CO2 LASER SURGERY IN THE TREATMENT OF GLOTTIC CANCER

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Abstract: Background. The aim of the study was to assess the effectiveness of CO2 laser endoscopic surgery in the treatment of glottic carcinoma limited to the true vocal cords or involving the adjacent regions.

Methods. Seven hundred nineteen patients (687 men and 32 women; mean age, 60.4 years; range, 33–86 years) with glottic carcinoma (432 T1N0M0, 236 T2N0M0, 51 T3N0M0) underwent CO2 laser surgery (mean follow-up, 5 years; range, 2–17 years). Statistical comparison was carried out with Wilcoxon test, considering \( p < .05 \) the minimum significance value.

Results. Overall actuarial survival, adjusted actuarial survival, and percentage of patients with no evidence of disease at 5 years were 85%, 97%, and 85%, respectively, in patients with T1a disease; 84%, 96%, and 83% in those with T1b disease; 77%, 86%, and 61% in those with T2 unilateral tumors; 77%, 88%, and 55% in those with T2 bilateral tumors; and 64%, 72%, and 60% in those with T3 disease. The statistical analysis showed the following: significant differences in the comparison of T1 versus T2 and T2 versus T3 tumors \( (p < .01) \), with the exception of no evidence of disease in the comparison of T2 versus T3 \( (p > .05) \); and no significant differences in the comparison of unilateral and bilateral tumors \( (p > .05) \). Actuarial local control, actuarial nodal control, and actuarial distant metastasis control at 5 years were 85%, 98%, and 99%, respectively, in patients with T1 disease; and 66%, 82%, and 91% in patients with T2 disease; and 66%, 83%, and 95% in patients with T3 disease. The laryngeal preservation rate was 97.3% in the T1 group, 82.5% in the T2 group, and 80.5% in T3 group.

Conclusions. CO2 laser endoscopic surgery is effective in the treatment of glottic carcinoma not infiltrating the cartilaginous skeleton; the results achieved are competitive with those of open conservative operations, if we take into account the possibilities afforded by salvage surgery and the rate of laryngeal preservation achieved in the study patients. © 2004 Wiley Periodicals, Inc. Head Neck 27: 566–574, 2005

Keywords: glottic cancer; endoscopic surgery; CO2 laser

CO2 laser was initially proposed in oncologic laryngeal surgery for the treatment of patients with limited glottic carcinomas.1–3 Some authors believe that CO2 laser should be used for the treatment of patients with vocal cord carcinomas with relatively conserved laryngeal motility.4,5 and involvement of the anterior commissure or severe impairment of cord motility should induce the surgeon to adopt surgical procedures by the external route.6–8

The aim of this study was to assess the oncologic results achieved with CO2 laser endoscopic
surgery in not only glottic carcinomas limited to a single vocal cord with no impairment of its motility (T1a) but also relatively extended tumors (T1b, unilateral and bilateral T2, T3).

**PATIENTS AND METHODS**

From 1991 to 1998, 953 patients with glottic carcinoma were observed at the Otorhinolaryngology Unit of the “Federico II” University of Naples. Of these, 227 patients with stage II to IV glottic cancer underwent subtotal/total laryngectomy with bilateral neck dissection. The remaining 726 patients with T1, T2, and T3 glottic carcinoma were selected for CO₂ laser endoscopic surgery according to the following inclusion criteria: (1) absence of potentially metastatic adenopathies and distant secondary neoplastic locations, confirmed by diagnostic imaging results available at the time of surgery (CT, MRI); (2) absence of cord fixation secondary to deep tumor infiltration and/or arytenoid involvement; (3) no previous relative treatment received.

Seven patients with T2/T3 disease, for whom infiltration of the thyroid cartilage or tumor extension beyond the laryngeal skeleton was ascertained during surgery (pT4), underwent total laryngectomy and were excluded from the study. Therefore, 719 patients underwent CO₂ laser endoscopic surgery and make up the caseload of this study. None of the study patients received complementary preoperative or postoperative therapy (chemotherapy, radiation therapy).

