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Laser Surgery for the Management of ENT Malignancies

A Controversial Issue

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Surgical Application of New Technologies: An Unruly Scientific Process

To progress in their field of research, scientists follow a step-by-step reasoning. First, they have to identify a problem, and to elaborate a pertinent question concerning it. Once this has been done, they develop a specific instrument which should theoretically serve to solve the problem. Finally, they test its actual efficiency to do so. This step-by-step procedure is not always respected in the application of new technologies in surgery. Such is the case for the use of a laser beam in endoscopic surgery of head and neck malignancies. Organ preservation surgery is a concept developed on the knowledge of biological aspects of tumor growth and spread. For each organ, the indications, contraindications, and the modalities of the open neck procedures are precisely described. At that moment, there was no question about the validity of the type of knife used to remove the tumor. In fact, surgeons who first used laser for endoscopic resection of malignancies acted as opportunists since different types of laser beams had long been developed and already utilized for many industrial works. Of course, some adaptations were required to render its use safe for patients and surgical teams. However, the fundamental question whether it would help in treating malignancies was raised only after it had already been used for some time! As cancer is a biological disorder, we may wonder how the course of the disease can be influenced by the kind of tool used to remove it, why it is no longer necessary to respect the classical margins of resection established on the basis of the

biological behavior of tumors and the existence of natural barriers to its spread, as claimed by the most enthusiastic laser users. Is the question of the knife pertinent? Is the choice of the laser beam instead of conventional blades a matter of fashion? Is the choice of endoscopic resection reasonable in terms of biological control of the tumor? The public is often fascinated by new developments. Therefore, when a reputed center starts using a new technology, others are compelled to adopt it to avoid losing credibility, even before the efficiency of such technologies has been convincingly proven. Surgeons are also encouraged to resort to new developments by manufacturers for obvious commercial benefits.

We hope, this discussion on laser surgery for the management of ENT malignancies will help clarify the safety of the use of lasers, the advantages for the patients and the convenience for the surgeon to use it in comparison with standard procedures, the indications and contraindications for laser surgery, and the consequences of laser burns on the histological examination of the resected tissue. We deeply regret that some reknown promoters of this method renounced to participate in the debate. However, we expect that some of the opinions expressed in this issue will raise additional comments among readers which we will be pleased to publish in the next issue of the journal.

Jean-Philippe Guyot, Geneva

Growth Pattern of T3 and T4 Piriform Sinus Carcinomas: Implications for Microendoscopic Laser Surgery

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Key Words

Piriform sinus carcinoma · Microendoscopic laser surgery · Growth pattern

Abstract

Objective: Carcinomas of the piriform sinus have an unfavourable prognosis despite aggressive treatments. Most authors are therefore increasingly hesitant to offer patients treatment options including total laryngectomy. There is a tendency to treat piriform sinus carcinomas in a manner that preserves the larynx, whether by radiochemotherapy (sequential or concomitant), classic organ-preserving surgery, microendoscopic laser surgery, or a combination of these treatment options. The value of laser surgery in the treatment of more extensive carcinomas has not yet been precisely defined, unlike that of classic function-preserving surgery. An attempt has been made in this study to evaluate the possibilities and limits of microendoscopic laser surgery in the treatment of cT3 and cT4 carcinomas, based on a histological analysis of the patterns of spread. **Methods:** A total of 70 specimens obtained by pharyngolaryngectomy were subjected to a whole-organ section study. The carcinomas were also evaluated in respect of possible classic organ-preserving surgery on the basis of established selection criteria, and an attempt was made to define selection criteria for the use of microendoscopic laser surgery on the basis of the histopathological pattern of spread. **Results:** On the basis of the established selection criteria, such as fixation of the vocal fold, cricoid infiltration, spread of the tumour to the retrocricoid region and infiltration of the pre-epiglottic space, only very few T3 and T4 carcinomas of the piriform sinus can be treated with classic function-preserving surgery. Laser surgery is primarily determined by the pattern of spread and less by given anatomical landmarks. Selection criteria, such as have been estab-

lished for classic function-preserving surgery, are not helpful for laser surgery. The main problem in microendoscopic laser surgery is the optimal exposure of the tumour. **Conclusions:** Assuming correct exposure of the tumour, function-preserving treatment by laser surgery can be carried out on more T3 and T4 carcinomas than would be possible with classic function-preserving surgery. The contraindication criteria for classic function-preserving surgery are not applicable to laser surgery because this form of surgery is determined by the tumour extension and not by anatomical landmarks.

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Wachstumsmuster von T3- und T4-Karzinomen des Sinus piriformis: Kriterien für die mikroendoskopische Laserchirurgie

Hintergrund und Fragestellung: Trotz aggressiver Behandlungskonzepte, die oft eine totale Laryngektomie beinhalten, haben Karzinome des Hypopharynx eine schlechte Prognose. Deshalb wird vermehrt versucht, diese Karzinome larynxerhaltend, sei es durch Radiochemotherapie, durch eine klassische funktionserhaltende Chirurgie oder durch eine mikroendoskopische Laserchirurgie zu behandeln. Der Stellenwert der endoskopischen Laserchirurgie bei fortgeschritteneren Karzinomen ist jedoch noch unklar. Das Ziel dieser Studie ist eine Evaluation der Möglichkeiten und Grenzen der mikroendoskopischen Laserchirurgie aufgrund einer histologischen Studie von Ganzorganschnitten. **Methode:** Siebzig Laryngopharyngektomie-Präparate mit cT3 bzw. cT4 Karzinomen wurden an Ganzorganschnitten histologisch untersucht. Aufgrund der histologischen Tumorausbreitung wurde einerseits analysiert, bei wievielen Patienten mit klassischen Indikationskriterien eine externe chirurgische larynxerhaltende Therapie möglich gewesen wäre, und

andererseits wurden mögliche Selektionskriterien für die mikroendoskopische laserchirurgische Behandlung von fortgeschrittenen Sinus piriformis Karzinomen evaluiert. **Ergebnisse und Schlussfolgerung:** Aufgrund der klassischen Selektionskriterien wie Stimmlippenfixation, Krikoidinfiltration, Tumorausbreitung in die Retrokrikoidregion oder Infiltration des präepiglottischen Raumes, hätten nur einige wenige fortgeschrittene Karzinome des Sinus piriformis durch eine klassische funktionserhaltende Chirurgie behandelt werden können. Die bei der klassischen funktionserhaltenden Chirurgie angewandten Kriterien eignen sich bei der Indikation zur Laserchirurgie nicht, da die Laserchirurgie nicht an anatomische Landmarken gebunden ist. Anhand der histologischen Analyse kann gezeigt werden, dass theoretisch eine relativ grosse Anzahl fortgeschrittener Karzinome laserchirurgisch behandelt werden könnte, vorausgesetzt, eine optimale Exposition des Tumors ist möglich.

Extension des carcinomes T3 et T4 du sinus piriforme: implications pour la chirurgie micro-endoscopique au laser

Introduction: Le pronostic des carcinomes du sinus piriforme est défavorable, même lorsque les patients sont traités de façon agressive. C'est pourquoi aujourd'hui, la plupart des auteurs hésitent à proposer à leurs patients une laryngectomie totale. La tendance actuelle est plutôt de traiter les carcinomes du sinus piriforme en préservant le larynx, soit par des traitements combinés de radiothérapie et chimiothérapie de façon séquentielle ou concomitante, soit par une chirurgie classique de conservation d'organe, soit par une chirurgie micro-endoscopique au laser, ou encore par une combinaison de ces modalités thérapeutiques. La valeur de la chirurgie au laser dans le traitement des carcinomes les plus étendus n'est actuellement pas bien déterminée au contraire de celle de la chirurgie classique de préservation d'organe. Cette étude vise à évaluer les possibilités et les limites de la chirurgie micro-endoscopique au laser dans le traitement des carcinomes cliniquement classés T3 et T4, sur la base d'une étude histologique des extensions de la lésion.

Méthodes: Un examen histologique de sections totales de l'organe a été réalisé sur 70 spécimens de pharyngo-laryngectomies. L'évaluation de l'extension vise à déterminer les cas qui auraient pu bénéficier d'une chirurgie classique de préservation d'organe, sur la base de critères pré-établis et à déterminer des critères de sélection pour une chirurgie micro-endoscopique au laser. **Resultats:** Sur la base des critères établis, telle qu'une fixation de la corde vocale, une infiltration du cartilage cricoïde, une extension de la tumeur dans la région rétro-cricoïdienne, une infiltration de l'espace pré-épiglotique, très peu de carcinomes T3 et T4 du sinus piriforme auraient pu bénéficier d'une chirurgie classique de préservation d'organe. La possibilité d'une chirurgie au laser dépend plus de l'aspect de l'extension que du dépassement de marges anatomiques précises. Les critères de sélection établis pour une chirurgie classique de préservation d'organe ne sont pas utiles pour la chirurgie au laser. Dans cette dernière, le problème principal réside dans une exposition optimale de la tumeur par l'abord endoscopique. **Conclusion:** A condition de pouvoir exposer correctement la tumeur, une chirurgie de préservation d'organe au laser peut être réalisée dans un plus grand nombre de cas T3 et T4 de carcinomes qu'il n'est possible de le faire avec une chirurgie de préservation d'organe classique. Les contre-indications pour une chirurgie de préservation d'organe classique ne sont pas celles de la chirurgie au laser, les possibilités de cette dernière dépendant essentiellement de l'extension de la tumeur plutôt que de marges anatomiques déterminées.

Introduction

Despite aggressive treatment consisting of radical surgery on the primary tumour and the neck combined with radiotherapy, piriform sinus carcinomas have an unfavourable prognosis. Clinically manifest or occult neck lymph node metastases are found in 75–85%. Piriform sinus carcinomas have a relatively great tendency to develop locoregional recurrences, which are often impossible to treat. Even if locoregional control of piriform sinus carcinomas is achieved, the patients not infrequently develop distant metastases or second primary carcinomas [1].

This raises the question of whether there is any point in carrying out classic, radical surgical therapy, mostly consisting of total laryngectomy and partial pharyngectomy, and whether patients should be expected to undergo the mutilation of this procedure, especially if a larynx which is not, or only partly affected, has to be sacrificed. If piriform sinus carcinomas are to be treated surgically, there has been a tendency in recent years to perform, whenever possible, function-preserving surgery [2, 3] or microendoscopic laser surgery [4]. However, the tumour extension is often a limiting factor in classic, function-preserving surgery, so that this surgical treatment can only be used in a relatively small number of patients. Transoral microendoscopic laser surgery is used in T1 and T2 carcinomas in several centres [5–7], but hardly any experience has been gained with laser surgery in T3 and T4 carcinomas, even though it is precisely in these tumours with an often poor prognosis that an alternative, function-preserving treatment should be provided [4].

Although the pretreatment assessment of hypopharyngeal carcinomas is now relatively accurate due to the combination of clinical findings, endoscopy and imaging [8, 9], to date there are no criteria which would make it possible to select those T3 and T4 piriform sinus carcinomas for which transoral laser surgical therapy might be indicated. Histopathological analyses of the growth patterns of T3 and T4 carcinomas of the piriform sinus have not so far been investigated in respect of possible transoral laser resection [10–12].

In this study, we investigated the patterns of growth and infiltration of cT3 and cT4 carcinomas of the piriform sinus and, on the basis of the histological analysis, we tried to evaluate criteria that might possibly be used to determine the indication for transoral laser surgery. In this study, we have deliberately only assessed the primary tumour, independently of the cervical lymph node status and possible distant metastases.

Materials and Methods

Seventy consecutive surgical specimens obtained from patients who had undergone partial laryngopharyngectomy (n = 5), total laryngectomy with partial pharyngectomy (n = 54) or circular pharyngolaryngectomy (n = 11) were subjected to a whole-organ section study. All patients had presented with cT3 or cT4 piriform sinus carcinoma and underwent primary surgical resection. None of the patients had preoperative radiation therapy. Twelve tumours occupied mainly the lateral wall, 7 tumours mainly the medial wall, and 51 tumours occupied both the lateral and medial walls with or without postcricoid involvement. Clinical observation revealed a fixed hemilarynx in 50 patients and impaired mobility in 13 of 70 patients.

All surgical specimens underwent fixation in 4% formaldehyde for 72 h and decalcification in De-cal histologic decalcifying agent (Patonal Diagnostic, Mainville, N.J., USA) for 1 week. Whole-organ slices were cut axially at a thickness of 3–4 mm, parallel to the plane of the vocal cords, as described by Michaelis and Gregor [13]. In selected cases, additional axial slices were cut at a thickness of 1 mm. At each level, at least one slice was processed for microscopic examination with haematoxylin and eosin staining.

The tumour extension was at first analysed based on the histological patterns of spread. The lesions were staged according to the International Union against Cancer Tumor, Node, Metastasis (TNM) classification and TNM supplement [14, 15] to permit comparison with the literature.

An analysis was then carried out to determine which tumours might possibly have been treated by classic function-preserving surgery. We also investigated the question of whether and which selection criteria might be used to determine the indication for transoral laser surgery.

Results

Tumour staging: According to the combined clinical, endoscopic and CT or MR staging evaluation, 13 tumours were classified as cT3 and 57 as cT4.

With regard to pathologic assessment, 2 tumours were staged as pT1, 10 as pT2, 14 as pT3 and 44 as pT4. Thus, the pretreatment evaluation of tumour extension was misinterpreted in 25 of 70 (36%) cases: 2 patients were understaged and 23 were overstaged.

The inaccurate staging was a result of misinterpretation of involvement of the cartilages, the paraglottic and pre-epiglottic space, and of the soft tissue of the neck. Furthermore, in a few cases, the tumour was essentially bulky, filling the whole piriform sinus and thus making the tumour assessment difficult.

Growth pattern: Details are shown in tables 1 and 2.

Laryngeal cartilage: In 38 of 70 specimens, neoplastic infiltration of the laryngeal framework was observed. The thyroid cartilage was infiltrated in 34 (fig. 1), the cricoid in 12 and the arytenoid in 10 cases.

Caudal tumour extension: In 59 of 70 specimens (84%), the apex of the piriform sinus and in 10, the oesophagus was reached by the tumour (fig. 2).

Table 1. Tumour infiltration of laryngeal framework

Thyroid cartilage	23
Cricoid cartilage	1
Arytenoid cartilage	1
Thyroid and cricoid cartilage	4
Thyroid and arytenoid cartilage	2
Cricoid and arytenoid cartilage	2
Thyroid, cricoid and arytenoid cartilage	5

Table 2. Spread of hypopharyngeal carcinomas

Oropharynx	7
Apex	59
Retrocricoid tumour extension	29
Oesophagus	10
Pre-epiglottic space	27
Paraglottic space (supraglottic level)	56
Paraglottic space (glottic level)	40
Cricoarytenoid joint	6
Tumour outside of thyroid ala	16
Thyroid gland	12
Contralateral tumour extension	35
Submucosal tumour spread >8 mm	29
Laryngeal muscles	43

Pre-epiglottic space: In 29 of 70 specimens (39%), the pre-epiglottic space was infiltrated by the tumour, in 6 cases with contralateral extension.

Paraglottic space: The paraglottic space was involved in 40 cases at the glottic level and in 56 cases at the supraglottic level (fig. 3).

Thyroid gland: Invasion of the thyroid gland was observed in 12 specimens. In a few cases, the thyroid gland was displaced by the tumour, but not infiltrated.

Laryngeal muscles: Intrinsic laryngeal muscle involvement was found in 43 cases, 37 times with a fixed hemilarynx, 4 times with impaired mobility. In 6 of these cases, the muscle involvement was associated with infiltration of the cricoarytenoid joint.

Retrocricoid extension: In 20 of 70 specimens (41%), tumour extension to the retrocricoid region was observed (fig. 4), in 22 cases with contralateral tumour spread.

Assessment of the Possibility of Function-Preserving Surgery

In our series, 5 piriform sinus carcinomas (2 pT1, 1 pT3 and 2 pT4) were treated through a classic partial pharyngolaryngectomy (fig. 5), in the other 65 carcinomas, a classic total laryngectomy with partial pharyngectomy (n = 54) or circular pharyngectomy (n = 11) was carried



Fig. 1. Horizontal section at the level of the cricoid cartilage. Neoplastic invasion of the thyroid cartilage (arrow). The tumour infiltrates soft tissue of the neck (asterisks).

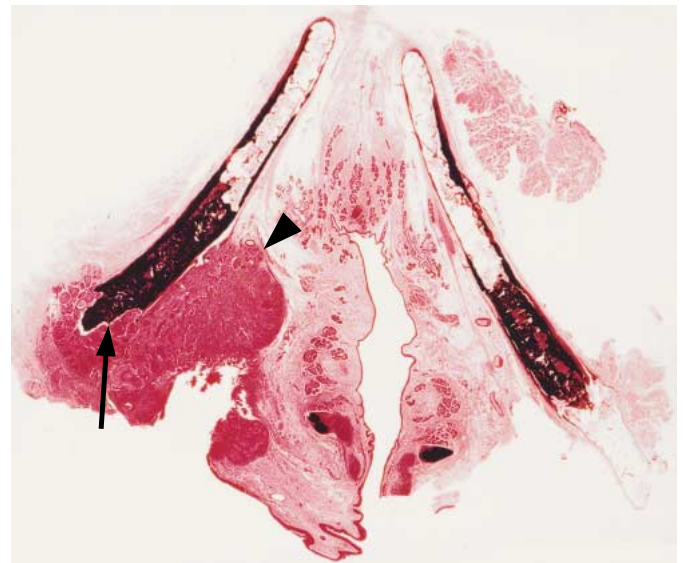


Fig. 3. Horizontal section at the supraglottic level. The paraglottic space is infiltrated (arrowhead). The posterior edge of the non-ossified thyroid cartilage is eroded (arrow).

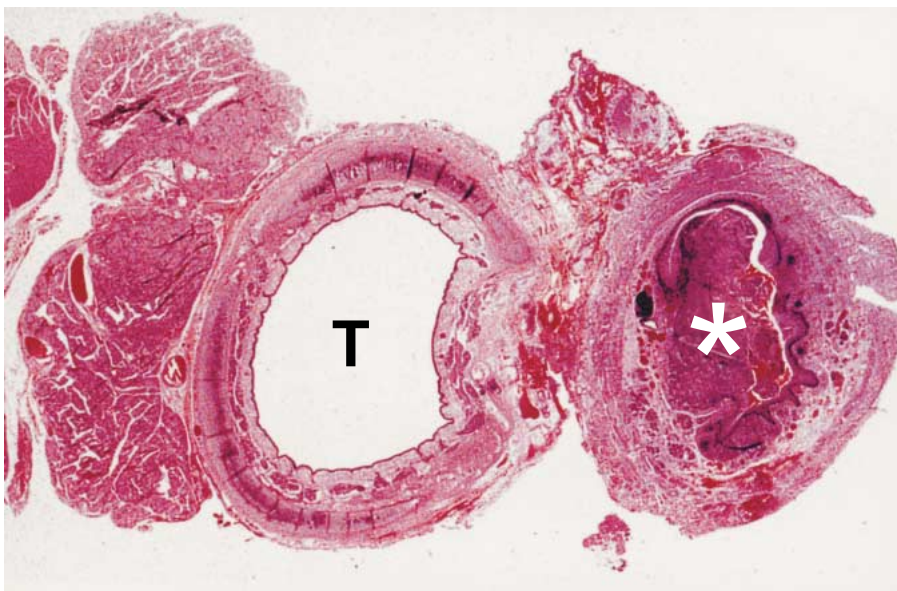


Fig. 2. Horizontal section at the level of the second tracheal ring. The oesophagus is infiltrated by the hypopharyngeal carcinoma (asterisks). T = Trachea.

out. Twelve of the 65 patients with total laryngectomy showed cricoid infiltration, which represents a contraindication to partial surgery.

