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Bumber, Željko; Prgomet, Drago; Janjanin, Saša

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Endoscopic CO_2 Laser Surgery for Supraglottic Cancer – Ten Years of Experience

Željko Bumber, Drago Prgomet and Saša Janjanin

Department of Otorhinolaryngology, Head and Neck Surgery, University Hospital Center »Zagreb«, Zagreb, Croatia

A B S T R A C T

We present our experience with primary CO_2 laser surgery for planocellular supraglottic carcinoma. During a ten-year period, we performed 64 curative supraglottic laryngectomies. Twenty-nine patients presented with T1 and 35 with T2 carcinoma. There were 46 patients without regional and/or distant metastases (N0 neck), and 18 patients with N+ neck. Thirty-three (52%) patients were treated with surgery alone, and in 31 (48%) patients surgical procedure was combined with radiotherapy. Estimated overall 5-year survival for all patients was 89%. Local and regional tumor control as well as survival rate were comparable with the results of other therapeutic options, i.e. radiotherapy or open supraglottic laryngectomy. Functional results outline the advantages of endoscopic laser surgery for laryngeal carcinoma. Transoral endoscopic CO_2 laser surgery is efficacious treatment for T1 and T2 supraglottic carcinoma, and can be combined with neck dissection and postoperative irradiation.

***Key words**: supraglottic cancer, laryngeal cancer, endoscopic surgery, CO_2 laser, neck metastases, functional results*

Introduction

Supraglottic laryngectomy is surgical therapy with the objectives of complete removal of a tumor arising on the epiglottis, aryepiglottic folds or ventricular folds, and preservation of the three main laryngeal functions: respiration, respiratory tract protection, and phonation. Today, two main surgical approaches are widely used: open and endoscopic supraglottic laryngectomy. Open laryngectomy was introduced by Alonso, who initially performed the procedure in two steps. Later it was modified by Ogura, who introduced one-step supraglottic laryngectomy[1,2]. The endoscopic treatment of supraglottic carcinoma emerged in the late 1930s, with Jackson's description of laryngoscope and punch biopsy forceps for excision of suprahyoid epiglottic carcinoma. Technologic developments such as the introduction of surgical microscope in the 1950s, the introduction of suspensive microlaryngoscopy in the 1960s, and the use of carbon dioxide laser for endolaryngeal surgery in the 1970s, have allowed for expansion of the endoscopic technique for the treatment of supraglottic cancer[3,4].

The aim of this report is to present our ten-year experience with CO_2 laser microsurgery in the management of supraglottic cancer.

Materials and Methods

During a 10-year period (from January 1, 1993 till December 31, 2002), 64 previously untreated patients with histologically verified squamous cell carcinoma of the supraglottis were endoscopically treated at the University Department of ENT, Head and Neck Surgery, Zagreb University Hospital Center, Zagreb. There were 59 men and five women, mean age 58 years (range 42 to 79 years). We considered patients with T1 and T2 lesions as candidates for endoscopic resection. Twenty-nine patients had T1 and 35 patients T2 lesions (UICC-AJCC staging, sixth edition). There were 46 (72%) patients without regional and/or distant metastases (N0 neck), and 18 (28%) patients with clinically positive neck lymphatics (N+ neck). Tumor stage distribution is presented in Table 1.

The routine preoperative examination included magnifying laryngoscopy, palpation, ultrasonography, and fine-needle aspiration of neck nodes. Computed tomography (CT) was not routinely employed.

One of the necessities for endosopic resection is complete tumor visualization. Optimal exposure and visualization of supraglottic region were obtained by use of direct laryngoscope and chest holder. The operations were

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TABLE 1
TUMOR STAGE DISTRIBUTION (UICC-AJCC STAGING, SIXTH EDITION)

Stage	No. of Patients	%
I	22	34
II	24	38
III	11	17
IV	7	11
Total	64	100

There were 46 patients without regional and/or distant metastases (N0 neck), and 18 patients with clinically positive neck lymphatics (N+ neck).

carried out with a CO_2 laser coupled to the operating microscope. The focus diameter of the micromanipulator was 0.3 mm and the delivered laser energy was 12 to 20 watts in continuous mode. Bleeding from large vessels was controlled by electrocautery. Allmost all supraglottic tumors were treated by *en bloc* removal.