Of the 719 patients, 687 (95.5%) were men and 32 (4.5%) were women (age range, 33–86 years; mean, 60.4 years), with a mean follow-up of 5 years (range, 2–17 years). Thirty-two patients (4.4%) were lost to follow-up before the end of the second year.

The study patients were classified into T1N0M0 cases (n = 432), T2N0M0 cases (n = 236), and T3N0M0 cases (n = 51), in accordance with the 1997 Union Internationale Contre le Cancer TNM staging system⁹, for all patients, the staging was based on the intraoperative findings (pT).

The histologic examination showed that 673 patients (93.6%) had squamous cell carcinoma of different grades (G1, 381 patients; G2, 180 patients; G3, 112 patients), whereas 46 patients had verrucous carcinoma.

The study patients were divided into five groups on the basis of extent of the tumor. Group 1 was made of patients with carcinomas limited to the true vocal cord (T1a) (n = 263). Thirty-three patients (12.5%), with a superficial tumor, underwent transmuscular excision of the true vocal cord, including the adjacent tract of the vocal ligament and the fibers of the medial thyroarytenoid muscle; in 230 patients (87.5%), a subperichondrial cordectomy was performed. Group 2 included patients with cord carcinomas involving the anterior commissure (T1b) (n = 169). The patients in this group underwent a bilateral cordectomy. Group 3 consisted of patients with unilateral cord carcinomas involving the ventricle and the false vocal cord, with possible initial infiltration into the subglottic region and reduced laryngeal motility (unilateral T2) (n = 154). The patients in this group underwent an enlarged unilateral cordectomy. Group 4 was made up of patients with glottic carcinoma involving the anterior commissure and, therefore, both true vocal cords, with possible initial infiltration into the subglottic region, at times extending to the supraglottic region (bilateral T2), and reduced laryngeal motility (n = 82). The patients in this group underwent an enlarged bilateral cordectomy. Group 5 consisted of patients with glottic carcinomas involving the adjacent regions (anterior commissure, Morgagni’s ventricle, false vocal cords) with absence of cord motility (T3) because of the bulky tumor protruding into the laryngeal lumen or the infiltration of the cord muscles, with possible initial infiltration into the subglottic region, but no involvement of the thyroid cartilage, subperichondrial cleavage plane, or cricothyroid membrane (n = 51). The patients in this group underwent an enlarged unilateral or bilateral cordectomy.

To ensure radical surgical excision, the tumor was isolated from the laryngeal skeleton following the cleavage plane under the internal perichondrium of the cricoid and thyroid cartilages, except in 31 circumscribed cases classified as T1a, in which a transmuscular cordectomy was performed.

In particular, the surgery implemented for the glottic tumors in relation to the extent of the tumor (T) was as follows.

1. Simple cordectomy and cordotomy (T1a tumors). The laryngoscope is inserted as far as the free border of the false vocal cord; Morgagni’s ventricle is easily exposed by placing light pressure from the outside on the thyroid lamina. The laser beam penetrates the mucosa of the lateral wall of the ventricle; the incision meets the internal perichondrium of the thyroid cartilage and
extends from the anterior commissure to the vocal process of the arytenoid. Cordotomy is a more limited operation that can be carried out in cases in which the tumor is limited to the middle tract of the true vocal cord and superficially involves the cord tissues. In this case, the excision involves the mucosa, the vocal ligament, and part (greater or lesser) of the thyroarytenoid muscle; the lateral cricoarytenoid muscle fibers and the internal perichondrium of the thyroid cartilage remain intact.

2. Bilateral cordectomy (T1b tumors). In cases in which the tumor goes beyond the anterior commissure and involves both true vocal cords, a horizontal “horseshoe” incision is first made a few millimeters above the free margin of the ventricular folds; it comprises the front two thirds of the false vocal cords and the anterior commissure. To expose the anterior commissure, slight pressure must be exerted on the bottom edge of the thyroid cartilage or on the cricothyroid area, near the median line. Two vertical incisions are then made in the area between the back third and the front two thirds of both false vocal cords, or halfway along, on the basis of the extent of the tumor lesion.