Tumour extension up to the apex of the piriform sinus and the retrocricoid region, as well as a contralateral

tumour spread are said to be further contraindications to classic function-preserving surgery [2] (fig. 6).

Of the 53 laryngectomy specimens without cricoid or subglottic tumour infiltration, 46 showed tumour extension up to the apex and 21 to the retrocricoid region, with

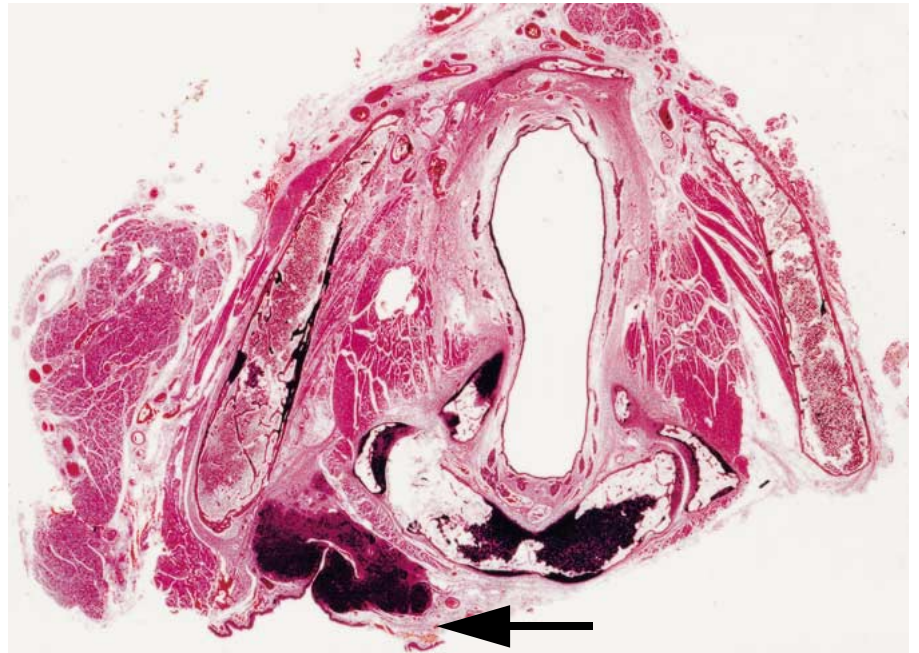


Fig. 4. Horizontal section at the level of the cricoid cartilage. Submucosal tumour extension to the retrocricoid region (arrow).

contralateral growth in 16 cases. Of the 7 pharyngolaryngectomy specimens without tumour extension up to the apex or to the retrocricoid region, the pre-epiglottic space was infiltrated in 5 cases, with contralateral tumour spread in 1 case. Fixation of the vocal fold was observed clinically in 1 of the remaining 2 pharyngolaryngectomy specimens.

If fixation of the hemilarynx is considered as the first selection criterion, then a fixed hemilarynx was observed clinically in 37 of the 53 pharyngolaryngectomy specimens without cricoid infiltration. Reduced mobility was observed in 12 of the remaining 16 patients and normal mobility in the other 4. Tumour extension up to the apex was observed in 11 of these 16 pharyngolaryngectomy specimens. Infiltration of the pre-epiglottic space could be demonstrated in 4 of the remaining 5 specimens, in 1 case with contralateral tumour extension.

On the basis of the established exclusion criteria – vocal fixation, cricoid infiltration, tumour extension up to the apex, to the retrocricoid region and into the pre-epiglottic space – only 1 patient in our series of 65 total laryngectomies with partial or circular pharyngectomy could have been treated with classic function-preserving surgery.

Criteria in Respect of Laser Surgery

We assume that infiltration of the cricoid or subglottic tumour extension also represents a contraindication to laser surgery. Our analysis is therefore based on 53 total pharyngolaryngectomy specimens, in which neither cricoid nor subglottic tumour infiltration was present.

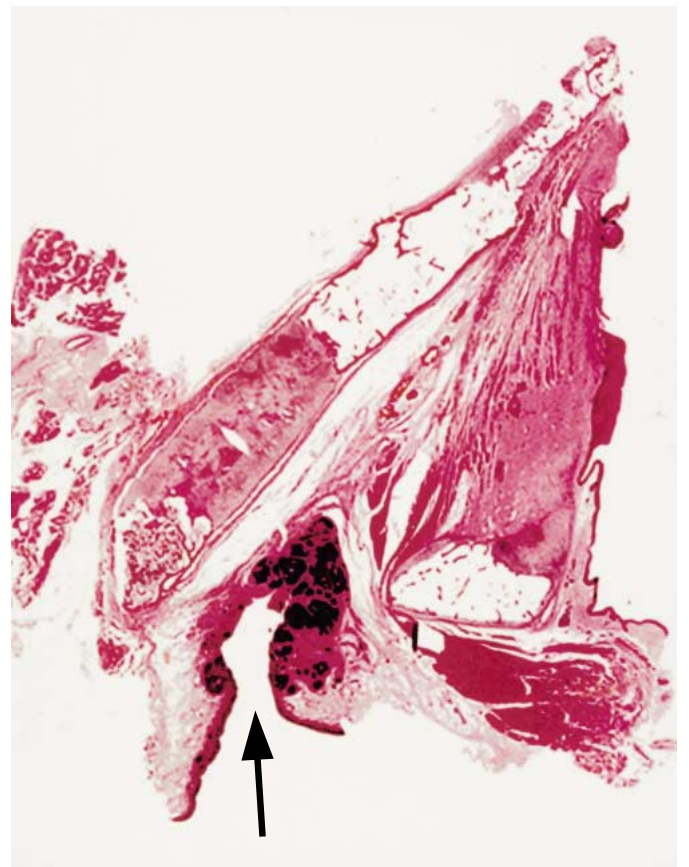


Fig. 5. Specimen of a supracricoid hemilaryngopharyngectomy with a piriform sinus carcinoma (arrow).

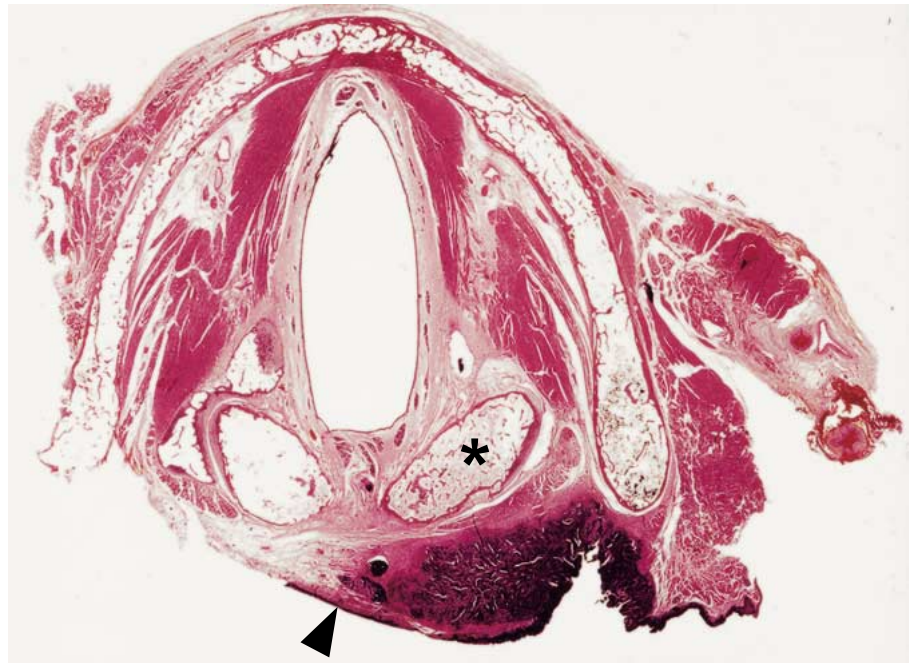


Fig. 6. Horizontal section just below the cricoarytenoid joint. Retrocricoid region involvement with contralateral tumour extension (arrowhead). Note severe inflammatory changes within the cricoid cartilage near the tumour (asterisk).

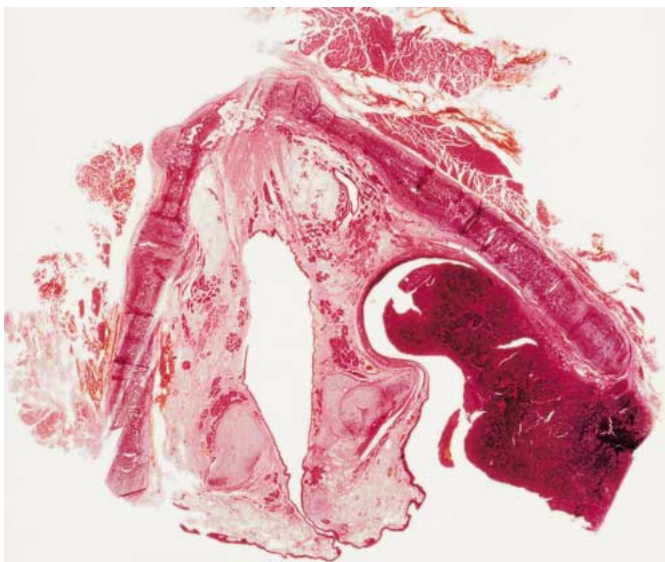


Fig. 7. Horizontal section at the supraglottic level shows a tumour bulk preventing mobilization of the arytenoid cartilage.



Fig. 8. Horizontal section at the level of the cricoarytenoid joint. Superficial tumour extension (arrow) at the retrocricoid region and lateral wall of piriform sinus.

We also hypothesise that infiltration of the oesophagus (fig. 2) and tumour extension into the neck soft tissue (fig. 1) represent a contraindication to laser surgery. In the 53 pharyngolaryngectomy specimens without cricoid infiltration, infiltration of the oesophagus was not seen in any case, but tumour extension into the neck soft tissue was observed in 7 cases (fig. 1).

If infiltration of the pre-epiglottic space is also considered to be a criterion against laser resection (in 20 of the

remaining 46 laryngopharyngectomy specimens), then there are still theoretically 26 patients in whom laser surgery would be possible.

Arytenoid and/or vocal fold fixation was observed pre-operatively in 19 patients of the remaining 26 specimens. In 1 of these patients, the cause was infiltration of the arytenoid cartilage. In 5 cases, only the posterior intrinsic musculature of the larynx – the muscoli cricoarytenoidei lateralis and posterior and interarytenoideus – was infil-

trated, and additionally the musculus thyroarytenoideus in 4 cases. In 2 specimens, the paraglottic space was infiltrated at both the supraglottic and the glottic level, and in 5 specimens, only at the supraglottic level. In two specimens, the immobility can only be explained by the exophytic tumour volume (fig. 7).

Discussion

The fact that favourably localized T1 and T2 carcinomas of the piriform sinus can be treated with classic function-preserving surgery [2, 3] or with a transoral laser resection [6, 7] is no longer questioned now. The question of how T3 and T4 carcinomas of the piriform sinus should be treated is discussed to a considerably greater extent because the classic therapy routinely carried out in most centres for a long time, i.e. total laryngectomy with partial or circular pharyngectomy followed by radiation, has shown unsatisfactory results. The problems of the classic treatment and also more modern treatments in carcinoma of the hypopharynx have been discussed in detail in several publications by the pioneer of laser surgery for hypopharyngeal carcinoma, Steiner [1, 4, 16–19], on the basis of an extensive analysis of the literature and of his personal experience. The objectives of the more modern treatments, besides elimination of the tumour, are the preservation of function and a better quality of life without any reduction in the survival time. Chemotherapy is systematically included in the treatment approach in several centres [20, 21]. The question of what value transoral laser surgery might have in the surgical treatment of T3 and T4 carcinomas of the piriform sinus has not yet been clearly defined.

Whereas classic function-preserving surgery on the pharynx and larynx does have a clear indication based on unequivocal criteria [2, 22], to date these are not available for possible microendoscopic laser treatment of T3 and T4 carcinomas of the piriform sinus. Can clear-cut indication criteria, like those for classic function-preserving surgery, also be established for laser surgery?

Adequate endoscopic exposure of the tumour is a basic precondition for laser surgery. If this is not possible, correct microendoscopic tumour resection cannot be performed. Some possible criteria based on the histopathological analysis of our surgical specimens are discussed in what follows.

Caudal Tumour Extension (Apex)

Tumour extension up to the apex is mostly a contraindication to classic function-preserving surgery of the hypopharynx [2, 22]. The histopathological analysis of our specimens showed tumour extension up to the apex in 46 out of 53 pharyngolaryngectomy specimens without cri-

coid infiltration. On the basis of the histopathology, laser surgery would have been possible in several of these cases – assuming correct exposure – because the tumour extension was relatively superficial in many cases (fig. 8).

Cartilage Infiltration

The cartilage that is most often infiltrated in piriform sinus carcinomas is the thyroid cartilage. It was affected in 23 out of 53 surgical specimens without cricoid infiltration; in 2 patients, the arytenoid cartilage was also affected in addition to the thyroid cartilage. It is usually the posterior edge of the thyroid cartilage ala that is infiltrated (fig. 3). Cartilage infiltration extends beyond the mid-line only in the most extensive carcinomas. Assuming that an ossified thyroid cartilage can be cut through with laser, infiltration of the thyroid cartilage is not a criterion that excludes laser tumour resection.

Contralateral Tumour Growth

Carcinomas of the piriform sinus not infrequently extend to the postcricoid region and grow there on the contralateral side. This criterion is also a contraindication to classic function-preserving surgery, but does not represent a criterion against treatment with laser surgery, on condition that the region can be correctly exposed.

Immobility of the Hemilarynx

The mobility of the arytenoid and also of the vocal fold is evaluated clinically. Most authors consider that fixation of the vocal fold is a contraindication to classic function-preserving surgery on the pharynx/larynx. Our histopathological analysis showed that in specimens with no cricoid infiltration, no infiltration of the neck soft tissue and no infiltration of the pre-epiglottic space, vocal fold fixation could be attributed to infiltration of the intrinsic musculature of the larynx and/or to infiltration of the paraglottic space in 18 cases. In 2 cases, the fixation of the hemilarynx had to be attributed to a voluminous exophytic tumour component (fig. 7).

Given favourable exposure of the tumour and of the piriform sinus and the corresponding part of the larynx, the infiltrated posterior intrinsic muscles of the larynx, including the arytenoid cartilage if necessary, can theoretically be resected with laser. The absence of laryngeal mobility is thus not a definite criterion against tumour treatment using laser surgery.

Conclusion

Carcinomas of the hypopharynx tend to be rather overstaged on the basis of endoscopy and imaging. It is probably not disputed that infiltration of the cricoid, tumour extension into the subglottic space – in our specimens

always combined with cricoid infiltration – and also tumour extension into the neck soft tissue are criteria that possibly contraindicate microendoscopic laser surgery. On the other hand, criteria such as tumour extension up to the apex, thyroid cartilage infiltration, restricted mobility or immobility of the vocal fold or tumour extension to the retrocricoid region which extends beyond the mid-line are not adequate as selection criteria excluding transoral microendoscopic laser surgery in many cases. Thus, the question of whether a T3 or T4 carcinoma, in which neither cricoid infiltration nor tumour extension into the neck soft tissue is present, can be resected by microendoscopy with CO₂ laser depends on the possibility of tumour exposition on the one hand, and the experience of the laser surgeon on the other.

In microendoscopic laser surgery of larger hypopharyngeal carcinomas, the resection is primarily determined by the tumour extension, for which the exclusion criteria

that apply to classic function-preserving surgery are not helpful in most cases. In the absence of any criteria for or against laser surgery, it is hardly possible at the present time to reproduce the therapeutic results achieved by different laser teams in a comparable way. Furthermore, it is difficult to compare the results from different hospitals. The histological analysis in respect of the precise tumour extension of the surgical specimen excised with the laser is made difficult on account of orientation problems, and in addition the resection is often carried out in several pieces in the case of more extensive tumours. Systematic histopathological processing of hypopharyngeal carcinomas with CO₂ laser is hardly possible, in contrast to the whole-organ sections after total pharyngolaryngectomy or classic function-preserving surgery. These are probably concessions which must be made in respect of the microendoscopic laser surgery of more extensive hypopharyngeal carcinomas at the present time.

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Comments

D. Chevalier (France): The authors did an important job to precise the histological extension of piriform sinus carcinomas. The preoperative assessment of the patients was well done; only one patient could be treated with an external or endoscopic approach. Therefore, it is difficult to assess the extension to the thyroid cartilage and to the infrahyoid muscles preoperatively. It is particularly true in case of microscopic infiltration. So, in my opinion, T3 and T4 carcinomas are always difficult to remove endoscopically with safety and this does not only depend on the surgeon's experience.

H. Eckel (Germany): Carcinomas of the hypopharynx are rarely found early when they are small and localized to the site of the primary lesion. Surgery, usually in combination with postoperative radiotherapy, is believed to provide the highest cure and local control rates in patients with cancer of the hypopharynx. Even more important, surgery immediately provides successful and long-lasting palliation for airway obstruction, obstructive dysphagia and aspiration since local control is frequently achieved even in locally advanced cancer [1].

Total laryngopharyngectomy with gastric pull-up or microvascular jejunum loops for the reconstruction of an alimentary tract has meanwhile evolved into a secure and reliable method of resection and reconstruction for advanced primaries, and organ-sparing procedures for smaller tumours are more frequently used than only a decade ago. Zbären and Stauffer provide a reappraisal of the role of current transoral laser surgery in the treatment of hypopharyngeal carcinoma based on histopathological findings obtained from 70 specimens. They conclude from their data that function-preserving treatment using transoral laser surgery can be carried out on more T3 and T4 carcinomas as compared with open surgery.

For patients with early-stage hypopharyngeal carcinomas, high overall survival, disease-specific survival, and local control rates can be achieved using transoral laser surgery in a multidisciplinary setting [1–3]. However, survival rates are invariably poor in those patients who require surgery for T3/T4 lesions. This has been the basis of a recent larynx preservation approach using induction chemotherapy followed by irradiation in good responders or by radical surgery in poor responders, or concomitant chemoradiation [4–6]. However, results from recent reports on treatment of hypopharyngeal squamous cell carcinomas indicate lower local control and overall survival rates with non-surgical treatment as compared with standard treatment protocols including surgery plus postoperative radiotherapy [4, 7]. Also, it is now obvious from recent reports on the results of organ-preserving surgical and non-surgical treatment modalities that successful organ preservation is not always identical with the successful preservation of laryngeal and pharyngeal function. In contrast, surgical reconstruction even after very extended resections (total laryngopharyngectomy) now restores the intake of a solid or soft diet in over 90% of all patients [8]. In most patients, traditional surgery (including mutilating procedures) represents the best chance for lasting local control and the best palliation for dysphagia, airway problems, and pain [9].

Apart from determining survival and larynx preservation rates, future studies will have to focus on local and regional tumour control, since these variables may be more relevant prognosticators for quality of life than organ preservation. Local control, even at the price of a sacrificed larynx, is probably more important for the patient's quality of life (and quality of dying) than organ preservation. Patients with stage IV disease (the vast majority of all patients) have an invariably poor life expectancy since advanced lymph node metastases often represent systemic spread of the tumour beyond the limits of local-

ized cancer treatment. Predictable and lasting local/regional control of the disease may then be the best palliation, if cure cannot be achieved.

Zbären and Stauffer derive their conclusion from the application of traditional criteria for patient selection to open partial surgery, while disregarding these criteria for transoral laser surgery [10–12]. While it is true that those surgeons using laser surgery use other indications for surgery than those who prefer open surgery, their final conclusions regarding the superiority of transoral laser surgery versus open surgery is not backed up by clinical data. Therefore, their results should be considered an interesting clinical hypothesis, but not as new insights into the true clinical value of endoscopic laser surgery versus open partial surgery. The dilemma of treating hypopharyngeal carcinoma [13] has not yet been solved.