Epiglottic T1 tumors of suprahyoid localization with N0 neck were not an indication for elective neck treatment. There were 14 such cases. Five patients with midline T2 tumors and N0 neck received elective radiotherapy instead of neck dissection. Neck dissection was performed in 45 (70%) patients: selective in 27 (42%) and curative in 18 (28%) patients. Selective dissection included nodal levels II–IV, whereas curative dissection was either radical or modified radical dissection. Unilateral neck dissection was performed in 19 patients with lateral tumor localization. In 26 patients with midline tumors, neck dissection was performed bilaterally. Bilateral dissections were performed in two acts: the first dissection was done simultaneously with primary treatment, and the second one was delayed by 7 to 10 days.

Thirty-three (52%) patients underwent surgical therapy alone, whereas 31 (48%) patients received postoperative radiotherapy. Besides the above mentioned five patients with midline T2 tumors and N0 neck who recieved elective neck irradation, indications for radiotherapy were positive or close resection margin of a primary tumor, multiple lymph node metastases, and lymph node metastases with extracapsular spread. Four patients had both positive/close resection margin and N+ neck.

Survival calculations were done by the Kaplan-Meier method using XLSTAT software for Microsoft Excel 2004 Pro (Addinsoft, NY, USA).

Results

Postoperative nasogastric intubation was often avoided in T1 cases. In others, the mean duration of nasogastric alimentation was 7 days (range 3 to 15 days). Nine (14%) patients were tracheotomized, one of them one month postoperatively because of a heavy laryngeal edema.

The mean follow up was 46 months (range 6–88 months). Survival calculations were done by the Kaplan-Meier method (Table 2). Estimated overall 5-year survival for all patients was 89%. On determination of overall survival we considered all deaths, including those caused by intercurrent deaths and second primary tu-

TABLE 2
KAPLAN-MEIER TABLE FOR THE FIRST 4 YEARS OF FOLLOW-UP – SURVIVAL CALCULATIONS WERE DONE BY THE KAPLAN-MEIER METHOD

Year	At risk	Failed	Censored
1	64	0	6
2	58	2	11
3	45	1	5
4	39	1	13

Estimated overall 5-year survival for all patients was 89%, while estimated 5-year recurrence-free survival for all patients was 93%.

Year – year of follow up, At risk – number of followed up patients in particular year, Failed – fatal outcome, Censored – patients who did not complain to follow up by the end of particular year

TABLE 3
FAILURE AFTER SUPRAGLOTTIC LASER LARYNGECTOMY

Sex/Age (yrs)	TNM	Therapy	Complication	Therapy for Complications	Outcome
M/59	T2N2aM0	SGL+RND+RT	Neck recurrence	/	Death, 31 mo
M/64	T2N1M	SGL+RND+RT	Bronchial cancer	CT	Death, 18 mo
M/57	T2N0M0	SGL+RT	Local recurrence	TL	Alive
M/49	T2N1M0	SGL+RND+RT	Aspiration Meta pulmo	TL CT	Death, 23 mo
M/62	T1N1M0	SGL+RND	Myocardial infarction	/	Death, 43 mo
M/51	T1N1M0	SGL+RND	Local recurrence	SGL, RT	Alive
M/64	T1N0M0	SGL	Lingual cancer	op, RT	Alive

Two patients died from tumor complications. Two patients suffered local recurrence, however, after secondary therapeutic regimen they are still alive. Two patients developed second primary cancer (bronchial cancer and lingual cancer).

SGL – supraglottic laryngectomy, RND – radical neck dissection, RT – radiotherapy, CT – chemotherapy, TL – total laryngectomy, op – operation

mors. The estimated 5-year recurrence-free survival for all patients was 93%. For the determination of recurrence-free survival uncensored observations included local and neck recurrences (including those successfully managed), distant metastasis and TNM-related deaths. We did not include patients who died due to second primary tumor and intercurrent deaths.

The causes of failure after supraglottic CO_2 laser laryngectomy are presented in Table 3. Two patients died from tumor complications (neck recurrence, pulmonary metastasis). Two patients suffered local recurrence, however, after secondary therapeutic regimen they are still alive. In one of these patients salvage total laryngectomy was performed. Two patients developed second primary cancer (bronchial cancer and lingual cancer). Temporary aspiration occurred in 17 (26%) patients. One patient suffered heavy aspiration and recurrent aspiration pneumonia, thus total laryngectomy was performed nine months after the laser procedure. Subsequently, this patient developed pulmonary metastasis and died. Major hemorrhage requiring surgical revision occurred postoperatively in two patients, and was managed succesfully in both cases. Three patients developed minor laryngeal stenosis as the result of laryngeal chondritis, however, requiring no additional surgical treatment. In all patients, the speech function was satisfactory. All tracheotomized patients were eventually decannulated.

