Endoscopic CO_2 laser treatment of supraglottic carcinoma

Il trattamento endoscopico con laser CO_2 del carcinoma sopraglottico

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Key words

Larynx tumours • Supraglottic cancer • Surgical treatment • Laser CO_2

Parole chiave

Tumori della laringe • Carcinoma sopraglottico • Trattamento chirurgico • Laser CO_2

Summary

Aim of the study was to evaluate whether laser endoscopic microsurgery is a reliable and appropriate approach to treatment of laryngeal supraglottic cancer. A retrospective study was made of 12 patients (11 M/1 F; mean age 62.5 years) treated from December 1995 to October 2001 in the Department of Surgical Sciences and Organ Transplantations, Section of Otorhinolaryngology, University of Cagliari, Italy. Surgical steps and oncologic results are reported. These 12 patients with supraglottic cancer underwent transoral laser surgery (TNM classification: T1, 3 patients; T2, 9 patients; N-, 9 patients; N+, 3 patients; M-, 12 patients). On the basis of the different subsites removed, the following resections were performed: 1 limited excisional biopsy (false chord), 3 wide excisional biopsies (2 or 3 subsites), 2 simple epiglottectomies, 1 extended epiglottectomy, 3 horizontal supraglottic laryngectomies, and 2 horizontal supraglottic laryngectomies that were extended to the anterior commissure and to one arytenoid, respectively. Five patients underwent functional neck dissection, and one patient underwent post-operative radiotherapy at sites of tumour and lymph nodes. Temporary tracheotomy was carried out in 10 patients. Mean follow-up was 33.3 months. No local recurrences were noted. Local control was thus 100%. Aspiration was the main post-operative problem, but there were no cases of aspiration-associated pneumonia. Moreover, no patient needed laryngectomy or a permanent tracheotomy for aspiration. In conclusion, although our experience with supraglottic cancers treated by endoscopy is still too limited to confirm the definitive oncologic validity of this type of surgery, in our hands, it seems to be a reasonable tool in selected cases and a safe, time- and cost-effective alternative to traditional surgery or radiotherapy for selected supraglottic carcinomas.

Riassunto

L'obiettivo di questo studio è stato valutare l'efficacia del trattamento endoscopico con laser CO_2 nel carcinoma sopraglottico. Si tratta di uno studio retrospettivo su 12 casi di carcinoma sopraglottico trattati tra il dicembre 1995 e l'ottobre 2001, presso la Sezione Otorinolaringoiatrica del Dipartimento di Scienze Chirurgiche e Trapianti d'Organo dell'Università di Cagliari. Sono stati valutati 12 pazienti (11 M/1 F; età media 62,5 anni) affetti da carcinoma squamocellulare sopraglottico (TNM: T1, 3 pazienti; T2, 9 pazienti; N-, 9 pazienti; N+, 3 pazienti; M-, 12 pazienti) sono stati sottoposti ad intervento di exeresi endoscopica mediante laser CO_2. Sono state eseguite 1 biopsia escissionale di modesta entità (falsa corda) e 3 biopsie escissionali ampie (due o tre sottosedi), 2 epiglottectomie semplici, 1 epiglottectomia allargata, 3 laringectomie orizzontali sopraglottiche, 1 laringectomia orizzontale sopraglottica allargata alla commissura anteriore ed una alla aritenoide. Cinque pazienti sono stati sottoposti a svuotamento linfonodale laterocervicale e un paziente a radioterapia complementare postoperatoria in sede di T e N. La tracheotomia temporanea è stata eseguita in 10 casi. Il follow-up medio è di 33,3 mesi. Per quanto riguarda i risultati, il controllo locale è stato del 100%. Due pazienti classificati preoperatoriamente come cT2N0Mx, hanno presentato metastasi linfonodali laterocervicali, rispettivamente a 5 mesi e 6 mesi dopo l'intervento, per le quali si è provveduto a praticare uno svuotamento linfonodale laterocervicale bilaterale di tipo funzionale (pN2c e pN2b). Due pazienti hanno mostrato fenomeni di aspirazione associati a tosse riflessa, ma non è stata osservata né disfagia grave né processi infettivi cronici o ricorrenti delle basse vie respiratorie. In conclusione il trattamento endoscopico del carcinoma sopraglottico con ausilio di laser CO_2, rappresenta a nostro avviso una valida alternativa alla chirurgia "open neck" dalla quale, a parità di risultati oncologici, differisce sostanzialmente per la possibilità di modulare il sacrificio di strutture anatomiche talvolta indispensabili per un più rapido recupero della funzionalità deglutitoria e respiratoria. Poiché l'incidenza di metastasi occulte, anche dei carcinomi T1 e T2, raggiunge in letteratura valori percentuali attorno al 25%, il trattamento linfonodale laterocervicale consensuale all'atto chirurgico endoscopico non contrasta, a nostro avviso, con il concetto di minore morbilità insito nell'approccio endoscopico e si rende indispensabile ai fini del corretto trattamento della malattia.