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M. Remacle (Belgium): I have read with interest the study of Zbären and Stauffer on the growth pattern of T3 and T4 piriform sinus carcinomas treated by pharyngolaryngectomy. Although I agree that fixation of the vocal cord, infiltration of thyroid or cricoid cartilages and, also important, the extension in the retrocricoid area are contraindications for partial laryngectomy, I totally disagree on the conclusions.

The authors claim that organ-sparing surgery is more frequently possible by an endoscopic approach than by open neck surgery. This conclusion is misleading. Local evolutions of cancers are the same whatever the approach. Decisions for partial reconstructive open neck surgery have been made on the knowledge of the growth pattern

and not directly on the anatomical landmarks. What makes endoscopic surgery useful is that usually follow-up is much easier for the patients.

Surgery itself is probably more difficult by an endoscopic than by an open neck approach because of the limitation of exposure. So, what is true regarding growth pattern for open neck surgery is also true for the endoscopic approach. The endoscopic approach must be favoured, as the authors have correctly pointed out, if a good exposure of the tumour is possible.

If a surgical technique is valuable by an endoscopic or open neck approach, guidelines must be provided in order to make this surgery reproducible, to teach and to train people. Of course, experience is indeed important and some trained surgeons can approach tumours that beginners cannot, but to be widely accepted and diffused, any surgical technique must be standardized to some extent.

J.A. Werner (Germany): In this study, Zbären and Stauffer investigated the patterns of growth and infiltration of T3 and T4 carcinomas of the piriform sinus and, on the basis of the histological analysis, criteria which determine the indication for transoral laser surgery were tried to evaluate. The results show that carcinomas of the hypo-

pharynx tend to be rather overstaged on the basis of endoscopy and imaging. While tumour extension into the subglottic space, into the neck soft tissue possibly contraindicate laser microsurgery, criteria such as tumour extension up to the apex, thyroid cartilage infiltration, restricted mobility of the vocal fold or tumour extension to the retrocricoid region are not yet adequate as selection criteria excluding transoral laser microsurgery in many cases. For this, the question whether T3 and T4 carcinomas, in which neither cricoid infiltration nor tumour extension into the neck soft tissue is present, can be resected by laser microsurgery depends on the possibility of tumour extension and the experience of the laser surgeon. This conclusion, which, in my opinion, is true for all carcinomas of the upper aerodigestive tract, supports the necessity to accept that laser surgery for difficultly accessible and advanced carcinomas is not a matter of occasional surgery but requires intensive training as well as a continuous application of this operative technique. In order to resect even advanced carcinomas with laser surgery, the role of downstaging by induction chemotherapy has to be clarified in the future. A possible risk accompanying such a strategy might be tumour infiltration of the laryngeal skeleton that could also persist in the context of an evidently positive reaction to chemotherapy.

Accuracy of Histological Examination following Endoscopic CO₂ Laser-Assisted Laryngectomy

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Key Words

Frozen section · Laser surgery · Endoscopic partial laryngectomy · Histological examination

Abstract

We reviewed 242 cordectomy or supraglottic laryngectomy cases operated since 1989. The vocal fold epithelium removed during subepithelial cordectomy with diagnostic intent or biopsies of the operative site after tumor resection underwent frozen section examination. However, the surgical specimen never underwent frozen section analysis. Conventionally, the histopathologist examined the margin area free of laser coagulation. Using the Acuspot micromanipulator alone, coagulation depth was less than or equal to 100 µm; with the Acublade, it was less than 20 µm. Of 181 frozen sections, 154 (85.1%) had negative margins, 23 (12.7%) had positive margins and 1 (0.6%) had moderate dysplasia of the section margin. Reading was inconclusive in 2 cases (1.1%) and impossible in 1 (0.6%). The second examination of the margins during examination of the surgical specimen did not reveal false-positive or false-negative results. Of the 23 patients with positive resection margins at frozen section analysis, 8 (34.8%) underwent immediate and more extensive cordectomy. Frozen section analysis is reliable and cost-effective in oncology for endoscopic partial laryngectomy.

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Die Verlässlichkeit der histologischen Untersuchung nach endoskopischer CO₂ Laser-unterstützter Laryngektomie

Wir untersuchten 242 seit 1989 operierte Patienten nach Chordektomie oder supraglottischer Laryngektomie. Das, im Rahmen einer diagnostischen subepithelialen Chordektomie oder einer Biopsie nach Tumorresektion, entnommene Stimmlippenepithel wurde ei-

ner Schnellschnittuntersuchung unterzogen. Das chirurgische Präparat selbst wurde keiner Schnellschnittuntersuchung zugeführt. Der Histopathologe untersuchte die nicht von der Laserkoagulation betroffenen Randgebiete. Bei Gebrauch des Acuspot Micromanipulator allein betrug die Koagulationstiefe weniger oder gleich 100 µm; mit dem Acublade betrug sie weniger als 20 µm. Von 181 Schnellschnittuntersuchungen hatten 154 (85.1%) negative Schnittränder, 23 (12.7%) hatten positive Schnittränder und 1 hatte eine moderate Epitheldysplasie im Bereiche der Schnittränder. Die Beurteilung war in 2 (1.1%) Fällen nicht konklusiv und in einem Fall unmöglich (0.6%). Eine Zweitbeurteilung der Schnittränder während der Untersuchung des Hauptpräparates deckte weder falsch-positive noch falsch-negative Resultate auf. Von den 23 Patienten mit positiven Resektionsrändern in der Schnellschnittuntersuchung wurden 8 (34.8%) einer sofortigen, ausgedehnteren Chordektomie unterzogen. Die Schnellschnittuntersuchung erlaubt eine verlässliche und kosteneffektive Beurteilung im Rahmen der partiellen endoskopischen Laryngektomie.

Validité de l'examen histologique après laryngectomie par voie endoscopique au laser CO₂

Nous avons revu 242 cas de cordectomie ou de laryngectomie supraglottique, opérés depuis 1989. L'épithélium de la corde vocale enlevé durant les cordectomies sous-épithéliales dans un but diagnostique ainsi que les biopsies du site opératoire après résection de la tumeur étaient examinés histologiquement dans un examen extemporané. Quant à la pièce d'exérèse, elle n'était jamais examinée en extemporané. De façon conventionnelle, l'histopathologiste a examiné les marges libres de coagulation au laser. L'utilisation du micro-manipulateur Acuspot seul entraînait une coagulation jusqu'à une profondeur inférieure ou égale 100 µm, celle de l'Acublade, une profondeur inférieure à 20 µm. Des 181 coupes examinées, 154 (85,1%) avaient des marges libres de tumeur, 23 (12,7%) avaient une atteinte tumorale et 1 (0,6%) montrait des signes de dysplasie modé-

rée. L'histopathologiste ne pouvait tirer aucune conclusion dans 2 cas (1,1%) et la lecture était impossible dans 1 (0,6%). L'examen des marges de la pièce d'exérèse chirurgicale n'a pas montré de résultats faussement positifs ou faussement négatifs. Sur 23 patients dont les marges de résection passaient en zone tumorale lors de l'examen extemporané, 8 (34,8%) ont bénéficié immédiatement d'une cordectomie plus étendue. En conclusion, l'examen extemporané est fiable et rentable lors de laryngectomies partielles par voie endoscopique assistée au laser.

Introduction

From its inception, CO₂ laser has been conceived as a surgical laser [1] combining hemostasis and the desired surgical effect (tissue section or destruction) while causing minimum thermal damage to surrounding tissues.

In comparison with other wavelengths, e.g. Neodymium-YAG laser or KTP laser, CO₂ laser can be considered hemostatically mediocre [2] because it cannot ensure the coagulation of vessels larger than or equal to 0.5 mm in diameter. However, whereas the thermal effect of Neodymium-YAG laser is several millimeters deep because of strong tissue penetration [3], the thermal effect of CO₂ laser is only microns deep [4, 5].

Since Strong's initial clinical work [6] in the early seventies, CO₂ laser has continued as the laser most used in ENT because its limited thermal effect preserves surrounding structures. However, Neodymium-YAG laser, because of its hemostatic property, has been applied more in pneumology and gastroenterology for coagulating tumors and controlling hemorrhage [7, 8]. In ENT, KTP and diode lasers progressively replaced Neodymium-YAG laser [9, 10]. KTP and diode lasers are fiber-guided lasers and are used for indications where their thermal effect, intermediary between that of Neodymium-YAG and that of CO₂ laser, is either sought for or without consequence [11, 12]. In contrast, 30 years of progress have refined CO₂ laser into a true surgical instrument by increasing surgical precision while reducing the laser thermal effect [13, 14]. Despite those improvements, examination of CO₂ laser-yielded surgical specimens is often considered difficult and frozen section analysis unsafe because of the thermal effect on the specimen [15].

We use CO₂ laser for all indications requiring laryngeal or pharyngeal microsurgery, and particularly endoscopic partial laryngectomy. This article reports our experience on the reliability of frozen sections and paraffin sections.

Materials and Methods

We reviewed 242 cordectomy or supraglottic laryngectomy cases operated since 1989. Surgical history of the larynx was known for 240 of those patients (table 1): 221 (92.1%) had never undergone laryn-

Table 1. Previous laryngeal modalities prior to endoscopic partial laryngectomy

Prior therapeutic modality	240
None	221 (92.1%)
Endoscopic cordectomy	13 (5.4%)
Radiotherapy	4 (1.7%)
External partial laryngectomy	2 (0.8%)

Table 2. Endoscopic partial laryngectomy

Procedure type	239
Subepithelial cordectomy	126 (52.7%)
Subligamentous cordectomy	19 (7.9%)
Transmuscular cordectomy	34 (14.2%)
Total cordectomy	35 (14.6%)
Extended cordectomy	20 (8.4%)
Supraglottic laryngectomy	5 (2.1%)

geal surgery, 13 (5.4%) had already undergone cordectomy, 4 (1.7%) radiotherapy, and 2 (0.8%) external partial laryngectomy.

The surgical procedure [17] was detailed for 239 patients (table 2): 126 (52.7%) underwent subepithelial cordectomy, 19 (7.9%) subligamentous cordectomy, 34 (14.2%) transmuscular cordectomy, 35 (14.6%) total cordectomy, 20 (8.4%) extended cordectomy, and 5 (2.1%) supraglottic laryngectomy.

All operations were CO₂ laser-assisted and performed with the Acuspot micromanipulator. The Acuspot micromanipulator provides a 250- μ m beam for a 400-mm focal distance. The laser is used in a continuous mode [16].

Until April 2000, the 'superpulse' wave was the only CO₂ wave type available with intensity peaks of 400–500 W lasting a few microseconds, with pauses, and with an average power that tallies with the requested power. Standard power averages 2–3 W for subepithelial cordectomy with diagnostic intent [17], and 7–8 W for other endoscopic partial laryngectomies.

We had been using the Acublade® [14] since April 2000 and found that it further improved the section ability of CO₂ laser. The Acublade was created by laser-integrated software that guided a scanner (Surgitouch®). The scanner piece, a set of mirrors, was placed between the laser arm and the micromanipulator. The software controlled the mirror movements that modified, with extreme swiftness, the beam reflection on the mirrors. The result, depending on the software-commanded movements, was a very rapid beam sweep across a surface or along an incision line. The beam sweep across the surface vaporized the surface. The beam sweep along a straight or curved line created an extremely regular incision with less thermal effect than with the micropoint. The very rapid beam sweep and uniform energy distribution along the incision line ensured this reduced thermal effect. This incision line was the Acublade. By means of a joystick to which it was electrically connected, the scanner rotated left or right. Rotating the scanner rotated the beam. Both the incision depth and length could be programmed. Although the incision length was true, e.g. 1.5 mm, the incision depth was theoretical and based on the average water content of human tissues: at equal power, the depth is deeper in Reinke's space than in hyperkeratotic epithelium because Reinke's space is hydrated. The theoretical depth habitually chosen was 0.5 mm. The software calculated the required power, ordinarily

18 W, which could be increased or decreased if required. Once resected, the surgical specimen was pinned to a cork plate. Orientation was specified. For procedures with curative intent, biopsies of the resection margins were made. They were also pinned to the cork plate and appropriately oriented. The whole was then wrapped in damp gauze and sent for frozen section analysis. The frozen section examination was performed on the vocal fold epithelium, removed during subepithelial cordectomy with diagnostic intent, or on biopsies sampled from the operative site. The surgical specimen did not undergo frozen section analysis.

It is conventional for the histopathologist to examine the margin undisturbed by laser coagulation. Previous studies measured the coagulation depth [18, 19]: less than or equal to 100 μm with the Acuspot micromanipulator alone and less than 20 μm with the Acublade.

When faced with dysplasia, with a positive margin or when any doubt remained over a lesion, we opted for complementary resection with further frozen section analysis. Prior to cordectomy with diagnostic intent (subepithelial cordectomy), informed consent had been acquired from the patients to complementary endoscopic resection in the event that further resection was necessary during ongoing surgery. If patients did not consent, then therapeutic modalities were rediscussed postoperatively. If external partial surgery was required, it took place as a second-stage procedure.

Frozen section preparation and examination usually requires approximately 20 min and mobilizes two staff members (one doctor and one technician). Frozen section analysis was introduced in our institution in the nineties. The department of pathology had to be restructured before systematic analysis could be performed. Occasionally, it is not performed for practical reasons, i.e. due to off duty histopathologist, or late surgery scheduling.

Results

Of the 242 patients, frozen section analysis was not performed for 61 patients (25.3%) because of the practical and historical reasons previously mentioned. Of the remaining 181 patients (table 3), 154 (85.1%) had negative margins, 23 (12.7%) had positive margins and 1 (0.6%) had moderate dysplasia of the section margin. Reading was inconclusive in 2 cases (1.1%) and impossible in 1 case (0.6%).

On second margin examination, performed during the examination of the surgical specimen, neither false-positive nor false-negative results were observed. Prior treatment modality did not preclude frozen section analysis (however, only 4 patients had undergone prior radiotherapy).

Of the 23 patients with a positive margin, 12 had undergone subepithelial cordectomy with diagnostic intent and 11 had undergone surgery with curative intent. Eight (34.8%) of those same 23 patients underwent immediate and more extensive cordectomy (table 4); following postoperative discussion, 3 patients (13%) opted for radiotherapy and 12 patients (52.2%) underwent external surgery.

Table 3. Frozen section analysis

Margins	181
Negative	154 (85.1%)
Positive	23 (12.7%)
Reading inconclusive	2 (1.1%)
Moderate dysplasia	1 (0.6%)
Reading impossible	1 (0.6%)

Table 4. Therapeutic decision for positive margin cases

Decision	23
More extensive endoscopic surgery	8 (34.8%)
Radiotherapy	3 (13%)
Open surgery – partial laryngectomy	12 (52.2%)

Discussion

Whether performed as intraoperative frozen section analysis or as postoperative paraffin section analysis, histological examination is possible and reliable following CO₂ laser-assisted surgery. In our study, examination was impossible for only 1 patient (0.6%) and inconclusive for 2 patients (1.1%).

Histological examination of the margin section is possible because of the moderate thermal effect of CO₂ laser compared with other wavelengths. This thermal effect is less than or equal to 100 μm with the Acuspot, and less than 20 μm with the Acublade [18]. Despite this thermal reduction, the histopathologist follows a conventional regulation: the coagulated area is not examined, and the investigation is restricted to the adjacent area free of thermal coagulation. This adjacent area must be considered as the true margin and assessed for tumoral invasion.

Because high-power laser can cause tissue retraction that, in turn, can interfere with the evaluation of the margin-to-tumor distance, we do not undertake frozen section analysis of surgical specimens [20]. Furthermore, electrocauterization, required for intraoperative bleeding, can increase the laser thermal effect.

When performing frozen section analysis during endoscopic partial laryngectomy, we follow the rules adopted by many surgeons for partial laryngeal surgery via the external approach [21]. We ensure safer surgery and avoid second-look surgery or complementary salvage treatment. Frozen sections can be less reliable during postradiation salvage surgery [22] whether surgery is performed by the external or endoscopic approach. We did not observe this problem in our series; however, only 4 patients (1.7%) had undergone radiotherapy before frozen section analysis.

Our examination reliability can probably be attributed to the fact that our histopathologist (M.D.) is a consultant highly experienced in this type of pathology and the only pathologist to work for our department.

Because section margins require close inspection, we prefer section vs. vaporization: vaporization does not provide a surgical specimen [23]. The same care for laser-yielded surgical specimens exists in other surgical fields, mainly gynecology [24].

Fluorescence-assisted contact endoscopy [25, 26] may progress in the future. To date, however, histological examination remains the examination of choice.

Frozen sections are time-consuming and require staff investment – two costs which many institutions currently find hard to support. Whereas the cost-effectiveness of

frozen section analysis during thyroid gland surgery, although frequently performed, could be questionable [27], we find frozen section examination cost-effective in oncology [20]. This matter of cost-effectiveness is particularly true for the surgeon less experienced in endoscopic techniques, as evidenced by our own initial experience. When we began with endoscopic cordectomy, we did not perform frozen section examination and histological examination of the surgical specimens revealed 23.5% positive margins [28]. In this series, positive margin identification required an immediate complementary procedure in 8 out of 23 cases (34.8%).

In conclusion, frozen section analysis is reliable and cost-effective in oncology for endoscopic partial laryngectomy.

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Comments

D. Chevalier (France): This paper confirms that endoscopic resection of laryngeal cancer is safe. The authors conducted a study based on frozen section analysis with important conclusions. Frozen section analysis is reliable and can be used routinely. That also means that in case of doubt or less experienced surgeons, frozen sections are very helpful. Another point worth mentioning is that frozen section analysis must be performed on the operative site to avoid false-positive results.

H. Eckel (Germany): Surgical margins have been a matter of debate ever since the onset of endoscopic laser surgery for the use in oncological surgery. The use of frozen sections, routinely applied to open surgery, has not been studied in detail for endoscopic laser surgery so far.

This article demonstrates that frozen sections are feasible and reliable in the setting of endoscopic laser surgery for laryngeal neoplasms. The authors provide essential details on their technical setup that is certainly needed for advanced endoscopic laryngeal surgery.

The authors address specific disadvantages, but conclude that intraoperative frozen sections are helpful and cost-effective. However, one wonders why only 8 out of 23 patients with positive margins had immediate and more extensive cordectomy.

J.A. Werner (Germany): Remacle et al. report on the accuracy of histological examination performing frozen section analysis of the section margin following CO₂ laser resection. Interestingly, 85.1% of the investigated specimen had negative margins, 12.5% had positive margins and 1.1% had moderate dysplasia of the section margin. Reading was inconclusive in 1.1% and impossible in 0.6%. On second margin examination, neither false-positive nor false-negative results were observed. With regard to the repeated discussion of the impossibility of histological examination of section margins following CO₂ laser resection, this report constitutes a major contribution to set an end to the discussions that have been conducted now for several years on the mentioned topic of the allegedly missing possibility of judging the section margins. The laser surgeon, however, must decide if very small secondary resections would not better be performed using conventional instruments.

P. Zbären (Switzerland): This paper demonstrates the necessity of a strong cooperation between the head and neck surgeon and an experienced ENT pathologist in treating laryngeal carcinomas by CO₂ laser surgery. As medicine becomes more and more specialized, a strong cooperation is furthermore needed with an ENT radiologist for the diagnostic work-up (exclusion of cartilage infiltration).

