ENDOSCOPIC CO\textsubscript{2} LASER MICROSURGERY FOR SUPRAGLOTTIC CARCINOMA

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ABSTRACT

Objective: Endoscopic CO\textsubscript{2} laser microsurgery represents a modern method of treatment in supraglottic cancer and was introduced few years ago in the ENT Department Timisoara. This retrospective study presents the indications, contraindications, limits and results of this modern therapeutic method. Material and methods: Between 01.01.1996-31.12.2004, 32 patients with supraglottic carcinoma T\textsubscript{1} or T\textsubscript{2} and N\textsubscript{0} have been treated with supraglottic laryngectomy with CO\textsubscript{2} laser. Careful preoperative selection is of utmost importance for the clinical outcome of patients. In the studied group we applied horizontal supraglottic laryngectomy in 26 cases T\textsubscript{2}N\textsubscript{0} and epiglottectomy in 6 cases T\textsubscript{1}N\textsubscript{0}. Results: The tracheotomy and nasogastric tube were not necessary in any case. Conclusions: Endoscopic CO\textsubscript{2} laser microsurgery appears to be an effective and safe alternative treatment for T\textsubscript{1}-T\textsubscript{2}N\textsubscript{0} supraglottic carcinoma, with superior oncologic and functional results than the conventional surgical procedures. Key Words: endoscopic microsurgery, supraglottic carcinoma, CO\textsubscript{2} laser.

INTRODUCTION

The most significant indication for CO\textsubscript{2} laser surgery is the treatment of laryngeal carcinoma. Supraglottic carcinoma is even more amenable for laser surgery than vocal cord carcinoma, since the upper parts of the supraglottis are not confined by the laryngeal skeleton.\textsuperscript{1} This retrospective study proposes to evaluate the functional and oncological results of surgical interventions, to establish efficaciousness and limits of this new technique; to draw up a modern treatment protocol with better functional and oncological results using the advantages provided by endoscopic CO\textsubscript{2} laser microsurgery in supraglottic carcinoma.\textsuperscript{2}

MATERIAL AND METHODS

Between 01.01.1996 and 31.12.2004 (retrospective study), 32 patients with supraglottic carcinoma stage I – T\textsubscript{1}N\textsubscript{0} (26 cases) and stage II – T\textsubscript{2}N\textsubscript{0} (6 cases) have been treated in the ENT Department Timisoara. All patients were males (100%). Mean age was 55.8 years, with a large range between 32 and 74 years. The most affected were those aged between 51-60 years (54.5% of all patients).
All patients underwent horizontal supraglottic laryngectomy with endoscopic laser CO\textsubscript{2} microsurgery and postoperative radiotherapy.

Selection criteria for endoscopic laser CO\textsubscript{2} treatment:

1. Supraglottic tumor, T criteria – T\textsubscript{1} and T\textsubscript{2}, exophytic type, limited to the supraglottic region and at least 2-3 mm distance to the anterior commissure with normal mobility of the vocal cords.

2. Regional lymph nodes, N criteria – without regional metastases, stage N\textsubscript{0}, at clinical, ultrasound and CT examinations.

3. Tumors accessible by video-endoscopy, with good exposure of the endolaryngeal surgical field.

The selection of the 32 patients with supraglottic carcinoma stage T\textsubscript{1}, T\textsubscript{2} and N\textsubscript{0} has been done based on history, clinical examination, laryngoscopy, videomicrolaryngoscopy, cervical and thoracic radiography, cervical ultrasound examination, and cervical CT scan. (Fig. 2, 3)

TNM classification represents the essential element in establishing the indications for a partial laryngectomy with laser. Endoscopic CO\textsubscript{2} laser partial horizontal microsurgery is, with oncological criteria applied, the surgical therapy of choice for supraglottic carcinoma in T\textsubscript{1} and T\textsubscript{2} stage. T\textsubscript{1} stage defines a small tumor, well circumscribed, less than 1.5 cm, limited to supraglottic region, with normal mobility of the vocal cords, at a distance of at least 2-3 mm from the anterior commissure, with normal aspect. T\textsubscript{2} stage defines a larger tumor, 1.5-3 cm, that involves more than an anatomical region, with extension to the nearest supraglottic regions, with normal mobility of the vocal cords.

Oncological aims of the endoscopic management with CO\textsubscript{2} laser are:

- Complete excision of the tumor, oncologically safe and histological exam confirms negative margins.
- Oncologically safe margins: the border between tumor and surrounding normal tissue is identified, an individually appropriate safety margin of 3-5 mm (average 3 mm) is then selected. CO\textsubscript{2} laser resection prevents neoplastic cells dissemination, obstructing blood and lymph vessels.

