Complications in CO_2 Laser Transoral Microsurgery for Larynx Carcinomas

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Abstract

Introduction Transoral laser microsurgery (TLM) has established itself as an effective option in the management of malignant tumors of the glottis, supraglottis, and hypopharynx. Nonetheless, TLM is not a harmless technique. Complications such as bleeding, dyspnea, or ignition of the air may appear in this type of surgery.

Objective The aim of this study is to describe the complications that occurred in a group of patients treated for glottic and supraglottic carcinomas in all stages by TLM.

Methods This study is a retrospective analysis of patients diagnosed with squamous cell carcinoma of the glottis and supraglottis for all stages (T1, T2, T3, T4), N -/ + , M -/+ treated with TLM between January 2009 and March 2012 in a tertiary hospital.

Results Ninety-eight patients met the inclusion criteria, which had undergone a total of 131 interventions. Ninety-four (95.9%) patients were male and 4 (4.1%) were female. The mean age was 64.2 years (± 10.7 years = min 45; max 88). The presence of intraoperative complications was low, affecting only 2% of patients. Immediate postoperative complications occurred in 6.1%, whereas delayed complications affected 13.2% of patients, without any of them being fatal.

Conclusion TLM has shown good oncologic results and low complication rate compared with traditional open surgery during intervention, in the immediate and delayed postoperative period and in the long-term with respect to radiotherapy.

Keywords

- complications
- CO_2 laser
- larynx
- carcinoma

Introduction

During the seventies, Strong and Jako proposed the use of endoscopic laser surgery in the treatment of laryngeal lesions.[1,2] Since then, the transoral laser microsurgery (TLM) has been gaining ground in the world of laryngeal oncology, establishing itself as an effective option in the management of malignant tumors of the glottis, supraglottis, and hypopharynx.

The treatment's advantages, such as magnification generated by the microscope, allows us to make limited resections to differentiate healthy tissue from that which has been affected, thus, preserving adjacent disease-free areas. In turn, it has allowed a decrease in the number of tracheotomies and in the use of nasogastric tubes.[3–5] Moreover, it is possible to achieve oncological benefits similar to those obtained through open surgery in patients with early and properly selected tumor stages.[5] The results reported in the literature show all patients that underwent this treatment presented relatively low rates of complications.

However TLM is not a harmless technique. Therefore, the aim of this study is to describe the complications that occurred in a group of patients treated for glottic and supraglottic carcinomas in all stages by TLM in a tertiary hospital.

Methods

A retrospective analysis of the patients diagnosed with squamous cell carcinoma (SCC) of the glottis and supraglottic

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for all stages (T1, T2, T3, T4), N −/+, M −/+ was performed according to the criteria of the Union Internationale Contre le Cancer (UICC) and the American Joint Committee on Cancer (AJCC) in a tertiary hospital. We included in the study patients treated with TLM between January 2009 and March 2012. We identified cases by searching the medical records of our department using the codes from the International Classification of Diseases (ICD) −9. The Ethics Committee of our institution approved this study.

By reviewing medical records we obtained demographic data (age, gender), medical history, tumor stage, diagnostic tests information, histological findings, complications, and type of surgery. In the final analysis, only complications strictly associated with the surgical technique were included. We excluded complications associated with anesthesia or exacerbation of chronic diseases that were not possible to associate with the use of this technique. The type of complications were classified according to the stage of presentation: intra-operatively or post-operatively and immediate or delayed.

Before the surgery, an interdisciplinary committee specialized in head and neck tumors discussed each case. Patients with lesions suspicious for malignancy were scheduled for laryngeal microsurgery with biopsy; those that were positive underwent glottic or supraglottic CO_2 laser resection. After surgery, the committee reviewed pTNM and assessed the need for reoperation or additional treatment with radiotherapy (RT).