Current Status of Endoscopic Laser Surgery in Head and Neck Surgical Oncology

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Key Words

Larynx neoplasm treatment · Pharynx neoplasm treatment · Larynx carcinoma · Laser surgery · Laryngectomy · Head and neck cancer · Surgical oncology · Minimally invasive surgery

Abstract

This review of the Cologne University Medical School experience with oncological laser surgery evaluates the potential role of transoral laser surgery for oral, oropharyngeal, laryngeal and hypopharyngeal carcinoma by reporting the treatment modalities and results in large, unselected cohorts of consecutive patients from a university-based referral center that prefers transoral laser surgery over open surgical approaches for all head and neck cancer cases if such an approach is considered feasible and oncologically sound by the contributing surgeons at our department. It seeks to determine the proportion of all oncological cases that can be managed using a transoral approach and to describe survival, local control and organ preservation rates with endoscopic CO₂ laser surgery. The data presented in this study suggest that transoral laser surgery is no longer a treatment modality that should be restricted to highly selected patients, but may well become a major treatment option for most infiltrating laryngeal and oral carcinomas, for important subgroups of pharyngeal cancer, and for practically all carcinomas in situ and verrucous carcinoma. Additional treatment options are required for the neck if suspect lymph nodes are detectable at the time of primary treatment or if the neck is considered to be at risk for regional metastases. In light of the recent literature on treatment modalities for head and neck carcinoma, the future may bring new roles for surgery and radiotherapy: organ-sparing surgery, including transoral laser surgery, may become a more widespread approach to early-stage disease, while organ preservation programs based on sequential or concomitant chemotherapy and radiotherapy may replace surgery as the most important treatment modality in advanced but resectable stages.

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Endoskopische Laserchirurgie in der operativen Behandlung von Kopf-Hals-Malignomen

Diese Übersicht fasst die Einsatzmöglichkeiten der endoskopischen Laserchirurgie und die hiermit erzielten onkologischen Ergebnisse, die in den zurückliegenden Jahren an der Universitäts-Hals-Nasen-Ohrenklinik in Köln gesammelt wurden, zusammen. Die Untersuchung zeigt, dass die transorale Laserchirurgie heute bei der Mehrzahl der Patienten mit Kehlkopf- und Mundhöhlenkarzinomen zur Anwendung kommen kann, wenn eine operative Therapie überhaupt möglich ist. Auch für einen erheblichen Anteil aller Patienten mit Pharynxkarzinomen ist ein laserchirurgischer Zugang heute möglich. Zusätzliche Behandlungsmassnahmen, insbesondere im Bereich der Halslymphknoten, sind allerdings häufig erforderlich. Der verstärkte Einsatz der Laserchirurgie einerseits und die Entwicklung moderner Behandlungsmethoden in der Radiologie andererseits könnte auf die Dauer zu einem Paradigmenwechsel in der Kopf-Hals-Onkologie führen: Die organerhaltende, minimal invasive Laserchirurgie könnte ein allgemein üblicher Behandlungsweg für Frühstadien und lokal begrenzte Karzinome werden, während innovative Chemo- und Strahlentherapiekonzepte eine dominierende Rolle bei der Behandlung fortgeschrittener Karzinome einnehmen könnten.

Etat actuel de la chirurgie endoscopique au laser en cancérologie de la tête et du cou

Cet article rapporte l'expérience de l'Université de Cologne dans la chirurgie oncologique au laser pour les carcinomes de la cavité buccale, de l'oropharynx, du larynx et de l'hypopharynx. Il en discute la place, décrit les modalités thérapeutiques et ses résultats. Les données sont basées sur une cohorte de patients non sélectionnés, adressés à un centre hospitalo-universitaire dans lequel la préférence est donnée à la chirurgie au laser par voie transorale dans tous les cas de cancer de la tête et du cou, à condition toutefois que cette

approche soit considérée comme faisable tant sur le plan technique que sur le plan oncologique. L'article vise à déterminer la proportion de cas dans lesquels une telle chirurgie est possible, rapporte le taux de survie, le taux de contrôle local et le pourcentage de cas dans lesquels la préservation de l'organe opéré a été possible. Cette étude porte sur les cancers opérés par voie endoscopique avec le laser CO₂. Les données de cette étude suggèrent que l'utilisation du laser par voie transorale n'est plus un traitement chirurgical réservé à un nombre très restreint de patients sévèrement sélectionnés, mais peut s'appliquer à une grande majorité de cas, à quasiment tous les cancers in situ ou verruqueux, à la plupart des cancers laryngés infiltrants ou cancers de la cavité buccale, ainsi qu'à un important sous-groupe de cancers du pharynx. Pour presque tous les cas, des traitements complémentaires sont nécessaires si des métastases ganglionnaires cervicales sont détectables au moment du diagnostic ou si de telles atteintes sont considérées comme hautement probables. Au vu de la littérature récente concernant les modalités de traitement des cancers de la tête et du cou, l'avenir pourrait apporter un nouveau rôle à la chirurgie et à la radiothérapie. Une chirurgie visant à épargner les organes, comme la chirurgie par voie transorale au laser, sera toujours plus répandue pour les tumeurs détectées précocement alors qu'un programme thérapeutique visant à préserver les organes basé sur un traitement séquentiel ou concomitant de chimiothérapie et radiothérapie sera réservé aux tumeurs plus avancées, en lieu et place de la chirurgie conventionnelle.

Introduction

The treatment of oral, pharyngeal and laryngeal carcinoma (termed head and neck carcinoma in this article) is not settled to date. Primary treatment protocols for early-stage disease (stages I and II) usually include surgery or radiotherapy as single agents. Advanced stages may be treated with surgery alone, with combinations of surgery and postoperative radiation, or with radical radiotherapy and surgical salvage.

Two novel approaches to the treatment of the disease have contributed to the spectrum of therapeutic options during the past two decades: transoral laser surgery (TLS), mostly used for early-stage carcinoma, and sequential or concomitant chemotherapy and radiotherapy for organ preservation in advanced stages [1–3].

Although transoral approaches to head and neck carcinoma are certainly not new, they have long been given up for open surgical approaches that seemed more promising with regard to surgical radicality and oncological outcome. Transoral approaches were thought to be inadequate for oncological interventions because of what was believed to be limited visualization of the surgical field, bleeding, difficult manipulation, and inability to reconstruct soft tissue defects.

With technical advances in endoscopic surgery in the 1960s achieved by Kleinsasser [4] and his microlaryngoscopic technique of endolaryngeal microsurgery and the implementation of medical laser systems by Strong et al. in the 1970s [5], things gradually changed from the early

1980s onwards. Clinical pioneers like Steiner, Grossenbacher, Rudert and Motta in Europe and Vaughn, Davis in North America were then able to demonstrate that highly selected malignant lesions of the upper aerodigestive tract could now be operated on endoscopically with promising oncological and functional results [6–13].

These authors were able to show that TLS provides advantages relating to its hemostatic effects and precision of tissue ablation. They reported laser surgery to cause minimal morbidity, good functional results, and to provide a cost-effective alternative to open surgical procedures and to radiotherapy.

Therefore, TLS is now a widely used surgical approach to small glottic and oral carcinoma. Moreover, successful treatment of stage II–IV lesions of the vocal folds, the supraglottic larynx, the oral cavity, and oro- and hypopharynx have recently been reported in the literature [14–17]. While the data presented in these studies indicate that TLS leads to oncological results that are comparable with more conventional treatment modalities in selected groups of patients, the potential role of laser surgery for larger series of unselected cases has not been settled to date.

This review of the Cologne University experience with oncological laser surgery evaluates the potential role of TLS for oral, oropharyngeal, laryngeal and hypopharyngeal carcinoma by reporting the treatment modalities and results in large, unselected cohorts of consecutive patients from a university-based referral center that prefers TLS over open surgical approaches for all head and neck cancer cases if such an approach is considered feasible and oncologically sound by the contributing surgeons at our department. It seeks to determine the proportion of all oncological cases that can be managed using a transoral approach and to describe survival, local control and organ preservation rates with endoscopic CO₂ laser surgery.

Laryngeal and Hypopharyngeal Carcinoma

898 patients with previously untreated squamous cell carcinoma of the larynx and hypopharynx were seen at the Department of Oto-Rhino-Laryngology, University of Cologne, Germany, from January 1st, 1986 to December 31st, 1996. The treatment protocol for these patients included transoral laser resection of the primary cancer for lesions classified T₁/T₂ (and some supraglottic T₃/T₄ lesions) that were judged to be endoscopically accessible; conventional vertical or horizontal partial laryngectomy for these lesions if they were not completely accessible endoscopically; total laryngectomy for most lesions classified T₃/T₄, total laryngo-pharyngectomy with reconstruction of the pharynx by gastric transposition or microvascular jejunum loops, and radiotherapy for those patients not

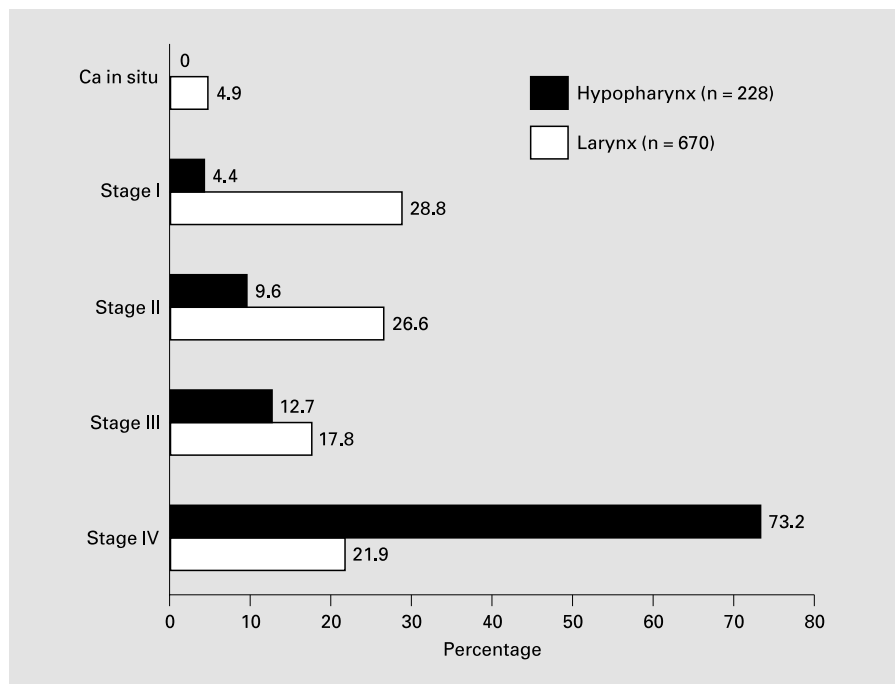


Fig. 1. Stage distribution for 898 laryngeal and hypopharyngeal carcinoma patients.

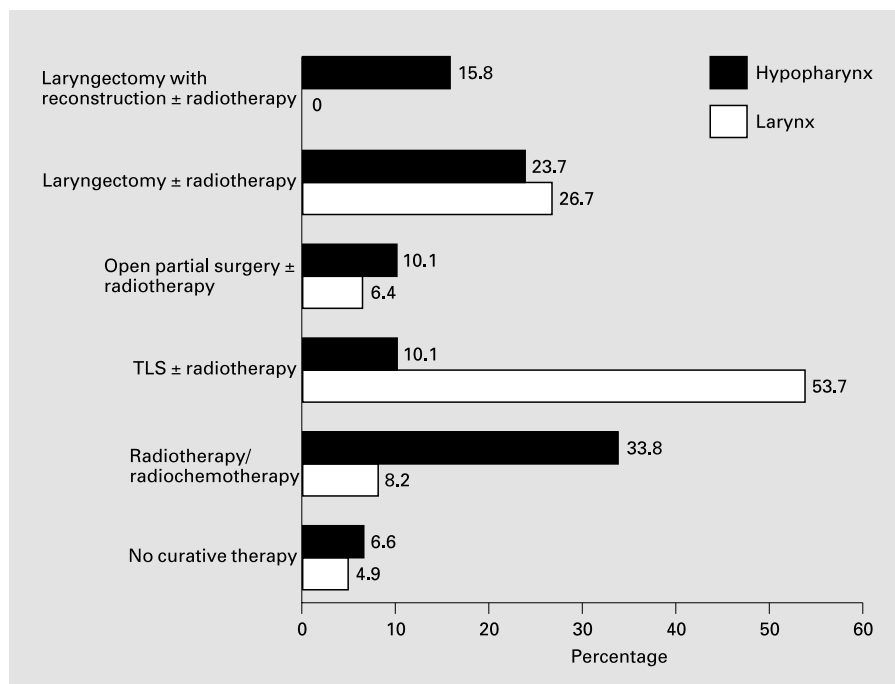
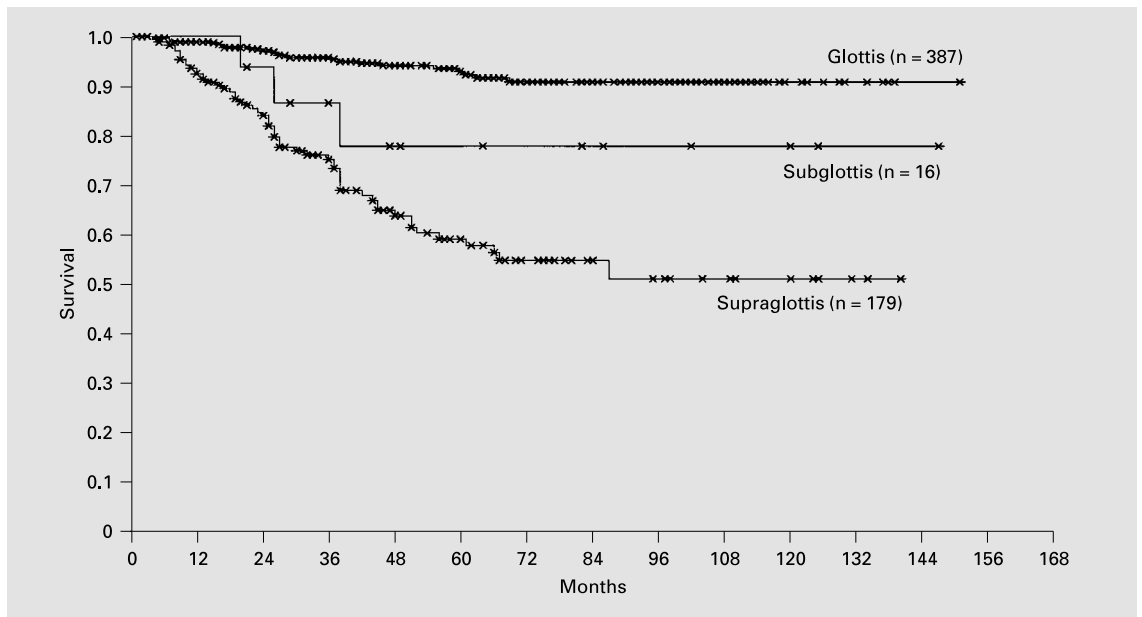


Fig. 2. Initial therapy: laryngeal and hypopharyngeal carcinoma (n = 898).

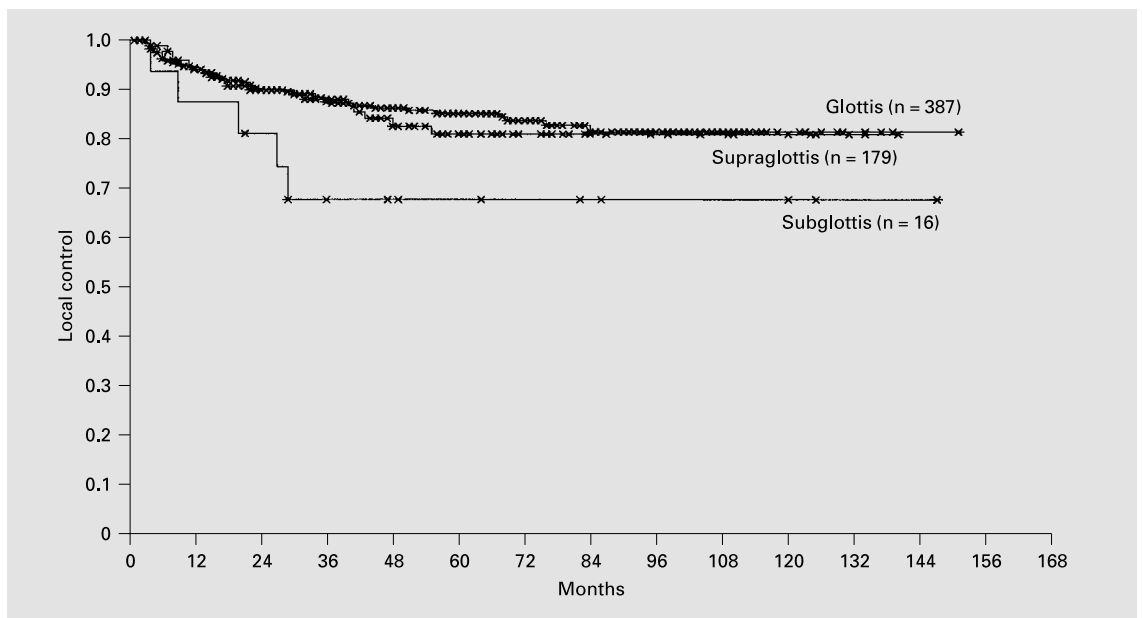
suites for, or rejecting, surgery. 228 patients were treated for hypopharyngeal lesions, 414 patients had glottic carcinoma, 239 patients had supraglottic tumors, and 17 had subglottic primaries. Details on stage distribution and initial therapy for these patients are listed in figures 1 and 2.

All patients underwent staging endoscopy of the pharynx, larynx, esophagus and oral cavity to permit detailed assessment of the tumor and to rule out synchronous coexisting primaries. Patients with clinically negative necks, as well as those with glottic primaries and clinically

negative necks were not offered additional prophylactic treatment for the cervical lymph nodes. Patients with T₃/T₄ glottic cancer were offered elective or therapeutic unilateral neck dissection on the involved side. Patients with supraglottic, subglottic or hypopharyngeal tumors, regardless of the extension of the primary tumor, were offered bilateral neck dissection independent of the kind of surgical procedure used to treat the primary. If open surgical procedures were performed, then neck dissections (ND) were performed synchronously. If transoral



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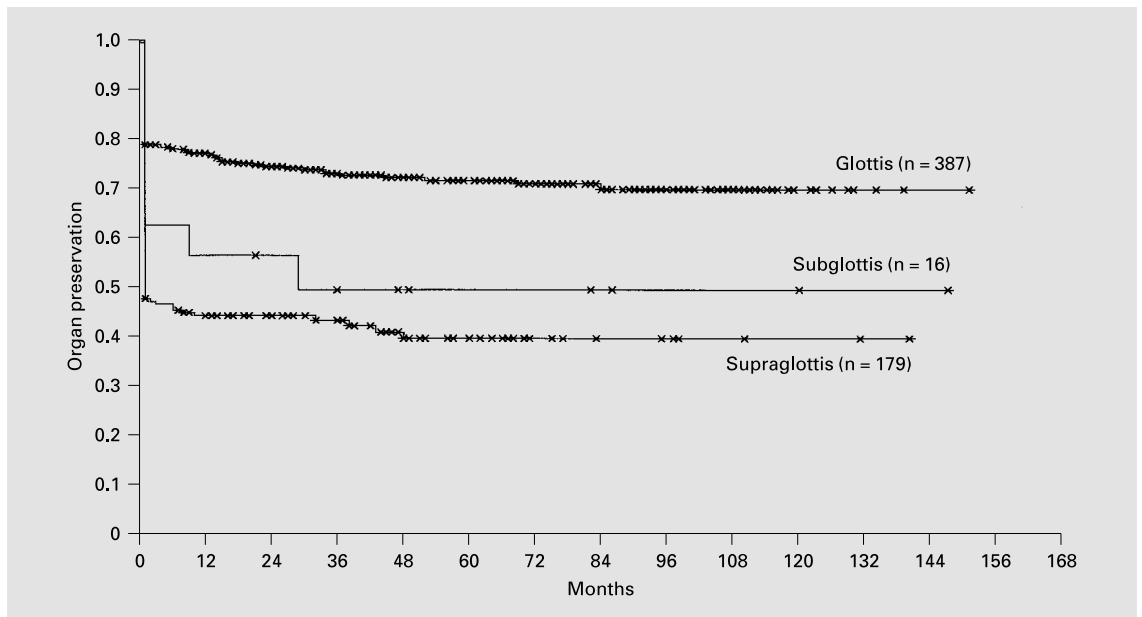
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Fig. 3. 582 larynx carcinomas treated with surgery ± postoperative radiotherapy: disease-specific survival.
Fig. 4. 582 larynx carcinomas treated with surgery ± postoperative radiotherapy: local control.