3. Enlarged cordectomy (unilateral T2 tumors). The first incision is made in the false vocal cord or in the aryepiglottic fold, on the basis of the extent of the tumor; this goes from the front median line to the arytenoid. Once the internal perichondrium of the thyroid cartilage has been reached, the vaporization of the insertion of the vocal ligament and detaching of the soft tissue of the larynx along the internal perichondrial plane can be carried out. At the same time, two vertical incisions are made, respectively, at the anterior commissure, centrally, and on the vocal process of the arytenoid, backward, to detach the surgical specimen at the front and back.

4. Enlarged bilateral cordectomy (bilateral T2, T3 tumors). If, besides the glottic plane, the bilateral tumor also involves Morgagni’s ventricles and the false vocal cords, a more extended surgical excision is necessary. The initial “horseshoe” incision will, therefore, be made higher up in the false vocal cords or at the base of the aryepiglottic folds. If the tumor also involves the subglottic region, the detaching will be extended down to the lower edge of the cricoid ring.

The power of the laser emission was 7 to 10 W in superpulse mode (200 Hz) in more limited resections and 15 to 20 W in continuous mode in more extended resections, with 0.27-mm² spot impact size and laser-induced carbonization approximately between 0.01 and 0.02 mm.

In all patients, an en bloc resection of the tumor was performed. The isolation of the tumor with an adequate safety margin was verified by intraoperative histologic examination of the margins of the surgical specimen. When examination of frozen sections cast doubt, biopsy samples were collected from the surgical wound, and, if necessary, the excision was enlarged.

After surgery, the clinical examinations were performed every month for the first 6 months, and then every 3 months for the following 2 years, and every 6 months thereafter.

The results of surgery were evaluated according to the following parameters: overall actuarial survival, adjusted actuarial survival, no evidence of disease (NED), actuarial local control, actuarial nodal control, actuarial distant metastasis control, ultimate actuarial local control after salvage surgery with CO₂ laser at 5 years, distribution of the salvage surgery procedures used, laryngeal preservation rate, and ultimate locoregional control.

The statistical comparison, applied to overall actuarial survival, adjusted actuarial survival, and NED values, was carried out with the Wilcoxon test (SPSS 8.0; SPSS, Chicago, IL), assuming p < .05 as the minimum value of statistical significance.

The postoperative evaluation was based on the complications after surgery, the mean hospital stay, and the time between surgery and the resumption of oral feeding.

RESULTS

Table 1 shows the overall actuarial survival, adjusted actuarial survival, and NED values for the study groups. The statistical analysis showed a correlation between the parameters considered and the extent of the primary tumor at the time of surgery. The findings were statistically significant when the data of T1 versus T2 and T2 versus T3 (p < .01) were compared, with the exception of NED for T2 versus T3 (p > .05). No statistically significant differences were found between unilateral and bilateral lesions (p > .05).

The data on the actuarial local control, actuarial nodal control, actuarial distant metastas-
sis control, ultimate actuarial local control after salvage surgery with CO\textsubscript{2} laser, laryngeal preservation rate, and the ultimate locoregional control are summarized in Table 2. The causes of the deaths that occurred are shown in Table 3.

Some complications occurred at the end of surgery or in the hours immediately after the operation. In 36 patients (5%), accidental penetration by the laser beam through the cricothyroid membrane caused a subcutaneous emphysema involving the neck and at times extending to the chest and face. In 22 of these patients, the emphysema disappeared spontaneously within 3 to 6 days; for 10 patients, aspiration drainage was applied; and for four patients, tracheotomy was necessary. Twelve patients (1.6%) had a hemorrhage, controlled in all of them by electrocoagulation of the bleeding vessels under direct microlaryngoscopy; for four patients, tracheotomy was necessary for respiratory failure caused by edema occurring after cauterization.

In 43% of the patients (309 of 719), granulations were seen after 30 to 60 days at the site of the excision, implanted on the thyroid cartilage deprived of its perichondrium; they were removed on an outpatient basis with forceps in microlaryngoscopy.

Oral feeding was resumed by all patients within 3 days after surgery. For patients with T1 and unilateral T2 disease, it was resumed 1 day after surgery, and for patients with bilateral T2 to T3 disease, it was resumed after 2 to 3 days. A nasogastric tube was never necessary after surgery, and no inhalation problems occurred after the resumption of oral feeding.