Introduction

Early stage supraglottic carcinomas can be submitted either to radiotherapy [1 2] or conservative surgery [3-5]. Of the traditional surgical procedures, open neck horizontal supraglottic laryngectomy (HSL) is one of the most widely performed [6-9]. It focuses on conservation of functions, but constantly sacrifices important anatomical structures that considerably modify deglutition and respiration.

Swallowing problems are the most frequent functional complications of HSL and enlarged HSL [6 10-16]. In some instances, prolonged artificial nutrition may be necessary, and in more severe cases, permanent tracheotomy or total laryngectomy become mandatory[17 18]. In patients undergoing HSL, the frequency of chronic functional problems has been reported to range from 40% to 70%, whereas the risk of developing pneumonia varies from 2.5% to 13% [7 11 19 20]. The extent of surgical resection (e.g., extension to an arytenoid or the base of the tongue), age, and level of compliance are among the major factors that influence functional and clinical parameters [11 17 18].

Endoscopic CO_2 laser treatment of early stage supraglottic carcinomas has been proposed as an alternative to traditional open neck surgery based on a lower morbidity, better functional results, and comparable control of local disease [3 5 21-25]. Not unlike results already achieved with endoscopic CO_2 laser surgery of the glottis, it has been possible to progressively extend the technique to supraglottic carcinoma. In fact, the endoscopic CO_2 laser approach has been employed to perform simple excisional biopsy in small tumours, simple or enlarged epiglottectomy, and surgical resection such as endoscopic HSL (EHSL), which may be more or less extended to adjacent subsites [5 22 26-29].

Endoscopic approaches appear to show promise in terms of fast and complete recovery of deglutition, which is directly correlated to the possibility of sparing the superior laryngeal nerves [30]. Moreover, complete sensitivity of the vestibule and hypopharynx is maintained, and accessory muscles that normally contribute to suspension and excursion in a cranial-caudal direction of the larynx are preserved [3 5 22 24 31]. Furthermore, semi-circumferential healing of the incision site is good, due to a process of late fibrosis and successive healing of the mucosa, which reduces the lumen of the larynx without stenosis [32].

Personal experience on the use of the endoscopic CO_2 laser approach in 12 cases of early supraglottic carcinoma is reported.

Patients and methods

Between December 1995 and October 2001, 12 patients (11 males, 1 female) with clinical early stage (I and II) squamous cell supraglottic carcinoma underwent endoscopic CO_2 laser surgery at the Section of Otorhinolaryngology of the Department of Surgical Sciences and Organ Transplantation at the University of Cagliari. The age of the patient cohort ranged from 50 to 81 years (mean 62.5). The average follow-up period in this group of patients was 33.3 months (range, 10-87) (Table I).

Preoperative work-up included objective local examination by flexible and rigid endoscopy. Ultrasound and computed tomography (CT) of the neck using

Table I. Clinical data.