Table 1. Treatment results after 5 and 10 years for 637 laryngeal cancer patients treated for cure

	5-year overall survival rates ¹	5-year disease-specific survival rates ¹	5-year local control rates ¹	5-year organ preservation rates ¹
Laryngeal cancer patients treated for cure (n = 637)	57.1 (34.7)	77.3 (73.9)	79.2 (75.9)	62.7 (60.7)
Glottic (n = 405)	65.9 (40.0)	90.9 (88.9)	84.0 (79.5)	71.7 (69.0)
Supraglottic (n = 216)	39.5 (24.0)	51.9 (45.0)	69.7 (69.7)	45.7 (45.7)
Subglottic (n = 16)	72.7 (43.6)	77.9 (77.9)	67.7 (67.7)	49.2 (49.2)
Hypopharyngeal cancer patients treated with surgery ± radiotherapy (n = 136)	39.5 (39.5)	58.1 (58.1)	66.3 (63.4)	25.9 (n.d.)

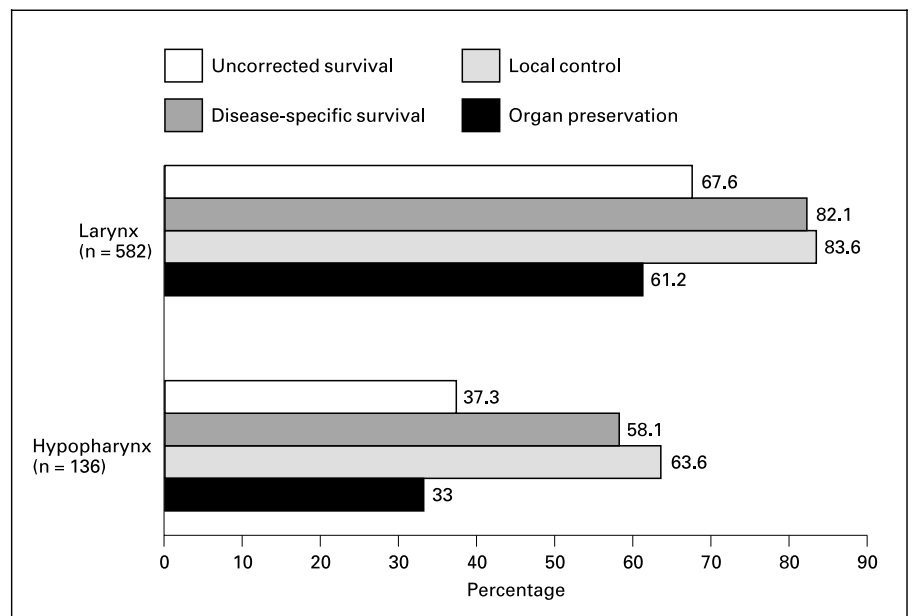
¹ Figures in parentheses refer to results after 10 years. n.d. = Not determined.



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Fig. 5. 582 larynx carcinomas treated with surgery ± postoperative radiotherapy: organ preservation.

Fig. 6. Treatment results after 5 years: patients with surgery ± radiotherapy.



6

procedures were chosen to treat the primary, then ND were staged for 2 weeks. Additional postoperative full-course radiotherapy was administered to the site of the primary and both sides of the neck for patients with T₄ lesions and for those with histologically proven lymph node metastasis.

The surgical technique for the transoral approach to early-stage larynx carcinoma used throughout this study has previously been described in detail. Therefore, only a short outline of the surgical procedures used for this study shall be given here. The surgical laser was always coupled to a Zeiss operating microscope and was generally set to an output power of 2–5 W in the superpulse mode at a spot size of approximately 0.5–0.8 mm². All patients were

intubated transorally for surgery except for those who had preexisting tracheostomy. Different laryngoscopes, including bivalved adjustable laryngoscopes as described by Steiner et al. [1], were used to expose the larynx.

Figure 2 illustrates that transoral laser surgery with or without ND and/or postoperative radiotherapy accounted for more than 50% of all treatment modalities in laryngeal cancer patients, but only for 10% in patients with hypopharyngeal carcinoma. Treatment results for all laryngeal cancer patients are summarized in table 1 and in figures 3–6. Results for the subgroup of patients treated with TLS for early stage (stages I, II, and Ca in situ according to UICC) are given in table 2. Results for the subgroup of hypopharyngeal cancer patients treated with

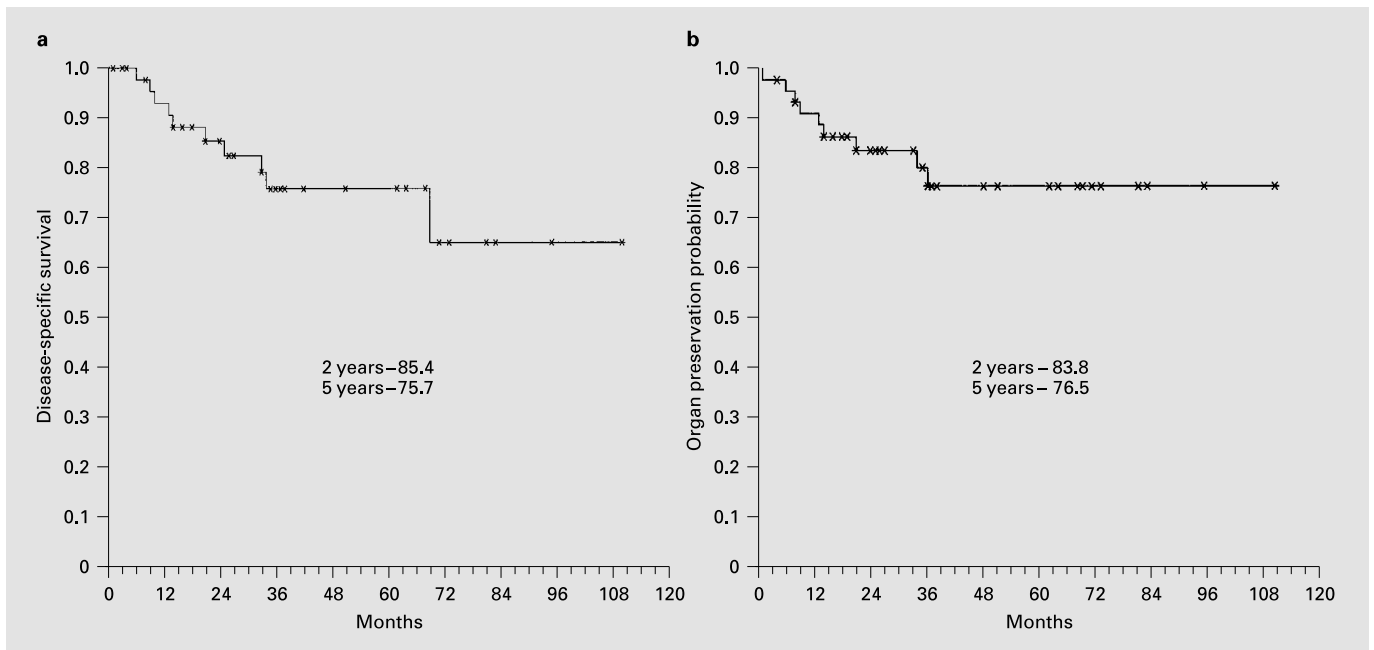


Fig. 7a, b. 46 hypopharyngeal carcinomas with organ-sparing surgical treatment ± radiotherapy.

Table 2. Actuarial 5-year overall survival, cause-specific survival, local control, ultimate local control, regional control, and laryngeal preservation rates for 285 patients treated with laser surgery for early-stage glottic carcinoma

	n	Overall survival	Cause-specific survival	Local control	Ultimate local control	Regional control	Larynx preservation
T _{is}	31	85.9	100.0	93.5	100.0	100.0	100.0
T ₁	161	69.7	98.5	86.5	98.2	99.1	93.9
T ₂	93	67.9	98.2	82.0	98.4	96.7	93.1

Data adopted from Eckel et al. [18].

organ-sparing procedures are condensed in figures 7a and b (n = 46; 23 were managed with open partial surgery and 23 with transoral laser surgery).

Oral and Oropharyngeal Carcinoma

Transoral surgical resection of malignant lesions of the oral cavity and oropharynx was formerly widely used prior to common usage of composite resection for tumors of these regions. Currently, transoral resection of oral and oropharyngeal carcinoma is generally believed to be indicated for the treatment of verrucous cancers and small epidermoid carcinomas in the absence of metastatic lymph nodes. However, such treatment is thought to be inadequate for more advanced carcinomas or tumors with

clinically positive or suspected occult lymph node metastases. In such advanced disease, an extraoral approach permits excellent exposure of the tumor, en block resection of the primary with the regional lymph nodes and the intervening lymphatics, and immediate reconstruction of the surgical defect.

In recent years, transoral resections of oral and oropharyngeal malignancies have gained new importance by the introduction of the CO₂ surgical laser. Functional results following TLS have been reported to be excellent. However, the advantages of the laser as a cutting instrument do not solve the problem of potential or obvious neck metastases in the treatment of oral and oropharyngeal tumors. As the cervical nodes cannot be controlled by transoral surgery, regardless of the surgical tool that is employed to ablate the tumor, there seems to be marginal

usage for laser surgery in the treatment of oral and oropharyngeal malignancies at risk to spread regionally. To date, the decision on how to treat these various forms of the disease is usually one between radiotherapy with salvage surgery if necessary and radical extraoral surgery with postoperative radiotherapy. An alternative surgical concept is transoral resection of the tumor and discontinuous, synchronous or asynchronous ND. Only limited and controversial data on this concept have been published so far.

At our department, patients presenting with oral/oropharyngeal carcinoma are considered candidates for a transoral procedure if they meet the following criteria:

(1) sufficient health to permit for repeated surgery under general anesthesia;

(2) adequate tumor exposure, i.e. accessibility of tumor site, absence of trismus, micrognathia or cervical spine deformities;

(3) absence of bone invasion as judged from the clinical aspect, conventional X-rays or CT scanning. If bone invasion of the tumor was apparent, an external approach to the tumor was chosen and segmental mandibulectomy was performed. Invasion of the periosteum without infiltration of the mandible was not considered to be an indication for extraoral surgery;

(4) absence of deep invasion of the primary into the cervical viscera with suspected infiltration of major cervical blood vessels. In particular, advanced tonsillar carcinomas were excluded because of potential injury to the internal carotid artery. If such infiltration was obvious from the clinical findings and preoperative CT scans, an extraoral approach to the primary was chosen and the surgical defect closed with a myocutaneous pectoralis flap or a microvascular flap, and

(5) resectability of apparent cervical metastases on physical examination and CT scanning. ND is based on the presence of infiltrating carcinoma, regardless of stage, likelihood of occult cervical metastases or apparent cervical adenopathy. Patients with superficial carcinoma, who are judged not to be at risk to develop cervical metastases, were not included in this study. If lymph node metastases were judged to be unresectable due to infiltration of the common or internal carotid artery, prevertebral fascia or superior mediastinum, no surgical treatment of the primary tumor was performed even if the primary seemed amenable to surgical treatment.

Management of the Primary Tumor

All of the transoral resections are performed under general anesthesia. The CO₂ laser is used coupled with a Zeiss operating microscope with a 300-mm lens allowing for precise coaxial delivery of both the helium-neon aiming beam and the CO₂ cutting beam to the operative field. The microscope laser head and the operating table were

positioned repeatedly to give optimal exposure of the surgical field. Larger vessels that could not be coagulated by the laser were managed by monopolar or bipolar cautery or ligation. If minor diffuse hemorrhage was noted at the end of the procedure, such wounds were covered with fibrin glue.

For soft palate, tonsil, retromolar trigone and buccal cavity carcinoma resection, a McIvor tonsil retractor is used to expose the tumor. An adjustable operation laryngoscope is used for exposure of tumors at the base of tongue. A mouth gag was used to expose tumors of the tongue and the floor of mouth. The tumor was resected en block to facilitate histologic examination of all margins.

Management of Neck Nodes

Elective treatment of the N0 neck includes limited selective or functional ND, while radical or modified radical ND were only performed for advanced nodal disease with fixation to the surrounding tissues. If the site of the primary suggests the risk of bilateral spread, e.g. in cancers of the tongue or the floor of mouth, simultaneous bilateral ND are performed. These are usually done 1–3 weeks after the resection of the primary. ND are staged to minimize the risk of fistula information.

Adjuvant Postoperative Radiotherapy

Postoperative radiotherapy is administered in patients with stage III–IV disease, and for all patients with T₄ primaries. Sixty to 67 Gy was given to the primary and 50 Gy to the supraclavicular necks. Postoperative radiotherapy is given 4–5 weeks after the initial resection of the primary tumor with the exception of 3 patients, in whom delay healing led to radiation onset 6 weeks after initial surgery.

The specific features of this concept are the following.

(1) No reconstruction of the oral or pharyngeal defect is required. The wound epithelializes from the margins of the defect by second intention. The result frequently is a surgical defect covered by normal oral/pharyngeal mucosa that may have functional advantages over transplanted full thickness skin grafts. It is noteworthy that surgical defects resulting from transoral laser resection of oral and oropharyngeal cancers are very similar, although frequently more extended, to those after simple tonsillectomy in adults. These defects are well known to heal by secondary intention without subsequent functional impairment. The findings of the functional reevaluation indicate that the same applies to oral or pharyngeal wounds after transoral laser resection.

(2) Two minor surgical interventions (transoral laser resection of primary and staged ND) replace one major procedure. Therefore, perioperative mortality is low (no patient in this series died related to tumor-directed treatment). Bleeding during these interventions is usually min-

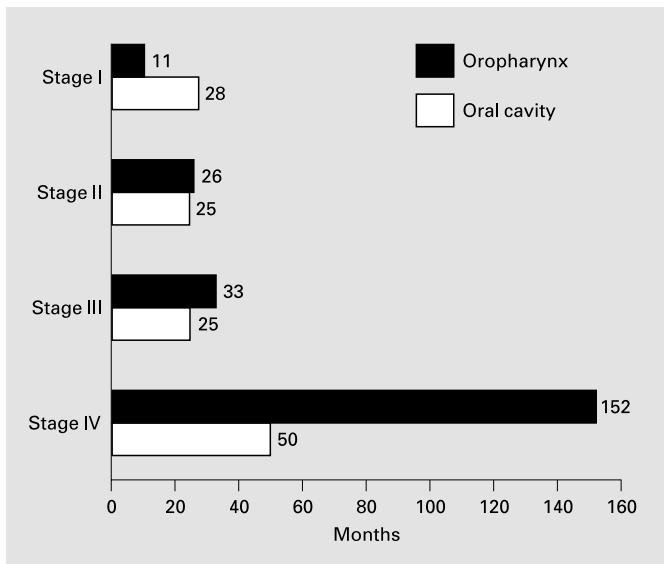


Fig. 8. Stage distribution for 350 oral and oropharyngeal cancer patients.

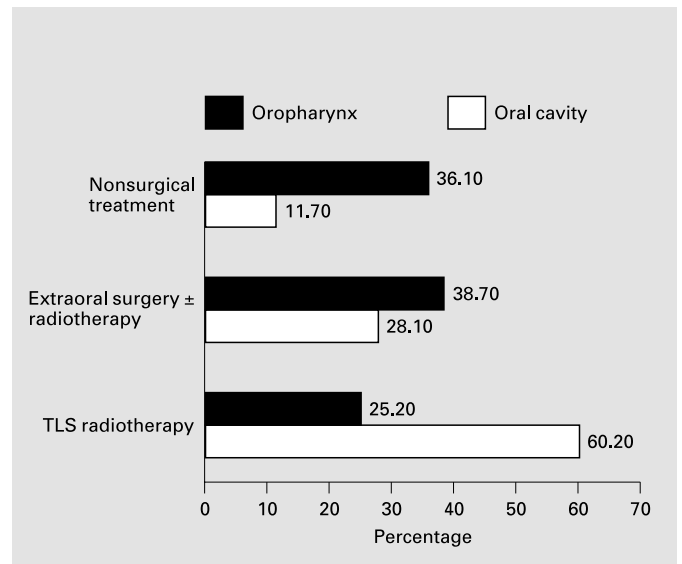


Fig. 9. Initial therapy: oral and oropharyngeal carcinoma (n = 350).

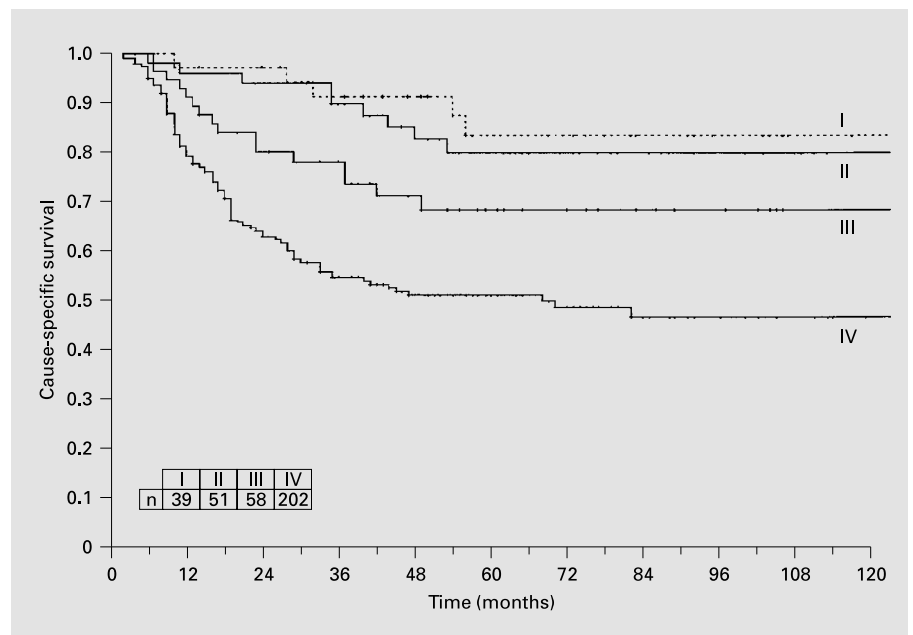


Fig. 10. 350 patients with oral/oropharyngeal carcinoma: disease-specific survival.

imal and transfusions of blood are not required as a rule. Fistula formation does not occur. Tracheotomy is not needed in combination with transoral resection of carcinoma of the oral cavity or oropharynx due to minimal swelling of anatomical structures surrounding the surgical defect. Patients can usually resume their normal diet within 1 or 2 days from surgery.

Figure 8 shows the stage distribution of 350 oral and oropharyngeal cancer patients treated for cure at our department from 1988 to 1996. Figure 9 gives details of the initial treatment modality (nonsurgical treatment ver-

sus extraoral surgery versus transoral surgery). Disease-specific survival for all 350 patients is depicted in figure 10, and local control rates for the 133 patients treated with TLS are shown in figure 11. From these data, it is obvious that laser surgery plays an important role in the treatment of oral carcinoma, where it accounts for 60% of all initial treatment modalities, while only 25% of all oropharyngeal carcinoma were suited for an endoscopic approach.