For the surgical procedure, all of the patients received general anesthesia with orotraqueal intubation with special tubes for laser surgery (Covidien - Mallinckrodt, Dublin, Ireland). The anesthetist reduced their O_2 level using narcotic gases, and protected the balloon tube in its distal portion with cotton sponges moistened with saline. The resection was performed using a Lumenis CO_2 laser device (Yokneam, Israel), with a power setting of 4–8 W, used in superpulsed mode and continuous setting, varying in size and shape of the spot according to the moment of the surgery by using the micro- manipulator Acublade (Lumenis). The type of cordectomy was classified according to the European Laryngological Society (ELSOC) proposal for glottic[6] and supraglottic endoscopic resection.[7] In the case of small tumors (T1a, T1b), whenever possible, en bloc resection was attempted. After resection, the piece was pinned and oriented on a corkboard. In bulky tumors (T2, T3, or T4), most cases required piecemeal resections. Laser vestibulectomy was performed when the lateral or anterior portion of the tumor was hidden by a ventricular fold. In all cases, the surgeons tried to achieve a margin of healthy tissue of 2–3mm, trying to preserve the functions without affecting the oncological radicality of the procedure.

In our Department, patients treated for head and neck malignant tumors are followed for at least five years at the Department of Head and Neck Oncology. For this study, however, we considered a group of patients that had been followed for a minimum of 36 months.

We conducted statistical analysis using SPSS for Windows, version 20.0 (SPSS, Inc., Illinois, U.S.A.). Quantitative variables in the study were expressed as mean ± standard deviation. We applied the chi-square test to study differences in hospital stay, the need to place SNG, or dysphagia, depending on T stage. We analyzed the correlations between variables using the Spearman test.

Results

From a total of 131 interventions (98 primary, 33 reoperations), 98 patients met the inclusion criteria. Ninety-four (95.9%) patients were men and 4 (4.1%) patients were women. The mean age of the study group was 64.2 years (± 10.7 years = Min 45 / Max 88). Of these, 22 (22.4%) were diabetic, 40 (40.8%) were hypertensive, 93 (94.9%) were smokers, and 41 (41.8%) consumed alcoholic beverages. Regarding to tumoral stage, 45 (45.9%) patients were classified as pT1, 32 (32.7%) as pT2, 15 (15.3%) as pT3, and 6 (6.1%) as pT4 (►**Table 1**). Eighty-seven (88.8%) patients were classified as N0, 6 (6.1%) as N1, 4 (4%) as N2a, and 1 (1%) as N2b. In the sample of patients included in the study, there were no cases of distant metastases. The mean follow-up was 40.1 months (± 14 = Min 5 / Max 72). As for most frequent type of cordectomy, in glottis tumors, Type 4 was performed in 28 (28.6%) patients, whereas, for supraglottic tumors, Type IVb was performed in 12 patients (12.2%) (►**Table 2**). The results will be presented in subgroups as glottis (GTG), supraglottic (STG), and transglottic tumors (TTG). The mean hospital stay was 3.6 days (± 8.3 = Min 1 / Max 66) for glottic carcinoma, 13.2 days (± 25.5 = Min 2 / Max 149) for STG group, and 38 days (± 54.8 = Min 2 / Max 116) for TTG group, being statistically significant when comparing the periods for different locations ($p < 0.0001$).

Table 1 Pathological tumoral stage, regional lymph nodes, and distant metastases

	N0	N1	N2	M	Total
pT1	44	1	0	0	45
pT2	28	2	2	0	32
pT3	9	3	3	0	15
pT4	6	0	0	0	6
Total	87	6	5	0	98

Abbreviations: M, distant metastases; N, regional lymph node patient groups; pT, pathological tumoral stage.

Table 2 Glottic and supraglottic cordectomy practiced as rated by the ELSOC

Type of cordectomy	pT1	pT2	pT3	pT4	Total (%)
GLS Type III	2	0	0	0	2 (2.04%)
GLG Type IV	27	1	0	0	28 (28.57%)
GLS Type Va	14	8	0	0	22 (22.44%)
GLS Type Vb	0	3	3	1	7 (7.14%)
GLS Type Vc	0	5	1	2	8 (8.16%)
GLS Type Vd	0	1	0	1	2 (2.04%)
SGL Type IIa	1	2	0	0	3 (3.06%)
SGL Type IIb	0	1	1	0	2 (2.04%)
SGL Type IIIa	0	5	0	1	6 (6.12%)
SGL Type IIIb	0	1	3	0	4 (4.08%)
SGL Type IVa	0	3	2	0	5 (5.10%)
SGL Type IVb	1	2	8	1	12 (12.2%)
Total	45	18	4	4	98 (100%)

Abbreviations: ELSOC, European Laryngological Society; GLS, glottic laser surgery; pT, pathological tumoral stage; SGL, supraglottic laser surgery.