Discussion

Supraglottic carcinoma can be managed with surgery, radiotherapy, and a combination of these two modalities. The best treatment approach is still controversial. Sessions et al. have recently published retrospective study in 653 patients with supraglottic laryngeal cancer, where none of the nine treatment modalities produced a survival advantage, either overall or within stages[5]. The decision on the treatment of supraglottic carcinoma depends on careful patient selection and surgeon's experience, and is highly individual. Also, early supraglottic lesions can be treated with either surgery or radiotherapy. The advantages of surgery as compared with radiotherapy are less tissue destruction, precise tumor resection, easier follow up examination, and reservation of radiotherapy for possible tumor recurrence. The advantages of radiotherapy are avoidance of postoperative morbidity and mortality, better preservation of speech and swallowing, and reservation of surgery for the possibly needed salvage laryngectomy[2]. The results recorded in the management of early stage carcinoma are similar for these two treatment modalities. Mendenhall et al. reported on a 100% 5-year survival rate for T1 tumors and 83% for T2 tumors in patients treated with radiotherapy alone[6]. The reported rates of 5-year survival rate for open horizontal supraglottic laryngectomy range from 90% to 100% for T1, and from 80% to 97% for T2[7–9].

In recent years, promising results of endoscopic CO_2 laser management of supraglottic cancer have been published[3,10–14]. Still, the reported series on supraglottic cancer reveal considerable variability in therapeutic approach: the indications for laser procedure, neck management, and postoperative irradiation are very inconsistent. The advantages of endoscopic laser surgery are avoidance of tracheotomy, shorter time of operative procedure, less postoperative complications, faster swallowing restitution, and lower cost of rehabilitation. In this article we reviewed our experience in 64 patients with supraglottic carcinoma.

In our study, we only operated patients with T1 and T2 lesions, with or without neck metastases. None of the patients inculded in this study had T3 tumor. Iro et al. emphasize that the indication for transoral surgery of T3 lesions should be considered with restraint[11]. Some authors described their experience with laser resection of T3 lesions. Motta et al. have recently published their experience on 116 supraglottic tumors, where they had 18 patients with T3 lesions (T3N0M0)[12]. They have reported actuarial 5-year local control in these patients to be 77%, and emphasized that in T3 lesions CO_2 laser should be implemented in those cases in which radical excision by endoscopic route is feasible. In the last years we also performed several endoscopic procedures on patients with T3 lesions (data were not included in this study), but solely for the lesions that were completely visualized through endoscope, and without neck disease. Short-term results seems to promising, but we need longer follow-up to draw the conclusions. Adequate exposure and visualization of the tumor is crucial for safe resection. If adequate resection margins are obtained, oncologic results of transoral laser surgery should be comparable to those of classic transcervical resection.

Eighteen of our patients had clinically positive neck lymph nodes. Most of the series on transoral laser microsurgery included patients with positive nodal disease, some of them with a significant ratio of stage III and IV patients[15]. It is well known that the presence of regional metastases results in cure rates that are approximately half those obtainable if metastasis to regional lymphatics is not present. Of 12 followed-up patients with stage III and IV cancer we had five (42%) patients with treatment failure/complication, compared with only 2 (6%) failures in 35 patients with early-stage carcinoma.

Nowadays, the management of clinically N+ neck is generally unique; however, the appropriate treatment of the clinically N0 neck is still a controversial issue[2,16]. Neck relapse remains a significant cause of failure in patients with supraglottic cancer. Levendag and colleagues found a 35 percent rate of nodal disease either upon elective dissection or subsequent relapse in a series of stage I and II supraglottic cancers[9]. Given the risk of disease and its morbidity, elective neck dissection is warranted in most cases of supraglottic cancer.

In our study, we have applied the following algorhytm for neck management: in patients with N+ neck, either radical or modified radical dissection was performed; in patients with N0 neck, only epiglottic T1 tumors of suprahyoid localization were not an indication for elective treatment; most of the other patients were treated

with neck dissection, and five patients with midline T2 tumors received radiotherapy instead of neck dissection. Lateral tumor localization was an indication for unilateral neck dissection, whereas in midline cases bilateral neck dissection was performed.