In cases in which no early postoperative complications occurred, patients with T1 disease were discharged after 2 to 5 days (mean, 3 days); patients with T2 disease were discharged after 2 to 7 days (mean, 5 days); patients with T3 disease

<table>
<thead>
<tr>
<th>T classification</th>
<th>No. cases</th>
<th>Overall actuarial survival at 5 y</th>
<th>Adjusted actuarial survival at 5 y</th>
<th>NED at 5 y</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1a</td>
<td>263</td>
<td>85%</td>
<td>97%</td>
<td>85%</td>
</tr>
<tr>
<td>T1b</td>
<td>169</td>
<td>84%</td>
<td>96%</td>
<td>83%</td>
</tr>
<tr>
<td>Unilateral T2</td>
<td>154</td>
<td>77%</td>
<td>86%</td>
<td>61%</td>
</tr>
<tr>
<td>Bilateral T2</td>
<td>82</td>
<td>77%</td>
<td>88%</td>
<td>55%</td>
</tr>
<tr>
<td>T3</td>
<td>51</td>
<td>64%</td>
<td>72%</td>
<td>60%</td>
</tr>
</tbody>
</table>

Abbreviation: NED, no evidence of disease.

<table>
<thead>
<tr>
<th>T classification</th>
<th>No. cases</th>
<th>Actuarial local control at 5 y</th>
<th>Actuarial nodal control at 5 y</th>
<th>Actuarial metastasis control at 5 y</th>
<th>Cured with salvage surgery</th>
<th>CO\textsubscript{2} laser</th>
<th>TL</th>
<th>ND</th>
<th>UALCL</th>
<th>Ultimate locoregional control rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>432</td>
<td>85%</td>
<td>99%</td>
<td>99%</td>
<td>4734 (92.0%)</td>
<td>1449 (100.0%)</td>
<td>1218 (96.7%)</td>
<td>414/441 (93.7%)</td>
<td>302/325 (93.0%)</td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>236</td>
<td>85%</td>
<td>99%</td>
<td>94%</td>
<td>6394 (96.8%)</td>
<td>1611 (100.0%)</td>
<td>850 (94.7%)</td>
<td>395/404 (97.8%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T3</td>
<td>51</td>
<td>51%</td>
<td>51%</td>
<td>82%</td>
<td>010 (100.0%)</td>
<td>001 (100.0%)</td>
<td>001 (100.0%)</td>
<td>001/001 (100.0%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: TL, total laryngectomy; ND, neck dissection; UALCL, ultimate actuarial local control after salvage surgery with CO\textsubscript{2} laser.
were discharged after 10 to 14 days (mean, 11 days).

DISCUSSION

The data from other studies concerning the oncologic results obtained with CO₂ surgery in laryngeal carcinomas are difficult to compare with our findings. Eckel and Thumfart¹⁰ considered all patients with T1 and T2 disease in a single group. Steiner¹¹ included in his series only selected T2 (mobile cord) cases. Eckel¹² reported high actuarial local control rates at 5 years for T1 (86.3%) and for T2 lesions (82.9%), but also a substantial number of deaths resulting from causes independent of the tumor, with a consequent decrease in the number of patients who might have had a recurrence (overall actuarial survival and adjusted actuarial survival at 5 years: 70.3% and 98.6% for T1 lesions; 68.0% and 97.0 for T2 lesions).

In our series, the limited differences between the overall actuarial survival and adjusted actuarial survival rule out any interference from causes of mortality independent of the neoplastic process.

Our study naturally confirms that the best oncologic results are achieved when the extent of the primary tumor is limited, but it also shows that for bilateral T2 and T3 tumors, encouraging results can be achieved.