In the group that had intraoperative complications, one patient with a transglottic tumor (pTIVa) suffered ignition of the airway, which the surgical team was able to control without vital impact for the patient, while another lost a tooth after surgery (2/98 = 2.04%). There were no skin burns or eye injuries in any of the patients nor laser injuries on operating room personnel. Immediate post-surgical complications occurred in 6 patients (6/98 = 6.1%), five of them presented post-surgical bleeding and required clipping of the superior laryngeal pedicle. Two patients in the STG (1pT3, 1 pTIVa), two patients in the GTG (1 pTIVa pT3), and another patient from the TTG (pTIVa), a total of five patients, required urgent tracheotomy postoperatively. Another patient from the STG (1pT2) needed urgent tracheostomy due to acute dyspnea secondary to airway edema (►**Table 3**).

Moreover, 42 (42.9%) patients required the use of a nasogastric feeding tube (NFT) in the immediate postoperative period, 13 (20.6%) in the GTG (pT1 2, 4 pT2, 4pT3, and 3 pT4a), 25 (80.6%) in the group of STG (1 pT1, 10 pT2, pT3 13, pTIVa 1), and 4 (100%) in the group of TTG (1 pTIVa pT2 and 3) ($p < 0.0001$). The mean duration of NFT was 0.9 days (± 2.2 days = Min 0 / Max 13) in the group of patients treated for glottic tumors, 6 days (± 5.7 days = Min 0 / Max 29) in the group with supraglottic tumors, and 15.5 days (± 19.2 days = Min 2 / Max 44) in the group of patients treated for transglottic tumors. Thus, the difference between the mean duration of the NFT in patients treated for supraglottic and transglottic tumors regarding patients by glottic tumors was statistically significant ($p < 0.0001$) (►**Table 4**).

During post-surgical follow-up, 13 (13/98 = 13.2%) patients had some type of late complication. Eight (8.1%) patients had aspiration pneumonia after surgery, 7 patients in the STG (2 pT2 and 5 pT3) and one in the GTG (pTIVa). Two (2.04%) patients had a cervical abscess, both in the STG (pT2 and pT3), and one of them complicated by mediastinitis. Two (2.04%) patients from the STG group (pT3) suffered laryngeal stenosis after treatment with TLM, and up to 3 interventions were required to achieve local control for both. One (1%) patient on whom the surgeon had to expose the thyroid cartilage during tumor resection required accurate hospitalization for medical treatment due to chondritis (Ca. glottis pT4a). Fourteen (14.2%) patients required TL: 6 (6.1%) of them secondary to aspiration pneumonia, 4 in the STG (3 pT3, 1 pT4a), and 2 in TTG (2pT4a). For the rest of TL, the surgical team had to achieve local control of the disease, which they were not able to achieve by TLM. Post-surgical delayed

Table 3 Intraoperative, immediate, and delayed postoperative complications associated with laser surgery

Complications	N	%	Type
Intraoperative	2	2.04%	One patient lost a tooth and another suffered ignition of the airway.
Immediate postoperative	6	6.1%	5 episodes of post-surgical bleeding and 1 episode of dyspnea secondary to airway edema.
Delayed postoperative	13	13.2%	8 patients suffered aspiration pneumonia. 2 patients had cervical abscess (one of them complicated with mediastinitis). 2 patients had stenosis of the laryngeal vestibule. 1 patient had thyroid cartilage chondritis.
Total	19	19.38%	–

Abbreviations: Min, minimum; Max, maximum.

