic fibrosis
Down syndrome
Mental retardation
Neural tube defects
Hemophilia
Sickle cell disease
Thalassemia
Huntington's chorea
Tay Sachs disease

OBSTETRICAL TRIPLE SCREEN

What Is Measured

This test measures maternal serum levels of α-fetoprotein, human chorionic gonadotropin, and unconjugated estriol. A standardized mean is established for levels of these three components during weeks 15 to 20 of pregnancy. Results are reported as multiples of the mean (MOM) and may be significantly higher or lower than the expected mean depending on the condition in question.

What Is Detected

Neural Tube Defects

Neural tube defects (NTDs) represent a variety of abnormalities in development of the central nervous system and spinal cord. The prevalence of such defects varies among different populations from rates of approximately 1 per 1000 to 1 per 100. Ninety percent of all NTDs occur in patients with no prior history, making universal screening advisable under most circumstances. A prior history of NTDs, however, does confer a significantly increased risk of subsequent defects. A past history of such defects is associated with a 2–5% risk in subsequent pregnancies.

NTDs should be suspected when triple screen values are higher than 2.5 MOM. At this threshold, use of the triple screen will detect approximately 80% of all open NTDs and 90% of all fetuses with anencephaly. Other conditions that should be considered with elevations in triple screen values include

incorrect gestational age calculation and multigestation. Additionally, the presence of a viable intrauterine pregnancy should be confirmed. Elevated triple screen values are falsely positive in approximately 5% of cases.

Down Syndrome

Down syndrome is a genetic abnormality of abnormal chromosomal distribution (trisomy) associated developmentally with mental retardation of variable degree, characteristic physical stigmata, and an association with a variety of other medical conditions including cardiac and hematological diseases. The prevalence of Down syndrome increases with increasing maternal age and with prior history of Down syndrome.

Down syndrome should be suspected with abnormally low triple screen results. Triple screen testing will identify approximately 60% of all cases of Down syndrome. Although this is sufficiently sensitive for low-risk populations, higher risk populations may require more accurate testing methods (*see* the next section). Abnormally low triple screen testing is falsely positive in approximately 5% of cases. The most common cause of false-positive testing is inaccurate gestational dating.

Confirmation/Follow-Up

Triple screen testing is, by definition, a screening test and all abnormal values require confirmation and diagnostic follow-up. For all abnormal values, confirmation of gestational age is critical. All data used to establish the gestational age should be reviewed and confirmed. Under some circumstances repeat triple screening may be indicated.

Confirmed abnormal elevations in triple screen results should be followed up with obstetrical ultrasound. This study will allow for careful examination of the anatomy of the developing fetus. In addition, ultrasonographic studies should allow for identification of multigestation and fetal demise.

Confirmed abnormally low triple screen results should be followed by genetics counseling with amniocentesis and fetal karyotyping.

Amniocentesis

Amniocentesis is a diagnostic procedure that consists of introduction of a sampling needle through the abdominal wall into the amniotic sac. A small sample of amniotic fluid is withdrawn, allowing for a variety of potential studies. The most common study performed with the fluid is determination of the fetal karyotype.

As noted earlier, an abnormal low triple screen is one indication for amniocentesis. Other indications include maternal age over 35 years, prior chromosomal abnormality, three or more prior spontaneous abortions, and known parental chromosomal abnormality.

Amniocentesis can be performed between 12 and 17 weeks gestation. The risk of complications is higher earlier in pregnancy. For this reason, most are performed between 15 and 17 weeks gestation. The most significant complication associated with amniocentesis is spontaneous abortion. The reported rate of post-amniocentesis spontaneous abortion is approximately 1 per 200 procedures, although the risk may be significantly lower in settings with highly experienced operators.

Chorionic Villus Sampling

The need to wait until 15 weeks gestation represents a significant limitation for amniocentesis in some cases. For this reason, alternative methods that may be performed earlier have been explored. One such method is CVS. The procedure is performed in a similar manner to amniocentesis but the target is the chorionic villus rather than amniotic fluid. CVS may be performed in earlier (during the first trimester) but carries a slightly higher risk of spontaneous miscarriage (up to 5%). For this reason CVS is generally limited to high-risk cases requiring earlier diagnosis.

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6 Intrauterine Growth Restriction

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KEY POINTS

1. Intrauterine growth restriction (IUGR) is defined as fetal weight below the 10th percentile and an abdominal girth below the 2.5 percentile.
2. Factors associated with IUGR can be categorized as fetal-genetic, uterine-environmental, maternal, toxic exposures, and constitutional.
3. Complications associated with IUGR include early complications (increased mortality, pre-eclampsia, preterm labor, still birth) and late complications (learning, behavioral, and developmental abnormalities).

BACKGROUND

Fetal growth is among the most important of parameters monitored during the course of prenatal care. Although the majority of pregnancies proceed with no complications in fetal growth a small number will show evidence of growth restriction. A variety of conditions are associated with or increase the risk for intrauterine growth restriction (IUGR). These factors are summarized in Table 1.

IUGR is defined as fetal weight below the 10th percentile and an abdominal girth below the 2.5 percentile for gestational age. As this definition implies, accurate fetal dating is critical to the diagnosis. At term, this corresponds to a

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Table 1
Risk Factors for Intrauterine Growth Restriction (IUGR)

Fetal-genetic factors
Chromosomal abnormalities (ex. Trisomy 21)
Neural tube defects
Achondroplasia
Osteogenesis imperfecta
Gastrointestinal (gastroschisis, duodenal atresia, pancreatic agenesis)
Renal disease (renal agenesis)
Neurofibromatosis
Uterine environmental factors
Infection
Cytomegalovirus
Rubella
Herpes, varicella
Influenza
Toxoplasmosis
Oligohydramnios
Placental abnormalities
Placenta previa
Abruptio placentae
Placental malformation
Multigestation
Uterine anatomic abnormalities
Maternal factors
Prior IUGR infant
Hypertension
Diabetes (may also be associated with macrosomic infants)
Nutritional deficits
Gastrointestinal malabsorption
Constitutional short stature
Vascular disease
Toxic exposures
Smoking
Alcohol
Illicit drugs (heroin, cocaine)
Prescription medications (folic acid antagonists, warfarin)
Constitutional
Constitutional short stature
Female
Birth order

birthweight of 2500 g (~5.5 pounds). By this definition, approximately 5% of all US infants demonstrate evidence of IUGR, accounting for approximately 175,000 infants annually in the United States.

RISK FACTORS

Factors associated with IUGR can be categorized into five categories: fetal-genetic, uterine-environmental, maternal, toxic exposures, and constitutional factors.

Fetal-Genetic Factors

A variety of genetic conditions are associated with restricted fetal growth and account for approximately 10% of all cases. Such conditions as Down syndrome (Trisomy 21) and Turner's syndrome are associated with an increased risk for IUGR. Structural growth defects such as anencephaly, achondroplasia, osteogenesis imperfecta, renal and gastrointestinal (GI) defects are all associated with an increased risk of IUGR.

Uterine-Environmental Factors

Abnormalities of the uterine environment may also contribute to growth restriction. Congenital infections such as cytomegalovirus, toxoplasmosis, or rubella are associated with restricted fetal growth. Fetal urinary tract outflow obstruction with concomitant oligohydramnios can be associated with IUGR. Placental abnormalities (placenta previa, abruption, placental malformation) and multiple gestation can both alter the uterine environment and therefore lead to growth restriction. The structure of the uterus itself may also contribute to growth restriction.

Maternal Factors

Growth in pregnancy is fundamentally reliant on a balance between fetal needs (especially nutrition and oxygen) and maternal ability to meet those needs. Maternal health and nutrition contribute significantly to fetal growth and a number of maternal factors can be associated with decreased fetal growth. Although specific maternal factors may not always be identified, a pregnant patient with a past history of IUGR is approximately twice as likely to have subsequent IUGR compared to those without such a history.

Underlying maternal diseases such as diabetes, hypertension, GI, and vascular disease are all associated with an increased risk for IUGR. Hypertension is associated with decreased placental perfusion resulting in decreased delivery of both oxygen and nutrients. GI disease with significant malabsorption will result in decreased delivery of nutrients to the fetus and may contribute to subsequent IUGR. It should be noted that less significant nutritional defects may not result in diminished fetal growth as nutrients are delivered preferentially to the fetus.

Fetal growth is dependent on adequate fetal oxygenation and delivery of necessary nutrients. Adequate delivery is dependent, in turn, on adequate vascular function. Maternal vascular disease associated with a number of diseases impairs maternal–fetal perfusion and therefore is associated with increased risk of IUGR. Such maternal conditions as diabetes mellitus, peripheral vascular disease associated with tobacco use, collagen vascular disease, and pregnancy complications such as pre-eclampsia can all decrease maternal–fetal perfusion, thus increasing the risk of IUGR.

Toxic Exposures

The use of toxic substances (tobacco, alcohol, and illicit drugs) has been associated with decreased fetal growth. Of these, tobacco use is by far the most common risk factor for diminished fetal growth. Pregnant patients who smoke approximately double the risk of IUGR, a risk that is proportional to the quantity of cigarettes smoked. Discontinuation of smoking before or during pregnancy is associated with reduction or elimination of this risk. Both alcohol and illicit drug use (especially heroin and cocaine) are associated with diminished fetal growth. Fetal alcohol syndrome infants are generally small for gestational age.

Prescription drug use may also be associated with decreased fetal growth. Folic acid is a critical component in fetal development. Supplementation with folate is recommended during the preconception and early prenatal course. Drugs that inhibit folic acid metabolism may result in decreased fetal growth among other complications. The use of warfarin for anticoagulation has also been associated with IUGR.

Constitutional Factors

Small mothers are more likely to have small infants. Although these infants are small for gestational age, they are otherwise healthy. If no maternal, fetal, or uterine factors can be identified, these infants are generally healthy and normal but small. There is some variation in size based on birth order and gender. First infants are slightly smaller, on average, than subsequent infants; female infants are somewhat smaller, on average, than male infants.

COMPLICATIONS OF GROWTH RESTRICTION

Although not all small babies have complications, IUGR represents the second leading cause of perinatal morbidity and mortality after prematurity. Infants with a birthweight below 2500 g have a mortality rate 5 to 30 times that of infants weighing more than 2500 g. IUGR (or associated underlying disease processes) is associated with an increased risk for pre-eclampsia, preterm labor/delivery, stillbirth, fetal electrolyte abnormalities, hypoglycemia, and aspiration. Long-term consequences associated with IUGR include increased risk for learning, behavioral, and developmental abnormalities.

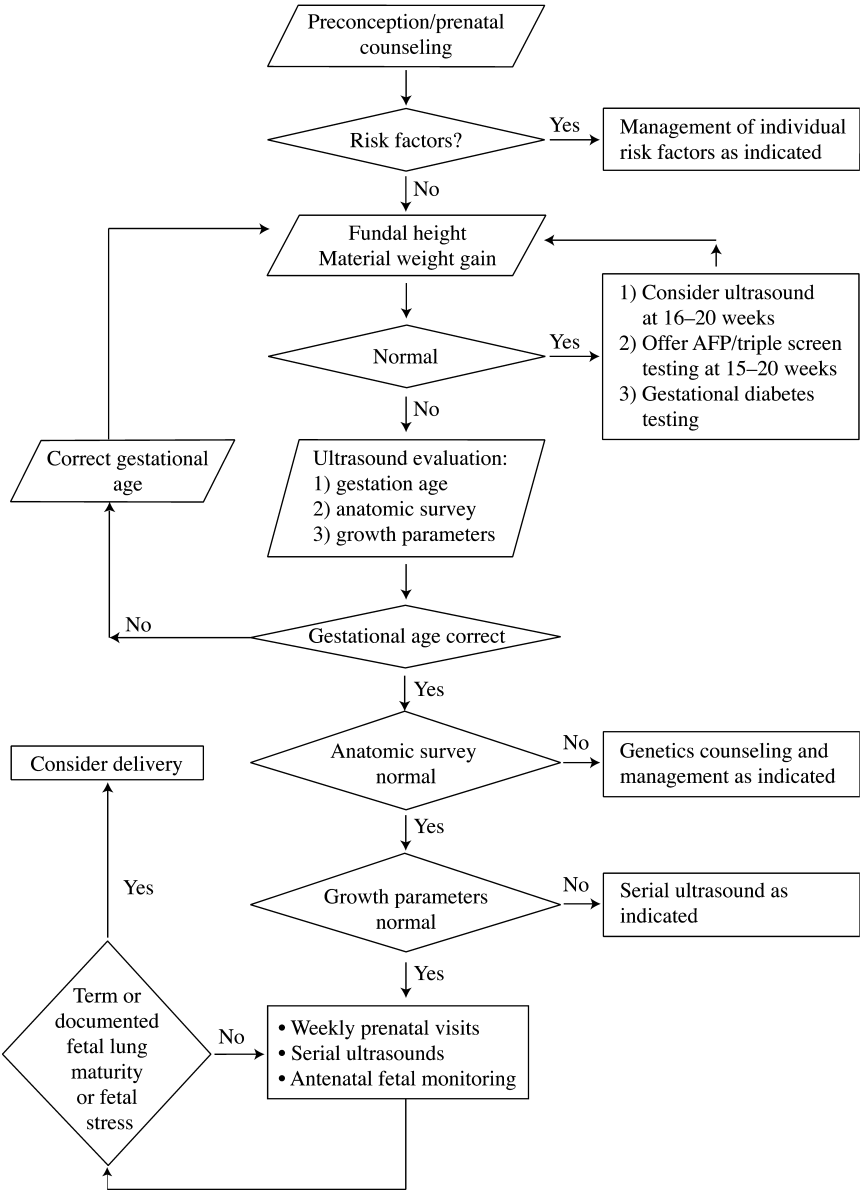

Fig. 1. Tracking fetal growth.

ANTENATAL TRACKING AND DIAGNOSIS

Every prenatal visit includes assessment of fetal growth either indirectly or directly. A general approach to tracking fetal growth is presented in Fig. 1. Indirect measures of fetal growth include maternal weight gain, fundal height,

and age-appropriate landmarks (e.g., fetal heart tones heard with handheld Doppler at approximately 10–12 weeks gestation). Direct measures of fetal growth can be obtained with obstetrical ultrasound. Interpretation of these markers depends on accurate pregnancy dating. Parameters for establishing gestational age and estimated date of delivery (EDD) are covered in Chapter 3. In addition to assessing markers of fetal growth, all patients should be screened for risk factors that may contribute to an increased risk for IUGR.

SCREENING FOR RISKS

The first prenatal visit will include a comprehensive historical review of the patient's, patient's family, and paternal risk factors. Particular note should be made of prior obstetrical history, including infant size at delivery, prior history of genetic abnormalities including neural tube defects and Down syndrome, and multiple gestation. The mother's history should be reviewed for chronic disease such as hypertension, cardiovascular disease, renal disease, diabetes mellitus (including prior macrosomic infants with or without a known diagnosis of diabetes mellitus), GI disease, and nutritional status. Note should be made of alcohol, tobacco, or illicit drug use.

Physical examination at the first prenatal visit should include assessment of uterine size (and comparison of this finding to estimated gestational age). If appropriate, fetal heart tones should be documented at this visit. Initial laboratory studies that may contribute to risk screening would include protein or glucose on urinalysis and evidence of cytomegalovirus, herpes, rubella, and/or toxoplasmosis.

Each subsequent visit will include interval updates for each of these risk factors. Patients should be screened for changes in nutritional status, toxic substance use, medications, or new exposures. Each prenatal visit will include documentation of blood pressure, maternal weight, fundal height, and fetal heart rate. Particular attention should be paid to fundal height measurement as this can be a significant clue to growth abnormalities. Fundal height (measured symphysis pubis to top of fundus) in centimeters should be equal to gestational age in weeks (± 2 cm).

At 15–20 weeks gestation, patients should be offered α-fetoprotein (or triple test) screening. Also, in this time period many patients will undergo obstetrical ultrasound examination. Key parameters on ultrasound include biparietal diameter, head circumference, abdominal girth, estimated fetal weight, and amniotic fluid index (AFI). Routine screening for gestational diabetes is performed at 24–28 weeks gestation but may be performed earlier in patients with increased risk.

Patients who show abnormalities in any of these parameters should be considered at increased risk for IUGR with appropriate follow-up and diagnostic testing when indicated.

DIAGNOSIS

Diagnosis of IUGR requires correlation of gestational age with ultrasonographic measurements of fetal growth. The accuracy of the diagnosis is ultimately dependent on the accuracy of each of these components. IUGR must also be understood to be a *growth* phenomenon; a single static measurement may be suggestive but is not diagnostic. Serial measurements are generally required to diagnose IUGR.

Estimation of gestational age is based on last menstrual period, key developmental markers (such as heart beat), and sonographic data. Sonographic data can be useful for three purposes: (a) estimation of gestational age, (b) identification of structural or developmental abnormalities, and (c) measurement of fetal growth parameters. The most accurate ultrasound parameters for estimating gestational age vary with the age of the fetus. Crown–rump length is most accurate in early pregnancy; biparietal diameter and head circumference are most accurate for second trimester evaluation. Third trimester estimates are decreasingly accurate but head circumference may be most accurate. The increased sophistication of obstetrical ultrasounds has yielded images capable of remarkable anatomic detail. Cardiac, renal, GI, and neurological anomalies may all be detected on ultrasound examination. Patients with suspected IUGR should undergo ultrasound examination with particular attention paid to detailed anatomic survey.

In addition to the parameters mentioned here, abdominal girth is particularly helpful in measuring fetal growth. Abdominal girth reflects subcutaneous fat that, in turn, is a marker for adequate fetal nutrition. IUGR is often associated with an oligohydramnios (decreased amniotic fluid) that can be measured via the AFI. The AFI is the sum of the largest fluid pocket in each of the four quadrants. IUGR with oligohydramnios is associated with increased morbidity compared with IUGR alone.

MANAGEMENT

Risk Reduction

Although early identification and management can reduce the morbidity associated with IUGR, risk reduction remains a critical component of management. Ideally, such risk evaluation and reduction would begin in the preconception period with identification of pre-existing risk factors. For patients with a strong history of genetic abnormalities, genetic counseling may be indicated prior to conception. Identification of pre-existing medical conditions and nutritional deficits may also contribute to a reduction in the risk for IUGR. Although the benefits of such management in IUGR have not been well established, control of blood pressure, euglycemia prior to conception, and nutritional augmentation,

among others, are recommended. Patients who smoke should be counseled to discontinue smoking; alcohol use should also be discontinued. The use of illicit drugs should be identified and cessation should be counseled. For many patients, pregnancy may represent a compelling reason to reduce or discontinue the use of toxic substances with benefit to both mother and fetus.

Infectious risks for IUGR should be reviewed with the patient and reduction of exposure counseled. Toxoplasmosis is associated with raw or undercooked meat and cat feces. Patients should be counseled concerning exposure to those with varicella and rubella. If patients are seen in the preconceptual period, immune status should be documented for varicella and rubella. Vaccinations for both are available and should be administered to non-immune patients who do not plan to become pregnant in the subsequent 3 months.

With diagnosis of IUGR, management involves three basic tasks: (a) identification and modification (when possible) of underlying etiology, (b) monitoring for anticipated or possible complications, and (c) evaluation of risks and benefits of continued pregnancy versus early delivery. Identification of the potential etiology is similar to preconception evaluation. The benefits of intervention are not well documented but management of medical conditions such as hypertension and diabetes, augmentation of nutritional status and reduction or elimination of tobacco, alcohol, and illicit drug use are recommended.

Complications associated with IUGR include prenatal and perinatal complications such as increased risk for of hypoxia, metabolic acidosis, preterm labor, pre-eclampsia and surgical delivery. Neonatal complications include aspiration, apnea, intubation, sepsis, hypoglycemia, electrolyte abnormalities (especially hypocalcemia), seizure, and death. Careful intrapartum monitoring is critical to early identification and management of these potential complications.

In patients with documented IUGR, careful assessment of fetal growth and well-being is critical to determining the timing and manner of delivery. Weekly prenatal visits are recommended, with careful monitoring of fetal status with review of fetal movement and kick counts. As noted serial measurements (every 2–6 weeks) of fetal growth are important for the diagnosis as well as for tracking. Antenatal fetal monitoring may also include nonstress testing, contraction stress testing, and/or biophysical profile measurements at least weekly. Amniotic fluid should be measured via AFI once weekly.

Management of IUGR requires individualized assessment and decision making. Timing of delivery should balance the benefits of further fetal maturity against the risks of continued exposure to an intrauterine environment that is less than optimal. Evidence of fetal maturity (well-documented gestational age of 38 weeks gestation or documentation of fetal lung maturity) or significant fetal stress should prompt delivery. For infants with reassuring antenatal monitoring and without evidence of maturity the benefits of intrauterine development may outweigh the risks of early delivery. Delivery should be planned for

a facility that is experienced with and capable of managing the high-risk infants of a pregnancy complicated by IUGR. Management of perinatal complications in the infant is best managed by an experienced neonatalogist.

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7 Preterm Labor

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1. Preterm labor is uterine contractions resulting in progressive cervical change prior to 37 weeks gestation. Preterm delivery is delivery prior to 37 weeks gestation; low birthweight infants are those that weight less than 2500 g at delivery.
2. Prior to 34 weeks gestation, most patients should be considered for tocolysis; from 34 to 37 weeks gestation such decisions must be made on a case-by-case basis.
3. Complications associated with preterm delivery include increased perinatal mortality and complications of prematurity (including respiratory distress, gastrointestinal dysfunction, hemorrhage, and abnormalities of growth and development).

BACKGROUND

Preterm labor is among the most common and most serious of prenatal complications. Preterm labor and its potential sequellae of preterm delivery and low-birthweight (LBW) infants remain one of the most significant challenges of current obstetrical practice. Preterm labor is defined as uterine contractions resulting in progressive cervical change prior to 37 weeks gestation. Preterm delivery is delivery prior to 37 weeks gestation. LBW infants are defined as those infants weighing less than 2500 g at delivery regardless of gestational age.

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LBW infants should be distinguished from small-for-gestational-age (SGA) infants who are defined as those infants below the fifth percentile for weight based on gestational age.

Preterm labor affects approximately 10% of all pregnancies. Preterm delivery affects approximately 13% of all live births. Preterm delivery and LBW infants represent approximately 70% of all perinatal mortality (~25,000 deaths annually) and 50% of all neurological morbidity.

FACTORS ASSOCIATED WITH PRETERM LABOR

A number of factors have been associated with an increased risk of preterm labor. These are summarized in Table 1. These factors can be divided into pre- and postconception factors. Although the mechanisms that link these factors to the onset of preterm labor is, in most instances, poorly understood, a thorough review of the patient's history will allow providers to more carefully outline the risk of preterm labor, preterm delivery, and LBW infants.

Although preterm labor alone is not associated with perinatal complications, concomitant conditions and outcomes are. Preterm labor may be complicated by preterm premature rupture of membranes (PPROM). PPROM is associated with a variety of complications discussed in Chapter 8. Preterm labor may also result in preterm delivery. Prematurity, in turn, is potentially associated with pulmonary dysfunction, gastrointestinal abnormalities, neurological complications, abnormalities of growth and development, and a significant risk of perinatal mortality. Complications of preterm delivery are the leading cause of perinatal mortality, responsible for approximately two-thirds of all deaths.

Preconception Factors

Environmental Factors

A number of environmental factors have been associated with an increased risk of preterm labor. The most significant environmental factor associated with preterm labor is lower socioeconomic status.

Patient-Related Factors

A number of pre-existing patient conditions also contribute to the risk of preterm labor. Patients may have a pre-existing genetic risk, a congenital anomaly (e.g., septate/bicornuate uterus or cervical incompetence), a pre-existing acquired obstetrical/gynecological risk (e.g., myomata, uterine surgery, diethylstilbestrol exposure), or a past history of preterm labor or second trimester spontaneous abortions. The recurrence rate of preterm labor is approximately 25%. Additionally, the risk of preterm labor is highest among younger (<18 years old) and older (>40 years old) obstetrical patients. These conditions can

Table 1
Risk Factors for Preterm Labor

Preconception factors
Lower socioeconomic status
Anatomic abnormalities (e.g., septate/bicornuate uterus, cervical incompetence)
Prior uterine surgery
Myomata
Diethylstilbesterol exposure
Past history of preterm labor
Under 18 years old, over 40 years old
Possible genetic predisposition
Postconception factors
Tobacco
Cocaine
Infection (e.g., Group B streptococcus, *N. gonorrhea, C. trachomatis*, trichomonas, gardnerella, ureaplasma, mycoplasma)

be screened for early in pregnancy (or during preconception counseling). Although many of these factors are not modifiable, there presence can usefully contribute to a conversation between the provider and the patient concerning the risk for preterm labor during the current pregnancy.

Postconception Factors

Once conception occurs, a number of additional factors contribute to the risk of preterm labor. An increased risk for preterm labor is associated with tobacco and cocaine use. Infections such as group B streptococcus, gonorrhea, chlamydia, trichomonas, gardnerella, ureaplasma, and mycoplasma have all been associated with increased preterm labor risk. Such exposures should be screened for at the first prenatal history (either directly through testing or via history) and as appropriate throughout the course of pregnancy.

DIAGNOSIS

As noted earlier, the diagnosis of preterm labor consists of three components: gestational age less than 37 weeks, presence of uterine contractions, and progressive cervical change.

The diagnosis of preterm labor begins with confirmation of the gestational age of the fetus. All data that contributed to the estimated date of delivery (EDD) should be reviewed for accuracy. The patient's last menstrual period should be reviewed for accuracy. Additional data such as prenatal ultrasound, sequential fundal height measurements and gestational age at quickening should also be reviewed. If no such data is available, an obstetrical ultrasound may be indicated. It should be emphasized, however, that an ultrasound

obtained late in pregnancy has significantly less accuracy for purposes of gestational dating.

The patient should be questioned concerning the presence of contractions (although the absence of patient reported contractions does not exclude the possibility of clinically significant contractile activity). If preterm labor is suspected, patients should be placed on tocometric monitoring to confirm the presence of uterine contractions.

Documentation of progressive cervical change, under most circumstances, requires serial cervical examinations. After confirming the absence of bleeding per vagina, providers should document cervical dilation and effacement as well as fetal station. Although the patient may demonstrate unequivocal cervical evidence of labor on initial examination, generally the diagnosis will require comparison of initial findings to findings on a follow-up examination.

INTAKE ASSESSMENT

History

In addition to the history noted earlier, patients should be asked about bleeding per vagina, rupture of membranes or fluid leak, and/or symptoms of infection. Special caution should be exercised if the patient reports a history of bleeding per vagina. The management of third trimester bleeding is covered in Chapter 10. A review of the past history should note the presence of cardiac, renal pulmonary, and/or endocrine abnormalities.

Physical Examination

In addition to the pelvic examination for assessment of cervical change, the intake physical examination should document blood pressure, pulse, temperature, rupture of membranes (*see* Chapter 8), fetal heart rate, and uterine contractions.

Laboratory Studies

Patients admitted with preterm labor should have all prenatal laboratory values reviewed with lab values ordered or updated as necessary. Patients may require testing for infection, including gonorrhea, Chlamydia, group B strep trichomonas, and bacterial vaginosis. Other studies that may contribute to evaluation of possible infection include increased interleukin-6 in amniotic or cervical samples, elevated ferritin in cervical or serum samples, and elevated granulocyte colony-stimulating factor in serum samples. Patients demonstrating clinical signs or symptoms of other obstetrical conditions (e.g., pregnancy-induced hypertension) should have laboratory evaluation as indicated for those conditions.

Controversy exists concerning the role of routine fibronectin testing in the management of suspected preterm labor. After 20 weeks gestation a result

greater than 50 ng/mL is associated with an increased risk for preterm delivery with a sensitivity of 70–90% and a specificity of 70–85%. The negative predictive value is approximately 99%. A negative test is a strong predictor of no preterm labor in the week following the test.

MANAGEMENT

The management of preterm labor is often limited in efficacy and duration and few modifiable factors have been identified. A general outline of management is shown in Fig. 1. Decisions concerning appropriate management should be tailored to the individual patient. Despite the challenge and variability involved in managing preterm labor a few general guidelines can be given.

Management Prior to 34 Weeks Gestation

In general, fetal lung maturity cannot be assumed in infants prior to 34 weeks gestation. For this reason, tocolysis is generally recommended. Although the efficacy and duration of such therapy is limited, a brief delay in delivery allows for administration of corticosteroids to enhance fetal lung maturity. All patients should be screened for contraindications to tocolysis (*see* Table 2). Contraindications to tocolysis include underlying medical contraindications (cardiac disease, renal insufficiency, pyelonephritis, pulmonary hypertension, untreated diabetes mellitus, and electrolyte abnormalities) and obstetrical contraindications (fetal stress, chorioamnionitis, eclampsia, fetal demise, and hemodynamic instability). Tocolytic options include the following:

1. Terbutaline (β-2-sympathomimetic): 250 μg subcutaneously every 3–4 hours.
2. Ritodrine (β-2-sympathomimetic): 100 μg per minute intravenous starting dose. Dose increased 50 μg per minute every 20 minutes until contractions cease.
3. Magnesium sulfate ($MgSO_4$): 6 g intravenous load over 15 minutes then 2 g per hour. May be increased every hour until contractions cease, maximum dose of 5 g per hour is reached or signs or symptoms of magnesium toxicity occur. Magnesium toxicity may be noted as neurological depression, cardiac depression or arrest, tetany, and hypotension. Monitoring of all patients on magnesium should include serum magnesium levels, maternal deep tendon reflexes, blood pressure, and strict recording of fluid input and output. Urinary retention is associated with magnesium use. Magnesium levels above 7 mEq/L are associated with diminished deep tendon reflexes; above 10 mEq/L with respiratory depression; above 12 mEq/L with cardiac depression and arrest. Magnesium toxicity is treated with calcium gluconate 1 g intravenous.
4. Indomethacin (nonsteroidal anti-inflammatory, prostaglandin inhibitor): 100 mg per rectum or 50 mg orally loading dose; 50 mg per rectum or 25 mg orally every 4–6 hours. Prior to 32 weeks, indomethacin has been shown to have equal efficacy to β-2-sympathomimetic agents probably by inhibiting

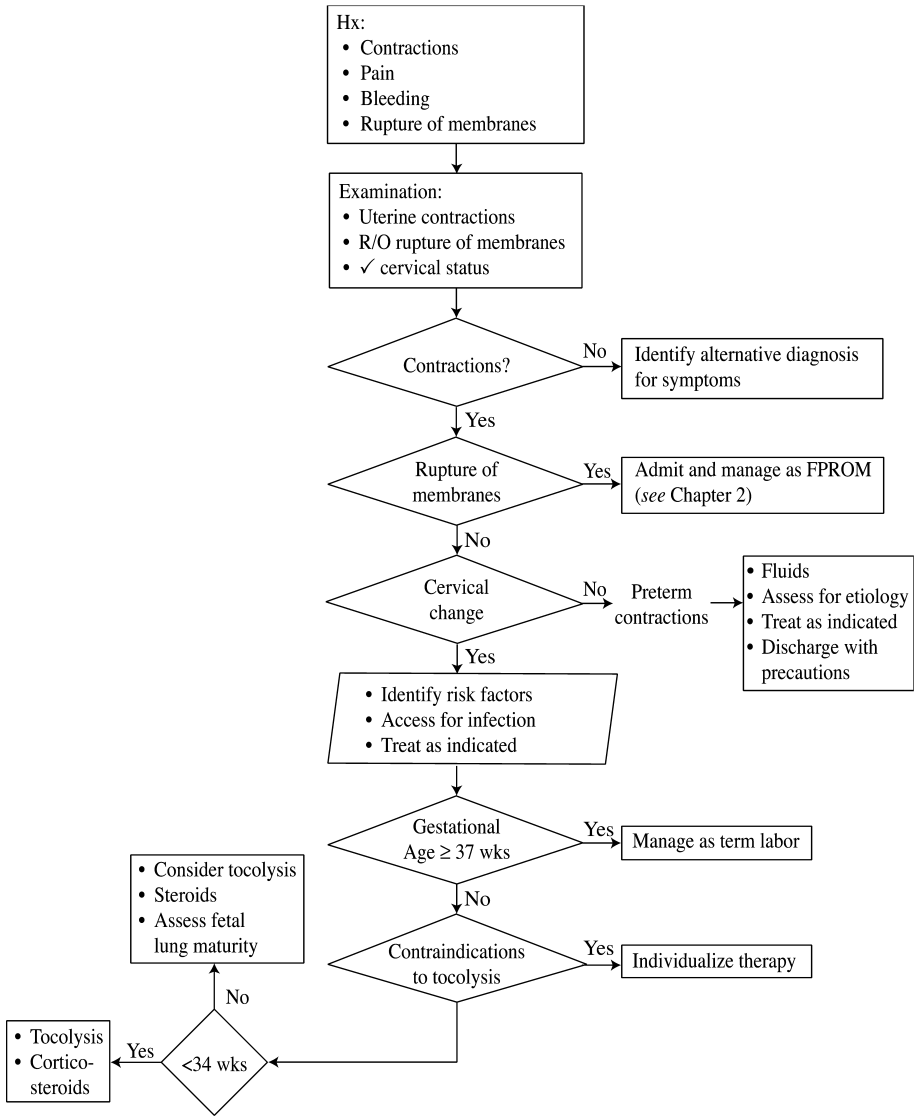

Fig. 1. Management of preterm labor.

prostaglandin synthesis. Use of indomethacin is associated with oligohydramnios and premature closure of the ductus arteriosus. For this reason, all patients on indomethacin should undergo frequent (every other day) ultrasound examinations to monitor for oligohydramnios. Because of the concern for premature ductus arteriosus, closure the use of indomethacin after 32 weeks gestation is controversial.