Several authors believe that the involvement of the anterior commissure is a contraindication to CO₂ laser surgery.⁴,⁷,⁸,¹²,¹³ This is supported by the considerable difficulties encountered when seeking a correct endoscopic exposure of this region and/or by the capacity of tumors located in this site to infiltrate the thyroid cartilage at the anterior commissure, having no perichondrial protection, and to invade the supraglottic and/or subglottic regions.⁷,⁸,¹²,¹⁴ Therefore, some authors suggest extensive conventional conservation surgery (frontolateral laryngectomy, horizontal glottectomy, reconstructive supracricoid laryngectomy) for carcinomas involving the anterior commissure.¹²,¹³,¹⁵–¹⁷

Steiner,¹¹ who included in his series patients for whom other types of therapies had been associated (radiation and chemotherapy), reported very satisfactory oncologic results in patients with bilateral lesions treated with CO₂ laser. However, this author indicates CO₂ laser surgery for T1 carcinomas involving the anterior commissure or T2 carcinomas with preserved cord motility.

Our findings suggest that a radical excision of carcinomas involving both vocal cords is feasible with a correct CO₂ laser microendoscopic procedure and affords excellent results not significantly different from those obtained in cases of unilateral carcinomas.

With regard to glottic carcinomas with laryngeal fixation (T3), Eckel and Thumfart¹⁰ were able to perform a radical tumor resection with CO₂ laser surgery in only one of 10 patients. On the other hand, Kirchner and Som¹⁸ studied 23 patients who had undergone total laryngectomy for laryngeal carcinoma with impaired laryngeal motility. Infiltration of the cartilage skeleton was present in only five patients. According to these authors, 18 patients (78%) could have been treated with conservative surgery. In our opinion, these findings validate endoscopic surgery for patients with relatively extended glottic carcinoma for whom the impairment of laryngeal motility depends on the involvement of the underlying muscles, with no spread to the cartilaginous skeleton or extralaryngeal tissues.

Last, in this series, the 5-year actuarial nodal control was shown to be 82% to 98% (Table 2). The low incidence of secondary lymph node metastases and the recourse to salvage surgery in these cases with prompt neck dissection rule out the need for this operation to be concomitantly performed as a prophylactic measure with the resection of the primary tumor.

Considering the outcome of salvage surgery and the ultimate organ preservation rate in the series presented here (Table 2), our results seem to

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**Table 3. Causes of death.**

<table>
<thead>
<tr>
<th>T classification</th>
<th>Other disease</th>
<th>Secondary tumor</th>
<th>Local recurrence</th>
<th>Nodal recurrence</th>
<th>Distant metastasis</th>
<th>Alive</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>40 (9.2%)</td>
<td>32 (7.4%)</td>
<td>14 (3.2%)</td>
<td>2 (0.5%)</td>
<td>1 (0.2%)</td>
<td>343 (79.4%)</td>
<td>432 (100%)</td>
</tr>
<tr>
<td>T2</td>
<td>17 (7.2%)</td>
<td>12 (5.1%)</td>
<td>18 (7.6%)</td>
<td>1 (0.4%)</td>
<td>11 (4.7%)</td>
<td>177 (75%)</td>
<td>236 (100%)</td>
</tr>
<tr>
<td>T3</td>
<td>9 (17.6%)</td>
<td>0 (0.0%)</td>
<td>11 (21.6%)</td>
<td>0 (0.0%)</td>
<td>2 (3.9%)</td>
<td>29 (56.9%)</td>
<td>51 (100%)</td>
</tr>
<tr>
<td>Total</td>
<td>66 (9.2%)</td>
<td>44 (6.1%)</td>
<td>43 (6.0%)</td>
<td>3 (0.4%)</td>
<td>14 (1.9%)</td>
<td>549 (76.3%)</td>
<td>719 (100%)</td>
</tr>
</tbody>
</table>

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be competitive compared with those reported for patients treated with extensive open-procedure conservation surgery.

The oncologic results after salvage surgery for patients with glottic tumor who had undergone conservative surgery have been critically evaluated by Laccourreye et al.19 These authors analyzed the prognosis for 103 patients with local recurrence after vertical partial laryngectomy for stage I to II glottic tumors and showed a markedly lower survival rate than that for a control group of 311 subjects and a significantly higher risk of regional and distant metastases. The same authors acknowledged a possible contamination of their series because of a lack of sensitivity of the follow-up, shown by the extent of recurrence in the 91 patients undergoing salvage laryngectomy (thyroid cartilage invasion, 52.7%; cricoid cartilage invasion, 17.5%; skin invasion, 34.9%) and a drastically low rate of laryngeal preservation (21.4%) in the sample. Undoubtedly, a close follow-up, like ours, is a fundamental assumption for a satisfactory control of locoregional recurrences, especially for conservative surgery and even more so for endoscopic procedures.