Patient n.	Age/sex	cTNM	Site	Surgery	Neck dissection	Post-op RT
1	52/M	T1N0Mx	Epi	E	–	–
2	51/M	T2N0Mx	AEF+PS	EB	Unilateral	–
3	62/M	T2N0Mx	Epi	HSL	–	–
4	58/M	T2N0Mx	FVC+AEF+V	EB	Unilateral	–
5	71/M	T2N0Mx	AEF+FVC+Ar	ExHSL Ar	–	–
6	79/M	T2N0Mx	Epi+AC	ExHSL AC	–	–
7	57/M	T2N0Mx	Epi	EE	Bilateral	50 Gy
8	81/M	T2N0Mx	Epi	HSL	Bilateral	–
9	50/F	T2N0Mx	Epi+FVC	HSL	Unilateral	–
10	52/M	T1N0Mx	FVC	EB	–	–
11	74/M	T1N0Mx	Epi	E	–	–
12	62/M	T2N0Mx	FVC+Ar	EB	–	–

Site: Epi, epiglottis; AEF, aryepiglottic folds; FVC, false vocal cord; Ar, arytenoid; PS, pyriform sinus; V, ventricle.
Surgery: EB, excisional biopsy; E, simple epiglottectomy; EE, extended epiglottectomy; HSL, horizontal supraglottic laryngectomy; ExHSL, extended horizontal supraglottic laryngectomy; AC, anterior commissure; Ar, arytenoid.

Fig. 1. Computed Tomography at level of epiglottis showing tumour pushing towards, but not macroscopically invading, the pre-epiglottic space.

Fig. 2. Endoscopic (0°) view of a wide intra-operative field obtained with bivalve pharyngo-laryngoscope (Weerda type).

contrast medium were also employed to exclude lymph node involvement and to confirm that the neoplasm was clinically T1-T2 (Fig. 1), and not T3 due to infiltration of the pre-epiglottic space. Functional pulmonary tests (spirometry, blood-gas analysis) were carried out in 2 cases with chronic obstructive pneumopathologies. Results of the preoperative work-up excluded the presence of synchronous primary tumours of the upper aero-digestive tract.

The preoperative TNM classification, according to the UICC system [33], was as follows: T1 in 3 cases and T2 in 9. All cases were clinically N0. In one case, involvement of the anterior commissure was also observed (Table I).

The following resections were performed according to the type of excision required: 1 limited excisional biopsy (false vocal fold), 3 wide excisional biopsies (2 or 3 subsites), 2 simple epiglottectomies, 1 extended epiglottectomy, 3 EHSL, and 2 EHSL that were extended to the anterior commissure and to one arytenoid, respectively (Table I). The procedure was performed under general anaesthesia via orotracheal or tracheal intubation with a Mallinckrodt tube Athlone, Ireland (I.D. 5.0-7.0 mm). To obtain complete exposure of the larynx, pharyngo-laryngoscopy was carried out using an adjustable bivalve Storz® (Tuttlingen, Germany) pharyngo-laryngoscope (Weerda type) (Fig. 2). Albeit, in order to permit continuous, optimal exposure of the supraglottis and adjacent sites, frequent repositioning of the pharyngo-laryngoscope was necessary. The surgical specimen was excised en bloc, in all cases (Fig. 3).

The following microscopes were used during the surgical procedure: Zeiss Universal S2 or Zeiss S21 (Jena, Germany) with 400 mm focal lens coupled with a Sharplan (Tel Aviv, Israel) 1030 CO_2 laser with an Acuspot 712 (Tel Aviv, Israel) focusing system, with which it was possible to obtain a 270 micron spot. The super-pulse mode was used at 2-3 watts. Blood vessels larger than 0.5-1 mm in diameter were coagulated with bipolar forceps or clamped with microclips. With respect to the cleavage plane, the laser was always used in the cutting mode and never in the vaporization mode in order to obtain precise histological information on the entire specimen.