Table 2
Contraindications to Tocolysis

Medical contraindications
Cardiac disease
Renal insufficiency
Pyelonephritis
Pulmonary hypertension
Untreated diabetes mellitus
Electrolyte abnormalities
Obstetrical contraindications
Fetal stress
Chorioamnionitis
Eclampsia
Fetal demise
Hemodynamic instability

5. Nifedipine (calcium channel blockade): 20 mg orally loading dose; 10 mg orally every 6 hours. Nifedipine's action in blocking calcium channel function in smooth muscle is postulated to explain its efficacy in reducing uterine contractility. Studies have demonstrated efficacy similar to β-2-sympathomimetic agents.

Patients should be admitted and placed on bed rest. If significant cervical dilation has occurred, patients may be placed in a head-down position. Routine management includes monitoring of fluid status, hemodynamic status, and fetal well-being. If there is question concerning the gestational age or fetal lung status, fetal lung maturity testing may be considered. Mothers of infants at risk for fetal lung immaturity (24–35 weeks gestation) should be treated with 12 mg of betamethasone, intramuscularly. Two doses should be given 24 hours apart. Patients with evidence of contributory infection should be treated as appropriate for the infection.

Management at 34–37 Weeks

Fetal lung maturity in this range is highly variable and decisions to initiate tocolysis must be individualized. When time permits, assessment of fetal lung maturity may assist in decisions concerning tocolysis versus expectant management.

ASSESSMENT OF FETAL LUNG MATURITY

Delivery of an infant prior to fetal lung maturation is associated with considerable neonatal morbidity and mortality. For this reason, assessment of fetal lung maturity is critical in all instances where gestational age cannot be firmly established or when prenatal complications require consideration of an early delivery.

Confirmation of the gestational age is critical. Gestational age can be confirmed by review of the last menstrual period, early obstetrical ultrasound results, and key developmental milestones such as quickening and fetal heart tones. Although these data may allow for accurate gestational dating when available, not all data will be available in all cases. Even with such data, a more accurate assessment of fetal lung maturity may be necessary to guide management decisions. A variety of options are available to assist in this assessment.

Lecithin-Sphingomyelin Ratio

As fetal lung maturity progresses, pulmonary secretions are accumulated in the amniotic fluid allowing for assessment of fetal lung maturity based on amniotic fluid sampling. Lecithin and sphingomyelin are present in approximately equal quantities until approximately 8 weeks prior to the EDD. Beginning at this point, lecithin concentrations increase and sphingomyelin concentrations remain stable. As the fetus nears maturation, therefore, the ratio of lecithin to sphingomyelin will increase. Although the exact interpretation of the results may be site-dependent, a lecithin-to-sphingomyelin ratio of 2:1 is associated with generally favorable neonatal pulmonary outcomes.

Phosphatidylglycerol

The presence of blood or meconium in the amniotic fluid may alter the results of the lecithin-to-sphingomyelin ratio. For this reason, alternative tests have been developed that are not sensitive to the presence of these substances. One such test is phosphatidylglycerol, a component of surfactant that is present in increases quantities as fetal lung maturity advances. Amniotic fluid samples may be tested for phosphatidylglycerol alone or in conjunction with lecithin–sphingomyelin testing. The presence of phosphatidylglycerol is associated with more advanced fetal lung maturity and therefore with generally improved neonatal pulmonary outcomes. The results may be reported either qualitatively or quantitatively.

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8 Premature Rupture of Membranes

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BACKGROUND
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MANAGEMENT
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KEY POINTS

1. Premature rupture of membranes (PROM) is defined as rupture prior to the onset of labor.
2. Preterm premature rupture of membranes (PPROM) is defined as PROM occurring prior to 37 weeks gestation.
3. Rupture of membranes is followed by onset of labor within 24 hours in 90% of term patients and 50% of preterm patients.
4. PROM is associated with an increased risk of ascending infection. This risk increases with duration of rupture.

BACKGROUND

For most women, the pattern of labor is predictable. In general, women first note the onset of contractions that are relatively mild and irregular. As labor progresses, the contractions become stronger, more regular, and of increased duration. Spontaneous rupture of membranes generally follows the development of a regular contraction pattern as cervical dilation progresses. In approximately 10% of cases, however, spontaneous rupture of membranes occurs prior to the onset of labor. This is defined as premature rupture of membranes (PROM).

Premature, in this case, does not refer to gestational age but to labor. If rupture of membranes precedes labor *and* is prior to 37 weeks gestation, the condition is referred to as preterm premature rupture of membranes (PPROM). Rupture of membranes is generally followed by onset of labor within 24 hours.

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Ninety percent of patients at term and 50% of preterm patients will begin labor within 24 hours of spontaneous rupture of membranes. For term patients, PROM will generally mark impending labor and management can be expectant. PPROM often marks the onset of preterm labor and patients should be managed appropriately for their degree of prematurity.

A number of factors have been associated with PROM including infectious, anatomic, and pregnancy-related factors (*see* Table 1). A considerable number of cases, however, are idiopathic. Trichomonas, bacterial vaginosis, urinary tract infection (UTI), gonorrhea, chlamydia, and group B strep are among the infectious agents known or suspected to be associated with PROM. Women with documented cervical incompetence are also at increased risk for PROM. Amniocentesis is associated with an increased risk of PROM. This risk may be, in part, related to the experience of the provider performing the procedure. For this reason, patients requiring amniocentesis should be referred to providers with considerable experience. Placental abruption is occasionally associated with PROM and should be considered in the evaluation of patients with PROM.

DIAGNOSIS

History

Patients with PROM will often report discharge or "leaking" per vagina. This fluid leak may be subtle (e.g., increased wetness noted on undergarments or pants) or may be substantial (e.g., a "gush" of fluid). A careful history should be obtained to distinguish the causes of discharge such as cervical infection, physiological mucus production (or loss of the mucus plug), urinary incontinence, or UTI. Although each of these requires evaluation and diagnosis, management varies considerably from that for PROM.

Patients with PROM have, by definition, ruptured the membranes that serve to protect the infant from ascending infection. Patients with PROM are, therefore, at increased risk for perinatal transmission of genital infection and/or vaginal flora such as group B strep. This risk increases with the duration of rupture. For this reason, the best possible estimate of the time of rupture is an important part of the history.

Patients may also present with reported "urinary" symptoms such as urinary incontinence or urinary frequency. Such symptoms are both common and challenging. Anatomic changes associated with pregnancy such as increased uterine and fetal size increase urinary incontinence. Physiological changes associated with pregnancy such as relative outflow obstruction and urinary stasis increase the likelihood of urinary tract infection. For this reason, such urinary symptoms should be carefully detailed to identify other symptoms consistent with UTI such as urgency, dysuria, hematuria, abdominal pain, fever chills, nausea, vomiting, or back/costoverterbral angle pain. As a general rule, evaluation of PROM

Table 1
Risk Factors for PROM

Infection
Hydramnios
Incompetent cervix
Placental abruption
Amniocentesis

should include assessment for UTI and evaluation of UTI should include assessment for PROM.

In addition to assessment for symptoms of urinary pathology, history should include information concerning bleeding per vagina and symptoms consistent with early or impending labor such as contractions, abdominal pain/cramps, back pain, or mucus plug loss. When symptoms that might be suggestive of more serious pathology are discovered, such as fever, bleeding, or severe pain, the history should be further expanded to include symptoms consistent with abruptio placenta, placenta previa, or infection/sepsis.

In addition to obtaining the history associated with the leakage of fluid, a brief review of the prenatal course is important. In particular, attention should be paid to prior infections, previous episodes of contractions or preterm labor, prior episodes of bleeding or multiple gestation. Review of the gestational dating, estimated date of delivery, and the data used to calculate these is also critical.

Physical Examination

If the history is consistent with possible PROM, providers should assume that the membranes have ruptured until this is ruled out. The primary concern under such circumstances is to minimize the possibility of ascending infection. Manual examinations should be minimized. Sterile speculum examination should be performed and assessment should include testing for common infectious agents.

Vital signs should be documented and should include temperature, pulse, and blood pressure. Note should be made of patient discomfort or pain. Abdominal examination should include documentation of fundal height, abdominal tenderness, and fetal position (via Leopold's maneuvers; *see* Table 2). The external genitalia should be examined for evidence of infection (such as herpes), discharge, and trauma. On sterile speculum examination, note should be made of blood, fluid, or discharge in the vaginal vault or at the cervical os. Samples should be obtained for gonorrhea, chlamydia, group B strep, herpes (if characteristic or suspicious lesions are noted), yeast, and trichomonas/bacterial vaginosis.

Fetal heart rate should be documented including rate and variability. Uterine contractions should be noted on tocometer.

Table 2
Leopold's Maneuvers

First maneuver
Identify fetal head, fetal body, and fundal height
Second maneuver
Palpate fetal body to determine position of the back (smooth and uninterrupted) and front (palpable fetal arms and legs)
Third maneuver
Move body side to side. Resistance to movement suggests fetal engagement.
Fourth maneuver
Identify cephalic prominence

Laboratory

As noted previously, laboratory studies may include evaluation for gonorrhea, chlamydia, group B strep, herpes, trichomonas, and bacterial vaginosis. Although gonorrhea, chlamydia, group B strep, and herpes will not be immediately available, evaluation for yeast, trichomonas, and bacterial vaginosis can be performed quickly and accurately in the office. A microscopic examination of discharge/fluid may reveal clue cells (bacterial vaginosis), flagellated organisms (trichomonas), or fungal elements (yeast). A more comprehensive review of these conditions can be found in Chapter 13. A urine sample should be obtained for urinalysis, culture, and microscopic evaluation.

PROM is most accurately diagnosed via laboratory evidence of amniotic fluid in the vaginal vault. The two most common tests for rupture of membranes are nitrazine testing and "ferning." A sample of amniotic fluid placed on nitrazine paper will turn the paper blue. False-positives may occur in the presence of blood, semen, or infection. A sample of the fluid should also be spread thinly on a microscope slide and allowed to air dry. The dried sample should show characteristic fern-shaped crystalline pattern on microscopic examination.

Occasionally, suspected PROM may represent other more serious prenatal complications such as pyelonephritis, abruption, or pre-eclampsia. If these conditions are suspected on the basis of history or physical examination, additional laboratory studies will be necessary. Evaluation for these conditions should be reviewed in the appropriate chapters for each.

MANAGEMENT

The initial step in managing PROM is to distinguish PROM from PPROM. For this reason accurate gestational dating is critical. Figure 1 outlines the general management of PROM.

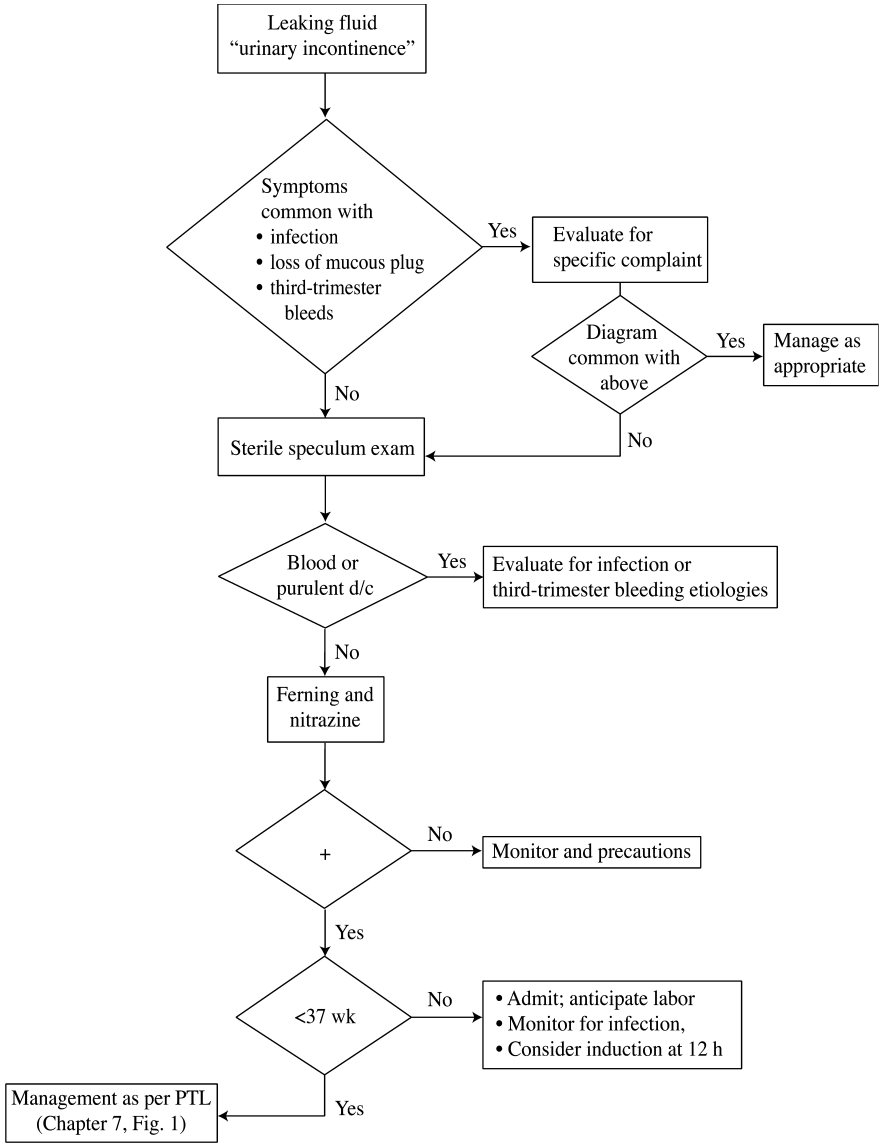

Fig. 1. Management of PROM.

Management at Term

For patients determined to be at term (>37 weeks gestation), management is similar to that for term labor. As the majority of these patients will begin labor within 24 hours, no additional intervention will be necessary for many. Because

the risk of infection increases as the duration of rupture increases, induction of labor may be necessary at 12 hours or with signs/symptoms of fetal stress or infection (tachycardia, fetal tachycardia, fever).

Preterm Management

Management of PPROM is considerably more complicated than for PROM. In addition to the considerations associated with the management of ruptured membranes, providers must also manage the impending preterm labor. (A complete discussion of preterm labor management can be found in Chapter 7.)

Patients with PPROM should be admitted with appropriate monitoring of fetal heart rate and uterine contractions. Baseline evaluation should include a history, physical examination, and laboratory studies, as noted previously.

Because delay in delivery is often desirable in preterm patients, particular attention should be paid to evaluation and management of possible infection. In addition to the studies previously mentioned, additional studies might include amniocentesis for culture and Gram stain, complete blood count, and blood and urine cultures. Patients should be closely monitored for uterine tenderness, fever, or discharge or bleeding per vagina.

Antibiotics are indicated for patients with evidence of infection. Suspected chorioamnionitis should be treated with an appropriate broad-spectrum regimen such as ampicillin and gentamicin (e.g., 2 g intravenous ampicillin every 4 hours and 2 mg/kg of gentamicin loading dose then 1.5 mg/kg every 8 hours). For patients with evidence of group B strep, penicillin or ampicillin is indicated (e.g., 2 g intravenous ampicillin loading dose then 1 g intravenously every 4 hours).

Of patients with PPROM, 50% will begin labor within 24 hours. For this reason, providers should consider the use of steroids to decrease neonatal pulmonary complications of immaturity. One such regimen is two 12 mg doses of betamethasone 24 hours apart.

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9 Early Pregnancy Bleeding

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SPONTANEOUS ABORTION
SOURCES

KEY POINTS

1. Evaluation of early pregnancy bleeding should focus initially on identification of ectopic pregnancy and spontaneous abortion.
2. The primary concern of initial management is assessment of hemodynamic stability and possible peritonitis.
3. Management of ectopic pregnancy is designed to (a) minimize maternal morbidity and mortality, (b) remove the ectopic pregnancy, and (c) maximize potential future fertility.
4. Management of possible spontaneous abortion begins with ruling out the possibility of ectopic pregnancy.

BACKGROUND

Bleeding per vagina may occur at any point during the course of pregnancy and always warrants careful attention to identification and management of the underlying etiology. Bleeding that occurs late in pregnancy (generally within the third trimester) is covered in Chapter 10. Bleeding that occurs early in pregnancy (generally within the first trimester) is of particular concern because of concerns with pregnancy viability and possible ectopic pregnancy with its associated morbidity and mortality. A careful review of common etiologies combined with a careful history, directed physical examination, and selected diagnostic studies will allow the provider to identify the underlying cause and initiate appropriate management in a timely manner.

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Table 1
Conditions Associated With Early Pregnancy Bleeding

Ectopic pregnancy
Threatened abortion
Incomplete abortion
Complete abortion
Trophoblastic disease
Cervical polyps
Cervical ulceration
Cervical cytological abnormalities

Early pregnancy bleeding per vagina is a relatively common presentation. Most cases of early bleeding are mild, self-limited, and of indeterminate etiology. Among the cases in which an etiology can be determined most are caused by either spontaneous abortion or ectopic pregnancy. Approximately 5–15% of all pregnancies will end in a clinically recognized spontaneous abortion (involuntary expulsion prior to 20 weeks gestation). A considerably larger percentage (up to one-third) will end in an unrecognized abortion that is perceived to be menstrual bleeding. Although less common than spontaneous abortion, ectopic pregnancy is responsible for approximately 15% of all maternal deaths. Although the differential diagnosis for early pregnancy bleeding includes several disparate conditions (*see* Table 1), the focus of initial evaluation is on identification of these two conditions. Less common causes of early pregnancy bleeding include trophoblastic disease and cervical pathology such as ulceration, infection, or cytopathology.

GENERAL APPROACH TO EARLY PREGNANCY BLEEDING PER VAGINA

As noted, most cases of early pregnancy bleeding per vagina are of indeterminate cause. A significant minority are related to spontaneous abortion. A smaller but significant number are associated with ectopic pregnancy. Initial evaluation will be directed toward identification of patients with these two conditions, documentation of the viability of the pregnancy, assessment of the medical stability of the mother, and reassurance for patients without evidence of either condition. Figure 1 outlines a general approach to the evaluation and management of early pregnancy bleeding.

History

A careful history should be obtained of the bleeding itself as well as associated symptoms. In regard to the bleeding itself, information should be obtained concerning the following:

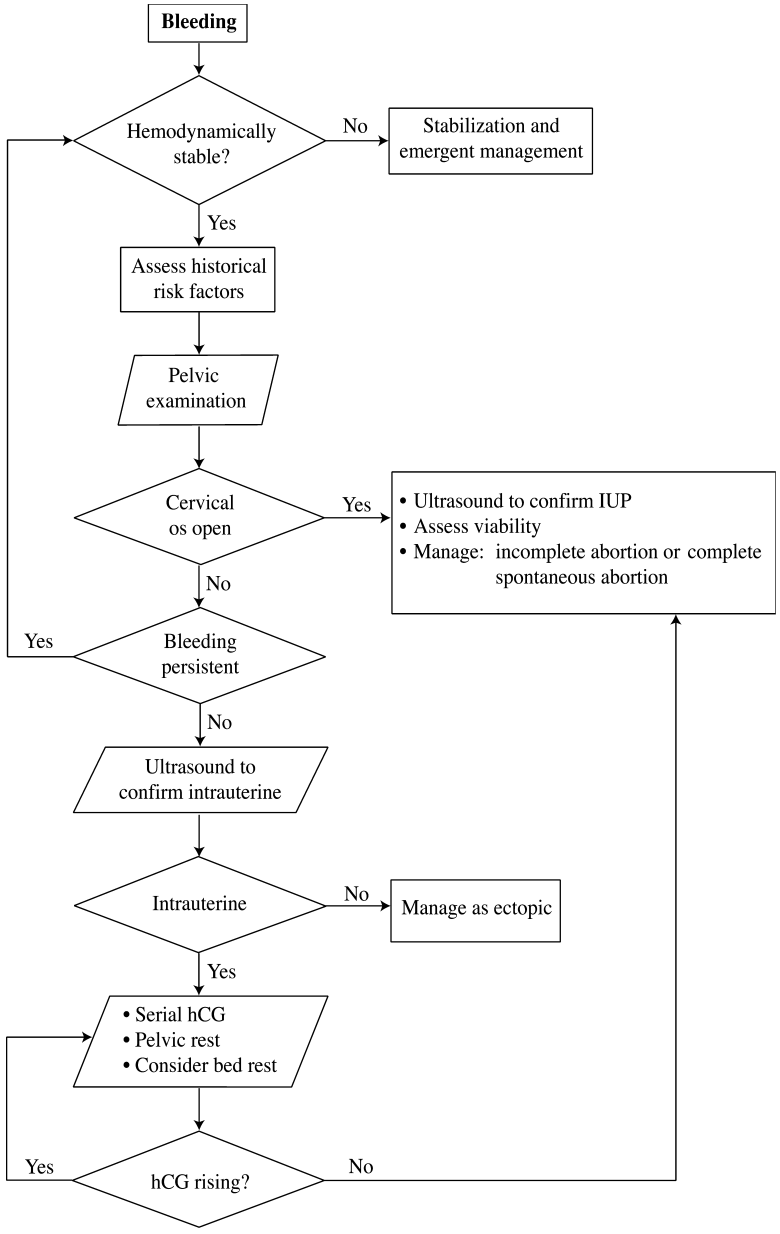

Fig. 1. Evaluation and management of early pregnancy bleeding.

1. Characteristics of the bleeding (e.g., is it scant or copious, bright red or brown and clot-like?).
2. Onset of the bleeding (e.g. did it start abruptly or gradually?).
3. Duration of the bleeding (how long has the bleeding lasted?).
4. Intensity of the bleeding (how much bleeding has been noticed? It may be helpful to use as comparison to normal menstrual flow although providers should note that there is considerable physiological variability in the quantity of normal menstrual flow).
5. Exacerbating factors (did anything appear to precipitate the bleeding or make the bleeding worse once it had started?).
6. Relieving factors (has anything made the bleeding diminish or stop?).

Particular attention should be paid to trauma, activity (including sexual activity) and associated symptoms such as pain, dizziness, or weakness. The patient's past history should be reviewed for risk factors such as smoking, multiple sexual partners, past history of pelvic inflammatory disease, or intrauterine device use. Prior gynecological surgery should be reviewed, including tubal ligation and uterine surgery (including myomectomy). Any prior diagnosis of anatomic abnormalities of the genital tract should be noted. The patient's obstetrical history should be reviewed for prior ectopic pregnancies and/or spontaneous abortions. The prenatal course should be reviewed for any high-risk conditions that may have been previously noted, including a family history of significant genetic abnormalities or significant toxic or infectious exposures. Note should also be made of the patient's gestational age and the means used to determine the estimated delivery date.

Physical Examination

Physical examination begins with a rapid assessment of the hemodynamic stability of the mother. Depending on the gestational age of the patient, assessment of fetal heart rate may also be indicated. The mother's blood pressure (BP) and pulse should be recorded including orthostatic measurements. (To measure orthostatic—positional—changes in BP and pulse, patients should first be placed in a recumbent position. BP and pulse are measured in the usual manner. Patient is then raised to a sitting position and the pulse and BP are measured a second time. Note is made of a significant drop in BP or a significant rise in pulse). The general assessment of the patient should include obvious signs of distress or discomfort. Abdominal examination should include assessment of uterine size. A pelvic examination should be performed. Note should be made of blood (location: at the cervical os, pooled in the vaginal vault; quantity: from scant discoloration to copious active bleeding; character: bright red, clotted, brown). Cervical status should be noted including dilation. The presence of other findings including discharge, amniotic fluid, or cervical lesions such as polyps or erosions should be documented. A bimanual

examination should be performed to assess for adnexal mass or tenderness. The uterus should be assessed for size and tenderness.

Ultrasound

Ultrasound examination may be critical in the assessment of early pregnancy bleeding. Confirmation of an intrauterine pregnancy is possible as early as 5 weeks gestation. In general, the presence of an intrauterine pregnancy significantly reduces *but does not eliminate* the possibility of ectopic pregnancy. Ultrasound examination is also diagnostic of trophoblastic disease. The absence of fetal heart activity may be indicative of a threatened or incomplete abortion.

Laboratory Studies

Early pregnancy bleeding per vagina may represent a significant obstetrical emergency in the case of an ectopic pregnancy that has ruptured. Blood loss may be rapid and difficult to control. For this reason, laboratory studies are ordered to establish baseline hematological status and in anticipation of a potential need for transfusion. Studies should include complete blood count with platelets, blood type, and crossmatch. If not previously documented Rh status should be confirmed. The second key function of laboratory surveillance is to document the viability of the pregnancy. For this purpose, quantitative β-human chorionic gonadotropin (hCG) should be obtained.

ECTOPIC PREGNANCY

Background

Ectopic pregnancy is diagnosed when pregnancy implantation occurs in a location outside the uterine cavity. The exact location can be variable and may include within the fallopian tubes or in an intraperitoneal/extrauterine location. Because blood supply and/or space is limited outside the uterine cavity, these pregnancies are capable of growing for a brief period but will eventually outgrow their space or blood supply. If the pregnancy implants in a location (such as the fallopian tube) where space is limited, rupture may occur with associated intraperitoneal bleeding.

Risk factors associated with an increased risk for ectopic pregnancy include prior history of ectopic pregnancy, prior history of pelvic inflammatory disease, prior pelvic surgery (including tubal ligation and reversal of tubal ligation), multiple sexual partners (probably related to an increased risk for unrecognized pelvic inflammatory disease and subsequent scarring), and smoking.

Diagnosis

HISTORY

Patients who present with early pregnancy bleeding per vagina should be carefully screened for risk factors that increase the probability of ectopic

pregnancy as noted previously. Patients with ectopic pregnancy may report bleeding, abdominal pain, symptoms of peritonitis, or may be relatively asymptomatic. The bleeding may be variable depending on the location of the pregnancy. Although copious bleeding should prompt evaluation for ectopic pregnancy, providers should maintain a high index of suspicion as the absence of clinically apparent bleeding does not eliminate the possibility of ectopic pregnancy. The onset of symptoms may be acute but is often subacute with gradual worsening of symptoms that may be initially quite mild.

Physical Examination

The physical examination should include those elements noted previously to assess maternal and fetal well-being, including vital signs, abdominal examination, and fetal heart rate monitoring when appropriate. The physical examination may be quite variable. For some patients, the findings on physical examination are all normal. For others with rupture and significant intraperitoneal bleeding, findings may be indicative of acute peritonitis including diminished bowel sounds and a rigid, tender abdomen with rebound and guarding. A pelvic examination should be performed to assess for the presence of blood and/or products of conception, cervical status, uterine tenderness, adnexal tenderness, and adnexal mass.

Ultrasound Examination

Although history and physical examination may contribute to the diagnosis of ectopic pregnancy, all patients with early pregnancy bleeding per vagina should be assumed to have ectopic pregnancy until it is ruled out. For this reason, all patients should have ultrasound confirmation of the presence, viability, and location of the developing fetus. Ultrasound may demonstrate a gestational sac in the extra-uterine space. Alternately, the ultrasound may show no evidence of a gestational sac despite elevated β-hCG levels. Transvaginal ultrasound should demonstrate intrauterine pregnancy when hCG levels reach approximately 6000 mIU/mL. Ectopic pregnancy should be strongly suspected if the ultrasound does not demonstrate either characteristic findings of trophoblastic disease or intrauterine pregnancy when β-hCG levels are greater than 2000 mIU/mL.

Laboratory Studies

Supportive laboratory studies include serum progesterone levels and serial quantitative β-hCG. Progesterone levels are rarely less than 5ng/mL in viable pregnancies. Conversely, less than 1% of ectopic pregnancies will demonstrate serum progesterone levels of more than 25 ng/mL. Serum β-hCG may also add useful data. Ectopic pregnancy is rarely associated with β-hCG levels greater than 50,000 mIU/mL. If initial findings are equivocal, serial β-hCG levels are

very helpful. In normal pregnancies, serum β-hCG doubles every 2–3 days. An increase in β-hCG less than 50% in 48 hours is considered abnormal and should warrant further evaluation.

Management

Management of ectopic pregnancy depends considerably on the stability of the patient. Following diagnosis of ectopic pregnancy, patients should be assessed for clinical stability. Patients with hemodynamic instability or evidence of peritonitis should be considered surgical emergencies. For patients who are stable, evaluation for surgical or medical management may be performed. The purpose of management is threefold: (a) to minimize morbidity and mortality for the mother, (b) to remove the ectopic pregnancy, and (c) to maximize future potential fertility options.