No reliable comparison can be made between our results and the results obtained by the authors who adopted extensive conservation surgery by the external route, in particular with reconstructive supracricoid laryngectomies, because of the differences in the case loads, which often included patients with differing tumor extents13,15,20–23 or those who had undergone preoperative complementary chemotherapy.13,20 Moreover, the oncologic results of reconstructive procedures markedly vary in the different series: the 5-year adjusted actuarial survival, where reported, ranges from 80.1%15 to 95.6%,20 and the 5-year overall actuarial survival varies from 68%21 to 90.8%.22

A lesser variability can be found in the 5-year actuarial local control, reported between 98.2% in T1 to T2 tumors and 94.6% in T2 to T3 tumors, with the laryngeal preservation rates ranging between 100% and 95.5%.13,22

The excellent oncologic results obtained with reconstructive procedures are marred by the numerous problems that severely interfere with the postoperative course. More precisely, in the different series on patients treated with these procedures, the hospital stay was prolonged, ranging from 22 to 35 days on average13,15,23; temporary tracheotomy was always required, and its closure was performed after 5 to 18 days on average13,21–23, a nasogastric tube had to be left in place for 15 to 16 days on average13,23,24; postoperative complications, many severe (laryngeal stenosis, pneumonia, perioperative deaths), were observed in 43.5%,13 37.7%,15 18.5%,21 51.0%,23 and 15.7%24 of cases and sometimes required total laryngectomy, gastrostomy, and permanent tracheostomy.

With regard to the oncologic results after radiotherapy in early glottic cancer, in large series the 5-year local control rate was between 85% and 88% for T1 tumors and between 70% and 73% for T2 tumors.25,26 Improved therapeutic results with high-dose radiation therapy were documented by Spector et al (ie, 5-year local control and overall actuarial survival of 89% to 95% for T1 tumors27 and 86.7% to 100% for T2 tumors).28

More recently, Mendenhall et al29 reported their experience with 519 patients with T1 to T2N0 glottic tumors treated with radiation therapy alone: a 5-year local control between 70% and 95% was achieved.

Schwaab et al30 reported a 14% local recurrence after radiation therapy in patients with T1a tumors (23 of 162 cases), 16% in patients with T1b tumors (five of 32 cases), 36% in patients with unilateral T2 tumors (19 of 53 cases), and 25% in patients with bilateral T2 tumors (three of 12 cases). Total laryngectomy was necessary for 78% of patients undergoing salvage surgery for a local recurrence.

Rucci et al31 reported on 182 patients with T1 to T2 glottic tumors involving the commissure. Conservative surgery, performed for 123 of these patients (frontolateral laryngectomy, cordectomy, anterior frontal laryngectomy, horizontal glottectomy, reconstructive supracricoid laryngectomy) afforded higher rates of local control and adjusted actuarial survival than radiation therapy did (local control, 86% vs 74%; actuarial adjusted survival, 97.5% vs 84%). Furthermore, much better oncologic results were observed for local recurrences appearing after surgery compared with those appearing after radiation therapy (ultimate local control, 97.5% vs 82%, respectively).

The results of CO₂ laser surgery are comparable to those of radiation therapy, with the added advantage of avoiding problems related to salvage surgery, if necessary after radiation therapy, or the inconvenience and costs that patients who live far away from radiotherapy centers have to face for treatment that usually requires from 40 to 60 days.
The validity of CO₂ laser surgery cannot be based only on the fact that it provides better functional phonatory results than conservative treatments by the external route, as shown for more limited tumors. Its effectiveness is mainly correlated with the oncologic results achieved with moderate risks, limited discomfort to the patients, shorter hospital stay, and lower costs.