Table 4 Mean hospital stay, percentage of placement, and duration of NFT according to tumor location

	Glottic (Mean = Min / Max)	Supraglottic (Mean = Min / Max)	Transglottic (Mean = Min / Max)	*p*
Mean hospital stay	3.6 days (± 8.3 = 1 / 66)	13.2 days (± 25.5 = 2 / 149)	38 days (± 54.8 = 2 / 116)	< 0.0001
NFT	20.6%	80.6%	100%	< 0.0001
NFT mean duration	0.9 days (± 2.2 days = 0 / 13)	6 days (± 5.7 days = 0 / 29)	15.5 days (± 19.2 days = 2 / 44	< 0.0001

Abbreviations: Min, minimum; Max, maximum; NFT, nasogastric feeding tube.

complications were more frequent in the TTG group, affecting 50% (2/4) of patients, and in the STG group, affecting 41% (13/31) of patients ($p < 0.001$). Furthermore, complications were statistically more frequent in larger tumors for all locations ($p < 0.001$) (►**Table 3**).

During follow-up, 40 (40.8%) patients had some degree of postoperative dysphagia. Twelve (20.04%) from the GTG group (3pT1, 3 pT2, pT3, and pT4a 2), 25 (80.64%) from the STG group (2 pT1 10 pT10 12 pT3 1 pT4a), and 4 (100%) in the TTG had some type of dysphagia, most of them improving after recovery from surgical site and through swallowing rehabilitation. Nonetheless, it is important to note that we do not have a standardized swallowing rehabilitation protocol in patients treated with partial laryngeal surgery. In 6 (6.1%) patients, catheterization percutaneous gastrostomy (PEG) was necessary (4 pT3 supraglottic, 1 pT4a glottis, and 1 Ca. transglottic pT4a). Regarding comorbidities, alcohol consumption and snuff consumption were statistically related to the occurrence of complications ($p < 0.001$); however, we found no statistical correlation between diabetes ($p = 0.863$) and the occurrence of complications. In this study, no patient died from complications of TLM.

Discussion

Authors have previously classified complications from laser surgery as intraoperative and postoperative (immediate or delayed), also being divided into minor and major, minor referring to complications that resolve spontaneously or can be treated in the office under local anesthesia without major consequences for the patient, while major complications are those requiring intensive medical treatment and even revision surgery.[3]

In this retrospective study, we analyzed the results of a group of 98 patients and 131 CO_2 laser interventions (98 primary, 33 reoperations) due to laryngeal tumors (pT1, pT2, pT3, and pT4) treated by primary intervention by TLM. We found that incidence of intraoperative complications was low, affecting only 2% of patients; whereas immediate postoperative complications occurred in 6.1% and delayed in up to 13.2% of patients. None of them were fatal.

Among the various types of complications that can affect patients, post-surgical bleeding is the most feared. In our series, this complication represents 5.1% of the immediate post-surgical complications, affecting 6.4% of patients in the STG, 3.2% of GTG, and 25% of TTG (¼). Vilaseca et al[3] reported 8% of bleeding in a series of 275 patients, of which 6.9% were in the group with supraglottic tumors and 2.9% had glottic tumors. Similarly, Steiner and Ambrosch[8] reported bleeding rate of 7% in supraglottic tumors and 0% in glottic tumors; whereas authors like Peretti et al,[9] Remacle et al,[10] and Canis et al[11] reported 4, 4.4, and 9% of episodes of post-surgical bleeding from treatment of supraglottic tumors. In our series, no late bleedings were evident; however, we believe these complications should be considered, as they are even more dangerous because the patient is at home and, thus, the possibility of a fatal outcome is higher.[12] For this reason, some authors recommend performing prophylactic electrocoagulation of blood vessels in the laryngeal pedicle. As for associating TLM with neck dissection, some authors suggest ligation of the laryngeal branches of the external carotid artery.[12] Moreover, Ellies and Steiner, in a study that included 1,528 patients treated for TLM, showed 4.7% (72 patients) incidence of post-surgical bleeding. External carotid ligation was required on 7 of such cases.[13]

In our study, 8.1% of patients suffered aspiration pneumonia after surgery. Our finding was lower than that described by Roh et al,[14] who reported an incidence of 11.5% of aspiration pneumonia after TLM and higher than that described by Vilaseca et al,[3] who reported a rate of 6.1% of pneumonia in the treatment of glottic, supraglottic, and hypopharyngeal tumors, and 2% described by Canis et al[11] after treatment with TLM of supraglottic tumors. Six (6.1%) patients included in our study, all of them over 65 years old, had to undergo TL due to recurrent episodes of aspiration pneumonia; 4 of them received treatment for extended supraglottic tumors, confirming the limited indication of these cases.