In addition to the conditions just listed, indications for surgical intervention include anemia, gestational sac greater than 4 cm on ultrasound evaluation, pain of more than 24 hours duration, suspected heterotopic pregnancy, or uncertainty of diagnosis requiring laparoscopic confirmation.

Indications for medical management include gestational sac smaller than 4 cm on ultrasound examination and hemodynamic stability.

Surgical Management

Patients with clinical evidence of hemodynamic instability or peritonitis should be treated as a surgical emergency. Providers should assume that blood products and fluid resuscitation will be necessary and should be prepared to provide both. Patients should be cross matched for at least four units of blood and should have at least two large bore intravenous access sites established as quickly as possible. A variety of surgical options exist depending on the clinical presentation of the patient, desire to preserve future fertility, and the experience of the operator. These options include salpingostomy, segmental resection, fimbrial expression, salpingectomy (in cases with significant bleeding, significant tubal damage, or recurrent ectopic pregnancies at the same location), and laparotomy (in cases with severe hemodynamic stability).

Medical Management

The use of methotrexate has emerged as a medical alternative to surgical management for appropriate patients. The success rate with single-dose methotrexate regimens is 80–90%. One such regimen is 50 mg/m^2 of methotrexate via intramuscular injection. Serum β-hCG levels are obtained on days 1, 4, and 7. A second dose is administered on day 7 if serum β-hCG has not demonstrated a significant (~15%) decrease. Serial weekly serum β-hCG levels should be obtained until levels are less than 15 mIU/mL.

SPONTANEOUS ABORTION

Background

Among cases of early pregnancy bleeding with a known etiology, spontaneous abortion is by far the most common. As noted, 5–15% of all pregnancies will end with a clinically apparent spontaneous abortion; up to one-third of all pregnancies end in spontaneous abortion. Although generally spontaneous abortion is not as medically concerning as ectopic pregnancy, the significance of spontaneous abortion for the patient (and her family) will often be quite high. For this reason, appropriate diagnosis and management of spontaneous abortion is critical.

Risk factors for spontaneous abortion include genetic abnormalities, toxic exposures, structural abnormalities (such as atypical uterine anatomy), smoking, and toxic exposure. Most cases of spontaneous abortion occur without a clinically apparent risk factor.

Spontaneous abortion may be divided into three general subtypes: threatened, incomplete, and complete.

Threatened abortion is defined as bleeding per vagina before 20 weeks without passage of tissue or premature rupture of membranes. Threatened abortion may present with or without cervical dilation. Bleeding per vagina prior to 20 weeks gestation in conjunction with cervical dilation is referred to as inevitable abortion.

Incomplete abortion is defined as bleeding and incomplete passage of the products of conception. This condition may be associated with hemodynamic instability in which case it should be considered an obstetrical emergency and should include all the usual elements associated with management of such unstable patients.

Complete abortion is defined as bleeding with complete passage of all products of conception. The distinction between incomplete and complete abortion is not always clear and care should be exercised to confirm the passage of all products prior to making the diagnosis of complete abortion.

Diagnosis

It should be recognized that patients will not present with a chief complaint of spontaneous abortion; they will present with a complaint of bleeding per vagina. For this reason, the general history for these patients will mirror that of patients with ectopic pregnancy.

HISTORY

History should include the elements described earlier, including a history of the bleeding, associated symptoms, a review of historical risk factors, and symptoms of hemodynamic instability. Particular attention should be paid to reports of passage of tissue or "clots." A past history of spontaneous abortion should raise providers' suspicion of abortion.

Physical Examination

Physical examination will begin with assessment of the hemodynamic stability of the patient. Pelvic examination will assess cervical dilation, bleeding, and/or products of conception. To assess for other potential causes of bleeding, providers should make note of adnexal tenderness or mass, cervical lesions, discharge, or other abnormalities.

Ultrasound Examination

The use of ultrasound in suspected abortion may provide limited but useful information. Ultrasound examination may demonstrate the presence or absence of a gestational sac, the presence or absence of fetal cardiac activity, and evidence of retained products of conception.

Laboratory Studies

Laboratory studies are generally limited for patients who are clinically stable. Serial serum β-hCG levels should be obtained to document continued viability (for threatened abortion) or appropriate decline in levels (incomplete or complete abortion). For patients who are clinically unstable, laboratory studies are the same as noted for ectopic pregnancy.

Management

Threatened Abortion

Effective management of threatened abortion is quite limited. Although few proven interventions exist, recommendations include bed rest, abstention from intercourse, and close monitoring for persistent bleeding. As noted earlier, documentation of serum β-hCG levels may be helpful.

Incomplete Abortion

By definition, patients with incomplete abortion no longer have a viable pregnancy and have not yet passed all of the products of conception. Management requires (a) assessment of hemodynamic stability, (b) removal of retained products of conception, and (c) documentation of declining serum β-hCG levels to confirm adequacy of treatment. For hemodynamically unstable patients, management includes fluids, blood, and rapid surgical intervention. The use of oxytocin (30–40 U/L of fluid) may help control bleeding. For stable patients, surgical evacuation should be performed and serial serum β-hCG levels obtained. Patients who are Rh negative should receive rhogam at the time of dilation and evacuation to prevent isoimmunization.

Complete Abortion

Management of patients with confirmed complete abortion is relatively straightforward. No intervention is required and serial serum β-hCG levels

should be sufficient to document adequacy of management. As previously noted, however, providers should exercise caution as the distinction between complete and incomplete abortions is not always clinically apparent.

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10 Late Pregnancy Bleeding

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1. Initial assessment of late pregnancy bleeding is designed to identify potential placenta previa and abruptio placentae.
2. No manual or speculum examination should be performed until placenta previa has been ruled out.
3. Placenta previa is an absolute contraindication to vaginal delivery.
4. Placenta previa and abruptio placentae are obstetrical emergencies and require rapid assessment and management.
5. Initial management of placenta previa and abruptio placentae is directed toward ensuring hemodynamic stability and safe delivery.

BACKGROUND

Bleeding per vagina may occur at any point during the course of pregnancy and always warrants careful attention to identification and management of the underlying etiology. Bleeding that occurs early in pregnancy (generally within the first trimester) is covered in Chapter 9. Bleeding that occurs later in pregnancy (generally within the third trimester) is of particular concern because of the potentially serious underlying etiologies and the possibility of significant morbidity that exists for both the mother and the infant. A careful review of common etiologies combined with a careful history, directed physical examination, and selected diagnostic studies will allow the provider to identify the underlying cause and initiate appropriate management in a timely manner.

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Table 1
Conditions Associated With Late Pregnancy Bleeding

Placenta previa
Placental abruption
Cervical cytopathology
Polyps
"Bloody show"

Late pregnancy bleeding per vagina is a relatively common presentation. Approximately 5% of all pregnancies is complicated by such bleeding. Although the differential diagnosis includes several disparate conditions, placental abnormalities comprise the majority of such bleeding (*see* Table 1). Half of all third-trimester bleeding is caused by either placental abruption or placenta previa. Other causes include cervical cytopathology, polyps, and "bloody show." Bloody show refers to limited bleeding per vagina just prior to or at the onset of labor. Such bleeding is a variant of normal, although patients may require evaluation for other causes of bleeding.

GENERAL APPROACH TO LATE PREGNANCY BLEEDING PER VAGINA

Most cases of significant late pregnancy bleeding per vagina are caused by placental abnormalities: placental abruption and placenta previa. The diagnosis and management of each is detailed here. When faced with a patient who presents with bleeding per vagina, however, a general approach to evaluation (outlined in Fig. 1) will allow for rapid evaluation and triage of those patients with such significant obstetrical problems from those with other less common presentations.

History

A careful history should be obtained of the bleeding itself as well as associated symptoms. In regard to the bleeding itself, information should be obtained concerning the following:

1. Characteristics of the bleeding (e.g., is it scant or copious, bright red or brown, and clot-like?).
2. Onset of the bleeding (did it start abruptly or gradually?).
3. Duration of the bleeding (how long has the bleeding lasted?).
4. Intensity of the bleeding (how much bleeding has been noticed? It may be helpful to use as comparison to normal menstrual flow although providers should note that there is considerable physiological variability in the quantity of normal menstrual flow).

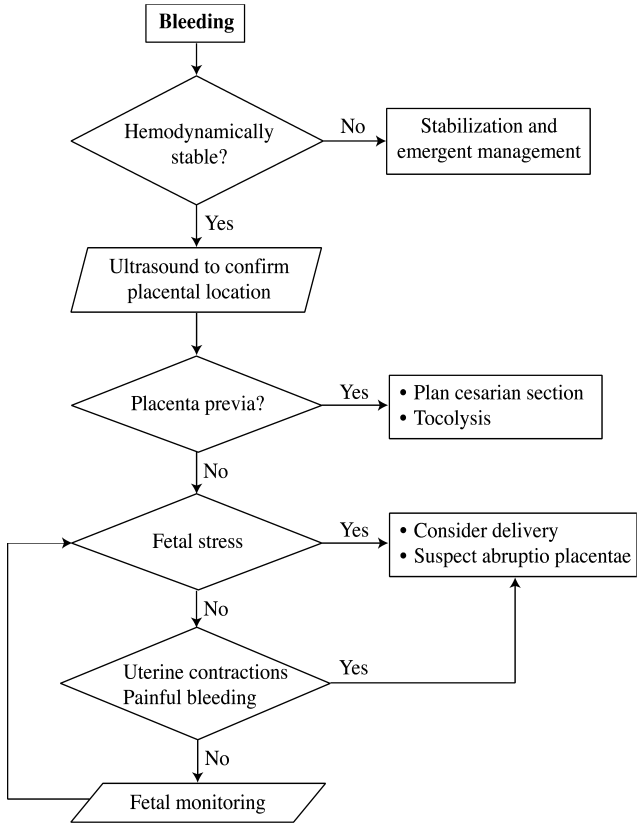

Fig. 1. Management of late pregnancy bleeding.

5. Exacerbating factors (did anything appear to precipitate the bleeding or make the bleeding worse once it had started?).
6. Relieving factors (has anything made the bleeding diminish or stop?).

Particular attention should be paid to trauma, activity (including sexual activity), and associated symptoms. Of particular importance are pain with bleeding and symptoms consistent with labor such as cramping, contractions, or back pain. In addition, the patient should be questioned concerning fetal movement and/or fetal kick counts. The prenatal course should be reviewed for any high-risk conditions that may have been previously noted. Note should also be made of the patient's gestational age and the means used to determine the estimated date of delivery. The patient's past obstetrical history, if any, should be reviewed for prior episodes of late pregnancy bleeding.

Ultrasound

Evaluation of late trimester bleeding will often require a pelvic examination and cervical assessment. *It is critical that no manual or speculum examination be performed prior to confirming the location of the placenta*. In the case of placenta previa, such an examination may cause placental damage and acute severe hemorrhage leading to an obstetrical emergency. Ultrasound examination should be performed before any vaginal examination. Ultrasound may be used to identify the location of the placenta and specifically to rule out placenta previa. It should be noted that although placental abruption *may* be seen on ultrasound, ultrasound is generally ineffective for detecting this condition with a sensitivity of approximately 15%.

Physical Examination

Physical examination begins with a rapid assessment of the hemodynamic stability of the mother and of fetal well-being. The mother's blood pressure and pulse should be recorded. The patient should be placed on electronic monitoring to assess fetal heart rate and contractions, if any. The general assessment of the patient should include obvious signs of distress or discomfort. Abdominal examination should include assessment of fetal size and position. Following ultrasound examination to determine the placental position, a pelvic examination should be performed. Note should be made of blood (location: at the cervical os, pooled in the vaginal vault; quantity: from scant discoloration to copious active bleeding; character: bright red, clotted, brown). Cervical status should be noted, including dilation and effacement. The presence of other findings, including discharge, amniotic fluid, or cervical lesions such as polyps or erosions, should be documented. The position of the fetus should be confirmed, including presenting part and station. The uterus should be assessed for size and tenderness.

Laboratory Studies

Late pregnancy bleeding per vagina may represent a significant obstetrical emergency. Blood loss may be rapid and difficult to control. For this reason, laboratory studies are ordered to establish baseline hematological status and in anticipation of a potential need for transfusion. Studies should include complete blood count with platelets, international normalized ratio, partial thromboplastin time, fibrinogen, fibrin split products, blood type, and crossmatch.

PLACENTA PREVIA

Background

Placenta previa may be diagnosed when the placenta is located in such a position as to partially or completely occlude the internal cervical os (and therefore to occlude the outflow tract of the birth canal). Total or complete placenta

previa, as the name implies, represents occlusion of the entire cervical os. Partial placenta previa represents less than complete occlusion. A marginal placenta signifies a location adjacent to but not occluding the cervical os. Although these categories are useful guides, it should be noted that the distinction may not be entirely clear on ultrasound examination. For this reason, particular caution should be exercised whenever the location of the placenta appears to be near or over the cervical os.

Under such circumstances, cervical dilation and/or direct trauma (such as fetal descent or pelvic examination) may cause laceration of the placenta and subsequent bleeding. Because of the highly vascular nature of the placenta, such bleeding may be rapid, copious, and life-threatening to both the mother and the fetus. Placental previa is estimated to occur in approximately 1 out of every 100 pregnancies.

History

Patients who present with late pregnancy bleeding per vagina should be carefully screened for risk factors that increase the probability of placenta previa. These risk factors include prior dilation and curettage, myomectomy, cesarean section, maternal age (prevalence increases with increasing maternal age), grand multiparity, and multiple gestation. The primary symptom associated with placenta previa is bleeding per vagina. The onset is usually acute, may be associated with trauma or physical manipulation such as examination, is often continuous, and may be variable but can be significant. It is classically not associated with pain (although the presence of pain *does not* rule out the possibility of placenta previa).

Ultrasound Examination

Although these historical factors may contribute to the diagnosis of placenta previa, all patients with late pregnancy bleeding per vagina should be assumed to have placenta previa until it is ruled out. For this reason, all patients should have ultrasound confirmation of the location of the placenta prior to manual or speculum examination. If prior ultrasound examinations have demonstrated a placental location away from the cervical os this is sufficient to rule out placenta previa as the placenta may migrate away from the cervical os but does not migrate toward the cervical os.

Physical Examination

The physical examination should include those elements noted previously to assess maternal and fetal well-being, including vital signs, abdominal examination, fetal heart rate monitoring, and monitoring for contractions. For patients in whom the ultrasound confirms placenta previa, no manual or speculum examination should be performed.

Laboratory Studies

Laboratory studies are the same as those noted previously.

Management

Providers should assume that blood products and fluid resuscitation will be necessary and be prepared to provide both. Patients with confirmed placenta previa should be cross matched for at least four units of blood and should have at least two large bore intravenous access sites established as quickly as possible. If the patient is actively contracting, tocolysis may be indicated to lessen the risk of further placental damage and bleeding.

Management at Term

For patients who have reached at least 36 weeks gestation, cesarean section is indicated. Placenta previa is an absolute contraindication to vaginal delivery. If the patient is actively contracting and the cesarean section cannot be performed immediately, tocolysis is indicated. Delivery of the infant and the placenta is the definitive treatment for placenta previa. Patients should be monitored for hemodynamic stability with blood and/or fluids administered to maintain adequate blood pressure and to replete circulating blood volume.

Preterm Management

Placenta previa with active bleeding per vagina is an obstetrical emergency. If the mother or infant are unstable and/or the bleeding cannot be controlled, cesarean section is indicated. Management of maternal hemodynamic status is the same as at term. Neonatal specialists should be present at the delivery to manage the newborn.

For preterm patients who are stable and not bleeding, care should be individualized. Such care might include tocolysis, assessment of fetal lung maturity, and preparation for cesarean section.

ABRUPTIO PLACENTA

Background

The maintenance of fetal perfusion, oxygenation, and nutrition requires the maintenance of the maternal–fetal placental unit. The interruption of placental function secondary to separation of the placental from the uterine wall is referred to as abruptio placenta or placental abruption. As with placenta previa, the severity of the condition may vary from minor separation with minimal signs or symptoms to complete abruption with significant compromise of maternal and/or fetal well-being. Although the variability in presentation makes exact prevalence difficult to calculate it is estimated that 1 out of 100 pregnancies are affected by significant placental abruption.

The classic presentation for placental abruption is abrupt onset painful bleeding with associated uterine contractions. However, the variability in severity as well as location of the abruption makes such "classic" presentations rather uncommon. Up to 80% of all cases of placental abruption present with no clinically apparent bleeding. The severity of the condition cannot be reliably predicted based on the quantity of clinically apparent bleeding. Patients with known or suspected placental abruption should be assumed to have bled significantly until proven otherwise. Because of the variability in presentation, providers should have a low threshold for suspecting placental abruption and manage such patients diligently.

History

As noted, the classic presentation for placental abruption is late pregnancy bleeding per vagina. The bleeding is associated with abdominal or back pain, acute in onset, and variable in quantity (or perhaps absent). Patients will often report the acute onset (or an acute increase in severity) of uterine contractions.

Ultrasound

As with all patients with late pregnancy bleeding per vagina, no pelvic examination should be performed until ultrasound confirmation of placental location has been obtained. Although ultrasound has a very low sensitivity for detection of placental abruption, approximately 15% of cases are ultrasonographically apparent.

Physical Examination

In general, the physical examination does not contribute significantly to the diagnosis of placental abruption. Suggestive findings include hemodynamic instability, evidence of fetal stress on fetal heart rate monitoring, firm or tender uterus, and/or back tenderness. Although neither sensitive nor specific, the finding of a very firm uterus that does not relax (or hypertonic uterus on tocometer) should prompt immediate consideration of the possibility of placental abruption. All patients with suspected abruption should be placed on fetal heart rate monitoring, tocometer and hemodynamic monitoring, including blood pressure and pulse.

Laboratory Studies

Laboratory studies are as noted in the previous sections.

Management

Appropriate management depends on a clinical assessment of the severity of the condition. As noted, however, the physical findings associated with abruption may be highly variable. When doubt exists concerning the severity of the condition, it is advisable to make preparations for management of severe abruption with significant maternal or fetal compromise.

Management of Mild Abruption

If the bleeding is mild or absent and both mother and fetus are clinically stable, management can be expectant. Patients should be placed on continuous hemodynamic, fetal heart rate, and uterine contraction monitoring. Evidence of stability includes normal maternal blood pressure and pulse and minimal symptoms. Fetal heart rate monitoring should demonstrate normal heart rate with adequate variability. Uterine contraction pattern should be monitored for signs of hypertonicity or tetanus. If the patient is preterm, tocolysis may be indicated to facilitate fetal lung maturity. Maternal coagulation status should also be monitored. Because of the possibility of worsening abruption and hemodynamic instability, all patients should have at least two large bore intravenous access sites and should have adequate crossmatched blood available.

Management of Moderate or Severe Abruption

For patients with more significant clinical abruption, management must focus on two primary concerns: management of the hemodynamic status of the mother and rapid delivery of the infant. Maternal shock is a possible sequela of severe placental abruption. These patients will require emergent manage with particular attention to the "ABCs" (airway, breathing, circulation) as dictated by the clinical presentation. Patients may require fluid infusion and/or blood product transfusion that may include fresh frozen plasma, cryoprecipitate, or platelets.

A clinical decision must be made concerning the instability of the mother and the likelihood of delivery. In less severe cases, induction of labor may be appropriate. In more severe cases, cesarean section may be indicated for more rapid delivery of the infant. Neonatology support should be present at the time of delivery for management of the newborn.

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11 Recurrent Spontaneous Abortions

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KEY POINTS

1. Spontaneous abortion is defined as delivery prior to 20 weeks gestation.
2. Recurrent spontaneous abortion is defined as three or more spontaneous abortions prior to 20 weeks gestation.

BACKGROUND

Spontaneous abortion is a common outcome of pregnancy, especially in the first trimester of pregnancy. Defined as delivery prior to 20 weeks of gestation, spontaneous abortion is often an unexpected and traumatic experience for the patient and her family. Spontaneous abortion is discussed in detail in Chapter 9. Briefly, abortion can be considered to fall into one of two categories: complete abortion, which is defined as delivery of all products of conception prior to 20 weeks gestation; or incomplete abortion, defined as delivery of some but not all products of conception prior to 20 weeks gestation.

In addition to these two categories, first-trimester bleeding can also indicate a possible impending abortion. Uterine bleeding prior to 20 weeks gestation without delivery of any products of conception is considered a threatened abortion. Uterine bleeding prior to 20 weeks with cervical dilation but without delivery of products of conception is referred to as an inevitable abortion.

Although spontaneous abortion is common, recurrent abortion (three or more consecutive abortions prior to 20 weeks delivery) is considerably less common, affecting approximately 1% of all women of childbearing age. In addition to the evaluation and management considerations that pertain to a

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Table 1
Risk Factors for Recurrent Spontaneous Abortion

Exogenous exposures
Alcohol
Tobacco
Cocaine
Obstetrical/gynecological abnormalities
Uterine abnormalities
Leiomyomas
Genetic uterine anatomic abnormalities (bicornuate, septate)
Cervical incompetence
Diethylstilbesterol exposure
Asherman's syndrome
Infection (gonorrhea, chlamydia, syphilis, listeria, mycoplasma, ureaplasma, toxoplasma)
Progesterone deficiency
Genetic abnormalities
Chronic medical conditions
Thyroid disease (hypothyroid and hyperthyroid)
Renal disease
Uncontrolled diabetes mellitus
Collagen vascular disease
Uncontrolled hypertension
Antiphospholipid antibodies (anticardiolipin antibody, lupus anticoagulant)

single episode of spontaneous abortion, recurrent spontaneous abortions require further evaluation and more significant management considerations (*see* Table 1).

Prior spontaneous abortion increases the risk for subsequent abortion, although the degree of risk is not well quantified. As noted in the previous chapter, spontaneous abortion, often not clinically diagnosed, occurs in up to one-third of all pregnancies. Among patients with a history of recurrent spontaneous abortion, the risk of spontaneous abortion rises to approximately 50%. Although that makes recurrence a frequent event, it should be emphasized that it is by no means inevitable.

DIAGNOSIS

The diagnosis of recurrent spontaneous abortion is made clinically in patients with an appropriate history. Although additional evaluation may be appropriate for evaluation and management purposes, no additional studies are required to make the diagnosis.

MANAGEMENT

Management of recurrent spontaneous abortion begins with a careful history, a directed physical examination, and diagnostic studies to elucidate an etiology. Although not all cases of recurrent spontaneous abortion will have an identified cause, identification of such a cause when present may contribute to successful management. In general, identified causes will fall into the categories of exogenous exposures (such as medication, tobacco, alcohol, illicit drugs, occupational exposures), obstetrical or gynecological abnormalities, genetic abnormalities, or chronic medical conditions (such as renal disease, diabetes). In general, outcomes for patients with recurrent abortions are good, with at least half of such patients eventually carrying a pregnancy to term.

History

A careful history should be obtained. The history should focus on likely underlying causes. As would be expected, the history begins with a focus on prior obstetrical and gynecological conditions. All previous pregnancies should be reviewed for complications and outcomes. Abnormal menstrual cycles may be indicative of hormonal dysregulation or previously unrecognized spontaneous abortions. Gynecological history should focus on fertility, especially hypofertility, and any known anatomic abnormalities. Gynecological surgeries, especially those involving the cervix, should be reviewed. A past history of sexually transmitted disease (STD) should be obtained as well as a history of any current symptoms consistent with STD.

The patient's exposure to exogenous agents should include medications, occupational exposures, and tobacco, alcohol, or illicit drug use. All medications, including over-the-counter, prescription, and complementary/alternative modalities, should be reviewed. If the provider is unfamiliar with any of the medications, referral to a maternal–fetal medicine specialist might be considered. The patient's work history should be reviewed for possible occupational exposures. Although less common as a source of exogenous toxins, the patient's hobbies and recreational activities should also be reviewed.

A review of the patient's family history may be helpful in at least two regards. A careful genogram for possible genetic abnormalities should be obtained. A genetics counselor may provide assistance with obtaining this history and the genogram. Additionally, the family history may reveal a familial predisposition to a variety of medical conditions for which the patient is at risk. Hypertension, diabetes, renal disease, and coagulapathies, among other disease processes, may be familial and may contribute to an increased risk for spontaneous.

Physical Examination

The physical examination is often directed by the findings of the history and is more limited in scope. The patient's vital signs, particularly her blood pressure,

should be measured. Examination of the head/neck should include palpation of the thyroid for enlargement and/or nodularity. Additionally, examination of the eyes may reveal evidence of hypertensive or diabetic retinal changes. Examination of the skin should be performed to detect the physical stigmata of endocrine disorders such as striae or changes in skin texture, consistency, or color. Cardiovascular examination should include documentation of murmurs, if any (especially renal bruits), and peripheral pulses. Neurological examination should include documentation of the peripheral sensory function.

Although unlikely to demonstrate any abnormalities, a pelvic examination should be performed to document normal anatomy and to obtain cervical samples for gonococcus and chlamydia.

Diagnostic Studies

Diagnostic studies will be directed toward the common underlying etiologies for recurrent spontaneous abortion. If genetic causes are suspected these studies include karyotyping of both parents. Routine laboratory studies include cervical sampling for gonorrhea/chlamydia, progesterone, thyroid-stimulating hormone, thyroxine, lupus anticoagulant, and anticardiolipin antibody. If diabetes is suspected on the basis of family history or patient symptoms, a fasting blood sugar may help to clarify the diagnosis. Renal function may be assessed via routine blood serum electrolyte testing and urinalysis. Under limited circumstances, a serum drug screen may be indicated, although this diagnosis is generally made by history rather than by laboratory studies. If anatomic abnormalities are suspected, evaluation of the lower reproductive tract via radiological (hysterosalpingogram, pelvic ultrasound) or endoscopic (hysteroscopy) means is indicated.

Management of subsequent pregnancies will depend in large measure on the findings of this diagnostic evaluation. Although several of the identified conditions are not directly correctable, others are. Treatment of infection, management of hypertension, treatment of thyroid disease, and elimination or reduction of toxic exposures may all enhance the likelihood of a successful pregnancy. Many patients with recurrent pregnancy loss will be managed in conjunction with a provider who specializes in this area of obstetrics.

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12 Rh Isoimmunization

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KEY POINTS

1. Rh isoimmunization represents a maternal antibody response to immunologically incompatible fetal blood.
2. Rh isoimmunization is a preventable outcome of maternal–fetal Rh incompatibility.
3. Fetal blood should be considered Rh positive unless documented otherwise.

BACKGROUND

Transfer of nutrients, proteins, and antibodies between mother and fetus generally occurs across the placenta without direct transfer of blood. Although the maternal and fetal blood supplies are separated from each other, they are, of necessity, in relative proximity and can, under certain circumstances, come into contact with each other. Under these circumstances, exposure to foreign proteins may elicit an immune response with potential health effects for either the mother or fetus.

Rh isoimmunization represents a serious maternal–fetal complication. All red blood cells are produced with a variety of surface antibodies that serve to identify one's own red cells from those of others. The presence of red blood cells from an outside source will elicit an immune response with subsequent

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hemolysis/removal of the foreign cells. This response may be relatively minor or may represent a significant medical complication.

The primary surface proteins serve to identify blood within the ABO blood type categories. Exposure to immunologically incompatible blood types within the ABO category will result in significant hematological complications. A second set of proteins (rhesus factor) also provide significant identification. Rh-negative ([Rh−] those without Rh factor) patients exposed to blood containing Rh factor (Rh positive [Rh+]) will produce an antibody response to that blood. It is this incompatibility that results in the complications of Rh isoimmunization. An initial exposure will lead to development of antibodies. Subsequent exposures will yield a significant antibody response and an associated reaction.

Pregnant Rh-negative patients exposed to fetal Rh-positive blood will also develop such an antibody response. Because such antibodies can cross the placenta and reach the fetus, all subsequent pregnancies that involve Rh-positive fetuses will potentially result in hemolysis and it complications for the fetus.

Rh factor is a genetically inherited trait with an autosomal-dominant inheritance pattern. An Rh-negative mother is, by definition, homozygous (Rh–/Rh–). An Rh-positive father may be homozygous (Rh+/Rh+) or heterozygous (Rh+/Rh–). As all children will receive one Rh-negative gene from such mothers, the Rh status of the child is dependent on the Rh status of the father. All children of homozygous Rh-positive fathers will be Rh positive. One-half of all children of heterozygous fathers will be Rh positive.

FETAL CONSEQUENCES OF ISOIMMUNIZATION

Although maternal blood does not generally cross the placenta, maternal antibodies do. The placental transmission of maternal antibodies to Rh factor will result in fetal hemolysis and subsequent anemia. In addition, the red blood cell destruction results in the release of heme and bilirubin. These breakdown products are cleared by the maternal circulation after crossing the placenta. The results for the fetus are generally related to complications of severe anemia (erythroblastosis fetalis) and may include heart failure, acute pericardial effusion, hypoxia, acidosis, and death.

NEWBORN CONSEQUENCES OF ISOIMMUNIZATION

Following delivery, Rh-isoimmunized infants lose access to the maternal circulation, but will continue to have circulating maternal antibodies. Under these circumstances, the neonate may be incapable of adequately clearing the bilirubin and heme that result from continued red blood cell destruction. The potential complications for infants will include those anemia, cardiac complications, acidosis, and death, as well as deposition of heme within the basal ganglia of the developing brain (kernicterus).

DIAGNOSIS

History

The Rh status of the infant is usually unknown, therefore, particular care should be taken to note the Rh status of the mother. When known, the Rh status of the father should also be noted. Prior pregnancies should be recorded, including the Rh status of the resulting infant. If the patient has had prior pregnancies, any administration of Rh immunoglobulin (discussed later) should be recorded. As noted previously, the initial exposure is less significant than subsequent exposures. For this reason, the history is particularly important in second and subsequent pregnancies.

Physical Examination

In general, the physical examination will not contribute to the diagnosis of Rh isoimmunization, but careful monitoring of fetal growth and development is critical in the management of pregnancies complicated by Rh isoimmunization.

Diagnostic Studies

Rh factor should be documented for all pregnant patients. For those patients found to be Rh negative, paternal testing may be indicated. If paternity is uncertain or paternal testing cannot be performed, the infants should be assumed to be Rh positive and management should proceed accordingly.

MANAGEMENT PRIOR TO ISOIMMUNIZATION

Overall management of Rh– patients is outlined in Fig. 1. The management of pregnancies with the potential for isoimmunization consists of the following three key principles:

1. Minimize the potential for maternal–fetal transfusion (*see* Table 1).
2. Administer Rh immunoglobulin if maternal–fetal transfusion is known or suspected.
3. Because all pregnancies are potentially complicated by minor maternal–fetal transfusions not recognizable clinically, all Rh-negative patients will receive immunoglobulin at about 28 weeks gestation.

At 28 weeks gestation, Rh-negative patients should be tested for evidence of Rh antibodies. If no antibodies are detected, patients should receive 300 μg of Rh immunoglobulin as a single intramuscular dose. Following delivery, the Rh status of the infant should be determined. If the infant is found to be Rh positive, a second dose of Rh immunoglobulin should be administered within the first 72 hours postpartum.