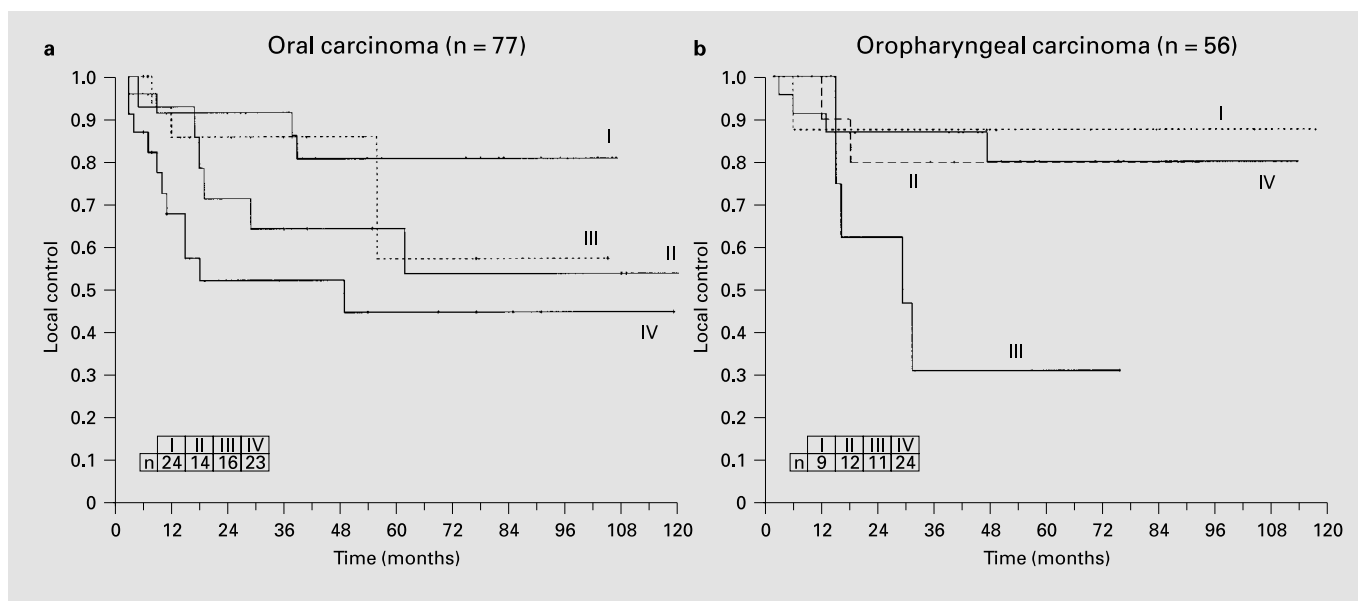


Fig. 11a, b. Local control following TLS ± ND ± radiotherapy for 133 oral and oropharyngeal cancer patients.

Discussion

TLS has some well-known advantages over open surgical procedures: tracheotomies are usually not required, perioperative morbidity is low, and hospitalization is usually short [18]. Deglutition seems to be less disturbed than after horizontal partial laryngectomy, and vocal function is usually satisfactory or good [7, 8, 19, 20]. As compared with radiation therapy, TLS is faster accomplished for the patient and is obviously more cost effective. Despite these well-known advantages, endoscopic surgery continues to be considered a treatment modality for a small number of highly selected patients only. Experimental and clinical studies have suggested that an endoscopic approach to glottic carcinoma may provide insufficient visualization of the tumor in a substantial portion of patients [21]. Only preliminary studies in the literature have so far described the relative percentage of patients with head and neck carcinoma in unselected material from one or more institutions that are suited for endoscopic laser surgery [16, 22–24]. The data presented in this study suggest that TLS may potentially become the most important single treatment modality for laryngeal and oral cavity carcinoma. These data were gained prospectively from a relatively large series of patients with sufficient follow-up to allow for oncological analysis. Survival rates, local control and organ preservation are equivalent or even superior to those previously reported for standard therapies. Therefore, the data presented here suggest that minimally invasive laser surgery is no longer a treatment modality restricted to highly selected patients, but may well become a major treatment option for

the majority of all laryngeal and oral cavity cancer cases, for a significant subgroup of all oropharyngeal carcinoma patients, and for a minority of hypopharyngeal cancers. For carcinoma in situ and for verrucous carcinoma, transoral laser surgery is now the treatment of choice [25–27].

In a recent survey on the patterns of care for cancer of the larynx in the United States, laser surgery accounted for 43.7% of all surgical interventions reported and for 24.8% of all treatment modalities during the period from 1990 to 1992, whereas it was used for only 34.2% of all surgical interventions reported and for 20.7% of all treatment modalities during the period from 1980 to 1985 [23]. These data confirm the increasing importance of TLS for the treatment of larynx carcinoma. In addition, recent reports in the literature suggest that TLS may further become an alternative approach even to more advanced stages. However, TLS has to be combined with additional treatment to the neck in supraglottic carcinoma and in more advanced glottic cases if the oncological soundness of this approach is not to be sacrificed. The treatment protocol used in this study therefore included ND for patients with stage III and IV glottic carcinoma and for all with subglottic, supraglottic, oral and pharyngeal carcinoma. Additional postoperative radiotherapy was recommended if lymph node metastases were histologically evident, or if patients refused ND that had been recommended as a part of the initial treatment protocol. Out of those 136 hypopharyngeal cancer patients found suitable for surgical treatment, only 46 could be managed with larynx-sparing procedures (20.2% of all patients and 33.8% of all patients treated with surgery). For this small portion of patients, high overall survival, disease-specific

survival, and local control rates could be achieved [28]. These data confirm previous observations that patients with early-stage hypopharynx carcinoma can be managed highly successfully in terms of survival, organ preservation and treatment-related morbidity with larynx-sparing surgery [2, 29, 30]. However, survival rates and quality of life as determined by the quality of (larynx) function preservation are invariably poor in those patients who require total laryngectomy for an oncologically sound resection of their tumor. In the present series, these patients achieved a 23.1 probability to survive for 5 years, with obviously no patient having the larynx preserved.

Options to treat recurrences after initial laser surgery are better than those after initial radiotherapy or open surgery, since wound complications as a result of previous irradiation are not encountered and the laryngeal framework is still intact. Therefore, such recurrences allow for further organ-sparing procedures if they are discovered timely [31]. However, meticulous follow-up of these patients is required, if local recurrences are to be discovered early enough for further voice-sparing therapy.

Conclusion

The data presented in this study suggest that TLS is no longer a treatment modality that should be restricted to highly selected patients, but may well become a major treatment option for most infiltrating laryngeal and oral carcinomas, for important subgroups of pharyngeal cancer, and for practically all carcinomas in situ and verrucous carcinoma. Additional treatment options are required for the neck if suspect lymph nodes are detectable at the time of primary treatment or if the neck is considered to be at risk for regional metastases [32]. In light of the recent literature on treatment modalities for head and

neck carcinoma, the future may bring new roles for surgery and radiotherapy: organ-sparing surgery, including TLS, may become a more widespread approach to early-stage disease, while organ preservation programs based on sequential or concomitant chemotherapy and radiotherapy may replace surgery as the most important treatment modality in advanced but resectable stages.

Endoscopic laser surgery has now become so widespread that the European Laryngological Society has recently worked out a classification of these endoscopic procedures to make teaching these procedures easier and facilitate a comparison of results [33]. Systematic teaching will help to maintain high oncological standards and will contribute to a wider clinical use of minimally invasive TLS. Surgical and technical innovations may further expand the clinical spectrum of laser surgery in head and neck oncology in the future [34, 35]. However, no data gained from prospective studies on the quality of voice, breathing, deglutition and patient satisfaction following different treatment modalities have so far been reported in the literature. Therefore, although the oncological soundness of laser surgery for larynx carcinoma is now well documented and the applicability of this therapeutic modality to large cohorts of unselected patients has been proven with the results of this study, further research work is needed to determine the functional outcome with respect to voice, airway patency and deglutition as compared with radiotherapy and conventional open surgery.

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Comments

D. Chevalier (France): This paper is an extraordinary overview of what can be done from an endoscopic approach. The author gives many information about the current status of this surgery.

M. Remacle (Belgium): This paper is an excellent summary of the huge experience of the school of Cologne in endoscopic laser-assisted surgery for oropharyngeal and laryngeal cancers.

If we compare the paper of Chevalier et al. [1] and of Eckel [2], we can see that both of them consider reconstructive open surgeries and endoscopic surgeries as complementary. But, of course, it is clear that endoscopic surgery is the first choice for Eckel and open neck surgery the first choice for Chevalier.

However, I still have some problems with the use of radiotherapy in the series of Eckel. The data are indeed presented with and without the use of radiotherapy and it is said at the end of page 6 that additional postoperative full-course radiotherapy was administered to the site of the primary and both sides of the neck for patients with T4 lesions, which makes sense to me, and to those with histologically proven lymph node metastasis which is more difficult to accept.

We have indeed to remember that 25% of N0 supraglottic laryngeal cancers present micrometastatic metastases. Above this, some T₂ glottic cancers can also present metastases. So, a rather important percentage of patients in these series have been irradiated on the primary tumor, which is not the case with open neck surgery. The gener-

al policy is indeed to avoid radiotherapy on the primary site after partial or reconstructive open neck surgery.

Nevertheless, after having read the paper of Chevalier and Eckel, it is obvious that the endoscopic approach is acceptable for small cancers. For more important cancers, the limit is a good exposition. More important T2 lesions involving, for instance, the anterior commissure will be treated by open neck surgery by the two authors; but we have to accept that it will remain a zone including mainly T₂ glottic cancers where Chevalier et al. [1] would prefer a reconstructive open neck surgery and Eckel [2] an endoscopic procedure.

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J.A. Werner (Germany): This review evaluates the potential role of transoral laser surgery for oral, oropharyngeal, laryngeal and hypopharyngeal carcinomas by reporting the treatment modalities and results in a large cohort of consecutive patients from the Cologne University of Medical School. Transoral laser surgery was preferred over open surgical approaches for all head and neck cancer cases, if such an approach was considered feasible and oncologically sound by the contributing surgeons at the ENT department. These included

transoral laser resection for lesions classified T₁/T₂ and some supraglottic T₃/T₄ lesions, while total laryngectomy was considered for most lesions classified as T₃/T₄ lesions. Based on the good functional oncological results Eckel summarizes that minimally invasive surgery is no longer a treatment modality restricted to highly selected patients, but may well become a major treatment option for the majority of all laryngeal and oral cavity cancer cases, for a significant subgroup of all oropharyngeal carcinoma patients, and for a minority of hypopharyngeal cancers. For carcinoma in situ and for verrucous carcinoma, transoral laser surgery is now the treatment of choice. Although I largely agree with Eckel's opinion that laser microsurgery can achieve excellent functional results and offers potential advantages over open surgery, the data presented do not allow to resume laser microsurgery as treatment of choice for all pharyngeal, laryngeal and oral cavity cancer patients. Even Eckel performed total laryngectomy for most T₃/T₄ lesions and it is out of the question that advanced cancers of the oral cavity, oropharynx or hypopharynx should be considered for conventional surgery or radiochemotherapy.

Prof. Dr. med. P. Zbären (Switzerland): There is no doubt that transoral laser surgery will become a more and more important treatment modality for head and neck carcinoma. The number of patients suitable for laser surgery is, first of all, dependent on the experience and enthusiasm of the surgeon as unequivocal criteria for laser surgery treatment are not available to date, especially for advanced-stage tumors. Not all otorhinolaryngologists who perform diagnostic microlaryngoscopy and phonosurgery are appointed to perform laser surgery for laryngeal and hypopharyngeal malignancies. If organ preservation treatment modalities (radiotherapy, radiochemotherapy, laser surgery, conventional surgery) are to be oncologically and functionally successful, the strong teamwork between the head and neck surgeon, ENT radiologist, radiooncologist and ENT pathologist is mandatory. Furthermore, one must keep in mind that organ preservation does not in all cases mean function preservation. Prospective studies are needed to analyze functional success after the different organ preservation treatment protocols.

Endoscopic Excision with CO₂ Laser for the Treatment of Glottic Carcinomas

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Key Words

Endoscopy · Larynx · Cancer · Surgery

Abstract

Endoscopic treatment of glottic carcinomas has received increasing attention since its introduction. It is an alternative to irradiation and external surgery. Despite good functional and oncological results, an endoscopic approach is not always indicated. Bad exposure of the larynx or of the tumour is the most important limitation of this technique. T1 glottic carcinomas are frequently treated by endoscopy. T2 glottic carcinomas have to be carefully evaluated before choosing the endoscopic approach. When properly indicated, oncologic results are similar with both techniques.

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Die endoskopische Exzision mit dem CO₂ Laser in der Behandlung des Glottiskarzinoms

Die endoskopische Behandlung des Glottiskarzinoms hat seit ihrer Einführung an Bedeutung zugenommen. Sie stellt eine Alternative zur Bestrahlungstherapie und zur offenen Chirurgie dar. Trotz guter funktioneller und onkologischer Resultate ist der endoskopische Zugang nicht immer indiziert. Eine schlechte visuelle Exposition des Larynx oder des Tumors ist die wichtigste Einschränkung dieser Operationstechnik. Während T1 Glottiskarzinome häufig endoskopisch behandelt werden können, muss bei T2 Glottiskarzinomen die Indikation entweder zum endoskopischen oder zum offenen Zugang sorgfältig abgewogen werden. Bei korrekter Indikationsstellung lassen sich mit beiden Techniken identische onkologische Resultate erzielen.

Traitement endoscopique au laser CO₂ des carcinomes glottiques

Le traitement endoscopique des carcinomes glottiques a connu un essor grandissant depuis les premières descriptions. Il représente une alternative au traitement par irradiation et chirurgie externe. Malgré de bons résultats fonctionnels et oncologiques, l'approche endoscopique n'est toutefois pas toujours indiquée. Une mauvaise exposition du larynx ou de la tumeur représente la limitation la plus importante de cette technique. Les carcinomes glottiques T1 sont fréquemment traités par endoscopie, mais les T2 doivent être évalués attentivement avant de choisir l'option thérapeutique, endoscopique ou par chirurgie classique. Les résultats oncologiques sont identiques avec les deux techniques lorsque les indications sont correctement posées.

Endoscopic treatment of vocal cord cancer is not a new concept but became more popular after the medical application of the CO₂ laser [1]. External radiotherapy, laryngofissure, and endoscopic excision are the commonly used options for the treatment of T1 glottic carcinomas. External partial laryngectomy and radiotherapy are the conservative treatment modalities advocated for the treatment of T2 glottic carcinoma, particularly in case of impaired motion of the true vocal cord. The increased accuracy of computerized tomography (CT) and endoscopy to assess the extent and depth of the tumour have made possible the principle of safe endoscopic excision.

Initial Work-Up and Technical Rules

Laryngeal carcinomas must be carefully assessed before decision making using physical examination, imaging and endoscopy. Vocal cord mobility and laryngeal function should be carefully assessed. Laryngeal invasion with limited mobility suggests more advanced disease and is significant, and must be considered at the time of therapeutic decision.

At the moment, CT [2] is the most useful imaging method used. The goal of CT is to make accurate the local and the neck extension in addition to the clinical evaluation. CT is preferably performed before endoscopy and biopsy to avoid inflammation, which may result in an overestimation of the tumour infiltration. The advantage of CT is to provide a map of the local extension of the tumour and to determine the tumour thickness and invasion to the contiguous structures. Anatomopathologic studies of serially sectioned laryngeal specimen have revealed that impaired motion of the vocal cord resulted from a paraglottic space invasion with extensive involvement of the thyroarytenoid muscle [3, 4]. It confirms that CT, by studying the tumour and its extensions, is an important tool. Direct endoscopic examination is performed under general anaesthesia. It is conducted with rigid telescopes to improve the quality of the mucosal assessment particularly in case of a small tumour. It is an indispensable diagnostic tool and has several goals: it allows multiple biopsies for histological examination, and provides an accurate evaluation of superficial tumoural spread. Finally, the systematic examination of the entire oral cavity, the oropharynx, the nasopharynx, the larynx, and the oesophagus allows detection of synchronous cancers.

Endoscopic excision is possible when the tumour is visible. That means that the safety of excision depends on the quality of exposure of the larynx and suspension laryngoscopy is the best technique. Many laryngoscopes are at our disposal with different shapes and sizes. Other important points are the anatomy of the mandible, the dentition, the tongue base, and the cervical spine. Endoscopic cordectomy is performed with the knowledge of the exact local extension of the tumour and according to the European Laryngological Society (ELS) classification [5]. By using this nomenclature, the aim is to better understand each surgeon's technique and to compare the results more rigorously [6]. The surgeon must always keep in mind that some patients are not eligible for endoscopic excision of glottic cancer because exposure is not satisfactory. In such cases, external surgery is a reasonable alternative to avoid incomplete resection of the tumour.

T1 Glottic Cancer

Early diagnosis, easy exposure, and low frequency of lymph node invasion lead to endoscopic treatment of glottic carcinomas. There is a general consensus to accept endoscopic treatment as one of the recommended treatments of T1a and T1S glottic tumour [6]. Therefore, it includes a large spectrum of lesions and is not only a small and exophytic tumour of the mid-true vocal cord.

Local control rates after CO₂ laser endoscopic excision are good, and frequently over 90% [7, 8]. The most important limitation is anterior commissure (AC) involvement. At the level of AC, there is no perichondrial barrier to prevent tumour extension to the thyroid cartilage. The very limited thickness of the tissues is another limitation for the safe removal of the lesion. Endoscopic resection of glottic tumours involving AC has been classically controversial. For some authors, there is a high risk of failure [9], and for others, there is no impact [10]. Like Peretti et al. [7] and Remacle et al. [5], we think that endoscopic treatment is limited to selected cases of AC cancer superficially spreading at the level of the glottis without deep extension.

T2 Glottic Cancer

Such tumours are not strictly confined to the true vocal cord and/or can be associated with impaired mobility. Initial work-up is important to determine as precisely as possible the local extension. The paraglottic space is susceptible of invasion and this is the reason why we advocate for a complete resection with free margins. It is also indispensable to get an excellent exposure of the glottis.

T2 glottic carcinomas are often treated with total cordectomy (type IV of the ELS classification) or extended cordectomy (type V). That means that false vocal cord or arytenoid or ventricular fold can be resected. If the exposure is not adequate, external surgery is the logical choice, in order to maintain a high local control rate.

From time to time, results in the literature are similar comparing external and endoscopic approaches. Five-year survival occurs between 75 and 85% with both techniques, with an acceptable local recurrence rate [11, 12]. De Campora et al. [13] in a retrospective study of 573 patients comparing the two approaches found that oncological results were similar in the two groups. They also concluded that, in case of local recurrence, the endoscopic group showed better possibilities of salvage. That means that CO₂ laser endoscopic treatment of T2 glottic carcinomas is feasible, but it requires a severe selection of the patients and of the tumours. External partial surgery including anterior frontal laryngectomy and supracricoid laryngectomy is an adequate and safe alternative.

Functional Results

Its is frequently reported that endoscopic treatment is associated with swallowing without aspiration except when the arytenoid cartilage is removed. The quality of voice is different and depends on the type of cordectomy.

Persistent dysphonia is frequent after cordectomy and the result is well evaluated after 6 months.

In conclusion, endoscopic treatment of glottic carcinomas is not a new surgical technique anymore and it is safe and effective.

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Comments

H. Eckel (Germany): The authors of this paper have pioneered, together with Professor Piquet at the University of Lille, France, innovative open surgical techniques for the treatment of glottic, supraglottic and hypopharyngeal carcinomas. Therefore, it is especially interesting to learn more about their indications for laser surgery in the treatment of laryngeal carcinomas.

They conclude from their large clinical experience that laser surgery is safe and effective if patient selection is optimized to choose among different surgical options. This is a clear confession from a group of highly experienced physicians who have worked hard on open surgical procedures. It should likewise be an attractive concept to those clinicians who usually prefer endoscopic laser surgery to incorporate advanced open procedures into their surgical spectrum. Departments of head and neck surgery with a special interest in oncological surgery now need to have access to both contemporary open techniques, to minimally invasive transoral laser surgery, and to innovative radio-oncological concepts.

Chevalier et al. interestingly address voice quality following transoral laser surgery. It would have been interesting to learn more on their approach to voice improvement following oncologically successful treatment of laryngeal carcinomas. Clearly, further prospective studies will be needed to determine the functional outcome of open and endoscopic techniques, especially regarding voice, airway, and deglutition.