With regard to the cost analysis of therapeutic options for laryngeal cancer, Myers et al calculated that the costs of CO₂ laser surgery for T1 cord tumors were approximately 50% of those for open-procedure hemilaryngectomy or for radiation therapy. More recently, these data have been confirmed in part by Gregoire et al who showed that the costs of CO₂ laser surgery and radiation therapy for the treatment of T1 glottic tumors are substantially identical if postlaser radiation therapy, in case of histologically positive margins, is associated. Both therapeutic options, considered separately, have a markedly lower cost than partial laryngectomy by the external route.

CO₂ laser surgery has definite advantages in the treatment of glottic cancer over open procedures: the operation is performed through the natural route, tracheotomy is usually avoided, the integrity of the cartilaginous skeleton is maintained, the incidence of complications is low, the postoperative course is rapid, and the hospital stay is extremely short.

CONCLUSIONS

CO₂ laser endoscopic surgery is a valid procedure for T1, T2, and T3 glottic carcinoma. The results for bilateral T1 and T2 glottic carcinoma did not differ from those observed for unilateral carcinoma; therefore, the involvement of the anterior commissure does not represent a contraindication to CO₂ laser surgery.

In selected T3 lesions, endoscopic surgery allows satisfactory results, with a short postoperative course, low risk of complications, and limited health-care costs.

REFERENCES

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The excellent results reported by the authors are not unexpected and are further supportive of earlier publications related to transoral laser surgery. The authors’ work is significant in that they have approached glottic cancer by en-bloc resection, which is more similar to open approaches than most previously published endoscopic resection series in which cancers are transected before being ultimately removed endoscopically. Both approaches have positive and negative aspects.

The concept that cancer can be resected endoscopically en-bloc while avoiding the morbidity of open procedures is very important and has been recognized for some time in T1a glottic cancers. The authors’ ability to extend this to T2 cancers or even selected more advanced cancers is a significant advance. Their report of local control and survival rates is at least comparable to open partial laryngectomy with remarkably lower morbidity than is seen in open approaches. It is critical to point out, however, that en-bloc endoscopic resection of larger T1 or T2 glottic cancer is, in fact, very difficult and has, at a minimum, a very steep learning curve. The readers of this article need to be aware of this and not embark on such resections without significant experience, both endoscopically and with open procedures.

Furthermore, the complication rate of subcutaneous emphysema caused by perforation of the cricothyroid membrane experienced by the authors is problematic. This likely relates to the poorer visualization with the en-bloc techniques. This complication has not occurred in my experience and is rarely or not mentioned in the reports of other transoral laser surgeons. Beyond the use of the en-bloc approach, the fact that extremely high-power densities were used is the additional factor relating to their complication rate. Endoscopic partial laryngectomy can be done with laser power settings of 6 to 8 W and a spot size of .7 mL. The authors used a very high-power density, which may not be safe.

Cancer approaching the cricothyroid membrane in the first place is a contraindication to even open vertical partial laryngectomy. The concern is that cancer can escape through this space and into the neck beyond the limits that would be resected by the open approach. One advantage of endoscopic partial laryngectomy is that cancer can be definitively followed to the inferior aspect of the thyroid cartilage or even across the cricothyroid membrane if this is approached very carefully with appropriate power settings. Cancer will often track superficially along the mucosa and submucosa to the cricothyroid membrane or beyond without penetrating the membrane.
With appropriate visualization and operative technique, these cancers can be resected and definitive biopsy specimens taken after cancer resection of the cricothyroid membrane from the inside. This, again, is not recommended to other than the most advanced endoscopic laser surgeons but can, in fact, be safely done. The issue that this membrane was perforated by the Motta group with subsequent subcutaneous emphysema is again unacceptable. Obviously, extension of cancer through the cricothyroid membrane would necessitate conversion of any endoscopic approach to an open approach. The idea that careful endoscopic staging in this area can be done safely is the experience of surgeons who use non en-bloc resection techniques.

The intent of endoscopic partial laryngectomy is not to create new oncologic guidelines beyond the simple observation just mentioned. As is well known, use of the CO₂ laser as a cutting tool is simply that and confers no new oncologic advantage in and of itself. Careful surgical technique, appropriate judgment, and the ability to convert open partial or total laryngeal procedures must yet be followed for the best interest of the patients to be maintained.

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