Under all circumstances where maternal–fetal transfusion is possible or suspected, patients should receive Rh immunoglobulin. In general, a single dose is sufficient for most exposures. If a larger than usual transfusion is suspected, further testing should be performed to determine the extent of exposure and

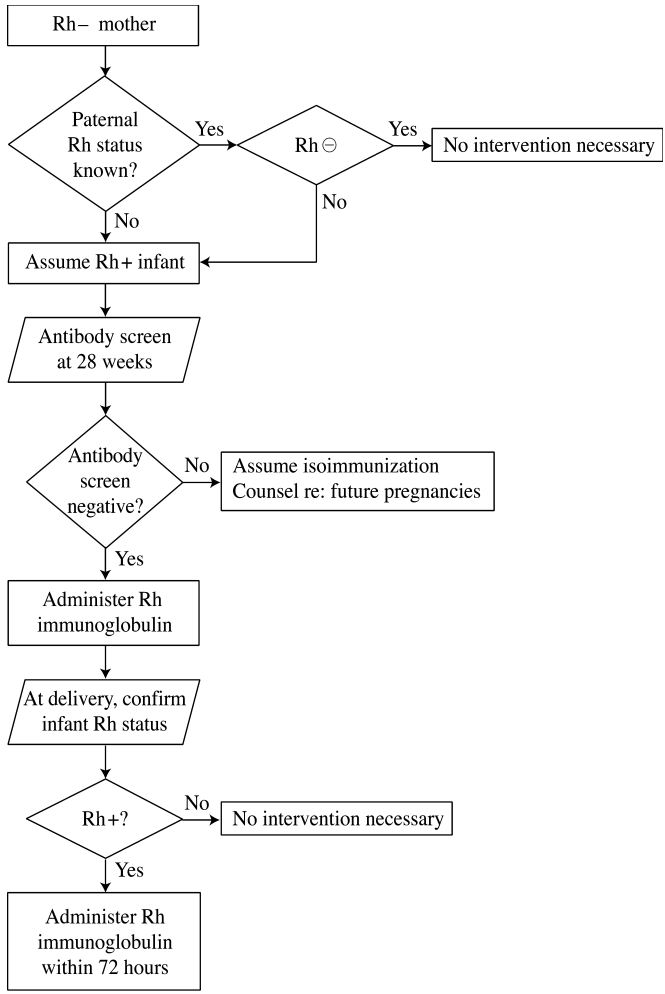

Fig. 1. Evaluation and management of Rh– patient.

Table 1
Potential Sources of Maternal–Fetal Transfusion

Spontaneous or induced abortion
Amniocentesis
Chorionic villus sampling
Hemorrhage
External cephalic version
Trauma

additional doses of immunoglobulin may be necessary. This occurs in less than 1 out of 200 cases.

MANAGEMENT OF PREGNANCIES WITH Rh-SENSITIZED MOTHERS

Management of the first pregnancy associated with isoimmunization is generally uncomplicated and will follow the guidelines for usual pregnancy management. Infants may require additional monitoring postpartum but can be expected to follow the usual newborn course. All Rh-sensitized mothers, however, should be informed of the development, the nature of the problem, and its potential effects in subsequent pregnancies. Critical discussions of contraception, preconception counseling, and future pregnancy planning should begin in the immediate postpartum period.

Patients known to be previously Rh sensitized require careful management and involvement of a skilled maternal–fetal medicine provider. Although a full discussion of the management of such patients is beyond the scope of this text, the general course of management is reviewed here.

For sensitized patients with no past history of fetal involvement, antibody titers should be drawn at intake, at 20 weeks gestation and every 4 weeks thereafter. If antibody titers remain below 1:32, careful antenatal monitoring and continued routine prenatal care are recommended. When titers rise above 1:32, management will proceed as described in the following section.

For previously sensitized patients with a past history of fetal involvement, management assessment of the severity of the condition in each subsequent pregnancy. Beginning 4 to 8 weeks earlier than the first noted complications of prior pregnancies, amniocentesis is performed. In addition, an ultrasound is performed to assess for evidence of fetal hydrops. Fetal involvement is graded as mild, moderate, or severe based on the results of these studies. Mild involvement will require amniocentesis every 2–3 weeks with delivery at term in the absence of an worsening of the fetal condition. Moderate involvement requires amniocentesis every 1–2 weeks with delivery when fetal lung maturity can be demonstrated (*see* Chapter 7) Severe disease requires weekly amniocentesis and may also require intrauterine transfusion.

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13 Infection in Pregnancy

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KEY POINTS

1. Infectious complications in pregnancy include maternal or fetal morbidity, teratogenic or developmental abnormalities, and disruption of the course of pregnancy.
2. Management of infection during pregnancy begins with thorough preconception evaluation.
3. Routine screening of all prenatal patients for common asymptomatic infections is a cornerstone of prenatal care.
4. Women should be screened by history for signs or symptoms that are suggestive of common infectious complications of pregnancy at each prenatal visit.

BACKGROUND

Infection presents a particular challenge in pregnancy. Symptoms of infection may be subtle, unusual in presentation or masked by other pregnancy-related symptoms. Infection may affect both mother and fetus; antibiotic choices may be limited by concerns related to pregnancy and fetal development. As with most elements of obstetrical care, management of infection in pregnancy ideally begins in the preconception period. The preconception history can provide important data concerning infection risk such as recent exposures

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(toxoplasmosis, tuberculosis, cytomegalovirus), immunization status (measles and varicella) and chronic infectious conditions (HIV, herpes, viral hepatitis). For some of these infections, appropriate preconception planning and risk reduction is the only effective intervention. A thorough physical examination may reveal evidence of such infections as active herpes, gonorrhea, or chlamydia. Preconception screening for HIV, tuberculosis, and syphilis among other conditions, may allow for treatment prior to pregnancy, thereby decreasing the likelihood of adverse prenatal outcomes.

Infections occurring during the course of pregnancy may have two significant consequences. Direct maternal–fetal transmission may lead to infection not just in the mother but also in the fetus. Such infections may have very serious consequences for the fetus or newborn. Herpetic infection in newborns, for example, is associated with a 50% mortality rate and significant morbidity among those infants who survive. In addition, some infectious agents are known to cause complications in course of pregnancy, particularly preterm labor. Although most studies have shown conflicting data concerning the demonstrated benefit of diagnosis and treatment, most authorities recommend screening and treatment.

SYMPTOMS OF INFECTION IN PREGNANCY

Although diagnosis of infection in pregnancy is critically important, symptoms of infection in prenatal patients may be absent or difficult to detect or interpret. Many infectious etiologies are asymptomatic. Syphilis, latent-phase herpes, HIV, and others may be present without producing any symptoms in the pregnant patient. For these conditions, routine screening is recommended for all pregnant patients by history, physical examination, and/or diagnostic studies.

Some disease processes produce characteristic symptoms, which should be further evaluated whenever present. Such symptoms as fever, chills, bleeding per vagina, severe abdominal pain, or dysuria should lead to prompt evaluation. For other disease processes, the symptoms associated with infection may be difficult to interpret or may be masked by some of the common symptoms associated with pregnancy. Cervical mucus production may be increased during pregnancy and some women may interpret this increased mucus as infectious in cause. By contrast, some women may interpret an abnormal vaginal discharge as “normal” for pregnancy, delaying evaluation or failing to mention such symptoms during the course of prenatal care. Nonspecific abdominal pain is also a relatively common symptom occurring during pregnancy. Providers should be diligent in eliciting suggestive symptoms and should maintain a low threshold for following up such symptoms with appropriate diagnostic tests. As a general rule, women should be screened by history for symptoms that are suggestive of common infectious complications of pregnancy at each prenatal visit. Those patients who report such symptoms should be further evaluated for the possible presence of infection.

Table 1
Antibiotics in Pregnancy

Infection	*Antibiotics*
Gram-positive	Penicillins
	First-generation cephalosporins
	Clindamycin
Gram-negative	Aminoglycosides (*see* text)
	Third-generation cephalosporins
Anaerobic	Clindamycin
Special conditions	
Urinary tract infection	Cephalosporins
	Nitrofurantoin
	Ampicillin (*see* text)
	Sulfisoxazole (*see* text)
Chlamydia	Erythromycin
	Azithromycin
Gonorrhea	Ceftriaxone
Syphilis	Penicillin
Yeast	Azole anti-fungal agents after first trimester
Bacterial vaginosis	Clindamycin
	Metronidazole after first trimester
Trichomoniasis	Metronidazole after first trimester
Herpes	Acyclovir; cesarean section indicated if present at time of labor
HIV	*See* Chapter 16
Group B strep	Ampicillin in labor

MATERNAL INFECTION

The primary concern in pregnancy is with the health and welfare of the mother. Timely diagnosis and treatment of infection has direct health consequences for the mother and should be approached in the same manner as in nonpregnant patients. Routine prenatal care includes screening for gonorrhea, chlamydia, syphilis, HIV, hepatitis B, and urine culture for bacteriuria. These tests are performed in all patients regardless of symptoms. It is worth noting that most of these infections are sexually transmitted. Pregnancy can be taken as good evidence of unprotected sexual activity and therefore confers the infection risk associated with unprotected sex. Prenatal patients are also routinely screened for evidence of human papilloma virus through pap smear screening. Although treatment is generally deferred until the patient is no longer pregnant, documentation of the presence and severity of dysplastic lesions is an important element of the comprehensive care plan. The timing and method of screening for these infectious conditions is reviewed in Chapter 3.

Patients with suggestive symptoms may also be screened for other infectious conditions. Patients with vaginal discharge should be evaluated for the presence of bacterial vaginosis and trichomoniasis in addition to gonorrhea and chlamydia. The presence of bacterial vaginosis has been associated with an increased risk of preterm contractions and preterm labor. Treatment of bacterial vaginosis or trichomoniasis is recommended after the first trimester. Patients with urinary symptoms such as dysuria or hematuria should be evaluated for possible urinary tract infection (UTI).

FETAL INFECTION

In addition to maternal considerations, many infectious processes have health consequences for the developing fetus. Infection in pregnancy may result in three related fetal complications: direct infection of the fetus or newborn, alteration in the normal course of pregnancy, and alteration of fetal development. Many maternal infections can be transmitted to the fetus either during pregnancy or at the time of delivery. Syphilis, gonorrhea, group B strep (GBS), and HIV, among others, all have demonstrated maternal–fetal transmission. Syphilis is associated with neonatal long bone infection; Gonorrhea may cause neonatal ophthalmological disease; GBS is a significant contributor to neonatal febrile illness including meningitis; maternal–fetal transmission of HIV remains a critical source of new HIV infections in many parts of the world.

Infectious agents may result in pregnancy complications even in the absence of direct fetal infection. Maternal infections, such as bacterial vaginosis or GBS, may affect the course of pregnancy resulting in such complications as preterm labor and delivery. Universal or directed screening of prenatal patients can identify a significant number of patients at risk. Several infectious complications have been associated with significant developmental abnormalities in fetuses. Cytomegalovirus, toxoplasmosis, and measles all have potentially serious effects on fetal development. Appropriate screening for exposure and/or timely vaccination can reduce the risk for these complications.

ANTIBIOTIC USE IN PREGNANCY

Antibiotic choice in pregnancy is complicated by the fact that several commonly used classes of antibiotics are contraindicated or should be used with caution in pregnancy. Prior to the use of any antibiotic in pregnancy, providers should review its safety and efficacy in pregnancy. If questions concerning safety remain, consultation with a maternal–fetal expert is recommended. A more complete review of the use of medications in pregnancy can be found in Chapter 4.

Although microbial sensitivity to antibiotics is important in the management of any patient, it is of particular importance in pregnant patients. The potentially limited number of available choices make culture and sensitivity studies critical

in pregnancy. Allergies to such common antibiotics as penicillin may further limit antibiotic choices. In such circumstances, providers may be considering third- or fourth-line antibiotic choices. Under such circumstances, knowing the specific microbe and its sensitivity to available antibiotics is often very helpful.

Although a comprehensive review of all antibiotic classes is beyond the scope of this text, a few key classes should be reviewed (a review of the risk classification for drugs used in pregnancy can be found in Chapter 4).

Sulfonamides

Sulfonamides are most commonly used as sulfamethoxazole in combination with trimethoprim. This antibiotic is routinely used for respiratory tract and UTIs in non-pregnant patients. Sulfonamides readily cross the placenta and levels persist in newborns for several days postpartum. Sulfonamides are a category B drug early in pregnancy but are category D near term. Complications include jaundice and hemolytic anemia. Currently available data do not suggest teratogenesis with the use of sulfonamides. Trimethoprim also crosses the placenta freely. Trimethoprim acts as a folate antagonist and may theoretically contribute to congenital abnormalities if used in the first trimester. There is no definitive data linking trimethoprim to congenital defect however, because of its mechanism of action and some data to suggest a possible increased risk trimethoprim is a category C drug.

Fluoroquinolones

This class of drugs includes such agents as ciprofloxacin, levofloxacin, lomefloxacin, norfloxacin, and ofloxacin. These are used for a wide variety of infections including UTIs and respiratory tract infections. Ciprofloxacin has been associated with cartilaginous defects in some animal studies. Data from human studies does not demonstrate a consistent pattern of congenital abnormalities. In general, safer alternatives to fluoroquinolones exist for most conditions. Fluoroquinolones are generally a category C drug.

Aminoglycosides

This class of drugs includes such agents as gentamicin, used widely for serious Gram-negative infections. Although aminoglycosides are used when indicated in pregnancy, there are several issues that should be considered prior to their use. Aminoglycosides cross the placenta and are present at significant but reduced levels (compared with maternal serum levels). Gentamicin is associated with nephrotoxicity in laboratory animals, although only one possible case of possible prenatal gentamicin-associated renal disease has been reported in the literature. Ototoxicity has also been reported with gentamicin use, although no cases associated with *in utero* exposure have been reported. Aminoglycosides are generally considered class C drugs in pregnancy.

VAGINITIS/VAGINOSIS

Background

A number of infectious agents may result in significant discharge per vagina during pregnancy. Many of the etiologic agents have significance in pregnancy, therefore a search for the cause and appropriate treatment is particularly important in pregnant patients. In the presence of a significant host inflammatory response this condition is referred to as vaginitis. In other circumstances, the presence of discharge in the absence of inflammation is referred to as vaginosis. Alteration in the normal vaginal environment including change in pH or elimination of normal flora with the use of some antibiotics allows for proliferation of such abnormal flora as *gardnerella, trichomonas*, or *candida* species.

Bacterial vaginosis has been associated with a variety of complications in pregnancy including amniotic fluid infection, chorioamnionitis, postpartum endometritis, premature rupture of membranes (rupture of membranes prior to the onset of labor), preterm labor, preterm delivery, and low birthweight. Complications associated with yeast vaginitis are less clearly defined. In addition to the complications just noted, infection with gonorrhea or chlamydia has been associated with maternal–fetal transmission at the time of delivery.

History

A careful history will often assist in elucidation of the underlying cause for symptoms of vaginitis. The most common, and often most prominent symptom, is discharge per vagina. Patients should also be questioned concerning systemic symptoms such as fever, nausea, vomiting, change in bowel habits, or urinary symptoms. Recent sexual contact should be reviewed (in addition to prior laboratory studies for gonorrhea, chlamydia, urinalysis, urine culture, or wet mount studies). Symptoms in the partner should also be elicited. A review of recent medications and a past history of similar complaints may yield additional information.

Physical Examination

In addition to the routine elements of a prenatal physical examination, a focused exam should be performed to identify key findings consistent with vaginitis or, less commonly, significant peritoneal infections. On abdominal examination, providers should note pain rebound or guarding. On the pelvic examination, note should be made of external or internal erythema or edema, discharge (including the quality and quantity of such discharge), blood, vaginal or cervical lesions, cervical motion tenderness, and adnexal masses or tenderness.

Laboratory Studies

Further testing is warranted when discharge is noted on exam. Patients should be screened for gonorrhea and chlamydia, especially in the presence of

significant mucopurulent discharge. In addition, a sample of discharge should be obtained and tested for pH, KOH (potassium hydroxide) "whiff," and microscopic examination with saline and KOH solutions.

PH TESTING

pH paper placed directly in discharge may be useful in screening for abnormalities. A pH greater than 4.5 is consistent with bacterial vaginosis or trichomoniasis. A pH less than 4.5 is consistent with yeast.

KOH "WHIFF"

KOH mixed with a sample of the discharge can be helpful in diagnosing bacterial vaginosis. A positive "whiff" test reveals a foul or fishy odor when the KOH is added.

MICROSCOPIC EXAMINATION

One slide prepared with saline and discharge; one slide prepared with KOH and discharge is often diagnostic. The saline-prepared slide may show evidence of bacterial vaginosis (clue cells) or trichomoniasis (flagellated protozoa). KOH will lyse most cellular elements within the discharge, leaving only yeast on the slide. The presence of fungal elements on a KOH-prepared slide is evidence of candidal infection.

Treatment

When an infectious agent is identified, most authorities recommend treatment. The benefits of treatment may include reduction of pregnancy-related complications and/or symptomatic relief for the patient. Care should be exercised to select agents with a good safety profile and proven efficacy in pregnancy. If appropriate treatment is unclear, consultation with a maternal–fetal expert is recommended.

Bacterial Vaginosis

Patients with bacterial vaginosis present with mild or no pruritis, minimal pain, thin grey discharge, pH greater than 4.5, positive whiff test, and clue cells on microscopic examination. Bacterial vaginosis may be treated with clindamycin 2% cream or oral clindamycin 300 mg by mouth twice a day for 7 days. After the first trimester, metronidazole is an alternative (0.75% gel 5 g daily for 5 days or 500 mg by mouth twice daily for 7 days).

Trichomoniasis

Trichomoniasis presents as mild pruritis, minimal pain, copious yellow thin discharge, pH greater than 4.5, negative whiff test, and flagellated protozoa on microscopic examination. It may be treated after the first trimester with oral metronidazole. Topical metronidazole is associated with a higher rate of treatment

failure and/or recurrence. Treatment is 500 mg of oral metronidazole twice a day for 7 days. An alternative regimen is 2 g of oral metronidazole as a single dose. This regimen is associated with a higher recurrence rate and increased gastrointestinal side effects.

Yeast Vaginitis

Patients with yeast vaginitis present with mild-severe pruritis, perineal irritation or pain, thick "curd-like" whitish discharge, pH less than 4.5, negative whiff test, and fungal elements on KOH-prepared microscopic examination. Yeast vaginitis may be treated with topical vaginal antifungal preparations, many of which are now available over the counter (OTC). Because of the desirability of obtaining a clear diagnosis and of minimizing the use of unnecessary medications during pregnancy, most patients should be cautioned against self-treating with OTC preparations without consulting their provider.

Gonorrhea/Chlamydia

Gonorrhea/chlamydia should be treated in the usual manner to prevent maternal and/or fetal complications. In pregnancy, the use of quinolones and most variants of tetracyclines should be avoided.

URINARY TRACT INFECTIONS

Background

Infections of both the lower and upper urinary tractsare more common in pregnancy. Anatomic and hormonal changes associated with pregnancy increase urinary stasis and may enhance ascending bacterial seeding. The increase in size of the uterus combined, later in pregnancy, with the presence of fetal body parts yields a functional partial obstruction of the outflow tract thereby increasing urinary stasis. Increased progesterone may yield ureteral smooth muscle relaxation, thus increasing the risk for ascending bacterial seeding and proliferation. Such changes appear to peak late in the second trimester or early in the third trimester. UTIs are associated with an increased risk of preterm delivery and low birthweight. In addition, the bacterial seeding can have serious consequences for the mother, including cystitis and pyelonephritis.

Women often report increased urinary frequency during the course of pregnancy. However, bacteriuria and its sequelae are also common during pregnancy. Approximately 5 to 10% of all pregnant women develop asymptomatic bacteriuria (with higher prevalence among some at risk populations). Of these, approximately one-third will develop clinically significant UTIs if not treated. Cystitis complicates about 1% of all pregnancies with an additional 1 to 2% of all pregnant women developing pyelonephritis. Commonly occurring pathogens include *E. coli* (80%), *klebsiella, proteus,* and *staph saprophyticus*. GBS is an

uncommon cause of UTIs but is of particular significance in pregnancy because of its association with an increased risk for preterm labor and neonatal infection.

Diagnosis

The challenge, then, in pregnancy is to distinguish "normal" pregnancy-related urinary frequency from the urinary symptoms (including frequency) associated with UTIs.

History

Many patients may be asymptomatic. Others may report urinary frequency, urgency, dysuria, hematuria, fever, abdominal pain, cramping or contractions, and flank or back pain. Although frequency and urgency may be normal in pregnancy, the presence of the other symptoms should always prompt further evaluation. A change in baseline frequency or urgency should also prompt re-evaluation. Because of the subtle or potentially confusing nature of the patients' presenting complaints, providers should maintain a high index of suspicion for UTI. The presence of any symptoms should generally prompt evaluation and treatment if indicated.

Physical Examination

The physical examination should focus on physical signs of infection and/or signs of ascending infection. Key elements of the physical examination should include temperature, abdominal pain, rebound or guarding, and costoverterbral angle tenderness. A pelvic examination is indicated for patients who present with abdominal or back symptoms or for those who report bleeding, contractions, or cramping.

Laboratory Examination

Urine culture remains the gold standard for diagnosis of UTIs. More than 100,000 colony-forming units per mililiter is considered a positive urine culture. In addition to assisting with the diagnosis, culture may also be useful in identifying the bacterial etiology and the antibiotic sensitivities of the isolated organism. More rapid assessment is often necessary, however, and a variety of additional tests are available that can provide results while the patient is still in the office (or within a few hours). Formal urinalysis performed in a laboratory may be helpful in assisting in diagnosis.

Other office-based tests are very specific but not sensitive. Dipstick leukocyte esterase testing is approximately 20% sensitive and a 95% specific. Dipstick nitrite is approximately 57% sensitive and 95% specific. Urine microscopy with more than 10 white blood cells per high-powered field on a spun urine sample is about 25% sensitive and 99% specific. These tests can be very useful if positive but may need to be followed up with urine culture if negative.

Treatment

Because of the potentially significant complications of untreated UTIs, treatment is recommended regardless of patient symptoms. There are several treatment options but, as always, each treatment option should be reviewed for safety and efficacy in pregnancy. Ampicillin has traditionally been the treatment of choice for UTIs during pregnancy. Its safety profile is excellent and it has been used widely during pregnancy. However, emerging ampicillin resistance in *E. coli* (more than one-third resistant in some regions) has led many providers to use alternatives as first-line therapy. Among the options for treatment are the following:

- Cephalexin (category B; 250–500 mg orally, twice a day)
- Nitrofurantoin (category B; 50–100 mg orally, twice a day)
- Sulfa drugs (sulfisoxazole 1 g orally, four times a day, TMP/SMZ 160/180 mg orally, twice a day; may be used in the second trimester but should be avoided in either first or third trimester)
- Fosfomycin (category B; 3 g single dose)

With the exception of fosfomycin, all treatment should be for 7–10 days for lower tract infections and up to 2 weeks for pyelonephritis.

GROUP B STREP

Background

GBS (most commonly *Streptococcus agalactiae*) are normal colonic flora. Under appropriate conditions, GBS colonize in the vagina, complicating pregnancy and the early neonatal course. Of all pregnant women, 10–30% are colonized with GBS in either the vaginal or rectal areas. GBS is a common and significant cause of prenatal and neonatal morbidity. GBS is associated with preterm labor, premature rupture of membranes, and preterm delivery. Less commonly, GBS is associated with UTIs. It is also associated with neonatal infection, including meningitis. Infants born to colonized women often develop early-onset invasive disease, 80% within the first 7 days of life. The prevalence of invasive disease is about 0.6 per 1000 live births. In the United States, GBS is responsible for about 2000 neonatal infections and 100 fatalities annually.

Treatment of GBS has been shown to decrease the incidence of such complications. The use of intrapartum antibiotic therapy to treat women at increased risk for transmission to their newborns can significantly reduce peripartum transmission and neonatal infection. Treatment of GBS UTIs and/or cervical colonization is associated with a reduction in rates of premature rupture of membranes and preterm delivery. The key to successful management is identification and treatment of those patients who are at risk for preterm complications or peripartum transmission.

Diagnosis

Diagnosis of GBS can be challenging. Most patients do not consistently demonstrate colonization throughout the course of pregnancy. Early GBS cultures do not correlate well with GBS status at the time of delivery. In addition, patients colonized with GBS are generally asymptomatic. For this reason, screening protocols that identify at-risk patients have been developed. Alternately, some authorities recommend universal screening of all prenatal patients regardless of risk or symptoms. For patients who present with suggestive signs or symptoms, GBS testing should be performed. High-risk conditions include preterm labor, premature rupture of membranes, or evidence of GBS UTI. Those patients with a past history of premature rupture of membranes, preterm delivery, or neonatal strep infection should also be considered high risk.

Universal Screening

All patients are screened during the course of pregnancy with treatment reserved for those who have positive cultures or who are at high risk.

- GBS testing is performed on all women at 35 to 37 weeks gestation (the results of which more nearly correlate with intrapartum GBS status than cultures obtained earlier in pregnancy).
- In the absence of GBS culture results, all patients with fever, prolonged rupture of membranes (>18 hours) or gestational age less than 37 weeks should be presumed GBS-positive.
- In the absence of GBS cultures, all patients with a past history of GBS UTI or neonatal GBS infection should be presumed GBS-positive.
- In patients with preterm premature rupture of membranes, GBS cultures should be obtained. Patients may be presumed GBS-positive until cultures results are available.

Risk-Based Screening

As an alternative to universal screening, risk-based screening, a protocol that initiates prophylactic treatment based on intrapartum risk factors, is also acceptable.

- Treatment should be initiated for all patients less than 37 weeks gestation at onset of labor, with prolonged rupture of membranes (>18 hours) or febrile in labor (≥100.4 F, 38°C).
- In patients with preterm premature rupture of membranes, GBS cultures should be obtained. Patients may be presumed GBS-positive until cultures results are available.
- Polymerase chain reaction testing at the time of presentation is available in some institutions and can produce results in less than 1 hour with a sensitivity of 97% and a specificity of 99%.

Treatment

Penicillin is the gold standard treatment for GBS in patients without penicillin allergy. Acceptable penicillin-based regimens include penicillin G intravenous, 5 million units loading dose followed by 2.5 million intravenous units every 4 hours or 2 g of ampicillin intravenous loading dose followed by 1 g intravenously every 4 hours.

Alternatives for patients with penicillin allergies include 900 mg of intravenous clindamycin every 8 hours until delivery or 500 mg of intravenous erythromycin every 6 hours until delivery.

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14 Hypertension in Pregnancy

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KEY POINTS

1. Hypertension in pregnancy is defined as blood pressure (BP) higher than 140 mmHg systolic or 90 mmHg diastolic on two occasions separated by at least 6 hours.
2. Pregnancy-induced hypertension is defined as hypertension diagnosed at or after 20 weeks gestation.
3. Pre-eclampsia is a multisystem disease characterized by hypertension and proteinuria.
4. Pre-eclampsia may lead to fetal complications including preterm delivery, intrauterine growth restriction (IUGR), fetal demise, and perinatal death, as well as maternal complications of seizure, stroke, and death.

BACKGROUND

Pregnancy may be complicated by hypertension either as a pre-existing condition or as a newly diagnosed condition during pregnancy. Each condition carries with it significant risks and important management considerations that may impact the well-being of both mother and fetus. Pre-eclampsia, a multisystem disorder that is marked by pregnancy-induced hypertension and proteinuria, is a significant obstetrical risk that affects approximately 5% of pregnancies.

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The exact cause of pre-eclampsia is unknown, but its multisystem complications are well described. Physiologically, pre-eclampsia is marked by increased vascular resistance, platelet aggregration, and endothelial dysfunction. Clincally, pre-eclampsia may be identified with hypertension (occurring after 20 weeks gestation), proteinuria, HELLP syndrome (**H**emolysis, **E**levated **L**iver enzymes, **L**ow **P**latelets), and seizures (eclampsia).

Chronic hypertension is defined as hypertension (repeated BP readings of systolic ≥140 or diastolic ≥90 mmHg) existing prior to pregnancy or first diagnosed prior to 20 weeks gestation. Obstetrical complications associated with chronic hypertension include increased risk for pre-eclampsia (discussed later), abruptio placentae, premature delivery, IUGR, fetal demise, and fetal stress. Pregnancy itself may worsen hypertensive renal disease. The majority of such complications occur in women with diastolic BPs higher than 110 mmHg although such complications may occur in women with lower BP.

Pre-eclampsia occurs in approximately 5% of all pregnancies and may be associated with many of the same obstetrical risks as chronic hypertension (Table 1): HELLP syndrome (10–20%), abruptio placentae (1–4%), and eclampsia (<1%). Rarely, it may also be associated with maternal stroke or death. Complications for the neonate include IUGR (10–25%), preterm delivery (15–67%), and perinatal death (1–2%). For both mother and infant, the presence of pre-eclampsia may be associated with long-term cardiovascular morbidity.

DIAGNOSIS

Diagnostic Criteria

The diagnostic criteria for hypertension in pregnant patients are similar to those for non-pregnant patients. Hypertension may be diagnosed in patients with at least two BP readings of more than 140 mmHg systolic or more than 90 mmHg diastolic separated by at least 6 hours but not more than 7 days.

Pre-eclampsia is diagnosed by a combination of hypertension first diagnosed after 20 weeks gestation and proteinuria (≥ 300 mg per 24 hours or 1+ dipstick protein in two random urine samples separated by at least 4 hours). In addition, hypertension associated with neurological (headache, visual changes, altered mental status), gastrointestinal (right upper quadrant pain, nausea, vomiting, elevated liver enzymes), or hematological (decreased platelet count) findings should also suggest pre-eclampsia. Ten percent of patients who develop HELLP syndrome and up to 33% of patients who develop eclampsia will not demonstrate the traditional findings of both hypertension and proteinuria.

Severe pre-eclampsia is diagnosed if any one of the three criteria (hypertension, proteinuria, multiorgan involvement) are severe. The criterion for severe hypertension in pregnancy is diastolic BP of more than110 mmHg. Proteinuria

Table 1
Risk Factors for Pre-Eclampsia

Maternal
Family history of pre-eclampsia
Early or late maternal age
Nulliparity
Prior history of pre-eclampsia
Assisted reproduction
Vascular disease
Diabetes
Obesity
Hypertension
Renal disease
Thrombophilia
Rheumatic disease
Infection
Paternal
Primipaternity
Prior pregnancy complicated by pre-eclampsia
Donated sperm
Fetal
Multifetal gestation
Hydrops fetalis
Chromosomal abnormalities
Congenital abnormalities

is considered severe at levels 5 g or more per day. Multiorgan involvement may be demonstrated by pulmonary edema, seizures, altered mental status, headaches, visual disturbance, persistent right upper quadrant pain with elevated liver enzymes, oliguria (<500 cc/day) or thrombocytopenia (<100,000).

HISTORY

Although the diagnosis of pre-eclampsia is generally made on the basis of BP readings and proteinuria, a number of risk factors have been identified and should be reviewed in the history. These risk factors are shown in Table 2 and include family history of pre-eclampsia, past history of pre-eclampsia, nulliparity, primipaternity, age over 40, assisted fertility, multiple gestation, chronic hypertension, diabetes mellitus, renal disease, thrombophilia obesity, maternal infection, and smoking.