The functional aim of CO\textsubscript{2} laser resection is to preserve a functional glottis and to protect the laryngeal fundamental functions – airway, swallowing and voice – with the strict adherence to oncological principles, for increased quality of patient’s life. During the laser CO\textsubscript{2} microsurgical interventions tracheotomies and nasogastric tube were not required.

Based on clinical stage of the tumor, we applied horizontal supraglottic laryngectomy – in 26 cases (81.2%) T\textsubscript{2}N\textsubscript{0} and epiglottectomy – in 6 cases (18.8%) T\textsubscript{1}N\textsubscript{0}.

Horizontal supraglottic laryngectomy consists in complete excision of the supraglottic region with glottic region preserved and with laryngeal functions maintained. Depending on primary tumor size and extent, we applied complete excision of the supraglottic region, en block or piece by piece, including: epiglottis...
with preepiglottic space, both aryepiglottic folds, ventricular folds and the superior part of the Morgagni ventricle till the floor of the ventricle represented by the superior face of vocal cords. (Fig. 4, 5)

Figure 4. Postoperative view after Laser CO\textsubscript{2} resection.

Figure 5. Postoperative view after Laser CO\textsubscript{2} resection, with a functional glottis.

Epiglotectomy consists in partial horizontal surgical intervention with partial excision of the supraglottic space in a horizontal plan. This technique could be practiced in small well-circumscribed T\textsubscript{1} tumors, strict located on median suprahyoid mobile epiglottis.

The follow-up period varied between 4 and 48 month (average 36 month). Follow-up data were available for all patients. All of them underwent a postoperative protocol based on clinical examination, videoendoscopic and radiological methods, cervical ultrasound examination or cervical CT scan.

The surgical interventions were performed under general endotracheal anesthesia, paying attention to the anesthesiological safety aspects of laser surgery. We used a minimal postoperative aftercare: antibiotic prophylaxis for 7 days with ampicillin 4g per day i.m. to prevent bronchopneumonia or a local infection (chondritis, perichondritis); mucolytics; minor antalgics in the first 24-48 hours to prevent local pain.

RESULTS

There were no accidents or complications during CO\textsubscript{2} laser procedures. No intra- and postoperative hemorrhages occurred. We had one postoperative complication in one patient (3.12 %) - represented by aspiration leading to bronchopneumonia; the patient presented supra and subhyoidian T\textsubscript{2} tumor and we performed a large excision with safety margins involving the median wall of the pyriform sinus on one side; this patient accused difficult swallowing in days 11-15.

The endolaryngeal wounds healed in 28-35 days, as seen during flexibil laryngoscopy control. None of the 32 patients had significant impairment of voice. The airway was not impaired by the endoscopic supraglottic resection.

In the first 24-48 postoperative hours all the patients received parenteral nutrition. The patients were able to swallow and were able to resume normal feeding afterwards. They were followed up and involved in a retraining of deglutition process. The swallowing impairment, with aspiration, required nasogastric tube for 3-4 days to prevent aspiration bronchopneumonia and pulmonary abscess.

Partial horizontal microsurgical interventions didn’t lead to swallowing impairments and if they still existed, disappeared in 21 days, when functional results were very good to 96.88% of the treated patients and good in 3.12%. This improvement of deglutition function was related to healing process and with minimal invasive character of the surgical procedures, without intraoperative nasogastric tube.

The oncological results of these 32 patients with supraglottic carcinoma, T\textsubscript{1}N\textsubscript{0} stage – 6 cases (18.8%) and T\textsubscript{2}N\textsubscript{0} stage – 26 cases (81.2%) were:

- Free of disease - 25 cases (78.1%);
- Local and regional recurrences - 21.9%, represented by 7 cases with supraglottic carcinoma T\textsubscript{2}N\textsubscript{0} stage, which developed local recurrences – 5 cases – and lymph nodes recurrences – 2 cases. (Fig. 6)

Overall survival at 36 months was 100% - 32 cases. At the end of follow up and oncological dispensarisation period of 36 months, all patients were alive. Overall survival included also the seven cases with local and regional recurrences, retreated with conventional open surgery, neck dissection and radiotherapy for lymph
nodes metastases. These patients had a favorable outcome, being alive at the end of the followed up period.

Very good results, with 100% healing rate, have been registered in T1 stage tumors – 6 cases (18.8%) when we performed epiglottectomy. In T2 stage supraglottic tumors - 26 cases (81.2%) with horizontal supraglottic laryngectomy healing rate was 78.1% with a rate of local and nodular recurrences of 21.9%.

Postoperative histopathological examination of the resected specimen demonstrated the cancer type–squamous cell carcinoma – and negative margins to all 32 patients.