M. Remacle (Belgium): This manuscript is a good summary of the general concept of laryngeal cancer treatment at the department of Professor Chevalier in Lille, France. It also summarizes the general trends in France. No personal data are presented. The proposed rules for treatment are carefully chosen and we can certainly agree on them. The manuscript is based on what might be called classical literature on the topic.

J.A. Werner (Germany): In their report of endoscopic excision with CO₂ laser for the treatment of glottic carcinomas, Chevalier et al. point out that despite good functional and oncological results, the endoscopic laser microsurgical approach is not always indicated. The authors emphasize bad exposure of the larynx or of the tumour to be the most important limitation of this technique. This especially applies to T2 glottic carcinomas, which have to be carefully evaluated before choosing the endoscopic approach. Additionally, I would like to point out that less experience of the laser surgeon, especially in the case of T2 glottic carcinomas, induces a higher risk of complications. Well exposable T1 glottic carcinomas are often considered as interventions for beginners. The comparably rarer T2 glottic carcinomas, however, can be much more difficult to be resected with laser surgery. For this reason, the majority of cases should be performed by experienced laser surgeons.

P. Zbären (Switzerland): No comment.

Laser Surgery for T2 Glottic Carcinoma

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Key Words

T2 glottic carcinoma · Laser surgery · Squamous cell carcinoma

Abstract

Background: Surgical therapy for T2 glottic carcinoma still is a topic of controversial discussion. The value of laser therapy in this stage of disease is difficult to determine due to selection bias. Data of comparative analyses have usually been collected from retrospective studies which are more prone to selection bias. **Patients and Methods:** A total number of 14 patients suffering from T2 glottic carcinoma were treated by transoral laser microsurgery. **Results:** During the median follow-up of 24 months, 2 patients developed recurrent disease in the anterior commissure, and 12 patients remained free of disease. **Conclusion:** Endoscopic laser therapy should be considered after weighing up the indication thoroughly. The sometimes extremely difficult conditions in transoral laser surgery are tightly bound to the experience of the operating surgeon and in cases of doubt, conventional partial laryngectomy should be preferred.

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Laserchirurgie für T2-Glottiskarzinomen

Fragestellung: Die chirurgische Therapie von T2-Glottiskarzinomen ist nach wie vor Anlass kontroverser Diskussionen. Daten retrospektiv erhobener Vergleichsanalyse erschweren aufgrund des zu erwartenden Selektionskriteriums die Analyse des Stellenwertes der Lasertherapie bei diesem Tumorstadium. **Patienten und Methoden:** 14 Patienten mit einem T2-Glottiskarzinom wurden einer transoralen lasermikrochirurgischen Resektion unterzogen. **Ergebnisse:** Über einen mittleren Beobachtungszeitraum von 24 Monaten entwickelten 2 Patienten ein Rezidiv im Bereich der vorderen Kommissur.

sur. Zwölf Patienten sind tumorfrei. **Schlussfolgerung:** Die teilweise erheblich erschwerten Resektionsbedingungen bei der endoskopischen Lasertherapie erfordern eine strenge Indikationsstellung zur Lasertherapie, die unmittelbar an die Erfahrung des Operateurs gebunden ist. Im Zweifelsfall ist eine offene Resektion von aussen zu favorisieren.

Chirurgie au laser des carcinomes glottiques de stade T2

Introduction: Le traitement chirurgical des carcinomes épidermoïdes T2 de l'espace glottique reste un sujet de discussion controversée. Actuellement, le bénéfice de la chirurgie au laser est à déterminer en raison des critères de sélection variables d'une étude à l'autre. La plupart des publications sont basées sur des données rétrospectives, particulièrement sujettes au biais de sélection des patients. **Patients et méthodes:** Dans cette série, 14 patients souffrant d'un carcinome de l'étage glottique classé T2 ont été traités par micro-chirurgie au laser, par voie trans-orale. **Résultats:** Avec un recul moyen de 24, 12 patients sont libres de récurrence et 2 ont développé une récurrence tumorale au niveau de la commissure antérieure. **Conclusion:** Une chirurgie au laser par voie endoscopique ne peut être envisagé qu'après une évaluation soigneuse des indications. Les conditions souvent très difficiles de ce type de chirurgie, l'accès à la lésion n'étant parfois pas aisé, requièrent beaucoup d'expérience de la part du chirurgien. En cas de doute, une chirurgie du larynx partielle et conventionnelle est préférable.

Introduction

Laser surgical therapy of laryngeal carcinoma may be performed with different intentions. Indications for this type of therapy are, among others, the curative resection of tumors, resection of recurrent tumors following primary radiation therapy and debulking of tumors, which threaten to compromise the airways. The aim of laser tumor debulking usually is to prevent tracheotomy [1].

In view of the functional results as well as with regard to the 5-year survival rate, early glottic laryngeal carcinomas belong to the tumor locations of the upper aerodigestive tract, which can be treated with greatest success. The different treatment options include conventional surgical resection, laser surgical resection or primary radiotherapy. Well-documented investigations showed high rates of local control and good 5-year survival rates [2–9].

Since the introduction of laser surgical treatment strategies into the concept of oncologic therapy of early glottic cancers, the question has arisen whether laser therapy is also of value in more advanced stages of the disease, e.g. in T2 glottic carcinoma. In the attempt to answer this question, various studies have been performed in the past, usually in a retrospective study design [2, 5, 10, 11]. The results of these studies have shown that the rate of recurrent disease following laser surgical resection of T2 glottic carcinoma is slightly less compared with primary radiotherapy and conventional surgical resection. When analyzed critically, the fact could not remain unnoticed that the retrospective study design and the connected selection bias could have had an influence on the results of these publications.

If the manifold literature to surgery of T2 glottic carcinoma is reviewed, it soon comes to mind that the respective number of investigated patients in T2 glottic carcinoma is relatively low when compared with T1 and T3 carcinoma. This observation might be explained by the fact that it seems to be more difficult to define the correct stage of T2 glottic carcinoma as compared with T3 glottic carcinoma. With this background, discussions about therapy of T2 glottic carcinoma should be a reminder of the difficulties in defining the correct T stage. The subclassification, which has been inaugurated by Kleinsasser and Glanz [12], should not be omitted in this context. Kleinsasser and Glanz staged glottic carcinomas with a size ranging from 15 to 25 mm as T2a carcinomas, and carcinomas exceeding 25 mm in size were staged as T2b glottic carcinomas. The above-mentioned subclassification, however, has so far only been taken into account in a few publications [9, 14].

The current investigation was performed according to the suggestion of Kleinsasser and Glanz, i.e. differentiating between T2a and T2b carcinomas.

Patients and Methods

Since 1998, a total number of 19 newly diagnosed patients were staged to suffer from T2 glottic carcinoma. In the meantime, they had had a follow-up of at least 6 months. Two patients were treated by primary radiochemotherapy. This type of therapy was deliberately chosen by both patients once they had been informed about the nature of their disease and the different treatment options. Open partial resection of the larynx was indicated in 3 patients because the anterior commissure had been affected by the disease and endoscopic exposure of the anterior commissure did not allow reliable transoral laser resection.

Fourteen previously untreated female ($n = 2$) and male ($n = 12$) patients (51–79 years, mean: 56 years) with squamous cell carcinomas of the glottis, all staged as T2N0M0 were treated by endoscopic CO₂ laryngeal laser surgery. Further details are summarized in table 1.

Subclassification of T2 glottic carcinomas revealed in 9 patients a T2a and in 5 patients a T2b glottic carcinoma. Median follow-up time was 24 months (range: 8–40 months).

The CO₂ laser was exclusively used as a dissecting device. While small carcinomas could be excised in one portion, larger tumors usually had to be divided and resected in two or more portions. Despite opposing conventional oncosurgical principles, the dissecting characteristics of the CO₂ laser allow this surgical approach (focus diameter of 0.25 mm and low laser power of 1–2 W, energy density: 2,000–4,000 W/cm²). The use of an operating microscope allows to distinguish between the margins of the tumor and healthy tissue on the surface of the incision. This special feature of laser microsurgery combined with the hemostatic capacity of CO₂ laser enable the surgeon to remove the tumor in two or more portions. Excised specimens are reassembled and pinned to a cork plate. The deep resection margin is marked with blue dye to allow precise histological evaluation. Additional biopsies can be obtained from the remaining operative field and be examined immediately by frozen sections.

Results

In all patients, the glottic carcinoma could be entirely resected with histologically confirmed clear margins. Prior to the operation, patients were carefully examined whether endoscopic resection was feasible. Only patients with good exposure of the glottis were scheduled for endoscopic surgery. All patients had been stages N0 by clinical examination and ultrasound. Elective neck dissection was therefore not performed.

On endoscopic exposure of the primary tumor during laser resection, 4/9 patients with a T2a glottic carcinoma showed involvement of the anterior third of the vocal cord, 2/4 with supraglottic and 2/4 with subglottic extension, once with involvement of the anterior commissure. Two patients suffered from a carcinoma of the anterior and middle third of the vocal cord with supraglottic extension. Two patients had a carcinoma of the middle and posterior third of the vocal cord, 1 with supraglottic and 1 with subglottic extension. The remaining patient showed a carcinoma of the anterior commissure with invasion of the subglottic region and the vocal cords.

Table 1. Patient data and results

Gender	Age years	TNM	Tumor location (vocal cord)	Follow-up months	Local recurrence, time
M	54	T2aN0M0	anterior third with involvement of the anterior commissure and subglottic space	8	tumor free
M	64	T2aN0M0	middle and posterior third with supraglottic extension	9	tumor free
M	55	T2aN0M0	anterior and middle third with subglottic extension	17	tumor free
M	65	T2aN0M0	anterior third with supraglottic extension	25	tumor free
F	79	T2aN0M0	anterior and middle third with supraglottic extension	29	tumor free
M	51	T2aN0M0	middle and posterior third with subglottic extension	31	tumor free
M	50	T2aN0M0	anterior third with supraglottic extension	33	tumor free
M	79	T2aN0M0	anterior third with subglottic extension	38	tumor free
M	66	T2aN0M0	anterior commissure with involvement of the vocal cords and the subglottic space	40	anterior commissure, 11 months postoperatively
M	55	T2bN0M0	anterior and middle third with involvement of the anterior commissure and supraglottic extension	13	tumor free
F	54	T2bN0M0	middle and posterior third with involvement of the arytenoid cartilage and subglottic extension	18	tumor free
M	56	T2bN0M0	anterior and middle third with involvement of the anterior commissure and supraglottic extension	26	anterior commissure, 8 months postoperatively
M	65	T2bN0M0	anterior and middle third with supraglottic extension	28	tumor free
M	62	T2bN0M0	middle and posterior third with supraglottic extension	35	tumor free

In 3/5 patients with a T2b glottic carcinoma, the clinical finding involved the area of the anterior and middle third of the vocal cord with supraglottic extension; 2 of these patients had additional involvement of the anterior commissure. Two other patients suffered from a carcinoma of the middle and posterior third of the vocal cord; 1 of them with supraglottic extension. The other patient showed involvement of the arytenoid cartilage of the affected side with subglottic extension.

The postoperative follow-up was an uneventful healing process; especially no postoperative hemorrhagic, delayed wound healing or edema with stridor was observed. None of the patients was tracheostomized for safety reasons. The patient with an involvement of the arytenoid cartilage underwent a removal of this structure. Postoperatively, he complained about slight aspiration which occurred when drinking liquids. This symptom resolved within 3 weeks without any specific therapy.

According to the date of diagnosis, the follow-up was of varying extent (mean follow-up: 24 months). Within the follow-up period, 2/14 patients developed local recurrence. In 1 patient, the initial tumor was a T2a glottic carcinoma of the anterior commissure infiltrating the vocal cord and the subglottic space. The patient developed local recurrence of the anterior commissure after a disease-free interval of 11 months. He was treated by frontolateral partial laryngectomy with histologically clear margins. The patient has now been disease-free for a period of 29 months after the initial diagnosis.

The second patient with recurrent disease initially suffered from T2b glottic carcinoma of the middle and anterior third of the vocal cord with supraglottic extension. Furthermore, the tumor had contact to the anterior commissure. After a disease-free interval of 8 months, the patient developed a limited local recurrence in the area of the anterior neoglottis and the anterior commissure, which could be resected by laser surgery with clear histologic margins. The patient has now been free of disease for 16 months since initial diagnosis.

None of the patients showed any signs of lymphogenic or distant metastatic spread during follow-up in the oncologic clinic. None of the patients expired throughout the follow-up due to tumor-related disease or concomitant disease. However, it must be mentioned that the median follow-up period is relatively short.

All of our patients had satisfactory restoration of the voice within half a year after laser surgical resection of the primary tumor. Voice restoration was established by speech therapy and enabled every patient to return to his/her normal social life and occupation.

Discussion

Laser surgical resection of early glottic cancers nowadays is a treatment strategy which is practiced in many centers. Early glottic cancer may be resected transorally with safe histologic margins, especially if the anterior commissure is not affected by the disease. Transoral laser

surgery is more difficult if the anterior commissure is involved or in cases of larger carcinomas, e.g. T2 glottic carcinoma.

Endoscopic resection of more advanced glottic cancers still is a matter of discussion because it is sometimes difficult to excise the tumor in a single portion. In certain cases, a resection of the tumor in several portions makes the resection more feasible and increases the safety of complete resection. This rather unconventional technique as it may seem from the oncologic point of view is feasible due to the specific tissue reaction to CO₂ laser radiation [9, 13–15]. For a long time, laser microsurgical treatment of T2 glottic carcinomas has been the central point of interest only in a few studies. In most of the publications, the results of conventional surgical therapy through an external approach were compared with the results of endoscopic laser therapy [10, 11, 16–18]. Due to the fact that these studies were usually performed in a retrospective study design, there was always a debate about selection bias. There were hardly any prospective randomized trials with an arbitrary distribution of the patients into the laser surgical or conventional surgical treatment group. Such a randomization seems to be problematic in the heterogeneous group of T2 glottic carcinoma. Factors like extent of the carcinoma, or feasibility of transoral exposure of the operation field basically influence the decision for the respective treatment strategy in such a way that randomization does not seem to be justified in certain situations. With this background, we would first like to discuss the criteria which will primarily make the treatment groups comparable. The presented analysis of transoral laser microsurgical treatment results in T2 glottic carcinomas was initiated to answer this question among others.

Difficult exposure of tumors of the anterior commissure often lead to open partial resection [19] as it could be shown in the past as well as in the present study. However, it could not be avoided that local recurrence occurred more often in groups that were treated by laser surgery [7, 10, 11, 20]. It is interesting to notice that recurrent disease in cases of open partial resection most often occurs in the middle and posterior third of the vocal cord [21]. This phenomenon may be explained by the mostly better exposure of the posterior glottic region in the transoral approach.

The result of increased relapses following laser surgery of the anterior commissure might be explained by the following facts. First of all, the transoral approach in itself makes the adequate exposure of the anterior commissure difficult, especially in patients with narrow prominent larynges. Sometimes the laser beam cannot dissect the tissue in the preferred vertical direction for the above-mentioned reasons, but rather in a tangential spread into ossified areas of the thyroid cartilage along Broyles' tendon or

along blood vessels which perforate into ossified thyroid cartilage. Recurrent disease in some cases can hardly be prevented if the carcinoma has infiltrated the thyroid cartilage, even if the infiltration is only superficial. Both factors – poor endoscopic exposure and involvement of the anterior commissure – may explain why laser surgery of carcinomas of the anterior commissure may be the second best surgical solution compared with open partial resection. This statement, however, holds true if the experience of the laser surgeon is taken into consideration. In some situations, it seems to be mandatory to perform a resection of cartilage which may be difficult in a laser surgical setting.

A critical review of the literature shows that so far, no truly valid data exist which allow a critical comparison between patients who were treated by conventional surgery and those treated by laser surgery free of selection bias. A prospective randomized trial with a representative number of patients seems to be desirable as a basis for comparative analysis with regard to the optimized treatment of T2a and T2b carcinomas.

The above-mentioned wish for a prospective, multicentric trial is often expressed without critically questioning the accompanying difficulties of such a trial. At present, such a plan would be bound to failure from the very beginning with regard to the aim of a study as discussed above. Laser surgery for difficultly accessible laryngeal carcinoma requires an enormous amount of experience with this technique and is thus a factor which can hardly be standardized as a criterion of quality of the operating surgeon.

Basically, it can be stated that the vast majority of T2 glottic carcinomas can be resected by very experienced surgeons by laser surgery. Steiner [8] repeatedly pointed out this fact. The criterion of an experienced surgeon weighs more for laser surgical resection of T2 glottic carcinoma as it does for conventional open partial resection. It seems to be obvious that it requires a higher level of surgical expertise to resect a difficultly accessible T2 glottic carcinoma through an eventually very narrow endoscope with good oncologic results than a resection of the tumor through an open approach with an open surgical field and excellent exposure. This holds especially true if the laser surgeon has to resect the tumor endoscopically in several portions. These facts once again enhance the demand for an intensive training of surgeons in endoscopic laser surgery if sound oncologic results for laryngeal surgery shall be achieved with this method. Doubts may be raised if surgeons attempt to resect advanced laryngeal carcinoma transorally by laser surgery at early stages of their operative training. There is no question about the fact that it will be easier to define an experienced group of surgeons who are well trained in open partial laryngeal resection than it will be to find an equally well trained group of

endoscopic laser surgeons. In addition to the initially mentioned anatomic selection criteria, these facts explain the dilemma of prospective comparative trials. It is certainly out of the question that open partial laryngeal resection also allows excellent functional results through reconstructive techniques. These techniques undoubtedly require an equally high level of expertise [22] as the endoscopic laser surgery of difficultly accessible laryngeal carcinomas. The most important question, however, is the achievement of surely oncologic resection. The questions

that have been raised above will not be clarified by retrospective studies, rather by an understanding as well as the acceptance of the fact that laser surgery for difficultly accessible and advanced carcinomas is not a matter of occasional surgery but requires intensive training as well as a continuous application of this operative technique. Only if these thoughts are generally accepted will it be sensible to compare results of conventional surgery and laser surgery in a prospective and multicentric setting.

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Comments

D. Chevalier (France): The authors are perfectly right when they write that it is difficult to define the correct stage of T2 glottic carcinoma. The classification of Kleinsasser and Glanz is a way to try to correct it. We can point out that CT scan is an important preoperative examination to stage the tumor. The authors mention the limitations of endoscopic treatment. Carcinoma invading the anterior commissure and the subglottis are sometimes difficult to visualize and to treat. External and endoscopic surgery are both difficult to learn, but they are also complementary techniques.

H. Eckel (Germany): For glottic carcinoma staged T2N0M0, excellent local control and survival rates have been reported for radiation therapy and for partial laryngectomy. Besides these well-established oncological approaches, transoral laser surgery has emerged as a major therapeutic alternative during the last 20 years.

It has been reported to cause minimal morbidity, good functional results, and to provide a cost-effective alternative to open surgical procedures and to radiotherapy. Therefore, it is now a widely used surgical approach to T2 glottic carcinoma. The data available in the

existing body of literature indicate that transoral laser surgery leads to oncological results that are comparable with more conventional treatment modalities for these patients. However, detailed information on local control rates and on patterns of local treatment failure has not been studied in detail for long. Such data certainly are essential for a critical appraisal of the role of transoral laser surgery for the treatment of T2 glottic carcinoma, and for a meaningful comparison of laser surgery with established treatment modalities, i.e. radiotherapy or open partial laryngectomy.

This paper evaluates the potential role of transoral laser surgery for glottic T2 carcinoma by reporting the treatment modalities and results in a group of 14 consecutive patients from a university-based referral center with vast experience in the use of transoral laser surgery as the standard approach to glottic carcinoma. The authors confirm the observation that the anterior commissure carries a higher risk for local treatment failures. They rightly emphasize the need for excellent training and demonstrate potential risk factors associated with endoscopic laser surgery.