In addition, all patients should be screened at each visit for symptoms suggestive of possible pre-eclampsia including headache, visual changes, altered mental status, abdominal pain, nausea, or vomiting.

Table 2
Complications of Pre-Eclampsia

Preterm delivery
Intrauterine growth restriction
HELLP syndrome
Pulmonary edema
Acute renal failure
Abruptio placentae
Perinatal death
Eclampsia
Stroke
Death

PHYSICAL EXAMINATION

Each prenatal visit should include documentation of the patient's BP. For patients who demonstrate elevated BP, a return visit should be scheduled within 1 week for a recheck of BP.

For patients with elevated BP, the physical examination should also include ophthalmological, neurological, and abdominal examinations as well as notation of peripheral edema (feet, hands, and face).

LABORATORY STUDIES

The most accurate test for proteinuria is a 24-hour urine collection with measurement of protein excretion. In settings where such collections are not practical, two separate diptick urinalysis tests demonstrating at least 1+ protein may substitute. Additional labs for patients with suspected pre-eclampsia should include complete blood count with platelets, liver enzymes, and a coagulation panel.

MANAGEMENT

Chronic Hypertension

Patients with a pre-existing diagnosis of hypertension should continue to receive treatment during the course of pregnancy. Providers should review the safety of their existing antihypertensive regimen and make adjustments as necessary. Antihypertensive medications are review in Chapter 4. Antihypertensive medications commonly used during pregnancy include methyldopa, hydralazine, and β-blockers. For patients diagnosed with hypertension after conception but prior to 20 weeks gestation, the role of antihypertensives is less clear. Patients with severe hypertension (diastolic over 110 mmHg) should probably receive pharmacological treatment but treatment of women with mild essential hypertension in pregnancy has not been shown to improve outcomes. Patients with

chronic hypertension should be carefully followed for signs or symptoms of pre-eclampsia as 15–25% will develop superimposed pre-eclampsia.

PRE-ECLAMPSIA

Prevention

As the risk factors associated with increased risk for pre-eclampsia have become increasingly well defined, interest has been focused on prevention of pre-eclampsia in patients at high risk. Proposed interventions have included dietary supplements, aspirin, and antihypertensive medications. Although the results have been mixed, there is little evidence to support the preventive benefits of diet and exercise, protein or salt restriction, magnesium, fish oil or antioxidant supplementation, heparin, or antihypertensive medications. Although some studies have shown potential benefit with the use of low-dose aspirin or calcium supplementation, insufficient evidence exists to make general recommendations concerning their use in the prevention of pre-eclampsia.

Management

The management of pre-eclampsia involves balancing the maternal risks of prolonged pregnancy against the neonatal risks of premature delivery. The potential risks and benefits for each patient must be considered individually. Although no universally acceptable management protocol can be recommended, a general approach to the management of pre-eclampsia is outline in Fig. 1.

Delivery is the definitive maternal management plan. For this reason, delivery should occur as soon as it can reasonably be achieved. For patients at term with mild disease, induction of labor is indicated. For patients with severe pre-eclampsia at or beyond 34 weeks, delivery is indicated with appropriate neonatal support. If the maternal condition appears stable but there is evidence of fetal compromise, management should follow a protocol similar to that of IUGR (*see* Chapter 6).

For patients with mild disease, no evidence of fetal compromise, and a gestational age of less than 34 weeks, ideal management is not well established. Under these circumstances, careful monitoring of maternal condition should be combined with close evaluation of fetal well-being. If both maternal and fetal conditions remain stable, delivery can occur at 38 weeks. If either maternal or fetal condition worsens, delivery should occur as soon as possible.

As noted for chronic hypertension, the use of antihypertensives has shown mixed results. For patients with severe hypertension, the use of antihypertensive medications has been shown to reduce maternal cerebrovascular complications. However, such treatment has not been shown to reduce neonatal complications and does not alter the maternal course of disease in relation to multiorgan complications. The use of antihypertensives has not been shown to improve maternal

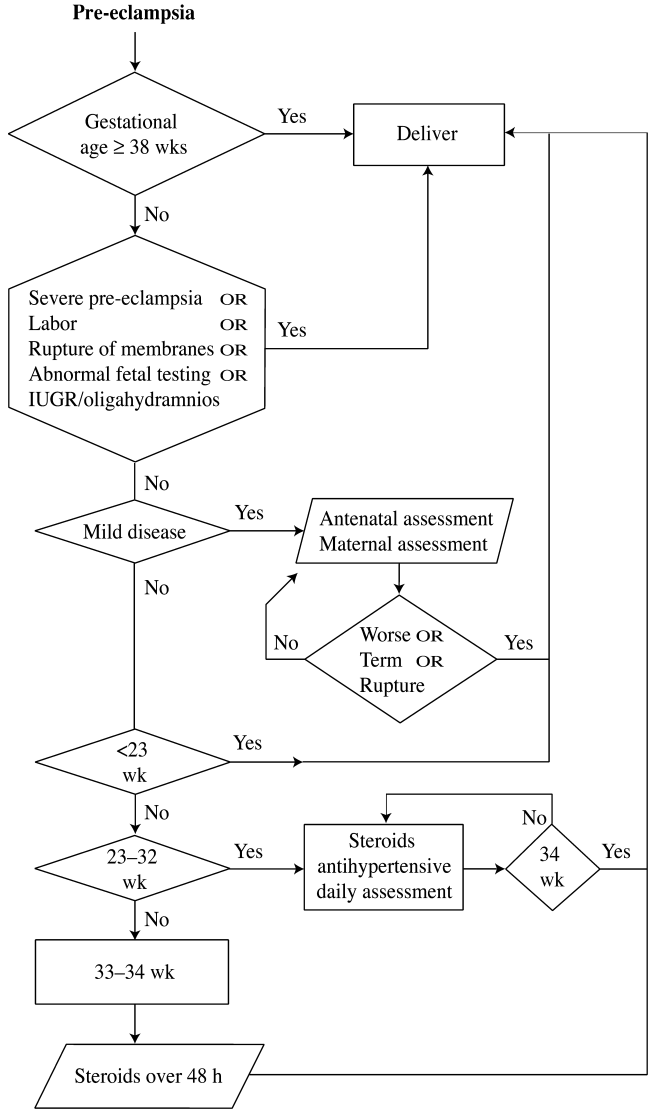

Fig. 1. Management of pre-eclampsia.

or neonatal outcomes in patients with mild disease. There is little evidence to support the use of any specific class of antihypertensive medications in the treatment of pre-eclampsia.

The use of corticosteroids has not been shown to improve maternal outcomes, although their use has been shown to improve neonatal outcomes for infants born prior to 34 weeks gestation.

Seizure Prevention

Seizure (eclampsia) is one of the most significant complications of preeclampsia and may occur without preceding warning signs. For this reason, seizure prophylaxis with magnesium sulfate is indicated for patients with preeclampsia in the intrapartum period. Specific regimens for the use of magnesium may vary between institutions and the specific protocol should be reviewed by each provider. One possible protocol is as follows: loading dose of 6 g of intravenous magnesium sulfate followed by 2 g per hour of continuous intravenous infusion. Magnesium may be toxic in high doses and patients should be monitored closely while undergoing magnesium therapy. Maternal BP, deep tendon reflexes, mental status, and urinary output should be monitored. Serum magnesium levels should be measured. Magnesium level above 7 mEq/L are associated with diminished deep tendon reflexes. Magnesium levels above 10 mEq/L are associated with respiratory depression. Magnesium levels above 12 mEq/L are associated with cardiac depression and arrest. Magnesium elevation is reversible with 10% calcium gluconate 10 mL intravenous given over 10 to 15 minutes.

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15 Diabetes in Pregnancy

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KEY POINTS

1. Diabetes mellitus (DM) is defined as carbohydrate intolerance resulting from either insulin deficiency or insulin insensitivity.
2. Exposure to elevated serum glucose is associated with increased risk for organogenic birth defects, macrosomic infants, shoulder dystocia, and birth trauma.
3. Gestational diabetes is defined as glucose intolerance first recognized during pregnancy.

BACKGROUND

DM (hyperglycemia secondary to either insulin deficiency or relative insulin insensitivity) is a significant medical condition with a potentially profound impact on pregnancy. Uncontrolled diabetes prior to or early in the course of pregnancy is associated with a variety of birth defects, including renal, gastrointestinal, cardiac, central nervous system, and skeletal abnormalities (*see* Table 1). The presence of diabetes may alter the interpretation of some prenatal tests including α-fetoprotein and obstetric triple screen. Pregnancy may, in turn, affect the course of diabetes, worsening glucose control in patients with pre-existing diabetes.

DM may be classified as type 1 diabetes, associated with pancreatic failure and insulin deficiency; type 2 diabetes, associated with ineffective insulin utilization (generally associated with hyperinsulinemia); or gestational diabetes mellitus (GDM), which is diabetes first diagnosed or recognized in pregnancy (generally associated with insulin resistance and similar to type 2 diabetes).

From: *Current Clinical Practice: Obstetrics in Family Medicine: A Practical Guide*
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Table 1
Congenital Abnormalities Associated With Diabetes

Duodenal and anorectal atresia
Hydronephrosis
Renal agenesis
Neural tube defects
Anencephaly
Ventricular septal defects
Aortic coarctation
Transposition of the great vessels

DIAGNOSIS

Diagnosis of types 1 and 2 DM i s made prior to pregnancy. The diagnosis is made on the basis of documented hyperglycemia with either insulin deficiency (type 1) or insulin resistance (type 2). The diagnosis of GDM is generally made on the basis of oral glucose testing during the course of prenatal care, although, in some cases, the diagnosis may be made on the basis of fasting blood glucose values.

Screening for GDM is an area of some controversy. Some authorities recommend universal screening of all patients at 24 to 28 weeks gestation, with earlier testing for those patients identified as high risk (*see* Table 2). Although universal screening is not recommended by all authorities, most patients will be screened at some point during the prenatal course.

Initial screening is via 50 g glucose tolerance testing. Patients are not required to fast and do not need to alter their dietary intake. A standardized 50 g glucose load is administered orally and serum glucose level is tested at 1 hour. The threshold for a positive screening test is also an area of some controversy and providers should be aware of the standard of care in their institution. Serum glucose values should be less than 130 mg/dL or 140 mg/dL. The lower value has a higher sensitivity (will miss fewer true cases of diabetes) but is associated with a higher false-positive rate. The higher value reduces false-positive findings (has a higher specificity), but may have a lower sensitivity.

Regardless of which threshold is used, all patients with a positive screening test should undergo diagnostic testing with a 3-hour 100 g oral glucose challenge test. Patients should eat a carbohydrate-rich or unrestricted diet for 3 days prior to testing, but should fast the night before the test. A standardized 100 g oral glucose load is administered, and serum glucose levels are drawn fasting, 1, 2, and 3 hours following administration. There is debate concerning the threshold values for this test as well. The National Diabetes Data Group's recommendation is presented in Table 3. According to this protocol, blood glucose levels should be below 105 mg/dL fasting and below 190 mg/dL, 165 mg/dL, and 145 mg/dL at 1, 2, and 3 hours, respectively. The test is considered diagnostic if any two values exceed the threshold.

Table 2
Risk Factors for Gestational Diabetes

Family history of diabetes
Family history of macrosomic infants
Ethnicity
Obesity
Past history of gestational diabetes
Past history of macrosomic infant
Multigestation

Table 3
Gestational Diabetes Diagnosis (100 g, 3-Hour Oral Glucose Tolerance Test)

Sample	*Threshold*
Fasting	105
1 hour	190
2 hour	165
3 hour	145

Note: The diagnosis of gestational diabetes is made if any two values exceed the values listed in the table.

PREGESTATIONAL DIABETES

Management

Preconception Management

The management of pregestational diabetes ideally should begin during the preconception period. Preconception management should include discussion of the effects of diabetes on pregnancy as well as discussion of the effects of pregnancy on diabetes. Patients should be counseled concerning the risks of maternal hyperglycemia on the developing infant and the importance of strict glycemic control prior to and throughout the course of pregnancy.

Preconception management should also include classification of the severity of diabetes. The Modified White's classification system is shown in Table 4. This classification is based on four factors: (a) treatment regimen, (b) duration of disease or age of onset, (c) associated disease, and (d) diabetic complications.

Because of the association of poor glycemic control with an increased risk for congenital defects, all patients should be intensively monitored and tightly controlled prior to conception. Because of the complexity of achieving tight glycemic control, such efforts should begin well before anticipated conception when possible.

Oral hypoglycemic agents are not generally utilized during pregnancy. Patients managed on oral hypoglycemic agents prior to conception may require

Table 4
White's Classification of Diabetes in Pregnancy

Class	*Definition*
A	Diet controlled
B	Age of onset ≥ 20 years, duration < 10 years
C	Age of onset 10–19 years or duration 10–19 years
D	Age of onset <10 or duration >20 years
F	Nephropathy (≥500 mg/day proteinuria)
H	Clinically evident arteriosclerotic heart disease
R	Retinopathy
T	Renal transplant

additional time (and education) to transition to the use of insulin. Patients may also require comprehensive diabetes education on diet, exercise, and blood glucose self-monitoring. Prenatal vitamins with folate should be prescribed as a part of preconception management as well.

Management in Pregnancy

For patients who did not receive preconception evaluation and treatment, all of the management just discussed should begin with the first prenatal visit. Because the early weeks of pregnancy are the period of organogenesis, rapid assessment and intervention are critical to improve outcomes. Patients may require more frequent visits and will probably benefit from intensive educational interventions, beginning with a review of the patient's own knowledge of her disease and its management.

Diet

All patients with diabetes should be counseled concerning the role of diet in the management of diabetes. Although specific recommendations may vary between patients, general recommendations include the following:

1. Caloric intake of 1800–2400 kcals per day generally as several small meals rather than fewer large meals.
2. Restriction of simple carbohydrates.
3. Inclusion of complex carbohydrates in an overall diet that includes approximately 40% carbohydrates, 30% fat, and 30% protein.
4. Regular and predictable caloric intake will facilitate glycemic control and reduce the likelihood of hypoglycemia.
5. A small snack should be available at all times in case of hypoglycemia.

Insulin

Pharmacological management of diabetes in pregnancy generally utilizes a combination of intermediate- and short-acting insulin. This combination allows

for more controlled adjustment of glycemic control than either oral hypoglycemic agents or long-acting insulin alone. The exact dose of insulin will be based on measured blood glucose values with target levels of less than 105 mg/dL fasting (95 mg/dL according to some authorities) and less than 120 mg/dL 2 hours postprandial. Insulin should be adjusted as necessary to achieve these target levels. Tight glycemic control has been demonstrated to improve obstetrical outcomes but have also been associated with increased risk of hypoglycemia. For this reason, patients should be educated concerning the symptoms of hypoglycemia and the appropriate steps to be taken should hypoglycemia occur.

Blood Sugar Monitoring

As noted, insulin dosing should be based on the results of blood glucose monitoring. For this reason, frequent fingerstick glucose monitoring should be a part of the management of patients treated with insulin. Although glycosylated hemoglobin values may provide adjunctive data concerning the level of glucose control, the long-term (3-month) retrospective nature of such testing makes it unsuitable for insulin management in pregnancy. Patients should be counseled to test blood sugar fasting and 2 hours after every meal on a daily basis. If such intense monitoring is not feasible, patients should be counseled to vary daily (e.g., fasting and 2 hours after lunch one day, 2 hours after breakfast and 2 hours after dinner the next) to allow for adequate assessment of insulin needs. Additional testing may be recommended at times when patients feel the symptoms of hypoglycemia to document the decrease in glucose levels.

GESTATIONAL DIABETES

Preconception Management

Preconception management of GDM begins with assessment of risk factors for the development of diabetes during pregnancy. The risk factors for GDM are listed in Table 1. All patients should be screened for risk factors for GDM. Patients found to be at increased risk may benefit from preconceptual diabetes testing as type 2 DM and GDM share common risk factors. Patients discovered to have diabetes prior to becoming pregnant should receive additional preconception counseling as noted earlier.

Management in Pregnancy

Patients with GDM should be managed similarly to those patients with preexisting diabetes. Although many patients with GDM can be appropriately managed with lifestyle modification alone, all patients should be counseled concerning the indications for further treatment with insulin if necessary. All patients with diabetes should test blood sugar regularly to assess the adequacy of their treatment regimen.

Because of the fetal risks associated with diabetes in pregnancy, all patients with diabetes should begin fetal surveillance in the third trimester of pregnancy. Antenatal assessment is discussed in Chapter 18. In addition, because of the risk of macrosomia, careful assessment of fetal growth should be included in prenatal assessment. Patients with evidence of macrosomic or small for gestational age fetuses should receive ultrasonographic assessment of fetal growth.

Management in Labor

During labor, efforts should be made to maintain the patient's serum glucose levels between 80 and 110 mg/dL. Care should be taken, however, not to induce maternal hypoglycemia in patients who are restricted from eating or drinking during the course of labor. This is especially true for patients with prolonged second-stage labor.

Postpartum Management

All patients diagnosed with GDM should be screened for diabetes in the postpartum period to document resolution of the diabetes. Such patients are at increased risk for subsequent diagnosis of type 2 diabetes.

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16 HIV and Pregnancy

*Paul Lyons and Sandy Green**

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KEY POINTS

1. Intervention in pregnancy can greatly reduce the incidence of transmission of HIV from mother to child.
2. HIV treatment is not without risk and should be discussed with the patient.
3. Two-thirds of HIV transmission occur during delivery.
4. The combination of elective cesarean section, antiretroviral therapy, and the avoidance of breastfeeding can reduce maternal to fetal transmission to 2–3%.
5. Women with HIV RNA greater than 1000 copies/mL should receive highly active antiretroviral therapy (HAART) with zidovudine (ZDV) as part of the regime.
6. Women with HIV RNA less than 1000 copies/mL may receive ZDV alone or ZDV ± HAART depending on necessity.
7. ZDV has been found to relatively safe in infants, with the only observed toxicity being a mild, reversible anemia in the first 6 weeks of life.

*Sandy Green, MD, is a first-year resident in internal medicine at Massachusetts General Hospital.

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8. Elective cesarean section at 38 weeks plus antiretroviral is the most effective way of preventing HIV transmission.

BACKGROUND

Infection with HIV is a critical condition in pregnancy. The ability to reduce maternal–fetal transmission represents one of the more significant advances in HIV management. Approximately 7000 HIV-positive women give birth each year. When untreated, HIV in pregnancy has an estimated maternal–fetal transmission rate of 15 to 25% in the United States and Europe and 25 to 40% in Africa. This rate is reduced to less than 5% with adequate prenatal and perinatal management. Adequate education in the postpartum period is also needed to prevent postnatal transmission through breast milk and other routes. For these reasons, management of HIV infection should ideally begin in the preconception period and continue through pregnancy and into the postpartum period. Multiple interventions can decrease the risk of HIV transmission. Providers must be actively involved in educating the parents concerning the maternal and fetal risks associated with HIV. The Public Health Service has developed four common scenarios concerning HIV and pregnancy. These scenarios are designed to help providers choose the most appropriate course of action when confronted with an HIV pregnant woman. The Public Health Service scenarios are as follow:

1. HIV-infected pregnant women without prior antiretroviral therapy.
2. HIV-infected women receiving antiretroviral therapy during the current pregnancy.
3. HIV-infected women in labor who have had no prior therapy.
4. Infants born to mothers who have received no antiretroviral therapy during pregnancy or intrapartum.

HIV SCREENING

Diagnosis

HISTORY

The known risk factors for HIV transmission are well described and should be reviewed with every woman of childbearing age. These risk factors include sexual activity, injection drug use, maternal–fetal transmission, and exposure to infected blood products. In addition to review of known risk factors, patients should be screened for medical events that may be suggestive of HIV infection. These medical conditions include frequent or recurrent infection, especially viral infections. Recurrent vaginal candidal infections, rapidly progressive cervical dysplasia, recurrent shingles, and nonspecific but persistent fever, weight loss, or fatigue may be symptoms of underlying immunocompromise conditions.

Women who are at increased risk should be offered further counseling and testing. Risk is conferred not only by the exposures of the mother, but also by those of the father. These risks may not be known with certainty. All women who express a desire to be tested should be screened. In addition, every newly pregnant woman should be offered a screening HIV test, unless HIV status is already known.

For patients newly diagnosed or known to be HIV-positive, initial evaluation should include confirmation of HIV status as needed, previous antiretroviral use, current antiretroviral use, past history of opportunistic infections, and review of (or repetition of) most recent CD4 count and HIV RNA levels.

Physical Examination

Although a variety of physical findings are suggestive of immunocompromise, physical examination alone is not sufficient to establish HIV status. In particular, the absence of suggestive physical findings in no way eliminates the possibility that a patient is infected with HIV. Suggestive physical findings would include diffuse adenopathy, oral thrush, abnormal skin findings (e.g., kaposi's sarcoma or severe eczematous lesions), or wasting.

Laboratory Studies

Testing should be voluntary, with counseling concerning the risks and benefits. Every woman considering pregnancy should be offered an HIV test. Diagnostic testing currently comprises a two-step process with an initial enzyme-linked immunosorbent assay (ELISA) test followed by confirmation via Western blot testing. In some settings, rapid screening tests may be available.

There are several options for HIV testing. The first and most commonly utilized test is an HIV antibody test. Although antibodies may develop as early as 4 weeks after inoculation, antibody tests may remain negative for up to 6 months. Results of antibody testing should be interpreted with caution in patients with relatively recent potential exposure to HIV. Use of antibody testing in newborns is not recommended as circulating antibodies are maternal and reflect the status of the mother rather than of the infant.

The most common testing regimen is a two-step test. The first step is antibody testing via either enzyme immunoassay (EIA) test and ELISA. Both tests take about 1 week to perform and require blood. If the test is positive, the second step is a confirmatory Western blot test. The EIA is currently the more common test. Alternatives to blood-based testing include sampling of either urine or saliva. The sensitivity of either is very good, although urine testing is slightly less sensitive than blood-based testing.

Because of the limitations of antibody testing, alternatives have been developed. One such alternative is P24 antigen testing. P24 protein is a component of the HIV and is measurable soon after infection (about 7 to 14 days), but is

not widely performed, and is not currently recommended for diagnosing HIV. A third alternative is rapid HIV testing available for office-based locations with results available at the time of testing. It take about 10 minutes to perform, and requires confirmatory Western blot if positive. The rapid HIV test is an ELISA-based test and therefore is subject to many of the same limitations as standard ELISA testing. Although it has been approved for use in many settings, it is relatively new, and has not been fully evaluated for use in pregnancy. It is most applicable at term or near term, where rapid determination of HIV status may be needed for key management decisions.

MANAGEMENT OF HIV IN PREGNANCY

Background

The management of HIV in pregnancy can be quite complex and should only be done by providers who are experienced in both obstetrical care and HIV management. The complexity of medication regimens and potential complications from the disease itself dictate that care be provided by individuals with considerable experience in both prenatal and HIV management. In instances where no one individual possesses such experience, referral or interdisciplinary management teams may maximize the benefit of appropriate HIV management in pregnancy.

As a general rule, pregnancy itself does not alter the overall management of HIV. Patients should generally be counseled to continue medications as previously prescribed. Although the safety and efficacy of antiretroviral therapy in pregnancy has not been fully studied, complications from disease and rates of transmission are related to such factors as viral load, which may be adversely affected by sudden changes in therapy.

Laboratory

For HIV-positive women, measurement of CD4 cell count, CD4 percent, and HIV RNA levels need to be taken approximately every trimester to determine the need for initiation of antiretroviral therapy for treatment of maternal HIV disease, change in antiretroviral regime, and possible initiation of prophylaxis against *Pneumocystis carinii* pneumonia (PCP) or *Mycobacterium avium* complex (MAC) at appropriate CD4 levels. Although HIV RNA levels do not determine if ZDV is needed in pregnancy (for HIV transmission to children has occurred with undetectable levels of HIV RNA) HIV RNA does correlate with disease progression and the necessity to begin HAART. The current guideline for beginning HAART treatment during pregnancy is 1000 copies/mL of HIV RNA in order to prevent prenatal transmission and progression of the maternal disease. There are no current universal guidelines on HIV screening in pregnant women.

Table 1
Antiretroviral Agents

Class	*Example*	*Class advantage*	*Class disadvantage*	*Mechanism*
NNRTIs	Efavirenz and Nevirapine	Less fat redistribution	Single mutation confers resistance CYP450 drug interactions	Binds to reverse transcriptase in HIV preventing it's function
NRTIs	Zidovudine	Minimal drug interaction	Hepatic steatosis and lactic acidosis Bone marrow suppression	Provides faulty DNA building blocks, halting the DNA chain that HIV makes
PI	Lopinavir/ ritonavir	Most data for survival benefit	Dyslipidemia, insulin resistance, CYP3A4 drug interactions	Interferes with the protease enzyme that HIV uses to produce infectious viral particles
Fusion inhibitors	Enfuvirtide	Possibly effective for people who have taken other anti-HIV drugs without success	Injection only Expensive	Interferes with the virus' ability to fuse with the cellular membrane

NNRTI, non-nucleoside reverse transcriptase inhibitors; NRTI, nucleoside reverse transcriptase inhibitors; PI, protease inhibitors.

Table 2
Initiation of Antiretroviral Therapy

Presentation	*CD 4$^+$ Count*	*HIV RNA*	*Recommendations*
AIDS-defining illness	Any	Any	Treat
Asymptomatic	<200/mm^3	Any	Treat
Asymptomatic	>200/mm^3 but <350/mm^3	Any	Treatment offered and know to decrease mortality
Asymptomatic	>350/mm^3	>100,000	Treatment offered Usually deferred
Asymptomatic	>350/mm^3	<100,000	Defer

MANAGEMENT

Current management guidelines for treating pregnant patients with HIV are much like those developed for non-pregnant HIV-positive individuals. Currently available antiretroviral medications are summarized in Table 1. Current recommendations for the initiation of antiretroviral therapy are summarized in Table 2.

All patients should be assessed for possible prophylaxis against PCP and MAC. Trimethoprim-sulfamethoxazole (TMP-SMZ) is recommended prophylaxis for PCP, although pentamidine may be used in the first and/or third trimester owing to concerns with adverse effects of TMP-SMZ in early and late pregnancy. MAC prophylaxis is azithromycin and is thought to be non-teratogenic.

The reduction of maternal–fetal transmission represents a significant success in the overall management of HIV infection. A landmark study documented that a three-part treatment regimen of ZDV during pregnancy, labor, and newborn reduces transmission by 70%.

MANAGEMENT PRIOR TO CONCEPTION

General recommendations for preconception management for patients of childbearing age include the following:

1. Do not use efavirenz (Sustiva) or amprenavir (Agenerase), d4T/ddI, Nevirapine, zalcitabine (ddC) and delavirdine owing to tetragentitc effects or toxicity in pregnancy.
2. Consider mental health services and drug treatment as needed.
3. Cigarette smoking, intravenous drug use, and unprotected sex with multiple partners increase the risk of prenatal HIV transmission.

PRENATAL MANAGEMENT

Drugs are the most teratogenic during the first 10 weeks. Particular attention should be paid to medication selection during this time period. The current standard adult ZDV dose is 200 mg three times daily or 300 mg twice daily, starting after 10 weeks. HIV-infected pregnant women with HIV RNA levels greater than 1000 copies/mL should receive HAART during pregnancy, preferably containing ZDV as one component of the regimen plus intravenous ZDV during labor and 6 weeks of ZDV to the infant, to reduce perinatal transmission. Women with HIV RNA levels below 1000 copies/mL could receive HAART or could receive ZDV alone antenatal, including intravenous ZDV during labor and 6 weeks of ZDV for the infant.

LABOR MANAGEMENT

The goal should be to reduce maternal fetal microtransfusions, which are thought to be the cause of maternal–fetal HIV transmission. Elective cesarean

section has been found to reduce transmission rates (prior to rupture of the membranes) by almost 50%. Cesarean section plus three-stage antiretroviral reduced transmission rates by 85% (both versus other modes of delivery without antiretroviral use.) Nonelective cesarean section has the same HIV transmission rates as unassisted vaginal delivery. There is a slightly increased risk of complications following cesarean section in HIV woman, thought to be the result of immunological suppression and an increased risk of infection. Thus, decreased risk of transmission must be weighed against complication rates following cesarean section. The American College of Obstetrics and Gynecology (ACOG) has issued an opinion that elective cesarean section delivery should be discussed and recommended for all HIV-infected pregnant women with viral loads above 1000 copies/mL. If the decision is made to perform an elective cesarean section delivery, the ACOG recommends it be done at 38 weeks gestation owing to the potential risk for labor and membrane rupture before the woman would reach 39 weeks gestation, which is the standard recommended time for operative deliveries in women without HIV infection. Antiretroviral prophylaxis should be provide regardless because of the added benefited. If vaginal delivery is chosen, instrumentation should be avoided.

POSTPARTUM MANAGEMENT

Breastfeeding is contraindicated for HIV-infected mothers. ZDV for preterm infants is 1.5 mg/kg per dose intravenously, or 2.0 mg/kg per dose orally, every 12 hours. Dosing can be advanced to every 8 hours at 2 weeks of age if the infant was 30 weeks gestation at birth or at 4 weeks of age if the infant was less than 30 weeks gestation at birth. ZDV has been found to be relatively safe for newborns, with the only recognized ZDV-associated toxicity being a mild reversible anemia in the first 6 weeks of life. Neonate monitoring should include a complete blood count and differential to monitor the anemia. Repeat measurement of hemoglobin is required after the completion of the 6-week ZDV regimen, and at 12 weeks when any hematological abnormality should have resolved. All infants born to HIV-positive women must be placed on PCP prophylaxis at 6 weeks of age. The gold standard is TMP 150 mg twice a day with SMZ 750 mg twice a day in divided doses and given three times a week on consecutive days. Prophylaxis should be continued until the age of 12 months in all infants. At the age of 12 months, prophylaxis is continued only in infected children as CD4 cell count dictates. Prophylaxis may be stopped in infants with two or more negative HIV tests, if the test was performed after 1 month of life. Women who have received only ZDV prophylaxis during pregnancy need to be evaluated to determine the need for postpartum antiretroviral therapy, and to monitor for postpartum complications.

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17 Multigestational Pregnancy

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KEY POINTS

1. Multigestational pregnancy presents unique management challenges beyond those encountered in singleton pregnancies.
2. Multigestational pregnancy may result from either a single or multiple fertilized ovum (ova).
3. Complications associated with multigestational pregnancies include spontaneous abortion, preterm delivery, pre-eclampsia, postpartum hemorrhage, and increased perinatal mortality.

BACKGROUND

Most pregnancies are the product of a single fertilized ovum and result in a single fetus. One to two percent of pregnancies, however, result in multiple fetuses, multigestational pregnancy. Such pregnancies present unique challenges for both prenatal management and delivery. Although uncommon, multigestational pregnancy occurs with sufficient frequency that primary care providers should be familiar with basic management considerations.