Regarding cervical complications, 2 (2%) patients had cervical abscess formation, one complicated by mediastinitis. No case of emphysema or cervical fistula was evident. However, Vilaseca et al[3] reported development of cervical emphysema in 3 patients and cervical fistula in one patient in their study, while Peretti et al[9] describe two other cases of persistent cervical fistula after performing temporary tracheotomy in their patients. Another 2% of our patients had stenosis of the laryngeal vestibule after extensive laser resection of supraglottic tumor, a higher incidence compared with 0.4% stenosis found in Canis et al[11] Only one (1%) patient included in the study required treatment for chondritis in the thyroid cartilage. These findings corroborate those described by Vilaseca et al,[3] showing 0.72% of cases of thyroid cartilage chondritis after TLM.

In our study, 42% of patients required NFT; 20.6% of these were from the GTG group, 80.6% from the STG, and 100% of

those patients treated in the TTG. It is important to note that, in most cases, the placement of NFT follows a security principle due to the width of resection. During admission, swallowing was evaluated and the NFT was removed after achieving adequate swallowing; hence, the difference in duration between the various groups. In 6.1% of patients, on the other hand, PEG placement was necessary due to deglutition complications. Bernal-Sprekelsen et al,[15] in a study in of 210 patients treated for tumors of the larynx and hypopharynx in stage T2 to T4, report an average use of NFT of 23.2% in patients with small tumors and 63% in advanced tumors. Of these patients, 6.2% required gastrostomy and another 3.8% required tracheostomy due to deglutition difficulties. Moreover, Canis et al[11] reported NFT averaging 74% during the first 14 days after surgery, requiring that the NFT be kept during 30 days in 18% of cases, of which 6% would require keeping it between 31 and 90 days. It is important to remember Canis et al. conducted their study in patients with supraglottic tumors and that most of these patients had advanced tumoral stages (III and IV). Finally, of all patients in the study by Canis et al,[11] 8 (3%) required additional measures due to swallowing failure, 5 patients would require gastrostomy, and 3 other total laryngectomy.

In our sample, air ignition was evident in one case, which we were able to treat immediately without conditioning further consequences for the patient. This occurred despite using special orotracheal tube for laser surgery and relying on the invaluable collaboration from anaesthetists to reduce levels of O2, and taking surgical precautions such as placing cottonoid sponge with saline. Nonetheless, it is clear that the risk of ignition is always present, even if every precaution is taken.

Finally, it is important to highlight that the complication rate for glottic, supraglottic, and hypopharyngeal tumors, at all stages, that have been operated on by experienced surgeons ranges between 3% and 19%.[3,12,16,17] This hypothesis may be confirmed by comparing tumor size, tumor location, and level of surgeon experience with the occurrence of complications.[3] Moreover, we must emphasize the limitations of our study. Given that it is a retrospective study, there is a possible risk of bias in our results, as it relies on the number of incidents reported by the surgeon in the surgical protocol and the rate of complication reported in the medical reports during follow-up.

Conclusion

Previous studies have compared the use of TLM showing good oncologic results and low complication rates, compared with traditional open surgery during the intervention, in the immediate and delayed postoperative period and in the long term, with respect to RT.[11,18] However, it is important to consider that life-threatening complications such as bleeding, dyspnea, or ignition of the air[19] may appear in this type of surgery, requiring immediate attention and close post-surgical follow-up due to the effects on these patients. In the long term, follow-up is also important to assess the occurrence of recurrent pneumonia and swallowing disorders among such patients, as thee are complications that will put the patient's life at risk or reduce their quality of life.

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