The supraglottic area is richly supplied with lymphatics and the incidence of occult metastases is around 30%[17]. The repetitive pattern of metastasizing (mostly affecting levels II, III and IV) has introduced lateral neck dissection as the treatment of choice. Elective lateral neck dissection of levels II–IV is recommended in T2–T4 N0 supraglottic cancers[18]; and according to Iro even in stage I disease[11]. Myers and Alvi conclude that patients with bilateral neck operation have a lower incidence of postoperative recurrences and even suggest bilateral neck dissection in all patients with supraglottic cancer[2]. In midline cases, bilateral neck dissection is mandatory. In pN+ cases as well as in those where the primary tumor specimen shows positive margins postoperative radiotherapy should also be used[13].

The reported incidence of adjuvant radiotherapy differs among authors and ranges from 2% to 45.4%[10,11]. We considered adjuvant radiotherapy for patients with lymph node metastases with extracapsular spread, and positive or close resection margins. On deciding on postoperative radiotherapy Rudert also considers the size of primary tumor[13]. In case of positive margins, Ambrosch recommends repeated resections[10].

Functional results recorded in our study significantly outline those after open supraglottic laryngectomies and have been reported previously. Besides general avoidance of tracheotomy, less postoperative complications, faster swallowing restitution, and overall therapy and rehabilitalion cost benefits, we recorded a significantly lower rate of aspiration. Aspiration was recorded on videofluoroscopy in 30% of our patients, compared to almost 90% of patients who underwent classic supraglottic laryngectomy[19]. The lower rate of aspiration and the absence of some other complications after endoscopic supraglottic laryngectomy by CO_2 laser have been ascribed to the preservation of vital structures that have important roles in the act of swallowing, such as the base of the tongue, prelaryngeal muscles, hyoid bone, arytenoid cartilage and extralaryngeal part of both superior laryngeal nerves, enabling restitution of the sensory function of the larynx and its normal mobility.

None of our patients had any clinical symptoms of dysphagia. Also, in many of our patients we avoided postoperative nasogastric intubation. Nowadays, our preference is general avoidance of nasogastric intubation, unless the signs of aspiration are present.

Conclusion

The use of endoscopic laser surgery for supraglottic tumor depends on the tumor localization and expansion, patient's general condition, surgeon's experience, and devices available. T1 and T2 supraglottic lesions could be successfully managed endoscopically, either by sole surgical therapy of primary tumor or by its combination with adjuvant radiotherapy or neck dissection. The presence of regional metastases results in much lower cure rates. Our results prove the validity of supraglottic laryngectomy by CO_2 laser as a method of treatment for carcinoma of the larynx.

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S. Janjanin

Department of Otorhinolaryngology, Head and Neck Surgery, Zagreb University Hospital Center, Kišpatićeva 12, 10000 Zagreb, Croatia
e-mail: s_janjanin@yahoo.com

NAŠE 10-GODIŠNJE ISKUSTVO U ENDOSKOPSKOM KIRURŠKOM LIJEČENJU SUPRAGLOTIČKIH KARCINOMA POMOĆU CO_2 LASERA

S A Ž E T A K

U radu smo opisali naše iskustvo u kirurškom liječenju primarnih supraglotičkih karcinoma pomoću CO_2 lasera. U razdoblju od 10 godina u 64 bolesnika je urađena kurativna endoskopska supraglotička laringektomija. 29 bolesnika imalo je T1, a 35 bolesnika T2 lezije grkljana. 46 bolesnika nije imalo regionalne niti udaljene metastaze (N0 vrat), dok je 18 bolesnika imalo metastatske promjene u vratu (N+ vrat). 33 (52%) bolesnika liječena su samo kirurški, dok je kod 31 (48%) bolesnika kirurško liječenje nadopunjeno radioterapijom. Očekivano 5-godišnje preživljenje za sve bolesnike iznosilo je 89%. Lokalna i regionalna kontrola tumora, kao i stopa preživljenja u naših bolesnika može se usporediti s ishodima drugih vrsta terapije ove bolesti, poput primarne iradijacije ili otvorene supraglotičke laringektomije. Prednost endoskopske laserske kirurgije grkljana nad ostalim metodama je u dobrim funkcijskim rezultatima. Transoralna endoskopska kirurgija CO_2 laserom je učinkovita u liječenju T1 i T2 supraglotičnih tumora grkljana i može se kombinirati s disekcijom vrata i postoperativnim zračenjem.