We performed postoperative radiotherapy in all cases, because patients have been selected with N0 – without cervical lymph nodes metastases at clinical examination, ultrasound exam and selective CT scan. Treatment protocol in N0 status – no clinical metastases with risk of regional recurrences or occult lymph nodes metastases – includes observation and carefully regulated surveillance. Postoperatively, we have performed cervical ultrasound examination and cervical CT scan in patients with high risk factors of lymph nodes recurrences and occult metastases because of their morphological primary tumor’s features: tumoral grade, inflammation infiltrate, vascular and perineural invasion in vascular stroma.

Tumor recurrences was noted in 21.9% of patients who presented large supraglottic primary tumor T2 stage located on supra and subhyoid epiglottis, and where we practiced horizontal supraglottic laryngectomy through en block excision technique. Time interval from surgical intervention to recurrences was on the average 22 months, between 16 months for local laryngeal recurrence and 28 months for regional lymph nodes recurrence. In cases of local endolaryngeal recurrence, the patient underwent total laryngectomy with neck dissection. In cases with regional lymph nodes recurrences treatment consisted in neck dissection and postoperative radiotherapy 50 Gy on the lymph nodes area; these patients had a reserved prognosis but were still alive at the end of the study. Local and lymph nodes recurrences developed after more than 22 months from the endoscopic CO2 laser surgery, represent a good prognosis factor and can be managed through surgical re-intervention or radiotherapy.

Average hospitalisation was 14.3 days, between 10 days and 25 days, for the patient with pulmonary complication.

Treatment failures, local and regional recurrences are due to local and locoregional uncontrolled evolution of the disease, conditioned by primary tumor’s localization and morphoclinical parameters.

**DISCUSSIONS**

Since the introduction of the endoscopic CO2 laser microsurgery into clinical otolaryngological procedures, laser surgery for malignant tumors in the upper airway and digestive tract has become increasingly important.

Supraglottic malignant tumors represent 24-42% from primary laringeal tumors by Rudert. Laser CO2 microsurgery allows the surgeon to perform a partial horizontal intervention with oncological aims, at the patients with T1 and T2 carcinomas, achieving excision of the supraglottic region and preserving the glottic space, with normal airway, fonation and swallow functions, without tracheotomy and nasogastric tube; this technique is recommended by Davis, Rudert, Zeitels and Motta. In the patients from this study with supraglottic T1 and T2 tumors and N0, we consider that endoscopic laser CO2 partial horizontal microsurgery succeeded to assure the local control, through a large excision with oncological safety margins. This is considered primary treatment method with postoperative radiotherapy. Modern management of the patients N0 with the highest risk for lymph nodes recurrences is observation and carefully regulated observation.

As many other authors, we do not agree on preventive or on principle neck dissection. If this method would be applied in all patients with high risk of occult lymph nodes metastases (20, 30 or 40%), too many patients (60, 70 or 80%) would be exposed to useless therapeutic risks. For this reasons, some authors, such as Friedman, consider this an inadequate treatment method. It is considered an unseasonable technique which compromises the already affected immune system of the patient, increase morbidity,
mortality, cost and hospital stay.

In 1978 Vaughan first pointed out the possibility of using endoscopic CO₂ laser for the resection of early supraglottic cancer. He reported first endoscopic microsurgical intervention in six patients with T₁ tumor: two patients with carcinoma of the epiglottis, two with lesions of the aryepiglottic fold and two with cancer of the false cord.¹,²

In 1983 Davis et al. discussed a series of 20 patients undergoing transoral partial supraglottic resection with the laser CO₂ for benign or malignant laryngeal tumors.³ In this study he described the first horizontal supraglottic intervention – epiglottectomy with limited resection of the suprathyroid mobile epiglottis as a primary treatment method. This was performed without tracheotomy for a small exophytic well circumscribed T₁ tumor situated on median part of the suprathyroid mobile epiglottis.

In 1991, Cummings et al. reported on 14 patients with planned supraglottic resection, with postoperative radiotherapy.⁴ One of them had modified radical neck dissection because of N₂ neck disease. Full en bloc resection was accomplished in eight of these patients with T₁ and T₂ lesions, and they underwent postoperative radiotherapy. All of these patients were alive and free of recurrences after an average follow up period of 33.5 months. None of their patients had swallowing impairment with prolonged aspiration.

In 1990, Zeiels et al. reported the Boston experience with laser epiglottectomy and endoscopic management of early supraglottic cancer, in 51 cases.⁵ In this group only 27 patients had malignant tumors of the supraglottis, and the laser procedure was applied exclusively for diagnostic purposes, serving for excisional biopsy in 20 patients. In 7 patients with T₁ or T₂ tumors, excisional biopsy was able to achieve R₀ resection (negative margins). The author considered the presence of T₁ and T₂ tumors to be an indication for curative laser resection of the supraglottic cancer. The authors recognize as absolute contraindication for partial endoscopic CO₂ laser surgery the presence of T₃ supraglottic tumor because of the invasion of the preepiglottic space and they preferred an external approach.