Five patients were submitted to neck dissection and one patient underwent post-operative radiotherapy in the sites of the tumour and lymph nodes (50 Gy) (Table II). Three patients were submitted to neck dissection at the same time as the local procedure (levels II-V), two after developing node metastases during the follow-up period. Temporary tracheotomy and the placement of a naso-gastric feeding tube were perfor-

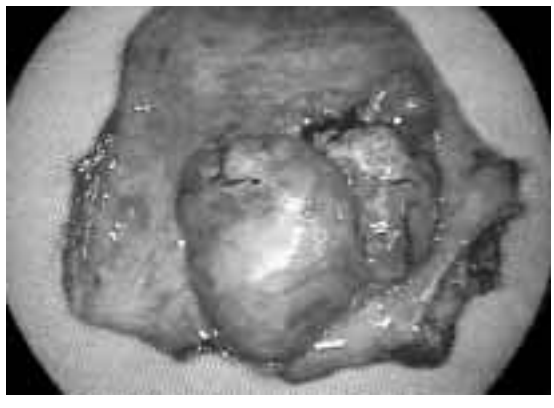

Fig. 3. An en-bloc resection specimen of a prevalently infra-hyoid epiglottic carcinoma.

Table II. Clinicopathological data.

No.	Age (yrs)/Sex	Clinical T	Pathologic T	Histologic typing & grade	Clinical N	Pathologic N	Status (mo)
1	52/M	T1	T1	SCC G2	N0	–	NED 34
2	51/M	T2	T2	SCC G3	N0	N2b	NED 35
3	62/M	T2	T2	SCC G1	N0	–	NED 33
4	58/M	T2	T2	VSCC	N0	N0	NED 29
5	71/M	T2	T2	SCC G1	N0	–	NED 23
6	79/M	T2	T2	BSCC	N0	–	NED 21
7	57/M	T2	T2	BSCC	N0	N2c	NED 19
8	81/M	T2	T2	SCC G3	N0	N2b	DOC 10
9	50/F	T2	T2	SCC G3	N0	N0	NED 17
10	52/M	T1	T1	SCC G2	N0	–	NED 87
11	74/M	T1	T1	SCC G2	N0	–	DOC 45
12	62/M	T2	T2	SCC G2	N0	–	NED 59

SCC, squamous cell carcinoma; BSCC, basaloid squamous cell carcinoma; VSCC, verrucous squamous cell carcinoma; NED, no evidence of disease; DOC, died of other causes.

med in 10 patients. Tracheotomy and the naso-gastric feeding tube were not considered necessary in 2 of the 4 patients undergoing excisional biopsy.

Results

No local recurrences were observed, for a local control rate of 100%. One patient died 45 months after surgery due to a second primary pulmonary adenocarcinoma, and another patient died 10 months after surgery due to myocardial infarction. One of the 3 patients submitted to neck dissection at the same time as the local procedure, showed node metastases (pN2b). Two patients with a pre-operative classification of cT2N0Mx undergoing extended epiglottectomy and EHSL, respectively, developed neck node metastases at 5 and 6 months after primary surgery. In these patients, bilateral neck dissection was performed (pN2c and pN2b). One of these 2 patients, whose histological diagnosis was basaloid squamous cell carcinoma, both in the primary tumour and node metastases, underwent post-operative radiotherapy. On the basis of histological examination of neck nodes and wait-and-see policy, the definitive TNM classification was modified as shown in Table II.

Bipolar cauterization was necessary in one patient due to post-operative (2 hr) haemorrhage. In patients undergoing tracheotomy, no significant consequences were revealed in the tracheal lumen.

The tracheotomy and naso-gastric tubes were removed after a mean period of 15.9 and 14.5 days, respectively. The major concern encountered during the post-operative period was aspiration. Regular oral feeding was recovered in all patients and severe dysphagia was not observed in any case. None of the patients presented chronic or recurrent infection of the respiratory tract due to aspiration.