Favorable local control rates and retreatment results in case of local failure for T2 glottic carcinoma treated with laser surgery are documented in this study. However, such results will only be achieved by excellently trained, highly experienced endoscopists. The authors conclude that laser surgery for T2 glottic carcinomas is not a matter of occasional surgery. They are perfectly right. Contemporary treatment of laryngeal carcinoma requires specialists capable of mastering different treatment modalities, not occasional laryngologists.

M. Remacle (Belgium): This manuscript clearly illustrates the difficulties of deciding the surgical approach according to the T classification. Werner et al. point out the necessity of a good exposure and localization of the tumor.

For instance, a T1b cancer at the glottic level involving the anterior commissure could be more difficult to approach and to resect completely than some T2. So, it is doubtful that a randomized study comparing open neck surgery and endoscopic surgery can be realized.

More than the T classification, the localization and infiltration of the tumor is very important. If we look at the series of Werner et al., the two local recurrences are located at the level of the anterior commissure and, above this, 3 cases of their series underwent open neck surgery because of infiltration of the anterior commissure.

If we consider that 2 of 6 cases involving the anterior commissure and treated by an endoscopic approach presented a recurrence, it means that we can expect 30% of local recurrence after the endoscopic approach for cancer involving the anterior commissure, which is not acceptable. Surgery for early glottic cancer must be decided according to the localization, infiltration and possible exposure of the lesions, instead of the T classification.

The authors emphasize the usefulness of the modified classification according to Kleinsasser and Glanz. According to this modified classification, T2a carcinomas range from 15 to 25 mm and T2b cancer exceeds 25 mm in size. It is interesting to remember in this regard that T2a and T2b previously had another sense in the literature written in French.

At that time, T2a meant T2 cancer with normal mobility of the vocal fold and T2b, T2 cancer with decreased mobility of the arytenoid.

Discussing histologic specimens, Werner et al. point out that it is useful to keep the tumor in several pieces in order to clearly see the limits. According to our own experience of endoscopic surgery, cutting through the tumor is necessary due to the volume or bulkiness of the lesion rather than due to the necessity to assess the safety of the margins. For our part, we try as much as possible to keep the specimen in only one piece to make histologic assessment easier.

P. Zbären (Switzerland): Strong indication criteria would be desirable but have been lacking up to now. The anterior commissure is a matter of discussion regarding laser surgery for T2 and T1b carcinomas. Recurrences of carcinomas with initial anterior commissure involvement after laser surgery or radical radiation are probably due to a missed thyroid cartilage tumor infiltration. Therefore, a diagnostic work-up is necessary; the MR imaging with its high sensitivity for cartilage infiltration could be the imaging modality of choice to exclude thyroid cartilage infiltration [1, 2]. Beside an accurate diagnostic work-up, the experience of the surgeon on the one hand and the endoscopic tumor exposure on the other hand are decisive for a safe laser surgery treatment of T2 laryngeal tumors.

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Risk of Late Fatal Secondary Hemorrhage in Laser Surgery of the Larynx

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Key Words

Laser surgery · Larynx · Complications · Secondary hemorrhage

Abstract

Objectives: Since 1979, a number of publications have appeared regarding complications of laser surgery of the larynx. Most publications focus on complications such as accidental burns, rouse of the ventilation tube, anesthesiologic problems, edema of the mucosa, and abnormal scar formation. Secondary hemorrhage has played a subordinate role and cases demanding postoperative treatment have only been reported sporadically. All cases occurred within the first postoperative week, and no case resulting in death has been reported. The aim of the article is to draw attention to the fact that after laser surgery of the larynx, late lethal secondary hemorrhage may occur. **Material and Patients:** We review the literature and describe a patient in whom a lethal secondary hemorrhage occurred 10 days after laser supraglottic laryngectomy. The case is analyzed and similarities to hemorrhages associated with tonsillectomy and laser surgery of the lingual tonsil are shown. **Results and Conclusions:** The risk of very late severe secondary hemorrhage after laryngeal laser surgery is considered to be very seldom and comparable with that after tonsillectomy. Due to the increase in laser application in the treatment of laryngeal carcinoma, secondary hemorrhage may be encountered. Consequences for preoperative information and postoperative control of the patients have to be discussed.

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Risiken einer späten, tödlichen sekundären Blutung nach Laserchirurgie des Larynx

Fragstellung: Seit 1979 erschienen zahlreiche Publikationen, die sich mit Komplikationen laserchirurgischer Eingriffe des Larynx beschäftigen. Im Vordergrund des Interesses standen hierbei unbeabsichtigte Verbrennungen durch Reflektion des Laserstrahls, Tubusbrand, spezielle anesthesiologische Probleme, Mukosaödem mit Luftwegobstruktion und überschüssige Narbenbildung mit funktionellen Problemen. Nachblutungen spielten eine untergeordnete Rolle. Berichte über Nachblutungen, die eine postoperative Behandlung erforderten, liegen nur sporadisch vor. Alle bislang veröffentlichten behandlungsbedürftigen, postoperativen Nachblutungen (mit Ausnahme des von uns publizierten Falles) traten innerhalb der ersten Woche auf. Keine der Nachblutungen verlief tödlich. Mit dem vorliegenden Artikel soll auf die Möglichkeit des Auftretens später, lebensgefährlicher, postoperativer Blutungen nach Laserchirurgie des Larynx hingewiesen werden. **Material und Patienten:** Neben einem Überblick über die bisherige Literatur wird der Fall einer Patientin beschrieben, bei der eine Nachblutung nach supraglottischer Kehlkopfteilresektion 10 Tage postoperativ zum Tode führte. Der Fall wird analysiert und es werden Ähnlichkeiten mit Blutungen nach Tonsillektomien und nach Laserchirurgie des Zungengrundes aufgezeigt. Mögliche pathophysiologische Mechanismen werden diskutiert. **Ergebnisse und Schlussfolgerungen:** Die sehr geringe Inzidenz sehr spät auftretender foudroyanter Nachblutungen nach laserchirurgischen Behandlungen von Larynxkarzinomen dürfte der nach Tonsillektomie ähneln. Mit der Zunahme der Zahl dieser Eingriffe muss mit einer steigenden Zahl postoperativer Nachblutungen gerechnet werden. Das hat möglicherweise Konsequenzen für das Aufklärungsgespräch und für die postoperative Nachsorge.

Risques d'hémorragie secondaire tardive après chirurgie au laser du larynx

Objectifs: Depuis 1979, beaucoup de publications mentionnent les complications de la chirurgie du larynx au laser. Plusieurs se concentrent sur des accidents de brûlures, des dommages causés au tube endotrachéal, des problèmes d'anesthésie, des œdèmes de la muqueuse et des formations cicatricielles anormales. Les hémorragies secondaires ne sont pas souvent mentionnées et les cas qui ont nécessité un traitement post-opératoire ne sont rapportés qu'exceptionnellement. Selon la littérature, les hémorragies apparaissent au cours de la première semaine qui suit la chirurgie. Aucun cas de décès n'a été rapporté. Le but de cet article est d'attirer l'attention sur le fait que la chirurgie du larynx au laser peut provoquer une hémorragie secondaire mortelle. **Matériel et patients:** Nous décrivons un cas d'hémorragie secondaire chez un patient opéré au laser de la région supralaryngée 10 jours auparavant et revoyons la littérature à ce sujet. Le cas est analysé et des similitudes sont établies avec les hémorragies post-opératoires survenant après une tonsillectomie ou après une exérèse chirurgicale au laser de l'amygdale basilinguale. **Résultats et conclusion:** Le risque d'hémorragie secondaire après chirurgie laryngée au laser est comparable à celui d'une tonsillectomie. Vu la tendance à utiliser de plus en plus souvent le laser pour le traitement des carcinomes du larynx, on peut s'attendre à une augmentation du nombre de cas présentant cette complication. Elle devrait être mentionnée dans l'information donnée au patient avant l'opération et faire l'objet d'une surveillance dans la période post-opératoire.

Introduction

Compared with scalpel wounds, CO₂ laser wounds show delays in inflammation, collagen production, reepithelialization, and in tensile strength [1, 2]. These delays could – besides other complications – result in a higher incidence of secondary hemorrhage (i.e. hemorrhage later than 24 h postoperatively). However, a review of the literature on the incidence of secondary hemorrhage after laser surgery of the larynx revealed only a few cases demanding treatment. Secondary hemorrhage occurred in 0.43% of patients undergoing laser surgery of the upper airways [3] and in 7.1% of patients undergoing laser surgery of a supraglottic carcinoma [4]. The review of the literature disclosed no hemorrhages occurring later than 7 days postoperatively [for an exception, see ref. 5] and no fatal hemorrhage after laser surgery of the larynx.

However, almost all surgeons consider the risk of major intra- and postoperative hemorrhage. Some very experienced surgeons recommend to identify and ligate the upper laryngeal artery to prevent secondary hemorrhage in laser supraglottic laryngectomy [6]. Others consider intraoperative coagulation as sufficient. Until now, literature has not contributed to a resolution of this problem.

Case Report

A 48-year-old female patient with a tumor at the top of the epiglottis was admitted to the ear, nose and throat department of a large urban hospital. Direct laryngoscopy was performed, showing a tumor affecting the laryngeal side of the epiglottis reaching ventrally to the endolarynx and infiltrating the anterior third of both vestibular ligaments. Only the very front parts of the aryepiglottic folds were affected by the tumor, and no spread towards the piriform sinus could be observed. The Morgagni sinus and the vocal cords were tumor free, and the vocal cords were not restricted in their mobility. Extralaryngeal spreading was not present. A sample of the tumor was taken. Histologic evaluation proved a moderately differentiated squamous cell carcinoma. The staging investigations of the tumor included computer tomography of the primary tumor and neck, X-ray of the chest, and ultrasound examination of the neck and abdomen. A supraglottic laryngeal carcinoma T1, N0, M0, G2 was diagnosed. All laboratory parameters, including the coagulogram, were normal.

Laser supraglottic laryngectomy was performed. During surgery, the epiglottis, part of the aryepiglottic fold on both sides and the vestibular ligament on both sides were resected in toto. Minor hemorrhages were coagulated electrosurgically; no major hemorrhage occurred. No identification and ligation of the upper laryngeal arteries were done. Histologic examination of the surgical resection specimen revealed a radical resection. No complications were recorded during the operation. After brief postoperative monitoring in the intensive care unit, the patient was extubated the same day. A nasogastric tube was removed the second day after the operation. The patient reported only a mild degree of discomfort and oral ingestion of food was possible without any problems. A moderate laryngeal edema, which occurred after the operation, regressed quickly and on postoperative day 9, the patient was discharged from the hospital. At this time, the patient was able to swallow without discomfort, and there was no sign of stridor. Indirect laryngoscopy on the day of the patient's release showed no irritation of the wound, which was coated with a layer of fibrin. The following night, severe bleeding suddenly occurred and the patient died before the doctor on call arrived. The autopsy showed blood loss in conjunction with the aspiration of blood to be the cause of death. The origin of bleeding was the operative wound in the supraglottic region which had not yet healed. An arrosion of a larger blood vessel was not found.

Comment

CO₂ laser was introduced to laryngeal surgery in 1971 [7] and has been widely applied since the 1980s. Previously only used for minor pathological lesions, it is now also used to treat larger tumors. The physical characteristics of the CO₂ laser beams enable it to cut the tissue very precisely with minimal damage to the surrounding area by heat conduction [8]. Simultaneously, small blood and lymph vessels are coagulated. Large blood vessels must be blocked separately, usually by electrosurgical coagulation, or in special cases by ligation. The cut areas, sloughed by the laser, require somewhat longer healing periods than scalpel cuts. Depending on the size of the defect, it takes roughly 1–6 weeks for new mucosa to grow over mucous scars in the upper airway and gastrointestinal tract. Experimental investigations have shown that laser scars are

weaker than knife scars during the first 2 weeks after operation. This seems to be due to prolonged inflammation and delay in collagen production, and in reepithelialization [1, 9]. Investigations of the effect of pulse duration on wound healing using a CO₂ laser showed that shorter laser pulse durations create less lateral thermal injury and scars with greater tensile strength, resulting in earlier wound healing [10]. Theoretically, the risk of secondary hemorrhage could be higher in laser surgery than in conventional surgery. However, until now no clinical investigation has shown an increased risk of secondary hemorrhage after laser surgery of the larynx, and in the literature, the most common complications after laser surgery of the larynx are endotracheal explosion and facial burns [11]. Rarely, secondary hemorrhage demanding postoperative treatment was reported [12–14]. To present, only two studies with large patient collectives have dealt with the incidence of secondary hemorrhage. In a study of 700 patients undergoing laser surgery of the larynx, secondary hemorrhage was found in 3 (0.43%) patients [3]. One patient needed tracheotomy and tamponade. No lethal hemorrhage occurred. In a study of 85 patients with a supraglottic carcinoma treated with laser surgery, secondary hemorrhage was found in 6 (7.1%) patients [4], all controlled surgically, and no lethal hemorrhages occurred. None of the hemorrhages occurred after the first postoperative week.

The main focus of postoperative care is on a free airway passage. The patients are then either monitored in the hospital or discharged, depending on the extent of the postoperative swelling and whether the breathing passage is obstructed. We have described the first case of lethal secondary hemorrhage 10 days after laser supraglottic laryngectomy [5].

Concerning the risk of secondary hemorrhage, in our opinion, the situation after laser surgery of the larynx is comparable with that following tonsillectomies. However, due to the impaired laryngeal protective reflexes and due to the proximity of the surgical site to the airway, the risk of aspiration and asphyxiation is higher when bleeding occurs after laser surgery of the larynx. Here as well, patients have sloughed wounds upon discharge from the hospital. It is well known that bleeding after tonsillectomies is more frequent and more severe within the first 24 h after the operation. Secondary hemorrhage after tonsillectomy occurs in about 3% of all patients [15, 16] and is rare around postoperative days 10–12, when usually only slight seeping hemorrhage occurs. Therefore, the patients are normally observed postoperatively for 1 or a few days and then discharged prior to complete healing. There is, however, a third pattern of secondary hemorrhage which rarely occurs after tonsillectomies. Here again, 10–12 days after the operation when – as part of the healing process – the slough is shed, acute life-threatening hemorrhage may occur. This is rarely seen, even in very large

central hospitals. From our experience, we conclude that in most of these cases, a local vascular anomaly is most likely the cause of hemorrhaging. Maurer et al. [17] reported 2 cases in which anomalies of the lingual artery caused recurrent late hemorrhages following tonsillectomy. Investigations comparing laser tonsillectomy and standard dissection tonsillectomy showed an increased risk of secondary hemorrhage of up to 19% after laser tonsillectomy [18, 19].

A third group of operations comparable with laser surgery of the larynx is laser surgery of the lingual tonsil. Here again, patients have sloughed wounds upon discharge from the hospital. Postoperative hemorrhage after laser surgery of the lingual tonsil is rare, but has to be taken into consideration in postoperative care [20, 21]. Only 1 case of a fatal postoperative hemorrhage on the first postoperative day has been reported until now [21]. However, we experienced a case referred from another hospital with a nearly fatal postoperative hemorrhage. In this patient, after laser surgery of the lingual tonsil, a major postoperative hemorrhage occurred on postoperative day 6. First, the hemorrhage was controlled by coagulation. One day later, the bleeding relapsed. Endoscopic hemostasis was not possible and an immediate ligation of the external carotid artery was necessary. Hereafter, the postoperative course was uneventful.

Life-threatening secondary hemorrhage more than 1 week after laser supraglottic laryngectomy had hitherto never been described. It is generally rare and usually occurs within the first days after the operation. Our case demonstrates that, even after laser supraglottic laryngectomy, life-threatening secondary hemorrhage can occur more than 1 week following the operation. Intraoperatively, no clinically relevant hemorrhage occurred. Possibly the ligation of the upper laryngeal arteries has a protective effect on the incidence of secondary hemorrhage. However, in our case, autopsy showed no arrosion of a larger blood vessel but diffuse bleeding of the operative wound in the supraglottic region.

Conclusions

We describe a case of lethal secondary hemorrhage 10 days after laser supraglottic laryngectomy. Until now, no similar case has been described. In the literature, all hemorrhages occurred within the first postoperative week. They were rare and required operative therapy only in exceptional cases. In our opinion, taking into consideration the common risks of hemorrhage after laryngeal laser resections, similar to that after tonsillectomies, there are no diagnostic means available to predict the danger of the occurrence of such bleeding. However, because of the influence of pulse duration on wound healing and tensile

strength [10], there is no discussion that a short pulse duration decreases the risk of postoperative hemorrhage. There is no evidence until now that the identification and ligation of greater vessels prevent postoperative hemorrhage. Theoretically, ligation offers a more resistant closure of greater vessels and therefore has to be recommended in our opinion. Experiences with laser surgery of the lingual tonsil show that late massive secondary hemorrhages may occur as well.

Since the number of laryngeal laser operations is never as high as the number of tonsillectomies, we can generally expect this occurrence to be much rarer. Nevertheless, possible medicolegal consequences have to be considered.

It remains to be discussed whether the risk of a life-threatening secondary hemorrhage should be addressed when the patient is first informed about this type of treatment.

Editors' Note

The paper of Kremer et al. has already appeared in the *Archives of Otolaryngology – Head & Neck Surgery* [5]. We considered it worth republishing in order to inform the readers of potential unusual complications, and to submit the opinion of Kremer et al. to the commentaries of experts and, in turn, to offer Kremer et al. the opportunity to comment on papers of these experts. The editors want to thank the publisher of *Archives* for the permission to reprint the paper here.

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Comments

D. Chevalier (France): The authors present a very interesting case. More commonly, such a complication occurs after tonsillectomy. It reminds that endoscopic surgery has the same risk of hemorrhage as external surgery. They recommend to prevent hemorrhage by ligation of greater vessels; but is it so easy to perform? And for what kind of endoscopic excision?

H.E. Eckel (Germany): No comment from my side.

M. Remacle (Belgium): This is an interesting case report which reminds us to be careful in the control of hemostasis during endoscopic surgery for larynx cancers. It must be remembered that by an endoscopic approach, the superior laryngeal artery is just under the pharyngoepiglottic fold. So, when approaching laterally the supraglottic part of the larynx, it is advisable to deeply coagulate the pha-

ryngoepiglottic fold to control in a better way a possible bleeding from this superior laryngeal artery.

J.A. Werner (Germany): This is an important contribution to the discussion of the safety of laser microsurgery. In the course of an often unjustified belittlement of laser excisions, this report of a late severe secondary hemorrhage after laser microsurgery should sensitize the readership that even this operative technology bears lethal risks. With regard to the extension of laser microsurgery, surgeons not only have to be aware of the risk of major intra- and postoperative hemorrhage, but also have to be trained in the handling of this severe complication.

P. Zbären (Switzerland): No comment.

21.3.-22.3.2003 Essen Germany	Tagung der Vereinigten Westdeutschen Hals-Nasen-Ohrenärzte	Information: Dr. H. Luckhaupt, HNO-Klinik, St.-Johannes-Hospital, Johannes-Str. 9-17, 44137 Dortmund Tel. +49 231 18432242, Fax +49 231 18432510 E-Mail hain@joho-dortmund.de
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Kiel Germany	B-Bild-Sonographie der Kopf-Hals-Region 11. Aufbaukurs: 13.6.-14.6.2003 11. Abschlusskurs: 14.11.-15.11.2003 Doppler- und Duplexsonographie der extrakraniellen hirnversorgenden Gefäße 1. Aufbaukurs: 15.6.2003	Information: OA Dr. J. Quetz, Universitäts-HNO-Klinik, Arnold-Heller-Strasse 14, 24105 Kiel Tel. +49 431 597 2240, Fax +49 431 597 2272 E-Mail quetz@hno.uni-kiel.de
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