In Europe, Steiner has systematically reported transoral laser resection of larynx carcinoma, and he obtained good oncological and functional results in a group of 30 patients with T₁ and T₂ supraglottic carcinoma.⁶

Rudert presents in a study from 1999 the results of 34 patients treated between 1981 and 1994: free of disease in 24 cases and local recurrences in 10 cases. Six patients needed temporary tracheotomy and 26 intraoperative nasogastric tube.⁷ Local recurrences rate was: 25% in case of T₂ tumor and 22% in case of T₃ tumor. The author notices no recurrence in T₁ tumors. The highest recurrences rate appeared in T₄ tumors, endoscopic CO₂ laser surgery have a palliative role in those cases. Survival rate in patients with early tumors T₁ and T₂ was 77%, significantly better than in patients with T₃ and T₄ tumors which presented a survival rate of 49%. Prognosis of the patients with N₂/N₃ is much better than those of the patients with N₀/N₁ who didn't survive over 3 years. The author recommends partial horizontal supraglottic microsurgery in T₁, T₂ and even T₃ tumors with limited extension in central part of the preepiglottic space because of superior functional and oncological results. The attitude regarding lymph nodes area is identical with that from external approaches.

In 1999 Csanady and Czigner reported their experience in 23 cases with supraglottic carcinoma (15 cases with T₁ and 8 cases with T₂) treated between 1987-1997 with CO₂ laser. They presented 16 cases free of disease (70%), with a follow up period between 1.5 and 9 years.⁸ Recurrences rate was 30% (6 cases) and salvage treatment consisted in: endoscopic CO₂ laser resection – 3 cases; radiotherapy – 1 case, horizontal supraglottic laryngectomy – 1 case and total laryngectomy – 1 case.

In 1996, Steiner and Ambrosch published the results of the Goettingen University group after laser surgery of supraglottic cancer in 99 patients.⁹ In 43 patients with stage I and stage II supraglottic cancer, the local recurrence rate was 9.5% and the 5-year overall survival rate was 72.8%; in 56 patients with stage III and stage IV cancer, the respective percentages were 19.5% and 48.8%.

In the patients from ENT Department Erlangen, overall 5-year survival rates was 75.4% for stage I and II and 56% for stages III and IV.

Steiner, Iro et al. evaluated the long-term results of endoscopic CO₂ laser surgery on a group of 141 patients, with mean age 60 years (between 36 and 90 years), operated between 1979 and 1993, selected from 387 patients with supraglottic carcinoma.¹⁰ Follow-up period was 37 months. The group included: stage I – 23.4% of cases; stage II – 25.5%; stage III – 16.3% and stage IV – 34.8% of cases. All patients underwent endoscopic CO₂ laser resection and frozen sections. Complete excision of the tumor with negative margins R₀ has been realized in 110 cases. Eighteen patients (12.8%) needed tracheotomy.
during surgical intervention or during radiotherapy treatment; 6 patients (12.8%) needed permanent tracheotomy. They had just one postoperative complication – aspiration bronchopneumonia, in 6 cases, with favorable evolution under antibiotics treatment. Overall 5-year survival rate free of disease was 65.7% (85% for stage I and 62.6% for stage II), and 10-years survival rate was 56.8%. Two- and three-year survival rates were 81.6% and 71.6%, respectively.

The recently introduced endoscopic CO₂ laser microsurgery treatment in the management of supraglottic carcinoma is still to be evaluated regarding indications, contraindications, lymph nodes approach and results.

CONCLUSIONS

Endoscopic partial horizontal CO₂ laser microsurgery with oncological aims is recently introduced through functional interventions for early supraglottic cancer T₁ and T₂, and it can be practiced only in medical centers with modern equipment.

A precise clinical stage diagnosis of supraglottic T₁ and T₂ tumor with a good selection and preoperative evaluation of the patients represent the most important factor to establish surgical indications for endoscopic horizontal CO₂ laser interventions.

These correct indications for partial horizontal microsurgery represent the outmost element in oncological success. Supraglottic T₁ and T₂ tumor represent the best indication for endoscopic CO₂ laser approach.

Supraglottic T₃ tumor is the absolute contraindication for endoscopic management because of the preepiglottic space involvement, in many cases.

Partial horizontal endoscopic CO₂ laser interventions conserve the integrity of laryngeal cartilages and allow rapid functional swallowing, without nasogastric tube.

Oncological results, with terapeutic failure through local and regional recurrences in 21.9% of patients, were due to uncontrolled local and loco-regional disease evolution, caused by localization and morphoclinical characteristics of the primary tumor.

The lymph nodes approach in patients with N₂, but with risk of recurrences through lymph nodes metastases, including occult metastases, in patients who underwent oncological radical excision of the primary tumor, consisted in observation and attentive and regular surveillance.

REFERENCES