Multiple gestation may be the result of either a single fertilized ovum that divides early in development or multiple fertilized ova from the same cycle. Monozygotic (MZ) twins are genetically identical fetuses produced from a single fertilized ovum. MZ twins make up about 30% of all twin pregnancies. Dizygotic (DZ) twins are the product of two separate fertilized ova. Although they are genetically similar, they are not genetically identical. DZ twins make up 70% of all twin pregnancies with a frequency of approximately 1 out of 80 pregnancies. Although significantly less common, multigestational pregnancy

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Table 1
Complications of Multigestational Pregnancy

Maternal complications
Spontaneous abortion
Stillbirth
Preterm labor
Preterm delivery
Placenta previa
Gestational diabetes
Anemia
Urinary tract infection
Pregnancy induced hypertension/pre-eclampsia
Postpartum hemorrhage
Fetal complications
Perinatal mortality
Developmental abnormalities
Growth abnormalities
Preterm delivery complications

may result in more than two developing fetuses. The expected natural frequency of multigestational pregnancy is approximately 1 in 80 twins, 1 in 6400 triplets, and 1 in 512,000 quadruplets. The increase in assisted fertility has significantly altered the frequency of multigestational pregnancies, however, and such figures may no longer be entirely applicable.

In addition to multiple fetuses, multigestational pregnancies may have several variations of multiple chorions and placentae. MZ twins may have a single placenta and a single chorion (~60%) or may have two chorions with either a fused placenta or two separate placentae (~20% each). DZ twins have two chorions and two placentae, which may be fused or separate (~50% each).

Multigestational pregnancies are associated with increased risk for a variety of prenatal and delivery-related complications (*see* Table 1). Maternal risks associated with multigestational pregnancy include spontaneous abortion, stillbirth, preterm labor, preterm delivery, placental previa, anemia, urinary tract infection (UTI), pre-eclampsia, and postpartum hemorrhage. Up to two-thirds of twin pregnancies will result in loss of one twin in the first trimester. The rate of fetal demise is twice as high as for single pregnancies. The risk of both anemia and UTI is two to three times normal. There is a threefold increased risk of pre-eclampsia and a fivefold increased risk of postpartum hemorrhage in multigestational pregnancy.

Fetal risks include developmental abnormalities, growth abnormalities, and preterm delivery complications, including a death rate that is three times the normal. Perinatal mortality is three times that of single pregnancy risk. The risk of

Table 2
Findings Associated With Multigestation

History
Family history of multigestational pregnancy (including patients who are themselves twins)
Past history of multigestational pregnancy
Assisted reproduction
Maternal symptoms
Nausea
Vomiting
Headache
Shortness of breath
Abdominal distention
Constipation
Physical findings
Uterus size larger than dates
Excess maternal weight gain
Multiple palpable fetuses
Multiple audible fetal heart tones
Laboratory/diagnostic studies
Significantly decreased hemoglobin
Elevated maternal serum α-fetoprotein
Ultrasound documentation of multiple fetuses

both major and minor malformations is double that of single pregnancies. The average gestational age at delivery is 36 weeks for twins and 33 weeks for triplets, significantly increasing the likelihood of complications from prematurity.

DIAGNOSIS

The diagnosis of multiple gestation is generally made via ultrasound (US) during the course of prenatal care. Careful prenatal care combined with the prevalence of obstetrical US has greatly diminished the number of unanticipated multigestational deliveries. Although the diagnosis is generally made ultrasonographically, the provider's index of suspicion may be heightened by historical or physical examination findings during the course of prenatal care. Key findings are summarized in Table 2.

History

Prior to conception or early in the prenatal course, a past history or family history of multigestational pregnancy should be explored. In addition, a history of assisted reproduction should be noted, when present. Patients with multigesta-

tional pregnancy may report an increase in pelvic pressure, nausea, vomiting, headache, shortness of breath, distention, and constipation. Although none of these symptoms is specific to multigestational pregnancy, the number of symptoms and/or the severity of the complaint may be increased in such pregnancies.

Physical Examination

Because the symptoms noted here are neither sensitive nor specific for multigestational pregnancy, suggestive physical findings may be important in identifying patients with multiple fetuses. Increased maternal weight gain is a nonspecific, but suggestive finding. Uterine size greater than expected for gestational age may also be a critical finding. Two palpable fetuses or multiple fetal heart tones, although less common, should prompt immediate US evaluation.

Laboratory and Diagnostic Studies

As previously noted, obstetrical US is the definitive study. In skilled hands, US may demonstrate multiple gestation as early as 4 weeks gestation. Other suggestive laboratory findings include decreased hemoglobin and elevated maternal serum α-fetoprotein (levels approximately two to three times higher than for singleton pregnancies even in the absence of fetal abnormalities).

MANAGEMENT

Prenatal Care

In general, the course of prenatal care is similar to that of singleton pregnancies with additional care directed toward specific increased risks associated with multigestational pregnancy. The diagnosis should be confirmed as early as possible. For patients at high risk (e.g., assisted reproduction), this may include US documentation as early as 4 weeks gestation. Because of the increased potential for genetic abnormalities, providers may consider offering genetic diagnosis for patients over the age of 33. The frequency of prenatal visits may be increased to monitor for signs/symptoms of preterm contractions or preterm labor.

Patients should be counseled concerning the increased need for careful dietary intake. Folic acid supplementation should be started at the first prenatal visit and iron supplementation may also be appropriate. Maternal weight gain should be closely monitored with a target weight gain of 35–45 pounds over the course of pregnancy.

Fetal growth should be closely monitored starting early in the third trimester (or earlier if patient is determined to be at risk for abnormal fetal growth). US studies every 4 weeks will allow for documentation of adequate and symmetric fetal growth.

Labor and Delivery

Management of multigestational deliveries is associated with several significant challenges. Providers with limited experience or without access to necessary obstetrical and neonatal support, should arrange for appropriate backup or transfer prior to the onset of labor. Patients with three or more fetuses are generally not candidates for vaginal delivery and arrangements should be made early in the prenatal course for appropriate cesarean section.

Because the method of delivery may vary with the presentation of the infants at the time of labor, patients with twin pregnancies should be admitted at the first signs of labor, bleeding per vagina, or rupture of membranes. On admission, US should be performed to confirm the position and presentation of each infant. All twin deliveries should be attended by one pediatric team (with all necessary neonatal resuscitation equipment) for each infant.

By convention, the first twin is designated twin A and the second, twin B. Possible variations of presentation include (a) twin A vertex, twin B vertex (~40%), (b) twin A vertex, twin B breech (~40%), or (c) twin A breech, twin B any presentation (~20%). Vaginal delivery can only be attempted if twin A is in a vertex presentation; therefore pregnancies with twin A in a breech position at the time of labor will require cesarean section delivery. If twin A is in a vertex presentation at the time of labor and there are no other contraindications, vaginal delivery may be attempted. In addition to the usual indications for cesarean section associated with any pregnancy (*see* Chapter 22), cesarean section is indicated in twin deliveries that demonstrate twin–twin transfusion.

Because the position of twin B cannot be absolutely known prior to delivery of twin A, all attempted vaginal deliveries should be performed in a setting equipped for a cesarean section if necessary. All patients should have intravenous access, available typed and crossmatched blood, and a complete blood count prior to delivery.

Vaginal delivery of the first twin is managed in a similar manner to singleton deliveries. Following the delivery of twin A, US should be performed to confirm the presentation of twin B. If twin B is in a vertex presentation, delivery is again managed in a manner similar to singleton pregnancies. If twin B is found to be in a breech position following delivery of twin A, external version may be attempted to position the infant in a vertex presentation. If twin B remains in a breech position, cesarean section should be performed.

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18 Post-Dates Pregnancy

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BACKGROUND
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MANAGEMENT
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KEY POINTS

1. Term pregnancy is defined as 37 to 42 weeks gestation.
2. Accurate pregnancy dating is critical to assessment and management of post-dates pregnancy.
3. Timing of delivery should be prior to 42 weeks gestation; earlier if antenatal testing is nonreassuring.

BACKGROUND

When a firm estimated date of delivery (EDD) is established early in pregnancy, providers can anticipate that most pregnancies will result in spontaneous delivery at term. Term in this setting is defined as 37 to 42 weeks gestation. Under some circumstances, however, pregnancy may continue beyond 42 weeks, requiring assessment and management as a post-dates pregnancy. Although the exact number of pregnancies that continue beyond term is not well established (3–12%), approximately 10% of all pregnancies will result in induction of labor (although not all for post-dates pregnancy).

A significant first step in identifying post-dates pregnancies is confirmation of gestational dating. As noted in Chapter 3, a variety of measurements may be used to establish the EDD, including last menstrual period (LMP) and obstetrical ultrasound (US). Confirmation of the EDD is critical to appropriate management of post-dates pregnancy. For this reason, all such data should be reviewed carefully and confirmed.

Although pregnancy is not considered post-dates until 42 weeks of gestation, planning for management should begin at or near the EDD. Careful fetal

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monitoring and management for delivery is critical as post-dates pregnancy is associated with an increased risk for operative delivery, macrosomia, shoulder dystocia, meconium aspiration, and fetal mortality (twice baseline at 42 weeks, six times baseline by 44 weeks).

DIAGNOSIS

Approximately one-half of all post-dates pregnancies are caused by inaccurate gestational dating. For this reason, confirmation of the appropriate gestational age is critical.

History

The patient's menstrual history should be reviewed, including the timing and normality of the LMP. Under a variety of conditions, the episode of bleeding considered to be the LMP may be inaccurate. Oligomenorrhea, prior use of contraception such as oral contraception or medroxyprogesterone, and pregnancy-related first-trimester bleeding may all alter the accuracy of menstrual history. First-trimester bleeding per vagina is very common and such bleeding may be interpreted as menstrual bleeding when, in fact, it was not. Early pregnancy bleeding is reviewed in Chapter 9.

The date of the first positive pregnancy test may be helpful in narrowing the possible dates of pregnancy. A review of the prenatal record should include obstetrical US results, if available, fundal height measurements, fetal quickening, and first noted fetal heart tones by US (4–6 weeks), handheld Doppler (10–12 weeks), or fetoscope (18–20 weeks). A pelvic examination with bimanual assessment of uterine size early in pregnancy may also provide confirmatory support for EDD.

Prior obstetrical history should be reviewed as a past history of post-dates delivery is associated with an increased risk of subsequent post-dates delivery.

Physical Examination

Primary confirmation of post-dates pregnancy is generally provided by a careful history. Physical examination is generally supplementary at term and should not alter an otherwise well-established EDD.

Diagnostic Studies

In the absence of adequate prenatal data to establish EDD, late pregnancy US may provide a broad estimate of gestational age. US accuracy diminishes with increasing gestational age, however, and late pregnancy results should be interpreted with caution. Although the exact accuracy of dating by US cannot be established, the "1 week per trimester" rule of thumb is a reasonable estimate of accuracy. US studies performed in the first trimester are accurate to within 1

week; those performed in the second trimester are accurate to within 2 weeks; those performed in the third trimester are accurate to within 3 weeks.

MANAGEMENT

Post-dates pregnancy presents two related challenges to providers: (a) assessment of continued fetal well-being and (b) assessment of need for induction.

Induction of labor is discussed in Chapter 20. As a general rule, the risk associated with post-dates pregnancy after 42 weeks gestation provides support for a policy of induction at or before that time. An overview of management is provided in Fig. 1.

Assessment of Fetal Well-Being

A variety of tests to assess fetal well-being are available. These tests range from patient-performed outpatient monitoring to formal monitoring with US examination. Prenatal care providers should be familiar with each of these options, their role in the management of post-dates pregnancy, and the strengths and limitations of each study. Assessment of fetal well-being should begin between 40 and 41 weeks of gestation and should continue until delivery.

Fetal Kick Count

Thirty to 60 minutes postprandial, lying on her left side, the patient monitors and counts fetal movements ("kicks"). Normal frequency is approximately five kicks per hour. Fewer than 10 kicks in 2 hours is considered abnormal. Although a reasonable adjunct to other methods of monitoring, fetal kick counts alone are probably insufficient to ensure fetal well-being. All reports of decreased fetal movement should be followed up by a non-stress test (NST) or a biophysical profile.

Non-Stress Test

During the NST, patients are monitored with external tocodynamometer and a Doppler fetal heart rate monitor. A reassuring NST consists of at least two accelerations in fetal heart rate in 15–20 minutes. Each acceleration should last at least 15 seconds and increase at least 15 beats per minute from baseline. (Fetal heart rate monitoring is reviewed in Chapter 26.). Non-stress testing should be repeated twice weekly beginning at 40–41 weeks gestation.

Non-reassuring NSTs may be associated with threats to fetal well-being, may represent a period of fetal sleep, or may be related to external factors such as medication. Non-reassuring NSTs should prompt additional follow-up.

Contraction Stress Test

Fetal stimulation associated with uterine contraction has been observed to induce decelerations of fetal heart rate in circumstances where fetal well-being is threatened. This observation led to the development of the contraction stress

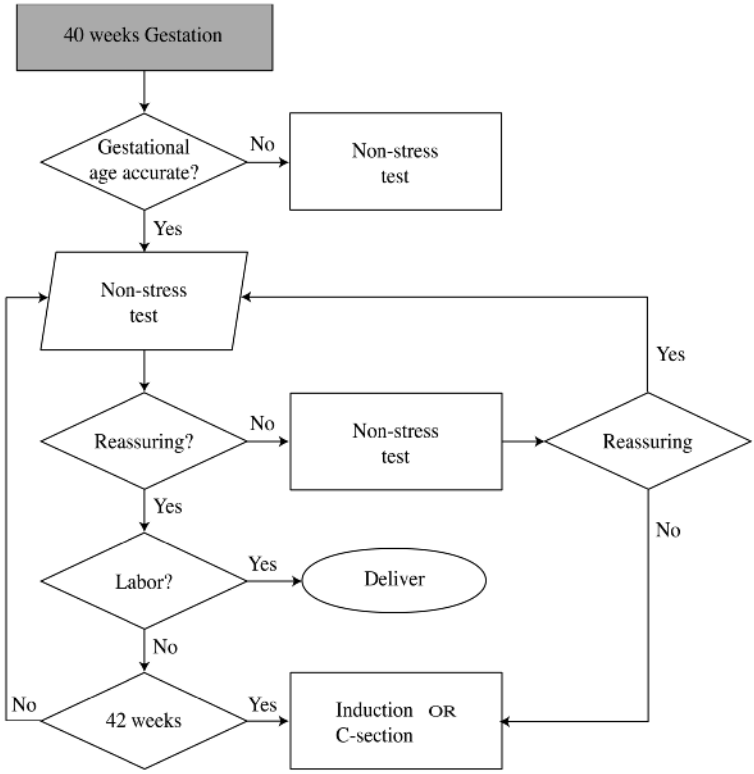

Fig. 1. Management of post-dates pregnancy.

test. Oxytocin is used to induce uterine contractions. The fetal heart rate is monitored, in turn, for decelerations indicative of fetal stress. Contraindications to contraction stress test include preterm labor risk, classical cesarean section scar, and placenta previa.

Oxytocin is started at 0.5–1.0 mU per minute and increased every 15 minutes until a pattern of three contractions every 10 minutes is established. Late decelerations with 50% or more of contractions is considered a positive test and requires further evaluation. Infrequent late decelerations should prompt close monitoring and possible further evaluation. Variable decelerations should be followed by US evaluation to assess amniotic fluid status. A normal or negative test (no late or variable decelerations) is reassuring and should prompt routine fetal monitoring.

Biophysical Profile

A biophysical profile is a multicomponent assessment of fetal well-being. Each of the five components is given a score of 0–2 with a maximum possible

Table 1
Biophysical Profile Scoring

Measure	*Normal (2 pts)*	*Abnormal (0 pts)*
Amniotic fluid	At least one pocket ≥2 cm	No pocket ≥2 cm
Fetal heart rate	Reactive two or more episodes; acceleration (≥) 15 beats per minute over baseline) lasting at least 15 seconds within 20 minutes	Nonreactive
Fetal tone	Active limb extension and flexion	Slow extension, no return to flexion, no movement or partially open fetal hand
Gross movement	At least two seperate limb or body movements within 30 minutes	Fewer than two separate limb or body movements within 30 minutes
Breathing movements	At least one episode lasting >20 seconds within 30 minutes	No episode of sufficient duration within 30 minutes

score of 10. A score of 8 is reassuring; 6 is suspicious; 4 indicates a need for acute intervention.

The scoring matrix is summarized in Table 1. Components of the biophysical profile include the following:

1. An NST is performed. A reassuring NST is scored 2. A non-reassuring NST is scored 0.
2. Amniotic fluid index (AFI) score is obtained. An AFI score of 5 or higher with at least one 2-cm × 2-cm pocket of amniotic fluid present is scored 2 points. AFI less than 5 or no pocket of fluid is scored 0.
3. Sustained fetal breathing is monitored. Sustained fetal breathing of at least 30 seconds is scored 2. Absence of fetal breathing activity or duration less than 30 seconds is scored 0.
4. Fetal movement is monitored. At least three limb or trunk movements is scored 2. Less than three movements is scored 0.
5. Fetal tone is measured. Fetus flexion at rest with at least one movement of extension followed by return to flexion is scored 2. Extension at rest or lack of at least one extension/flexion movement is scored 0.

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III Labor and Delivery

19 Normal Labor

CONTENTS

BACKGROUND
PRELABOR
LABOR
ASSESSMENT
LABORATORY STUDIES
MANAGEMENT

KEY POINTS

1. Labor is defined as uterine contractions resulting in progressive cervical change.
2. Assessment of labor begins with confirmation of gestational age.

BACKGROUND

The experience of labor and delivery is the culmination of the prenatal period. It is the period with the most potential for both the most joy and the most anxiety.

PRELABOR

Prior to labor there is generally a sequence of predictable events that mark the physiological preparation for delivery of the infant. Beginning 4–8 weeks prior to delivery, the patient may begin to experience slight, irregular, and non-sustained contractions. These contractions, referred to as Braxton-Hicks, are marked by only mild discomfort in most circumstances and do not lead to cervical change.

Approximately 2 weeks prior to delivery, the fetal head will often settle into the pelvic brim. This settling is referred to as lightening and the patient may report that the baby has "dropped." There is potentially a measurable decrease in fundal height and the patient may report a decrease in pregnancy symptoms related to intra-abdominal pressure. The woman may also, however, report an increase in symptoms related to fetal pressure within the pelvis.

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Table 1
Bishop Scale Cervical Scoring

	Score			
Indicator	*0*	*1*	*2*	*3*
Dilation (cm)	0	1–2	3–4	5–6
Effacement (%)	0–30	40–50	60–80	80–100
Fetal station	–3	–2	–1/0	≥ +1
Consistency	Firm	Medium	Soft	
Cervical position	Posterior	Mid	Anterior	

Beginning several days to several weeks prior to delivery, the cervix will begin to undergo preparatory changes that will include softening and may also include some degree of effacement and dilation. Dilation up to 3 cm may occur during this phase and is generally more pronounced in multiparous patients. A standardized measure of cervical condition exists and is often used in the evaluation of patients for possible induction of labor, when necessary. The Bishop Scale is summarized in Table 1.

As the cervix begins to dilate and efface, the cervical mucus plug that has occupied the os during the course of pregnancy comes out. This is occasionally associated with a small amount of blood referred to as "bloody show." The loss of the mucus plug and bloody show are generally signs that the onset of labor is imminent.

LABOR

Labor is divided into three separate stages, which are summarized in Table 2. The first stage of labor is from the onset of contractions through full cervical dilation and effacement. Because the early cervical changes may be protracted and unpredictable in their course, the first stage of labor is divided into early- or latent-phase labor and active-phase labor. Although no absolute distinction can be made between these two phases of the first stage of labor, patients are generally considered in latent-phase labor until cervical dilation reaches approximately 4 cm. The second stage of labor begins with full cervical dilation and continues until delivery of the infant. The third stage of labor begins with the delivery of the infant and is complete with the delivery of the placenta. Although the duration of each stage is highly variable, the duration tends to shorten with each subsequent pregnancy.

ASSESSMENT

History

Assessment of possible labor begins with an abbreviated history. Accurate pregnancy dating is critical to the appropriate management of labor. If uncertain dating

Table 2
Stages of Labor

First stage	Onset to full dilation	Primigravid 6–18 hours	1.2 cm/hour	Effacement, dilation, station
		Multiparous, 2–10 hours	1.5 cm/hour	
Second stage	Full dilation to delivery of infant	Primigravid, 1.5–3 hours		Descent, rotation
		Multiparous, 5–30 minutes		
Third stage	Delivery of infant to delivery of placenta	Up to 30 minutes		Delivery of placenta

makes preterm labor a possibility, the patient must be managed as if preterm. A complete discussion of the management can be found in Chapter 7. In addition to gestational dating, the history should include a review of the prenatal course and any complications that arose during pregnancy. Pre-existing medical conditions, including any allergies, should be reviewed. A history of the contractions should include onset, frequency, duration, and intensity. Patients should be asked about bleeding or rupture of membranes. Fetal movement should be confirmed.

Physical Examination

The physical examination should include vital signs, abdominal examination of the abdomen including Leopold's maneuvers, and a clinical estimate of fetal size. A manual examination of the cervix should be performed to determine dilation, effacement, station, and presentation.

Dilation

Cervical dilation is measured in centimeters and ranges from 0 (closed) to 10 (complete). Standardized instruments exist that allow providers to "feel" various degrees of dilation and providers should occasionally test their own assessment against these instruments. Hand size varies significantly, but 1 cm dilation is approximately equivalent to a fingertip. A measurement of 3 cm is approximately equivalent to two fingers side by side. A 5 cm dilation is approximately equivalent to spreading index and middle fingers in a "victory" sign, and 10 cm is roughly equivalent to fully spread index and middle fingers.

Effacement

Effacement represents thinning of the cervix over the fetal head (or presenting body part in non-vertex presentations. This can be visualized as equivalent

to pulling a tight turtleneck sweater over one's head. Effacement is described in percentages, with 0% effacement marking no change and 100% effacement representing no appreciable thickness to the cervix. Although dilation and effacement often occur in tandem, either may occur without evidence of the other.

Station

Station refers to the position of the fetal head in the birth canal. Zero station is defined as the level of the ischial spines. Positions above the ischial spines are measured as negative values, whereas positions below the ischial spines are measured as positive values. Traditionally, the distances were divided in thirds. A fetal head one-third of the distance between the ischial spines and the outlet is +1, two-thirds +2, at the outlet +3. The same applies in reverse for negative station measures. Some authorities now recommend measuring in centimeters from the spines, which translates to a –6 to +6 scale. Considerable head molding may occur during descent and providers should be careful to measure distance to the fetal head and not to the fetal caput.

Presentation

During the examination, the presenting body part should be examined and confirmed. If a cephalic (head first) presentation cannot be confirmed on manual examination, an ultrasound should be performed.

LABORATORY STUDIES

Prenatal labs should be reviewed and any missing laboratory values should be ordered. In particular, hemoglobin, platelets, and evidence of infection (including group B strep) should be noted. Additional labs may be required if the patient is presenting with a complication of pregnancy or labor.

MANAGEMENT

In the first stage of labor, management is generally expectant. Patient should be admitted (preferably as late in the first stage as possible under most circumstances). Blood pressure should be checked every 2–4 hours, fetal heart rate should be monitored every 30 minutes, unless abnormalities arise. Patients may be allowed to ambulate, but intake by mouth should be limited. Adequate anesthesia should be provided at the request of the patient. Recent studies support the use of early anesthesia if requested by the patient.

The second stage of labor is marked by descent of the fetal head through the birth canal. The usual sequence of head movements is engagement, flexion, descent, internal rotation, extension, external rotation, and expulsion.

Delivery will usually occur without any necessary assistance on the part of the provider. At the time of delivery of the head, gentle counterpressure may be

applied to control delivery and minimize perineal trauma. Delivery of the anterior shoulder is effected with gentle downward traction followed by delivery of the posterior shoulder in an upward motion.

With delivery of the head, a quick check is made to ensure that no nuchal cord is present and bulb suction of the infant's nose and mouth should be performed. The mother should breathe rather than push during this activity. With delivery of the body, the umbilical cord is clamped and then cut. The infant should be held above the level of the uterus while at this point to minimize transfusion of blood from the cord to the infant.

Delivery of the placenta also requires little assistance from the provider under normal circumstances. Gentle traction on the umbilical cord may assist with release, but excess traction may lead to uterine inversion and excess postpartum hemorrhage.

20 Induction and Augmentation

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BACKGROUND
PREPARATION
INDUCTION

KEY POINTS

1. Induction is defined as artificial initiation of labor.
2. Augmentation is defined as artificial stimulation of labor.
3. Induction should always be performed for a specific indication.

BACKGROUND

Under most circumstances, the initiation of labor occurs without assistance at the appropriate time. Under some circumstances, however, induction of labor is indicated prior to the onset of labor via natural processes. Table 1 presents a list of indications for induction. Induction should always be performed for a specific indication and, when possible, under circumstances where cervical status is favorable for delivery.

PREPARATION

Prior to induction patients should be carefully assessed for contraindications to induction (*see* Table 2). In addition, cervical status should be assessed. A Bishop cervical score (*see* Chapter 19) of 8 predicts a success rate for induction approximately equivalent to spontaneous labor.

If the cervical status is not favorable for induction and the need for delivery is not immediate, cervical preparation may be a helpful adjunct in preparing for delivery. Several modalities are available to enhance favorable cervical status, including mechanical and pharmacological options.

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Table 1
Indications for Induction

Pre-eclampsia
Chronic hypertension
Diabetes mellitus
Heart disease
Post-dates
Rh incompatibility
Fetal abnormalities or demise
Chorioamnionitis
Premature rupture of membranes
Intrauterine growth restriction

Table 2
Contraindications to Induction of Labor

Pelvic abnormalities incompatible with vaginal delivery
Placenta previa
Classical cesarean section scar
Full-thickness myomectomy
Hysterotomy
Breech presentation not compatible with vaginal delivery

Pharmacological Options

Prostaglandin formulations are available including PGE1 (misoprostil) and PGE2 (dinoprostone). Both mimic the prostaglandin activity physiologically present with the onset of spontaneous labor. Misoprostil is available as a pill that can be placed intravaginally (25 μg every 4–6 hours). Dinoprostone is available in a gel formulation (0.5 mg/2.5 mg gel). A single dose is placed intracervically 12 hours prior to induction. Contraindications to prostaglandin use include unexplained bleeding per vagina, rupture of membranes, and prior cesarean section. In addition to those general contraindications, dinoprostoneis is contraindicated in patients with a history of asthma, glaucoma, or myocardial infarction. Side effects include fetal stress and decelerations, hypertonicity, nausea, vomiting, and fever.

Mechanical Options

Two mechanical options are also available for cervical ripening. These are placement of a foley bulb and laminaria. A foley catheter with a 25–50 cc balloon may be inserted above the internal os, inflated and withdrawn to the internal os. Within 12 hours, the cervix can be expected to dilate 2–3 cm. This dilation will be apparent clinically when the foley bulb falls out of the cervix. Laminaria

are made of dried seaweed, which serves to draw fluid into the laminaria. The laminaria is placed in the cervix and as the fluid is absorbed the laminaria swells to three to four times its original size within 6–12 hours.

Preparation for induction should also include preparation for failure of induction and therefore should only be performed in a setting where access to operative delivery is available.

INDUCTION

Induction is generally performed with oxytocin. Specific protocols vary between institutions and providers should be aware of the specific protocol at their own institution. One potential regimen is 10 units of oxytocin in 1 L fluid (1 μ/cc). The oxytocin is attached to an infusion pump and is slowly titrated up until adequate contractions are achieved or contraindications to continue induction develop. Complications include hyperstimulation with possible tetanic contractions, abruptio placentae, uterine rupture, precipitous delivery, cord prolapse, and fetal stress. Because of the potential serious nature of these side effects, patients must have vital signs monitored regularly and must have both fetal heart rate and tocodynamometer monitoring during the course of induction. Details of fetal heart rate monitoring are reviewed in Chapter 26.

21 Pain Management in Labor

CONTENTS

BACKGROUND
NONPHARMACOLOGICAL MANAGEMENT
PHARMACOLOGICAL MANAGEMENT

KEY POINTS

1. Pain in labor is a multifaceted experience with physiological, psychological, and social components.
2. Pain management in labor requires a multifaceted approach, including pharmacological and nonpharmacological options.
3. Appropriate pain management will greatly enhance the experience of labor.

BACKGROUND

Virtually all labor is accompanied by pain. Uterine contractions, cervical dilation, fetal descent, and perineal stretching (and, when it occurs, laceration) are all associated with pain. Although pain accompanies all labor, the patient's perception of and response to pain is highly variable. Providers must be aware of all factors that contribute to the patient's pain and adequately address each of these factors in order to achieve appropriate pain control.

Although the patient's perception of pain depends on a variety of factors, the physiological basis of pain is reasonably well described. In the first stage of labor, most pain is secondary to uterine contractions, intermittent ischemia, and cervical dilation. The primary neurological innervation associated with these components is located at the level of T10-L1. In the second stage of labor, vaginal and perineal distention are the primary source of pain. Innervation is at the level of S2-S4, the pudendal nerve.

Options for pain management include pharmacological and nonpharmacological modalities with which providers should be familiar. Among the nonpharmacological options are hydrotherapy, hypnotherapy, positioning, and

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support. Pharmacological options include epidural/spinal anesthesia, narcotic pain management, and local anesthesia.

NONPHARMACOLOGICAL MANAGEMENT

Ideally, nonpharmacological modalities are a part of the management of all labor. Such management begins in the prenatal period with appropriate education concerning the process of labor and delivery and a discussion of reasonable expectations concerning pain in labor. In addition, patients will often benefit from a prenatal course in one of the many nonpharmacological approaches to pain management.

Although the specifics of each approach vary somewhat, several key principles are shared among all approaches. These principles include relaxation, suggestion, concentration, and preparation. With appropriate preparation and intrapartum support, the efficacy of nonpharmacological approaches is quite high, approaching 80% in some populations.

Patients should be educated concerning the duration of each stage of labor, the expected events of each stage, and the active role that laboring mothers have in contributing to the success of each stage. Patients should receive education concerning pre-admission management of pain, appropriate timing of presentation to the labor and delivery suite, and warning symptoms that require prompt assessment.

At the time of labor, patients are counseled to anticipate contractions, to focus on each contraction in turn, to develop a point of focus for each contraction, and to use relaxation techniques including visualization and breathing techniques. As with all skills, practice is an important component of the success of this technique and introduction should begin early in the course of pregnancy to allow for adequate preparation.

PHARMACOLOGICAL MANAGEMENT

Narcotic Analgesia

Narcotic analgesics are nonspecific agents for pain management and can be successfully utilized for pain management in labor. Narcotics, in general, cross the placenta and will affect the fetus as well as the mother. Fetal side effects may include sedation and respiratory depression. Narcotic analgesia should be used with caution late in the course of the first stage of labor to minimize these side effects in the newborn. All delivery suites should have ready access to naloxone for use in infants with evidence of narcotic-related side effects at the time of delivery.

A variety of analgesic options are available for use in labor and the specific agents used will vary from one institution to another. Providers should be

familiar with the commonly employed agents at their institution. Among the acceptable agents commonly used in labor are 60 mg of codeine via intramuscular injection and 50–100 mg via intramuscular injection or 25–50 mg intravenously of meperidine.