Discussion

The endoscopic approach to supraglottic carcinoma with CO_2 laser has been proposed as an alternative to open neck supraglottic surgery [5 22 24 26-28 34-36]. With respect to the conventional approaches, the potential advantages offered by the endoscopic techniques include the possibility to adapt the extent of the resection to the size of the tumour with similar oncologic results, lower morbidity, reduction of hospital stay and healing times [24 26], in addition to a more rapid recovery of deglutition [5]. According to some Authors, there is also no need for temporary tracheotomy [25 26]. The endoscopic CO_2 laser approach is appropriate for T1 and T2 carcinomas of the epiglottis, the aryepiglottic fold, and false vocal folds. It may also be indicated in selected cases of T3 neoplasms, since a limited invasion of the pre-epiglottic space is not a contraindication for endoscopic surgery. Although major invasion of the pre-epiglottic space can be easily evaluated by means of pre-operative CT and magnetic resonance (MR), the latter, also with the aid of the sagittal planes [37], microinvasion of the pre-epiglottic content through the foramen of the infrahyoid epiglottis, is usually underestimated. As a consequence, in those cases in which the infra-hyoid epiglottis is involved, dissection of the pre-epiglottic space is recommended in order to correctly evaluate the anterior microscopic spread by the tumour at histology [35]. In those cases, in the present series, in whi-

ch the pre-epiglottic space was completely resected, no evidence of infiltration was observed at histological examination. The content of the pre-epiglottic space was preserved in all cases in which small lesions of the suprahyoid epiglottis were present.
The oncologic data reported here refer to a selected group of patients with early stage carcinoma. The results cannot, therefore, be easily compared with those reported in major studies on conventional surgery or radiotherapy for the treatment of supraglottic carcinoma. However, they demonstrate good tumour control and survival and indicate that trans-oral laser resection of supra-glottic carcinoma may cover a wide spectrum of patients. In our experience, we have seen no local recurrence of the disease during a mean 33.3-month follow-up. Thus, local control was 100%, although 2 patients developed neck recurrences 5 and 6 months, respectively, after primary surgery that were treated by bilateral neck dissection.
In our opinion, the possibility to adapt the extent of the resection to the objective size of the neoplasm should be considered the main advantage of the endoscopic approach using CO_2 laser in the management of supraglottic carcinoma. In fact, resection can be limited to excisional biopsies for small neoplasms, but if the supraglottic region is easily exposed, resection may also be carried out as an EHSL or extended EHSL for larger tumours. Excisional biopsy, which has been widely adopted for carcinomas of the glottic area [38-47], has also been proposed for selected carcinomas of the supraglottic region [28]. Moreover, it is possible to carry out excisional biopsies that are limited to one subsite or to perform partial, extended, or total epiglottectomy, even up to complete EHSL and extended EHSL, with the only difference, the preservation of thyroid cartilage. Although conservation of the thyroid cartilage does not apply to open neck HSL, it does not appear to influence the oncologic results of the endoscopic approach. Moreover, in our opinion, it represents a potential barrier to anterior extension of eventual recurrent disease. In 5 patients, complete endoscopic HSL was performed, the only difference with respect to open neck HSL being that the entire thyroid cartilage was left intact.
In our experience with CO_2 laser-assisted endoscopic surgery, when performed with a micromanipulator coupled with an Acuspot focusing system, we were able to obtain a spot of at least 270 μ with complete visualization of the cutting area and surrounding tissues. Moreover, thermal damage to the margins of the excised specimen is limited. Use of the bivalve pharyngo-laryngoscope also allowed complete disclosure of the supraglottic region and adjacent subsites of the pharynx and the glottis, at the same time. These conditions allowed en bloc resection in all cases, which was also favoured by the absence of an oral-tracheal tube in those cases submitted to tracheotomy in the early phases of the procedure.

Fig. 4. Post-operative result after EHSL.