Local Anesthesia

A variety of local anesthetic options are available and may be utilized during the course of labor. Local anesthesia is also often used postpartum prior to repair of lacerations or episiotomies. Commonly used options include tetracaine, lidocaine, and bupivacaine.

Epidural/Spinal Anesthesia

The most commonly employed pharmacological pain management modality in the United States is epidural or combined epidural–spinal anesthesia. Approximately 60% of all laboring patients receive such anesthesia. Epidural anesthesia involves introduction of pharmacological agents directly into the lumbar epidural space via a specialized needle and catheter system. Combination epidural–spinal anesthesia involves epidural anesthesia along with the use of medication delivered to the subarachnoid space usually as a single dose. This bolus allows for relatively rapid effect. The addition of an epidural catheter allows for continued pain management over the course of labor, which as previously noted, may be protracted. A significant benefit of the combined approach is the ability of the patient to ambulate for a longer time period than with epidural anesthesia alone.

Epidural anesthesia is delivered via catheter placed at the L3-L4 epidural space. The appropriate landmarks are identified and a long epidural needle is introduced to the epidural space. A hollow needle is introduced first, followed by placement of the epidural catheter through the needle. The needle is then withdrawn and the catheter remains in place. Medication can be delivered continuously and/or as individual boluses through the catheter. Medication often includes a combination of analgesic and anesthetic agents.

Combination therapy involves introduction of the epidural needle followed by placement of a spinal needle into the subarachnoid space. A bolus of medication is delivered to the subarachnoid space. The spinal needle is withdrawn, the epidural catheter is placed, the epidural needle is withdrawn and epidural anesthesia may follow as needed via the epidural catheter.

Patients should be closely monitored for changes in blood pressure and all patients should be on fetal heart rate monitors and tocodynamometers. Side effects associated with epidural anesthesia include maternal fever (which is probably not infectious in nature) and a 3% risk of placement in the subarachnoid space. Subarachnoid placement may be associated with post-anesthesia

headache. Recent studies have demonstrated that early placement of epidural anesthesia does not appear to be related to delay in delivery or to an increased rate of cesarean section. Although local backache may be a transient side effect of epidural anesthesia, studies have shown no increase in long-term backache measured at 12 months postpartum.

22 Operative Delivery

CONTENTS

BACKGROUND
FORCEPS DELIVERY
VACUUM-ASSIST DELIVERY
CESAREAN SECTION

KEY POINTS

1. Operative delivery is defined as any procedure undertaken to facilitate delivery of an infant.
2. Operative delivery methods include vacuum-assist delivery, forceps delivery, and cesarean section.
3. Operative delivery should be undertaken for specific indications and those indications should be specifically noted in labor record.

BACKGROUND

Although most deliveries will result in spontaneous vaginal delivery, under some circumstances, additional assistance is required to deliver the infant. Operative delivery is defined as any procedure undertaken to facilitate the delivery of the infant. These procedures may include vacuum-assist delivery, use of forceps, and cesarean delivery.

FORCEPS DELIVERY

The use of forceps has become increasingly uncommon in obstetrics and is now relatively uncommon. The use of forceps, however, remains a critical skill in modern obstetrics and a familiarity with the indications and general use of forceps is important for all providers of obstetrical care. The use of forceps should always be preceded by an assessment of the risks and benefits measured against the possibility of a cesarean section. Because of the skill and experience required to effectively utilize forceps and the potential complications associated with inappropriate use, forceps delivery should only be attempted

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for specific indications, when superior alternatives are not available or have been attempted, and by a provider with experience in both the identified indication and the appropriate use of forceps.

A variety of forceps models exist and providers should be familiar with the available types and the indications for their use. In general, all forceps consist of two pieces with curved blades and locking handles. The curve of the blades is designed to accommodate the fetal head and the maternal pelvis. The blades are not interchangeable and must be positioned correctly to assist with the two principle activities of traction and fetal rotation.

Complications associated with the use of forceps include extension of the episiotomy, laceration, uterine or bladder rupture, transient facial paralysis, and intracranial damage.

The use of forceps is classified in part on the position of the infant in the birth canal. Historically, forceps have been used with fetuses in a variety of positions and in varying degrees of descent in the birth canal. Modern use of forceps is primarily limited to two areas, outlet forceps use and low forceps use.

Outlet forceps is defined as the use of forceps for an infant that is crowning with the skull at the pelvic floor. In addition, the position of the infant head must be identified with the sagittal suture in the anterior–posterior, right–left occiput anterior or right–left occiput posterior positions. Use of outlet forceps should be limited to no more than 45° of fetal rotation.

Low forceps is defined as use of forceps for an infant whose skull has reached at least +2 station but that is not yet at the pelvic floor. Because low forceps use is, by definition, associated with less advanced infant progression through the birth canal, delivery may be associated with either less than or more than 45° of rotation.

Indications for forceps delivery include failure to progress with a prolonged second stage of labor, maternal cardiac or pulmonary disease, or nonreassuring fetal heart tracings. As previously noted, however, each of these indications should be considered in relation to the possibility of cesarean section as an alternative to forceps use.

Use of Forceps

Prior to the use of forceps, providers must first assess the adequacy of labor, maternal pelvic adequacy, fetal position and station, and must identify the specific indication for forceps use. There must be adequate uterine contractions, no evidence of cephalopelvic disproportion, and the fetal head must be at or below +2 station with an appropriate presentation.

The steps involved in the use of forceps to effect forceps delivery are as follow:

1. Identify specific indication.
2. Rule out contraindications to forceps delivery, including assessment of maternal pelvic adequacy (ischial spine prominence, sacral contour, and suprapubic arch size).

3. Assess risks and benefits of cesarean section as an alternative.
4. Determine fetal head presentation.
5. Determine fetal head station.
6. Prepare for cesarean section in case of failed forceps delivery.
7. Place forceps appropriately.
8. Gentle traction and or rotation for delivery.

VACUUM-ASSIST DELIVERY

The use of vacuum-assist is similar to that of forceps. Providers should be aware that the use of vaccum-assist rather than forceps does not alter the necessary steps prior to delivery. Although the mechanics of placement and delivery may appear to be less complex than for forceps delivery, vacuum-assist delivery remains an operative delivery with associated risks and benefits and specific indications and contraindications.

A variety of vacuum-assist devices exist and providers should be familiar with the specific device utilized at their institution. In general, vacuum-assist devices consist of a cup applied to the fetal head, a handle for providing traction, a mechanical or electric device for producing vacuum pressure, and a meter for measuring pressure.

Indications for vacuum-assist delivery are similar to those for outlet forceps delivery. The nature of the vacuum-assist device does not allow for fetal head rotation and attempts to rotate the head may result in characteristic lacerations of the scalp. Contraindications to the use of vacuum-assist devices include cephalopelvic disproportion and abnormal presentation. As with forceps delivery, all vacuum-assist deliveries should be preceded by an assessment of the risks and benefits of cesarean section as an alternative operative option.

The steps involved in the use of vacuum-assist to effect delivery are as follow:

1. Identify specific indication.
2. Rule out contraindications to vacuum-assist delivery, including assessment of maternal pelvic adequacy (ischial spine prominence, sacral contour, and suprapubic arch size).
3. Assess risks and benefits of cesarean section as an alternative.
4. Determine fetal head presentation.
5. Determine fetal head station.
6. Prepare for cesarean section in case of failed forceps delivery.
7. Place vacuum-assist device appropriately.

Delivery with a vacuum-assist device is somewhat different than with forceps. The cup is applied over the sagittal suture approximately 3 cm in front of the posterior fontanelle. Negative pressure (vacuum pressure) is developed and gentle traction is applied with contractions. Traction should not be applied

in the absence of contractions and no attempt should be made to rotate the position of the fetal head. In general, delivery should be expected within a few contractions and in no more than 30 minutes. If the infant has not been delivered, the attempt should be considered failed and cesarean section should be performed.

CESAREAN SECTION

Cesarean section is the operative delivery of the infant through an abdominal and uterine incision. The placenta and membranes are also delivered transabdominally. The indications for cesarean section include all instances when vaginal delivery is either contraindicated or not feasible. For a complete description of cesarean section, providers should consult a text on operative obstetrics.

IV Complications of Labor and Delivery

23 Prolonged Labor

CONTENTS

BACKGROUND
COMPLICATIONS OF LABOR

KEY POINTS

1. Complications of labor include prolonged transition from latent- to active-phase labor, failure of cervical dilation, and failure to descend.
2. Diagnosis of an abnormality of labor requires a firm understanding of the normal progress of labor.
3. Each complication of labor requires individual assessment and management.

BACKGROUND

Most pregnancies will proceed with a minimum of abnormality and delivery will occur without significant complications. All deliveries have the potential for complications; providers should be aware of and prepared for the potential complications associated with delivery of the infant.

COMPLICATIONS OF LABOR

Labor is defined as uterine contractions resulting in progressive cervical dilation, effacement, and eventual delivery of the infant. The normal course of labor is reviewed in Chapter 19. Routine labor management includes sequential assessment of labor progress via manual examination of the cervix and presenting fetal body part. Although labor is predictable and progressive in most patients, under some circumstances the normal progression is disturbed. These may include a delay in the transition from latent- to active-phase labor, failure of cervical dilation to occur, and occurrence of dilation but not fetal.

Prolonged Latent-Phase Labor

Latent-phase or early labor is the period marked by contractions and initial cervical dilation. The contractions are generally frequent and less strong than

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those of active labor and the progress of cervical dilation may be variable. Although average latent-phase labor lasts between 5 and 8 hours, there is considerable variability. Often, the management of latent-phase labor occurs outside the medical facility. Ideally, patients without obstetrical complications or medical risk factors would arrive at the hospital in active labor, having self-managed the latent-phase of labor.

Under some circumstances, however, patients will present for management while in latent-phase labor. When the latent phase of labor has continued significantly beyond the expected duration, management decisions must be made. Most patients with prolonged latent-phase labor will progress to active labor and subsequent vaginal delivery.

History

Management begins with a review of the patient's history. Review of the gestational age, prenatal course, and prior obstetrical history, if any, should be performed. Although most instances of prolonged latent-phase labor are idiopathic, use of sedation and alcohol, and prior episodes of prolonged labor may all be associated with a prolonged latent phase.

Physical Examination

Assessment of cervical status is the key physical finding. Cervical dilation, effacement, and fetal descent should all be noted. Rupture of membranes should also be noted, as management will vary if membranes are ruptured. Documentation at regular intervals will assist in determining the rate of labor progression and the degree to which the current pregnancy deviates from the norm. As feto–pelvic disproportion may contribute to prolonged a latent-phase assessment of fetal size, presentation, and pelvic adequacy should be noted.

Laboratory/Diagnostic Studies

Generally, diagnostic studies are of limited value in the management of prolonged latent-phase labor. Obstetrical ultrasound may assist in assessment of fetal size and examination of pooled vaginal fluids, if any, may contribute to assessment of possible rupture of membranes. Fetal heart tones should be monitored intermittently to assess fetal well-being.

Management

Most patients with prolonged latent-phase labor require no specific intervention. Of patients with latent-phase labor, 10–15% will show little if any cervical change. These patients have not yet started true labor and may be sent home to rest or walk, with precautions concerning when to return. Rest and hydration will result in active labor in the majority of patients (80–85%) who are kept in the hospital. A small percentage (5–10%) will demonstrate active uterine contractions but insufficient cervical dilation. These patients may benefit from the

use of oxytocin to augment labor. Patients with ruptured membranes should be admitted and monitored for signs or symptoms of infection. Details concerning the management of such patients can be found in Chapter 8.

Failure to Dilate/Efface

With the onset of active labor, most patients can be expected to follow a predictable pattern of cervical dilation and effacement. As noted in Chapter 19, expected dilation is approximately 1 cm per hour for primigravid patients and 1.5 cm per hour for multiparous patients. Total duration of active first-stage labor is approximately 10 hours (6–18 hours) for primigravid and 5 hours (2–10) for multiparous patients. Documented failure to dilate at the expected rate despite the presence of organized uterine contractions is a second complication of labor.

The underlying etiology for failed cervical dilation is not well understood. Broadly understood, the problem may be with the fetus (size, presentation), with the birth canal (feto–pelvic disproportion), or with the uterine forces necessary to complete expulsion of the fetus. Evaluation of failure to dilate requires assessment of each of these components.

History

The history may contribute to assessment of risk factors associated with either the fetus or the birth canal. The patient's prenatal course should be reviewed, with a particular emphasis on malpresentation and risk factors for macrosomia such as gestational diabetes. Past obstetrical history should also be reviewed for prior failure to dilate, past history of gestational diabetes, or prior macrosomic infants. Feto–pelvic disproportion is largely a diagnosis of exclusion, however, those patients with bony abnormalities of the birth canal can be expected to have recurrent difficulties.

Physical Examination

Physical examination contributes significantly to the diagnosis and management of delayed cervical dilation. Serial cervical examination to assess dilation, effacement, and station should be performed and the results plotted on a normal labor curve. Identification of abnormal presentation may be apparent on physical examination. Abnormal presentations such as occiput posterior, brow, or face presentation occur in approximately 5% of all deliveries and should generally be apparent on examination. Breech presentation with abnormal presenting fetal body parts may also be determined on pelvic examination. An assessment of fetal size should be performed, as ultrasound assessment of fetal size at term may be inaccurate. Although the reliability of manual assessment of pelvic adequacy has been questioned, a brief evaluation of the birth canal should also be performed as a part of the pelvic examination.

Critical to the assessment and management of prolonged dilation is an assessment of the adequacy of uterine contractions. Although external monitors may be useful for determining the frequency of uterine contractions, determination of the strength of those contractions requires the placement of an intrauterine pressure catheter (IUPC).

Laboratory/Diagnostic Studies

In general, laboratory and diagnostic studies are limited in the management of delayed cervical dilation. An obstetrical ultrasound may assist in the assessment of fetal size or presentation.

Management

Management of delayed cervical dilation requires assessment of which, if any, identifiable factors are contributing to the delay. The management of malpresentation is covered later. The indications for operative delivery are reviewed in Chapter 22.

In the absence of clearly contributory factors such as malpresentation or macrosomia, adequacy of uterine contractions should be assessed. Placement of an IUPC allows for calculation of the adequacy of uterine contractile activity. The most common and the most simple measure of uterine activity is the Montevideo unit, measured as the increase in intrauterine pressure with contractions (maximum pressure-baseline pressure) over a 10-minute period. The Montevideo units for each contraction are calculated and all contractions in a 10-minute period are added together. A total of 200 Montevideo units is considered evidence of adequate uterine contractile activity.

For patients without adequate uterine contractile activity, oxytocin augmentation should be administered until adequate contractions are established. Cervical dilation should be periodically documented thereafter. Failure to dilate may be diagnosed with 2 hours of adequate uterine contractions and no cervical change. If cervical dilation is occurring, management depends on the status of the infant. Slow but steady cervical dilation (with or without oxytocin augmentation) should be allowed to progress unless evidence of fetal stress is noted.

Patients for whom inadequate uterine contractile activity is the only apparent source of incomplete cervical dilation will generally have an excellent outcome, with two-thirds eventually delivering vaginally.

Failure to Descend

Despite full cervical dilation, the fetus may fail to descend through the birth canal. Although inadequate uterine contractile activity contributes to many of these cases, feto–pelvic disproportion makes up roughly half them. Evaluation is similar to that for failure to dilate. Particular attention should be paid to clinical evidence of pelvic adequacy, fetal size, and malpresentation. If clinical

evidence suggests feto–pelvic disproportion, consideration should be given to cesarean section delivery. In the absence of clinical evidence of feto–pelvic disproportion, assessment of uterine activity adequacy and oxytocin augmentation, if necessary, would be indicated.

24 Shoulder Dystocia

CONTENTS

BACKGROUND
DIAGNOSIS
MANAGEMENT

KEY POINTS

1. Clinically, shoulder dystocia may be diagnosed when delivery of the head is followed by an inability to deliver the shoulders.
2. Shoulder dystocia is a serious complication of delivery and must be managed rapidly to minimize maternal and fetal morbidity.

BACKGROUND

Shoulder dystocia is an uncommon but serious complication of delivery. Clinically, shoulder dystocia may be diagnosed when delivery of the head is followed by an inability to deliver the shoulders. Shoulder dystocia generally requires additional maneuvers to free the shoulders and effect delivery of the infant. Although the exact mechanism is not well studied, the postulated mechanism is impaction of the anterior shoulder against the maternal symphysis pubis or impaction of the posterior shoulder on the sacrum. Rarely, dystocia may be the result of or may be made worse by impaction against the soft tissue of the birth canal.

The risk for shoulder dystocia is approximately 1 in 100 for normal-size infants. A variety of risk factors (*see* Table 1) have been associated with an increased risk for dystocia, including prior history of shoulder dystocia, known anatomic abnormalities of the birth canal, gestational diabetes, post-dates pregnancy, macrosomia, and protracted labor. Although most cases cannot be identified on the basis of identifiable risk factors, infant size is clearly related to an increased risk for dystocia. Macrosomic infants (>4000 g) have a 5- to 10-fold increase in risk (absolute risk 5–9%).

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Table 1
Risk Factors for Shoulder Dystocia

Assisted delivery
Protracted labor
Post-dates pregnancy
Macrosomia
Diabetes
Constitutional short stature
Abnormal pelvic anatomy
Prior shoulder dystocia
Prior macrosomic infant

The complications of shoulder dystocia include direct trauma to the mother and/or infant, hemorrhage and, less commonly, possible complications of the delivery itself. Direct trauma to the mother may result in laceration, extension of episiotomy, and postpartum hemorrhage. Approximately 10% of deliveries with shoulder dystocia result in postpartum hemorrhage (for management, *see* Chapter 28). Approximately 3–4% of deliveries will result in fourth-degree lacerations or extensions of an existing episiotomy. Although the connection between birth trauma and subsequent neonatal outcomes is not clear, approximately 10% of all deliveries complicated by shoulder dystocia will result in brachial plexus palsy. Of these, approximately 10% will be persistent. An increased risk for clavicular fracture is also associated with shoulder dystocia.

The management of shoulder dystocia is critical to minimize the medical complications associated with its presentation. Despite appropriate management, shoulder dystocia is associated with an increased risk for clavicular fracture, humeral fracture, fetal hypoxia, and fetal death.

DIAGNOSIS

As noted, shoulder dystocia is a clinical diagnosis made at the time of delivery. No such diagnosis can be made prior to the delivery itself. Prenatal patients should, however, be screened for historic risk factors associated with dystocia, including gestational diabetes, prior macrosomic infant, prior shoulder dystocia, known pelvic anatomic abnormalities, or prior deliveries complicated by feto–pelvic disproportion. Risk factors from the current pregnancy should also be reviewed, including macrosomic infant, gestational diabetes, or risk factors for previously undiagnosed macrosomia, including abnormally large weight gain or abnormally large fundal height.

The diagnosis of shoulder dystocia is made at the time of delivery. Following delivery of the fetal head, the fetal shoulders are delivered via gentle downward

Table 2
Management of Shoulder Dystocia

Get assistance
Flex and abduct hips
Suprapubic pressure (NOT fundal pressure)
Shoulder rotation
• Anterior shoulder forward
• Posterior shoulder backward
• Posterior shoulder forward
Reposition patient on all fours
Emergency maneuvers

traction. With delivery of the anterior shoulder, the posterior shoulder and the remainder of the infant body is delivered via upward movement. When shoulder dystocia occurs, the head is delivered but delivery of the shoulder is impaired and cannot be achieved with reasonable levels of traction. On occasion, the provider may notice that the head is delivered with a contraction but subsequently retracts with the cessation of the contraction (like a turtle retracting its head back into the shell). When normal traction fails to deliver the shoulders, the diagnosis of dystocia should be made and management should be immediately instituted.

MANAGEMENT

Patients at risk for shoulder dystocia should be managed from the onset of labor with the anticipation that shoulder dystocia will occur. All delivery room personnel should be aware of the risk, all necessary equipment should be available in the room, and delivery should be performed with sufficient support staff available to immediately begin management if necessary. In addition, some experts recommend immediate delivery of the anterior shoulder with the head for patients who are at high risk for shoulder dystocia. This maneuver, although widely recommended, has not been well studied in clinical trials.

With the diagnosis of shoulder dystocia, management should begin immediately, as outlined in Table 2. Each intervention is completed in a stepwise manner until the infant is delivered:

1. If sufficient assistance is not available in the room, help should be summoned immediately and staff should be made aware of the situation.
2. Following failure of gentle traction to deliver the shoulders, the patient should be positioned with hips flexed and abducted (McRoberts Maneuver) and suprapubic pressure should be applied while the patient pushes. It should be noted that fundal pressure is contraindicated; pressure should be downward and administered just above the symphysis pubis.

3. If delivery is not achieved with these maneuvers, an episiotomy should be performed to decrease soft-tissue dystocia and facilitate delivery.
4. If delivery is still not achieved, internal rotation of the infant's shoulders should be attempted. The anterior shoulder is rotated forward (pressure is applied from behind the anterior shoulder directed forward from the infant's perspective). This is followed by rotating the posterior shoulder backward (pressure on the anterior surface the shoulder directed backward from the infant's perspective). This is performed while maintaining the forward pressure on the anterior shoulder.
5. If delivery has not been achieved, then forward rotation of the posterior shoulder is attempted followed by delivery of the posterior arm/shoulder. The posterior arm is swept forward across the infant's chest, elbow flexed.
6. Repositioning the patient on all fours may sufficiently alter the position and forces to allow for delivery of the infant.
7. If all of the above have failed to deliver the infant, immediate emergency maneuvers will be required to effect delivery. These may include clavicular fracture and/or replacing the head in the birth canal followed by cesarean section (Zavanelli maneuver).

25 Malpresentation

CONTENTS

BACKGROUND
OCCIPUT POSITIONS
NONOCCIPITAL PRESENTATIONS
BREECH PRESENTATION
COMPOUND PRESENTATION

KEY POINTS

1. Normal delivery is marked by a characteristic fetal presentation and a stereotyped series of fetal repositions.
2. Failure to present in the usual occiput anterior position may lead to prolongation and complications of labor and may be incompatible with vaginal delivery.
3. Careful assessment of fetal presentation is critical to the diagnosis and management of abnormal presentations.

BACKGROUND

Although fetal position during the prenatal period is variable and subject to change (especially prior to 36 weeks gestation), most infants will arrive head first, neck flexed with the occiput (either right or left occiput) in an anterior position. Variations from this position and presentation do occur, however, and providers should be aware of possible variants. Assessment of fetal presentation should be a routine component of late prenatal care and with all patients at the time of labor. Complications with the progress of labor, as noted earlier, should prompt re-evaluation of fetal presentation and position.

OCCIPUT POSITIONS

Occipital position is described in relation to the anterior surface of the mother. In the usual dorsal lithotomy position, this will place the anterior surface upward. In the normal presentation, the fetus will present vertex first with

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the occipital portion of the skull in an anterior location (occiput anterior; occiput toward the symphysis pubis, upward in the usual dorsal lithotomy position). The occiput may, however, be either posterior (occiput away from the symphysis or downward in the dorsal lithotomy position) or transverse (occiput horizontal or to the side in the dorsal lithotomy position). With the onset of labor, most infants will already be in the occiput anterior position. Approximately 20%, however, will be positioned in an alternative position at the beginning of labor. For most of these infants, occiput posterior or occiput transverse is only a temporary postion that will revert to occiput anterior during the course of delivery. Fewer than 5% of infants will present with occiput posterior or occiput transverse at the time of delivery.

Diagnosis

Diagnosis of fetal position is made via manual examination at the time of delivery. Examination should reveal anterior and posterior fontanelles as well as the normal fetal suture lines. These three landmarks should be sufficient to determine the orientation of the fetal head.

Management

Occiput posterior and occiput transverse positions are both compatible with vaginal delivery although their presence is associated with a higher rate of assisted or surgical deliveries. If fetal size is within normal limits and there is no evidence of pelvic abnormalities, rotation of the fetal head may be considered. The use of forceps should be limited to patients without the above abnormalities and should only be performed by a provider with considerable experience with the use of forceps. In the absence of such an experienced provider, in the presence of macrosomia, feto–pelvic disproportion, or with prolonged failure of dilation or descent, cesarean delivery may be indicated.

NONOCCIPITAL PRESENTATIONS

Although occipital (or vertex) presentation is the most common presentation other presentations are possible. Brow presentations (partially deflexed neck) are uncommon and are generally self-limited. Approximately 50% of such presentations will revert to vertex presentation with the continuation of labor. Brow presentation at the time of delivery occurs less than 1 in 1000 births. Diagnosis is made by manual examination and management consists of continued management with an expectation of vaginal delivery. If the patient has been on oxytocin, this should be discontinued to minimize the possibility of dystocia. Failure of brow presentation to revert to vertex presentation is associated with a high likelihood of dystocia and is an indication for cesarean delivery. Face presentations represent fully deflexed neck position with the face

descending the birth canal in the lead position. Face presentation is more common than a brow presentation but is still uncommon, only occurring approximately 2 per 1000 deliveries. The retroflexion of the fetal neck combined with the presentation of the chin as the presenting body part significantly increases the likelihood of cephalopelvic disproportion and is not generally compatible with vaginal delivery. If the chin is in a posterior position (mentum posterior), cesarean delivery is indicated. If the chin is in an anterior position, vaginal delivery may be attempted, but such an attempt carries a higher than expected risk of failure and subsequent cesarean delivery.

BREECH PRESENTATION

Although most infants will descend the birth canal in a head-first position, a small number will present with an alternative presenting part. Such abnormal positions can be determined during prenatal care and as such should be noted at all visits in the last 2 months of the prenatal course. Breech presentation at term but prior to labor may be amenable to manipulation/rotation (external cephalic version) to position the infant's head in a downward position. External version should be done at approximately 37 weeks gestation to minimize the likelihood of reversion and should be done in a setting that allows for management of labor, including tocolysis. External version is an indication for the use of rhogam in Rh-negative patients. Between one- and two-thirds of such procedures are successful (defined as vertex presentation at the onset of labor).

Breech presentations may be classified by the presenting body part and the position of the fetal body. Frank breech implies buttock presentation with flexion at the hips and extension of the knees (in essence, folded in half at the hips with the buttock in the birth canal and the head at the uterine fundus). Complete breech is buttocks presentation with both hips and knees flexed (the typical "fetal position" with buttock presentation and the head near the uterine fundus). An incomplete breech—sometimes referred to as a footling breech—implies presentation of one or more of the lower extremities. In the United States, delivery of breech presentation is generally via cesarean section, although optimal management remains controversial. If vaginal delivery is to be attempted, all of the following should be true: at or near term in labor with no evidence of fetal stress, frank breech presentation with full neck flexion, normal fetal size (2500–3800 g), no known congenital abnormalities, and no known pelvic abnormalities. Only providers with experience in the use of piper forceps and with cesarean back-up ready at the time of delivery should perform such an attempt.

COMPOUND PRESENTATION

Compound presentation is the presentation of an arm or leg along with the presenting part. It is most commonly associated with either small infants or

large birth canals. The most common variant is presentation of a hand along with the head. Diagnosis is made on manual examination at the time of labor and management generally consists of expectant vaginal delivery. Care should be exercised to determine that the umbilical cord has not prolapsed along with the compound body part. In addition, providers should be prepared to proceed to cesarean section in the case of fetal compromise, failure of dilation or descent, or dystocia. Repositioning of the presenting body part is generally not recommended.

26 Fetal Heart Rate Monitoring

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BACKGROUND
NORMAL FETAL HEART TRACINGS
EVALUATION OF FETAL HEART RATE BASELINE
EVALUATION OF FETAL HEART RATE VARIABILITY

KEY POINTS

1. The common use of continuous fetal heart rate monitoring requires that providers be aware of the interpretation of variations in fetal heart tracings.
2. Normal fetal heart rate is 120 to 160 beats per minute (bpm) with evidence of short- and long-term variability.
3. Fetal heart rate acceleration must be distinguished from fetal tachycardia and is generally considered a favorable finding.
4. Abnormalities of fetal heart tracings may be related to either rate or deceleration.

BACKGROUND

The advent of electronic fetal heart rate monitoring has dramatically changed intrapartum management within the United States. The almost universal presence of such monitoring during the course of most deliveries presents providers with a variety of challenges. Controversy exists concerning the clinical benefit of continuous electronic fetal monitoring. Such controversy, however, does not eliminate the need for obstetrical providers to be familiar with the basics of electronic fetal monitoring, normal and abnormal findings, and appropriate management for abnormal tracings.

NORMAL FETAL HEART TRACINGS

Routine fetal heart tracing should be evaluated for baseline heart rate as well as variation from that baseline rate. Normal baseline fetal heart rate during pregnancy is between 120 and 160 bpm. The baseline heart rate may be determined by examining a fetal heart tracing of sufficient length to determine the heart rate

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Table 1
Nonreassuring Fetal Heart Rate Patterns

Fetal tachycardia (persistently >160 bpm)
Fetal bradycardia (persistently <120 bpm)
Variable deceleration (decelerations with onset mid-contraction)
Late deceleration with or without short-term variability (decelerations with onset after peak of contraction)
Prolonged severe bradycardia (persistently or recurrently <100 bpm)
Sinusoidal pattern (smooth, rounded, wave-like pattern)

bpm, beats per minute.

to which the tracing consistently returns. It may be helpful to use a ruler or other straight edge along the course of a fetal heart rate tracing to help determine the baseline value. Fetal heart rate tracing should demonstrate a degree of variability over the course of time. A fetal heart rate tracing with little evidence of variability requires careful monitoring and evaluation if persistent.

Once the baseline fetal heart rate has been determined, variation from this baseline should also be noted. Is should be apparent that this variation from baseline may be in either direction. Variation upward (toward higher fetal heart rate) is referred to as *acceleration*, whereas variation downward (toward lower fetal heart rates) is referred to as *deceleration*. In addition to the absolute direction of movement, note should be made of patterns of fetal heart rate activity that may be indicative of careful follow-up or intervention. Nonreassuring fetal heart rate patterns are outlined in Table 1.

EVALUATION OF FETAL HEART RATE BASELINE

The baseline fetal heart rate may, under some circumstances, vary from the normal range of 120–160 bpm. When the baseline is determined to vary from this normal range, a careful review of potential causes should be performed.

Tachycardia

Tachycardia is defined as a baseline at or above 160 bpm. Mild tachycardia is defined as 160–180 bpm. Severe tachycardia is defined as more than 180 bpm. Fetal tachycardia may be associated with fetal hypoxia; maternal fever, drug, or medication use; infection; fetal cardiac abnormalities; anemia; and hyperthyroidism. Persistent tachycardia should prompt review of potential causes and intervention if indicated.

Bradycardia

Fetal bradycardia is defined as a baseline at or below 120 bpm. A variety of conditions may produce bradycardia in the range of 100–120 bpm. If variability

is good and no other abnormalities are noted, careful monitoring may be sufficient. Prolonged or severe fetal bradycardia may be associated with cord compression or prolapse, anesthesia, uterine tetany, or rapid descent of the fetus through the birth canal.

EVALUATION OF FETAL HEART RATE VARIABILITY

Once the baseline fetal heart rate has been determined, variation from this baseline should also be noted. This variation from baseline may be in either direction. Variation upward (toward higher fetal heart rate) is referred to as *acceleration*, whereas variation downward (toward lower fetal heart rates) is referred to as *deceleration*. In addition to the absolute direction of movement, note should be made of patterns of fetal heart rate activity that may be indicative of careful follow-up or intervention.

Acceleration

In contrast to a persistent rise in baseline fetal heart rate (tachycardia), fetal heart rate acceleration is generally a favorable finding and may be associated with fetal stimulation (e.g., with contractions or cervical examinations). Fetal heart rate acceleration following variable deceleration (*see* below) is a common finding and is generally considered a good prognostic indicator.

Early Deceleration

Early decelerations are defined by a slow onset that coincides with the onset of contractions. The decelerations are thought to correspond to fetal head compression and are considered reassuring. The slow onset is matched by a similarly slow recovery producing a symmetric shape that corresponds with the duration of the contraction.

Variable Deceleration

As implied by its name, the onset, shape, and recovery of variable decelerations is less uniform than for either early or late decelerations. Interpretation of variable deceleration is likewise dependent on the associated clinical factors and the specific findings noted on the tracing. In general, variable decelerations have a relatively rapid onset and recovery with a shape that resembles a "V." As noted earlier, variable decelerations are often associated with accelerations immediately preceding onset and immediately following recovery, yielding a pattern that resembles shoulders. Variable decelerations are thought to be associated with umbilical cord compression and their interpretation is therefore dependent of the potential causes of such compression. Mild decelerations are of less than 30 seconds in duration and are no lower than 80 bpm at their nadir. Moderate decelerations last between 30 and 60 seconds and reach 70–80 bpm

at the nadir. Severe variable contractions last longer than 1 minute and/or reach less than 70 bpm at the nadir. Several findings on the tracing are considered nonreassuring in the assessment of variable decelerations. These include increasing frequency or severity, delayed recovery, decreased variability, and loss of associated accelerations ("shoulders").

Late Decelerations

Late decelerations are characterized by an onset at or after the peak of the associated uterine contraction. Distinguishing late decelerations from persistent variable decelerations may be difficult under some circumstances. Late decelerations are thought to be related to utero–placental insufficiency and are often indicative of fetal hypoxia. Conditions associated with an increased risk for late decelerations include diabetes, hypertension/pre-eclampsia, and post-dates pregnancy.

27 Maternal Fever in Labor

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BACKGROUND
DIAGNOSIS
MANAGEMENT

KEY POINTS

1. Labor may be complicated by maternal infection with associated maternal and neonatal risk.
2. Management of maternal fever requires a knowledge of the common sources of infection and appropriate antibiotic coverage for those organisms.
3. Management of maternal infection requires an awareness of the risks and benefits of antibiotic use in pregnancy.

BACKGROUND

Maternal fever during the course of labor is surprisingly uncommon given the number of potential pathogens in the genitourinary (GU) and gastrointestinal (GI) tracts and the nonsterile conditions of labor and delivery. Despite the relative rarity of maternal fever, providers should monitor maternal temperature regularly and be prepared to intervene appropriately if maternal fever develops.

DIAGNOSIS

History

The prenatal history should be reviewed for prior infection as well as risk factors for intrapartum infection. In particular, the results from any recent testing for gonorrhea, chlamydia, group B streptococcus, urinary tract infection, and bacterial vaginosis should be noted. Although herpes and syphilis infections are not usually associated with fever, both should be noted if present. Prior antibiotic use should be documented.

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The nature and timing of rupture of membranes should also be noted. In addition, manipulation should be reviewed including artificial rupture of membranes, frequent manual cervical checks, or placement of fetal scalp electrodes, intrauterine pressure catheters, or bladder catheter placement.

Physical Examination

Physical examination should include documentation of maternal temperature, blood pressure, and pulse. Maternal fever may be associated with fetal tachycardia, therefore, fetal heart rate should also be documented. Examination of the lungs for abnormal lung sounds should be performed. Abdominal examination may reveal abdominal tenderness. Although vaginal discharge may be difficult to determine during labor, sterile pelvic examination may also be indicated.

Diagnostic Studies

Although not all maternal fevers are infectious, all such fevers should be assumed to be of infectious etiology until proven otherwise. Blood and urine cultures should be sent. If not previously performed, gonorrhea, chlamydia, and group B streptococcus testing should performed. A complete blood count should be reviewed. Although the maternal white blood cell count may be elevated in pregnancy, an elevated white blood cell count in the setting of maternal fever may be indicative of infection.

MANAGEMENT

As noted, fever should be assumed to be infectious until proven otherwise. Administration of appropriate antibiotic therapy may be of benefit to both mother and the fetus. If a specific etiology is known, antibiotic choice should be dictated by the sensitivity of that infectious agent. If no specific etiology is noted, broad-spectrum antibiotic coverage sufficient to cover routine GU and GI flora should be initiated.

28 Postpartum Hemorrhage

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BACKGROUND
COMPLICATIONS CAUSING HEMORRHAGE
DIAGNOSIS
MANAGEMENT

KEY POINTS

1. Postpartum hemorrhage may result from lacerations, retained placenta, uterine inversion, or coagulapathy.
2. Management of postpartum hemorrhage begins prior to delivery with assessment of precedent risk factors including macrosoma, polyhydramnios, precipitous labor, grand multiparity, anesthesia, augmentation, and cesarian delivery.
3. Postpartum hemorrhage is a critical postpartum complication that requires rapid identification and management.
4. Management of postpartum hemorrhage should proceed in a stepwise manner until hemorrhage is controlled.

BACKGROUND

Postpartum hemorrhage complicates 5–10% of all deliveries. It is the second leading cause of maternal mortality, causing approximately one-sixth of all such deaths. All deliveries are associated with blood loss. Postpartum hemorrhage is defined as blood loss in excess of 500 cc. Actual blood loss during the course of routine delivery may exceed 500 cc if carefully measured. Although the definition of postpartum hemorrhage remains unchanged, from a practical standpoint, postpartum hemorrhage is often understood as hemorrhage that persists beyond expectation. Early postpartum hemorrhage is defined as blood loss occurring in the first 24 hours postpartum. Late postpartum hemorrhage is defined as blood loss occurring between 24 hours and 6 weeks postpartum.

Postpartum hemorrhage may be caused by a variety of obstetrical complications including uterine atony, lacerations, retained placenta, and obstetrically

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related coagulapathy. Most cases of postpartum hemorrhage are caused by obstetrical complications, however, providers should also be aware that preexisting coagulapathies may also manifest as postpartum hemorrhage.

COMPLICATIONS CAUSING HEMORRHAGE

Uterine Atony

Following routine delivery, myometrial contraction results in vascular constriction and control of bleeding. A variety of conditions may result in diminished myometrial contraction and subsequent uterine atony. Factors associated with an increased risk of uterine atony include (a) anatomic conditions such as leiomyosis; (b) uterine distention from such conditions as multigestation, polyhydramnios, or macrosomia; (c) labor-related factors such as prolonged or precipitous delivery; (d) management factors such as anesthesia, augmentation/induction, or cesarien delivery; (e) maternal factors such as multiparity; and (f) postpartum complications such as infection. Uterine atony is responsible for 50% of postpartum hemorrhage cases.

Lacerations

Delivery often results in trauma to the birth canal and may result in lacerations to the uterus, cervix, vagina, or perineum. Significant lacerations are associated with both precipitous and operative delivery. Although bleeding from such lacerations is generally self-limited or controlled with routine repair, lacerations are responsible for up to 20% of postpartum hemorrhage cases.

Retained Placenta

Retained placenta represents the third significant cause of postpartum hemorrhage. Approximately 10% of cases are related to this cause.

Coagulapathy

Although relatively uncommon, a number of obstetrical complications may lead to coagulapathy, which may in turn lead to persistent postpartum bleeding. Factors associated with coagulpathy include fetal demise, amniotic fluid embolus, pre-eclampsia/eclampsia, sepsis, and abruptio placenta.

Uterine Inversion

Under some circumstances, the uterine fundus may invert, preventing myometrial contraction and vascular constriction.

DIAGNOSIS

Diagnosis is generally straightforward and consists of persistent bleeding that exceeds expected levels following delivery. Although the exact blood loss

may be difficult to quantify, any suspicion of excess blood loss should lead to an immediate investigation of potential causes. In addition, providers should have a low index of suspicion for initiating general management steps, as postpartum hemorrhage may be both rapid and severe.

MANAGEMENT

Management of postpartum hemorrhage begins prior to delivery. Patients with predisposing risk factors should be identified and complications should be anticipated. For patients with significant predisposing risk factors, intravenous access and cross-matched blood products should be arranged prior to delivery. The risk of postpartum hemorrhage may also be reduced with appropriate management of delivery. The delivery should be controlled, operative deliveries should be minimized, and delivery of the placenta should be performed with gentle traction applied to the umbilical cord. Recent studies have suggested that the early administration of oxytocin (with the delivery of the anterior shoulder) may also reduce the risk of persistent bleeding.

Despite appropriate predelivery and postpartum management, postpartum hemorrhage may occur. Because postpartum hemorrhage may represent a life-threatening complication, initial steps should be taken to ensure hemodynamic stability. Blood should be typed and cross-matched. Intravenous access should be established preferably with two large bore access sites. Patient blood pressure should be closely monitored. Significant drops in blood pressure should lead to initiation of fluid support with either intravenous fluid or blood products. In addition, appropriate labs should be sent including a complete blood count and a coagulation panel.

While performing the measures mentioned above, a review of risk factors should be performed and common causes explored. Uterine tone should be assessed. A comprehensive inspection of the perineum, vagina, and cervix should be performed. Under some circumstances, exploration of the uterine cavity (either manually or via ultrasound) may also be indicated.

Laceration

Significant lacerations will require repair. Laceration and episiotomy repair are discussed below. The presence of laceration does not preclude the possibility of either uterine atony or coagulapathy. Repair of lacerations does not necessarily ensure the cessation of bleeding and such bleeding must be managed as noted here if it persists.

Persistent Bleeding

Management of persistent bleeding will generally follow a stepwise approach:

1. Uterine massage: bimanual massage with one hand on the abdomen and one hand in the vagina.
2. Oxytocin: may be started with the delivery of the anterior shoulder. Oxytocin may be administered as either 10 U intramuscularly or 10–20 U in 1 L of normal saline delivered intravenously.
3. Methylergonovine: efficacy is similar to oxytocin but is associated with more significant side effects, including a significant rise in blood pressure. The usual dose is 0.2 mg intramuscular.
4. Prostaglandins: prostaglandin F-2-α or 15-methylprostaglandin serve to enhance uterine contractility.

If bleeding persists despite the measures just given, immediate evaluation for possible surgical or embolization intervention is indicated.

29 Perineal Laceration and Episiotomy

CONTENTS

EPISIOTOMY
PERINEAL LACERATION

KEY POINTS

1. Laceration and episiotomy are common complications of the delivery process.
2. Lacerations and extension of episiotomies may be minimized with careful management of delivery.
3. Laceration and episiotomy repair is an essential skill for all providers who deliver babies.

EPISIOTOMY

Background

Episiotomy is a planned incision of the perineum designed to facilitate delivery of the infant. Although routine episiotomy is not generally considered indicated, a variety of conditions may require episiotomy. Such conditions include shoulder dystocia, assisted delivery, or an anticipated macrosomic infant. Studies concerning the use of episiotomies to reduce the likelihood of laceration extension to third or fourth degree have shown conflicting results. The role of episiotomies under the conditions just described, however, have generally been recognized to assist with delivery of the infant.

Procedure

Following appropriate anesthesia (epidural anesthesia if present, or local anesthesia if not), preparation is made for surgical incision of the perineum. With early crowning, a sharp incision is made through the perineal tissue. Median episiotomies are directed posterior toward the rectum with caution to avoid the anal sphincter and rectum. Medio-lateral episiotomies are directed posteriorly approximately 45° left or right of midline.

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Table 1
Grading of Vaginal/Perineal Lacerations

Degree	*Description*	*Repair*
First degree	Superficial laceration involving skin (vaginal or perineal). These may also be superficial periurethral laceration	Generally no repair is necessary unless persistent bleeding from the site is noted
Second degree	Deeper laceration involving perineal tissue up to but not including the capsule of the anal sphincter	Approximation of laceration tissue with suture repair of laceration
Third degree	Laceration involving the anal sphincter but sparing the rectal mucosa	Approximation and suturing of lacerated ends of the anal sphincter followed by repair of the more superficial tissue as with second-degree laceration
Fourth degree	Laceration involving the rectal mucosa	Repair of the rectal mucosa followed by repair of the sphincter and more superficial tissue as noted above

PERINEAL LACERATION

Background

Either with or without a planned episiotomy, delivery of an infant may result in laceration of the vagina, perineum, or rectum. Lacerations may involve the vagina, perineum, cervix, or uterus, as well as the vestibular tissue. Careful inspection of each of these areas should occur when postpartum hemorrhage persists beyond the expected interval. Perineal lacerations are graded (first to fourth degree) based on the degree of tissue involvement and the repair varies by laceration type. Generally, an episiotomy is equivalent to a second-degree laceration, but clinical conditions may require a more extensive episiotomy or secondary extension of the episiotomy may increase the degree of involvement. Repair of lacerations and episiotomies are generally similar and are summarized in Table 1.

Diagnosis

History

Any delivery may result in laceration, however, some deliveries may increase the risk of laceration. Rapid deliveries, especially those for which control of the exiting head or shoulders could not be maintained, increase the risk. Assisted deliveries (with either forceps or vacuum-assist devices) are often

associated with laceration, are often accompanied by a planned episiotomy, and may also result in a lacerated extension of the episiotomy. Larger infants may increase the risk of laceration. Deliveries complicated by shoulder dystocia are at increased risk for episiotomy and/or laceration. Prior cesarean section increases the risk of uterine rupture/laceration.

Physical Examination

All deliveries should be followed by thorough inspection of the outlet tract to identify any possible lacerations. Such lacerations may be present in the vagina, the perineum surrounding vestibular tissue, the cervix, or the uterus itself. Careful inspection with appropriate visualization (including retraction when necessary and appropriate lighting) will allow for determination of the presence and degree of lacerations, if any. All identified lacerations should be fully inspected to determine the full extent of tissue damage. This includes both the depth of involvement and the length of the laceration.

Management

Management of a laceration depends on the location and degree of tissue involvement. General principles of management are included in Table 1.

First-Degree Lacerations. First-degree lacerations will rarely require repair. Careful inspection should be performed to determine that persistent bleeding does not occur at the site, however.

Second-Degree Lacerations. Second-degree lacerations will often require repair. Once the extent of the laceration is determined, the area is infiltrated with local anesthesia such as 1% plain lidocaine. Anatomic approximation of the lacerated tissue is critical, although exact approximation may be difficult owing to uneven, irregular, or damaged tissue margins. Repair is usually performed with medium-weight absorbable suture. Repair begins above the apex of the laceration and proceeds toward the vaginal opening to the hymeneal ring. Deep tissue of the perineum between the hymeneal ring and the rectum is then approximated, followed by repair of the superficial tissue and skin.

Third-Degree Lacerations. These lacerations will require repair in almost all cases. The first step involves identification of the lacerated ends of the anal sphincter. Once the ends are secured, repair of the anal sphincter and capsule is performed. The remainder of the repair is similar to that of a second-degree laceration

Fourth-Degree Lacerations. Fourth-degree lacerations are the most significant of the perineal lacerations, with the highest likelihood of both short- and long-term complications. For this reason, repair of fourth-degree lacerations should only be performed by providers with considerable experience and expertise. Consultation with an experienced provider is recommended if personal experience is limited. Repair begins with repair of the rectal laceration, proceeds to repair of the anal sphincter, and is completed with the repair described for second-degree lacerations.

V Postpartum Management

30 Newborn Evaluation

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BACKGROUND
THE EXAMINATION

KEY POINTS

1. The newborn examination forms the basis for all subsequent management. It is therefore comprehensive in nature.
2. The newborn evaluation includes a review of prenatal and peripartum history, as well as newborn nursery course and physical examination.

BACKGROUND

The initial newborn examination occurs immediately postpartum and will be repeated each day of the newborn's hospital stay. This examination forms the basis for all subsequent management by providing an assessment of development and congenital abnormalities, if any. This examination is therefore comprehensive in nature.

THE EXAMINATION

History

The newborn history consists primarily of a review of the prenatal and delivery course, including complications, if any. Particular attention should be made of the family history of congenital abnormalities, maternal medical conditions, and prenatal exposures including infection, medications, tobacco, alcohol, and illicit drugs.

Physical Examination

As noted, the newborn physical examination will serves as the baseline comparator for all subsequent examinations. It should, therefore, be comprehensive, detailed, and guided by an understanding of the most common areas of abnormality.

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Vital Signs

Vital signs include temperature, pulse, respiratory rate, length, weight, and head circumference. Temperature can be checked in a variety of locations and the specific location should be noted along with the reading. Pulse and respiratory rate are both measured most accurately with the infant resting quietly, preferably in a parent's arms or lap. Length is often most easily measured by marking the disposable paper on the exam table. A mark can be made at the crown of the head. The infant's legs can be fully extended and a mark made at his or her heel. The infant is then removed and the distance between the two marks is recorded. The additional weight of clothing and diapers can be significant for infants, so weight should be measured with the infant fully disrobed. Head circumference is measured as the circumference from brow (above the eyebrows) to temple (above the ears) and around the occiput (roughly equivalent to the position of a hat band).

General Observation

General observations should include whether the child appears healthy, comfortable, and normal.

Head and Neck

The face should be observed for rashes. The ear canals should be checked for patency and the ears for position. Also, the preauricular pits should be noted when present. One should check the mouth and soft palate for defects and make note of the mucosal lining for both moisture and oral thrush, if present. Both anterior and posterior fontanelles should be open. The neck should be palpated for adenopathy. When the child is gently raised from the table, the head lag should be noted.

Eyes

All infants should be checked for red reflex and for normal eye movement in all directions. Reaction of pupils to light should be noted.

Cardiovascular

Although it is often difficult for students to distinguish heart sounds in a rapid infant cardiac cycle, note should be made of S1 and S2 in all infants and murmurs, if present. Congenital heart defects may not be apparent at birth and may be picked up for the first time in the physician's office. Palpate peripheral pulses with particular note made of femoral pulses (both quality and symmetry).

Pulmonary/Thoracic

Normal breath sounds and, if present, adventitial (rales, rhonchi, wheezes) sounds should be noted. Note should be made of the chest wall contour, especially at the sternum; the clavicle should be palpated for uneven contour, which

may indicate a fracture. The provider should examine the breasts and palpate for breast tissue.

Abdomen

Particular note should be made of the umbilical stump if present. This generally detaches by 2–4 weeks of age. The umbilical region should also be examined for umbilical hernia, noted as either a palpable defect below the umbilicus or as a visible bulging of the area below the umbilical stump.

Genital Examination

Males should be examined for the presence of both testicles. When applicable, the site of circumcision should be inspected. In uncircumcised males, the foreskin should be retracted to examine the glans. In females, patency of the vagina should be noted. The inguinal region should be examined for the presence of congenital hernias.

Anus

The anus should be checked for patency and note should be made of rashes that might represent either diaper contact dermatitis or candidiasis.

Spine

The entire course of the spine should be examined for evidence of spina bifida. Particular attention should be paid to the upper- and lower-most portions of the spine.

Skin

Note should be made of the tone of the skin, as well as the presence of any congenital birthmarks. Particular note should be made of face, scalp, posterior neck, and the sacral spine.

Extremities

All extremities should be examined for symmetry and shape. Note should be made of muscle tone and symmetry of movement and normal posture. Hips should be examined for evidence of hip dysplasia via the Barlow and Ortolani tests. The Barlow test is performed with the hips flexed to 90° and adducted. Downward pressure is applied to the knees. In infants with unstable hips, an audible and/or palpable click is noted. The Ortolani test is performed with the hips flexed to 90°. The hips are then gently aducted and then abducted. Again, note is made of an audible and/or palpable click.

Laboratory and Diagnostic Studies

All states mandate routine neonatal screening for a variety of abnormalities, including phenylalanine and thyroid-related disease and hemoglobinopathies.

When appropriate, newborns will also be screened for syphilis and hyperbilirubinemia. Additional laboratory studies may be indicated based on the prenatal and maternal history. Most newborns will also undergo a newborn hearing screen.

Vaccination

Most children will have received the first hepatitis B vaccine prior to discharge from the newborn nursery. Providers should confirm that this occurred.

31 Routine Hospital Postpartum Management

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BACKGROUND
POSTPARTUM DAY 1
POSTPARTUM DAY 2

KEY POINTS

1. Postpartum management serves to identify early complications, if any, of the postpartum period.
2. Postpartum management includes educational as well as medical components.
3. Preconception management may begin in the immediate postpartum period.

BACKGROUND

Immediate postpartum management falls largely within the domain of labor management and was discussed in detail in Chapter 19. The postpartum management of patients serves to identify early complications of the postpartum period as well as providing the basis for ongoing management of both the mother and new infant.

POSTPARTUM DAY 1

History

Evaluation on postpartum day 1 should begin with a brief review of the prenatal and labor and delivery course. Particular attention should be paid to those issues that may impact immediate postpartum care. Maternal laboratory values from the prenatal period should be reviewed. Particular note should be made of Rh status, maternal infection (urinary tract infections, sexually transmitted disease, and rubella and varicella immune status). Medical complications of pregnancy, such as hypertension, diabetes, and infection, should be noted.

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Complications of delivery including prolonged labor and delivery method, and immediate postpartum complications such as hemorrhage, uterine atony, or maternal fever should be reviewed. The management of these conditions and current status of each should be noted.

A variety of medical conditions such as an abnormal pap smear may be uncovered in the prenatal course of management. These conditions will usually be deferred until after pregnancy. When present, these medical conditions should be noted. In addition, the management of a variety of medical conditions may have been modified during the course of pregnancy. Examples of this might include a change in hypertension medication or the discontinuation of antiseizure medications. When such changes have been made, the postpartum history should include pre-pregnancy treatment management as well as the management regimen implemented during pregnancy.

The history of postpartum day 1 focuses on a few key elements. Bowel and bladder function should be reviewed. When present, pain location and severity should be noted. Patient activity, including ambulation, should be noted. Patients should be asked about bleeding, discharge per vagina, and subjective fever.

Physical Examination

The postpartum examination is comprehensive but focuses primarily on a few key elements. Vital signs should be reviewed for maternal tachycardia and blood pressure. In patients for whom fluid status is being monitored (e.g., those with pre-eclampsia, or those who are postoperative), weight should be recorded daily. Cardiovascular examination should include note of cardiac murmurs. Pulmonary examination should note the presence of rales, rhonchi, or wheezing.

The most important elements of the physical examination are the abdomen and the perineum. On abdominal examination, note should be made of the size and consistency of the uterus as well as any tenderness if present. In general, the uterus should feel firm and the fundal height should be at or below the umbilicus. For patients who underwent operative delivery, note should be made of the surgical wound status. In the perineum, the external genitalia should be examined for swelling and tenderness. For patients who had an episiotomy or laceration, the site of the repair should be noted.

On postpartum day 1, all patients will have both bleeding and discharge per vagina. Note should be made of the quantity and quality of the bleeding. Although the distinction between normal and abnormal bleeding postpartum is sometimes difficult to make, normal postpartum bleeding should, in general, be no more than heavy menstrual bleeding. Clots may be noted in the early postpartum course, but should resolve relatively quickly. In addition to bleeding, all postpartum patients will have a normal discharge per vagina referred to as lochia. Lochia represents a mixture of decidual tissue and blood in varying contents that changes in a predictable manner over time. In the first 3 to 4 days

postpartum, this lochia includes considerable red blood cells and therefore appears red (lochia rubra). On postpartum day 3 or 4, as bleeding diminishes, the lochia becomes more pale or straw-colored. This is referred to as lochia serosa. As the quantity of discharge diminishes and the presence of leukocytes increases, the lochia becomes clear (lochia alba). Lochia alba is variable in quantity and may last up to 8 weeks postpartum.

Laboratory Studies

As noted, all prenatal laboratory values should be reviewed. In the postpartum period, key laboratory values include hemoglobin or hematocrit (to assess for anemia) and rapid plasma reagin test (if not performed near term). In patients with fever or other signs of possible infection, a complete blood count with differential may assist in evaluation. White blood cell count must be interpreted with caution as it is often elevated in the postpartum period even in the absence of infection. In addition urine, blood, and wound cultures should be obtained when appropriate.

Management

In addition to those items just noted, management will consist of assessment of and education concerning newborn care. Newborns can be expected to perform five basic functions: sleeping, eating, crying, urinating, and defecating. In addition to noting the presence or absence of each, providers should educate new parents about normal expectations for each, signs or symptoms of concern in each area, and appropriate follow-up for such warning signs. Although it is beyond the scope of this chapter to discuss each of these in detail, a few basic facts should be noted. All infants can be expected to urinate within the first few hours of life and note should be made of the number of wet diapers. If questions arise concerning the adequacy of urine output, these diapers can be weighed to determine the quantity of urine produced. All infants can be expected to stool prior to discharge, although they may not have done so by the time of the first post-partum rounds. The initial stools consist of meconium, a grainy, green material with little or any odor. These will gradually transition to more typical stools as the infant increases oral intake of either breast milk or formula.

All infants cry and parents should be made aware of the fact that this is neither abnormal nor of significant concern as long as the infant can be consoled and assessment is made that possible infant needs (hunger, stool, comfort) are met. Infants can be expected to sleep up to 18 hours each day. Parents should be made aware, however, that this likely represents short periods of sleeping interspersed with periods of being awake. That is to say, it will not feel to most parents as if their newborn is sleeping most of the time. Parents should be educated to sleep when their infants sleep in anticipation of being awake at times when they might not usually anticipate being awake.

In general, all mothers without a specific contraindication to breastfeeding should be encouraged to breastfeed their newborn. This may begin in the immediate postpartum period while the patient is still in the delivery room setting. Breastfeeding itself stimulates the production of breast milk and earlier initiation enhances the likelihood of success. In the first several days, the principle available breast product is colostrum rather than breast milk. Parents should be assured that this is sufficient for most infants' needs in the period prior to the onset of breast milk production. New mothers may benefit from the assistance of skilled teaching in the breastfeeding technique by nursing staff, specialized lactation consultants, physicians, or other family members with breastfeeding experience.

POSTPARTUM DAY 2

History

For most patients with uncomplicated vaginal deliveries, postpartum day 2 represents the day of discharge to home. In addition to the elements just reviewed, providers should inquire about arrangements for transportation home (many institutions will not allow discharge of an infant unless the parents have a car seat) and arrangements at home.

Physical Examination

The examination on postpartum day 2 is similar to that of the first day. Abnormal findings noted on day 1 should be reviewed and particular attention should be paid to those areas on day 2.

Laboratory Studies

In general, there are no additional laboratory studies necessary on postpartum day 2, unless prior abnormal values require follow-up.

Management

As noted, postpartum day 2 is often the day of discharge from the hospital. Management should focus on transition of care from the hospital setting to the home setting and any needs the patient may have in arranging for this transition.

32 Complications of the Hospital Postpartum Period

CONTENTS

BACKGROUND
FEVER
INFECTION

KEY POINTS

1. Fever in the postpartum period may be a sign of significant infection.
2. Although maternal temperature elevation may be normal in the first 24 hours, persistent, markedly elevated, or unexplained fevers must be evaluated.

BACKGROUND

For most pregnancies, the postpartum period is uncomplicated and the routine management is discussed in the Chapter 31. Occasionally, however, the hospital postpartum period is complicated by a variety of developments. Among these complications, postpartum hemorrhage, fever, and infection are the most common. Postpartum hemorrhage is discussed in Chapter 28. This chapter focuses on a discussion of an approach to the postpartum patient with fever and infection.

FEVER

A variety of conditions may contribute to an elevated maternal temperature, especially in the first 24 hours following delivery. Many of these conditions do not require specific intervention and are not considered a true fever. Maternal fever in the postpartum period is defined as a temperature of 38°C (100.4°F) on two occasions at least 24 hours apart.

True maternal fever is relatively common, occurring in up to 10% of all pregnancies. Risk factors for postpartum fever include preceding maternal

From: *Current Clinical Practice: Obstetrics in Family Medicine: A Practical Guide*
By: P. Lyons © Humana Press Inc., Totowa, NJ

infection, prolonged rupture of membranes, and operative delivery. Although most postpartum fever will have an identifiable and treatable etiology, postpartum infection contributes to approximately 5% of maternal deaths.

When infection is identified, most consist of mixed anaerobic and aerobic flora of the genitourinary and gastrointestinal tracts. Common organisms include staphylococcus, *streptococcal species, E. coli*, gonorrhea, gardnerella, and mycolasma. Because of the local trauma inherent in delivery, most women will demonstrate asymptomatic colonization in the immediate postpartum period. As noted, however, true infection occurs in only 10% or less of women. Sterility of the intrauterine cavity can generally be demonstrated within 1 month of delivery.

INFECTION

Postpartum infection is generally one of three conditions: endometritis, urinary tract infection (UTI), or wound infection of the laceration or episiotomy. Of these endometritis is, by far, the most common. UTI and wound infection are considerably less common, although each must be considered in the postpartum patient with true fever.

Endometritis

Endometritis is defined as an infection of the endometrium. As noted earlier, colonization of the endometrium following delivery is almost universal, but infection following routine delivery is considerably less frequent (~10%). Risk factors that increase the likelihood of endometritis include operative delivery, prolonged rupture of membranes, prolonged labor, pre-existing maternal infection including preceding chorioamnionitis, manual manipulation, and internal monitoring during pregnancy (intrauterine pressure catheter or fetal scalp electrode).

The diagnosis is suspected in the presence of maternal fever with foul-smelling lochia. The uterus is generally soft and tender and the patient may demonstrate cervical motion tenderness. Laboratory studies include a complete blood count with differential, blood cultures, and a urinalysis (to exclude the possibility of an UTI). The white blood cell count may be elevated with endometritis, but patients without infection may also demonstrate elevations in white blood cell count up to 20,000. Bacteremia is present in up to 10% of patients with endometritis, making blood cultures useful if positive but less helpful if negative.

In general, endometritis may be caused by a variety of aerobic and anaerobic *streptococcal species*, Gram-negative coliforms, chlamydia, or mycoplasma. Treatment should include broad-spectrum intravenous antibiotics with activity against suspected organisms. One such regimen would include clindamycin (Gram-positive and anaerobic coverage) plus an aminoglycoside (Gram-negative coverage plus ampicillin (if enterococcus is suspected).

Urinary Tract Infections

The combination of considerable manipulation and bacterial seeding with the urinary stasis associated with late-stage pregnancy makes UTI in the postpartum period a relatively common occurrence. Approximately 3% of pregnancies will be complicated by postpartum UTI. Diagnosis is made via urinalysis and urine culture. Treatment is directed by culture results or presumptive treatment for common pathogens (*E. coli*, *Proteus mirabilis*, *S. saprophyticus*). UTI diagnosis and management are discussed in detail in Chapter 13.

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