Temporary tracheotomy at surgery was performed in 10 patients on the basis of pre-operative planning, whereas it was avoided in the two small supraglottic tumours for which a very limited excisional biopsy was performed. Tracheotomy was carried out after adequate patient counselling in order to prevent aspiration of saliva and possible passage of massive amounts of blood in the case of post-operative haemorrhage. This occurred only in one patient, 2 hours after surgery, and was controlled, in the operating theatre with bipolar cauterization. In our opinion, the risks correlated with massive endo-luminal haemorrhage, which may be even fatal [48], should be taken carefully into consideration when planning the extent of the resection.
The role of tracheotomy is no less important in preventing post-operative subcutaneous emphysema when complete dissection of the pre-epiglottic space is carried out. Furthermore, disorders in deglutition and respiration can easily be overcome by means of temporary tracheotomy.
The extent of resection has an important role in determining subsequent dysphagia and aspiration. Wide resections, especially if extended to the arytenoid, are associated with frequent disorders in deglutition [11 38 49]. One of the 2 patients presenting temporary consistent aspiration (case 5) underwent EHSL that was extended to one arytenoid. None of the patients undergoing excisional biopsy and simple epiglottectomy presented significant dysphagia, confirming that the epiglottis is important, but not necessary, for deglutition [38].
In our opinion, the good functional recovery observed in our series of patients was largely due to preservation of the superior laryngeal nerves, maintaining complete sensitivity of the vestibule, in addition to a semicircular fibrosis and secondary healing (Fig.

4). This reduces the lumen of the larynx, without causing symptomatic stenosis, as reported by others [30 32]. The definitive removal of the nasogastric and tracheotomy tubes in the 10 patients was possible at a mean time of 14.5 and 15.9 days, respectively. The mean times appeared to be negatively influenced by the increased time that the nasogastric feeding tube and the tracheotomy tube were left in place in the two patients undergoing EHSL extended to one arytenoid and pyriform sinus, respectively. The first patient had the nasogastric and tracheotomy tubes removed at 30 and 20 days, and the second case at 25 and 30 days, respectively.

Even if patient age was not strictly correlated with the phenomenon of aspiration, as reported by others [50], reduced respiratory reserve, caused by severe restrictive and obstructive pneumopathologies, as in elderly patients, woud appear to delay functional recovery and may even lead to chronic aspiration. Thus, when planning an endoscopic approach to the supraglottis, it is, in our opinion, crucial to adequately evaluate the general conditions of the patient, considering also the functional aspects, especially when extended surgery is necessary.

The endoscopic approach to supraglottic carcinoma does not resolve the problem concerning cervical lymph nodes. In fact, the incidence of occult metastases ranges from 0% to 14% in T1 and is around 20% in T2 supraglottic carcinomas [51 52]. In the present series, elective unilateral functional neck dissection was carried out in 3 patients in whom histological examinations were negative for metastases in 2 patients. One patient with a basaloid squamous cell carcinoma and one patient with an invasive squamous cell carcinoma, both with clinically negative cervical lymph nodes at the time of primary surgery, developed neck metastases at 6 and 5 months, respectively. They were subsequently submitted to bilateral functional neck dissection (pN2c and pN2b).

None of the T1 carcinomas showed lymph node metastases whereas 3 out of 9 (33.3%) of the T2 neoplasms had node metastases. According to Redaelli de Zinis and co-worrkers the treatment of supraglottic carcinomas by open neck techniques [52], elective treatment of the lymph nodes should be considered an important part of the surgical treatment programme for supraglottic carcinoma. Bilateral neck dissection is recommended when the carcinoma is centrally located [9 24 51-53], whereas unilateral neck dissection is performed for lateral supraglottic tumours since contralateral lymph nodes are only occasionally involved [52]. The high incidence of metastases in the T2 tumours, in the present series, led us to carry out elective neck dissection in all new cases of T2 supraglottic carcinomas treated endoscopically at our Institute.

Conclusions

In our experience, endoscopic CO_2 laser treatment of supraglottic carcinoma is a convincing alternative to traditional open neck surgery. In the present series, it gave good oncologic results and the possibility to leave selective anatomic structures intact. This was essential for an adequate recovery of deglutition and respiratory functions. In our opinion, elective neck dissection is not in contrast with the concept of lower morbidity of the endoscopic approach, and should be considered essential for proper treatment of the disease. Nonetheless, a high level of experience, in endoscopic surgical techniques, is crucial for scrupulous removal of the specimen, which may be extremely difficult due to the amount of tissue excised in a very narrow working space.

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