Laser carbon dioxide cordectomy versus open surgery in the treatment of glottic carcinoma: Our results

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OBJECTIVE: To analyze oncologic results in patients with glottic cancers treated respectively, by laser CO2 or open surgery, taking into account specific-disease survival, rate of locoregional recurrences, and their salvageability.

STUDY DESIGN: Retrospective study of 198 patients treated from January 1993 to June 2002 in the department of otorhinolaryngology at a Catholic university in Rome.

METHODS: Glottic carcinoma were treated by laser CO2 cordectomy in 132 patients (group 1) and by open surgery in 66 patients (group 2). The statistical analysis was performed by Kaplan Meyer method, log rank test, and χ² test.

RESULTS: The log-rank test points out significant differences between the 2 groups regarding specific-disease survival; no differences were found for disease-free survival. Within group 1, 16 patients developed local failure, which was retreated in 6 cases with laser surgery; in 9 (6.8%) with total laryngectomy, only 1 case was inoperable. In this group, 10 patients (62.5%) were salvaged. Within group 2, 18 patients developed local recurrences, which was retreated in 14 (21.21%) cases with total laryngectomy; the other 4 cases were not suitable for surgery. Of these 18, 8 patients (44.5%) were salvaged.

CONCLUSIONS AND SIGNIFICANCE: Our results show significant differences between the 2 groups concerning the specific-disease survival and the salvageability of local recurrences. In fact, in group 1 we found a higher salvage rate and a lower incidence of total laryngectomy. As already suggested, laser therapy leaves the laryngeal cartilaginous framework intact, avoiding the spread of the tumor out of laryngeal organ and resulting in a more favorable oncologic outcome. (Otolaryngol Head Neck Surg 2005;132:857-61.)

Glottic carcinoma of the larynx is the most common head and neck cancer in the United States and Europe. It arises mainly on the anterior portion of the vocal cords, with frequent involvement of the anterior commissure. Malignant spread to regional lymph nodes is seldom observed, and distant metastases are extremely rare.1 Studies on patients with early carcinoma have shown a 5-year specific-disease survival rate ranging from 90% to 97%.2-4 The majority of deaths caused by cancer in patients with T1 glottic carcinoma, are due to a new primary malignancy that is localized mainly in the lungs.5

Patients categorized as T1N0M0 have tumors ranging from microcancers confined to 1 vocal cord to larger ones involving the anterior commissure and both vocal cords. The aim of this treatment is to cure the cancer and to achieve at the same time the best functional results without any serious complications. For this reason, the treatment of T1-T2 glottic carcinomas has given rise to much controversy in the literature, because they can be successfully treated either by radiation therapy or by external or endoscopic conservative surgery. Radiotherapy and conservative surgery traditionally have been considered equally effective for Tis, T1a with comparable local control rates,6-11 but radiotherapy preserves voice better than laser treatments; nevertheless, cost analysis shows laser to be significantly cheaper than radiotherapy.12-15

Literature data from the past 2 decades have shown that endoscopic CO2 laser surgery can be considered the best surgical approach to T1-T2 glottic cancers, resulting in a progressively decreased popularity of external surgery. In fact, laser resection offers minimized postoperative morbidity, particularly because of better deglutition, and rarely requires tracheotomy. Furthermore, in cases of local recurrences, laser surgery does not preclude further treatments such as adjuvant radiotherapy, laser retreatment, or salvage surgery.

Several studies demonstrated that radiotherapy and conservative surgery (laser or open) have equivalent oncologic results on Tis, T1, and T2a glottic cancer,16,17 whereas few data are available concerning salvageability in cases of recurrences after laser, open surgery, or radiotherapy. The aim of this study was to analyze oncologic results in patients with glottic cancers treated, respectively, by laser (group 1) or open (group 2) surgery and to compare in the 2 groups the
results concerning specific-disease survival, the rate of local or regional recurrences, and their salvageability.

MATERIAL AND METHODS

A retrospective review of 281 consecutive patients with untreated primary glottic squamous cell carcinoma, admitted to our Department of Otolaryngology at the Catholic University in Rome between April 1993 and June 2002, was performed.

Preoperative staging of the tumor was performed by endoscopy (indirect laryngoscopy, videolaryngoscopy, strobolaryngoscopy, and phoniatric evaluation) in T1a cases and by endoscopy and imaging (computed tomography/magnetic resonance) in T1b and T2 cases. All patients were restaged retrospectively according to the International Union Against Cancer staging system (1997 TNM).

The patient cohort included 281 glottic cancers, including 265 males (94.3%) and 16 females (5.7%). The average age was 63 years (range, 34-88 y). A positive history for tobacco use was obtained in 250 patients (88.9%). Alcohol consumption was present in 187 cases (66.5%). Of the 281 patients, 40 (14.2%) were classified as T1b and were submitted to a frontolateral partial laryngectomy, 43 (15.3%) showed a T3-T4N+ transglottic cancer and underwent a total laryngectomy, and 198 (70.5%) were T1a or T2 without involvement of the anterior commissure and underwent cordectomy. Of these last 198 patients, 132 (66.6%) were submitted to endoscopic laser CO2 procedure (group 1), and 66 (33.4%), to open surgery (group 2). The assignation to surgical procedure of the patients was random. In the 1st group, 118 patients were cT1aN0M0 and 14 cT2N0M0, and in the 2nd group, these numbers were 60 and 6, respectively. According to the European Laryngological Society Classification, a type III laser cordectomy was performed in 20 cases, whereas type IV was performed in 98 and type Vc, in 14.

Transoral surgery was performed with a Sharplan CO2 laser, mounted on a Zeiss surgical microscope (Carl Zeiss, Oberkochen, Germany) and generally set to an output power of 4.5-7, with a super pulse mode at a spot size of 0.6 mm. The pulse mode resembles the fractionation technique used during radiotherapy in that it gives the normal adjacent cells time to recover. It is therefore more discrete and represents a better cutting tool. The excised tissue was whole-mounted on a slide and oriented, with the anterior and medial margins marked. If the frozen sections histologically revealed a positive margin, resections were extended until healthy margins were obtained. External cordectomy was performed through a laryngofissure as described by Buck.

Tracheotomy was not required for any patient of the 1st group, whereas it was needed for 4 patients of the second. Follow-up was performed every 2 months for the first 3 years, every 6 months for the next 2 years, and then annually by indirect laryngoscopy and videolaryngoscopy. Repeated microaryngoscopy and excisional biopsies were performed only when relapses were suspected.

In our series, salvage surgery included conservative laser surgery, total laryngectomy, and neck dissection. Chemotherapy was used mainly in the management of pain or in the end-stage recurrent disease.

Statistical analysis of the data was performed with SPSS computer software. Survival curves were calculated from the day of diagnosis by the Kaplan-Mayer method. We evaluated the 5-year disease-specific survival (DSS), considering salvage surgery and disease-free survival (DFS) regardless of salvage treatment. The end point for DSS was the day of death specifically resulting from laryngeal cancer or the day of the last consultation, for patients who were alive and well. The end point for DFS was the day of diagnosis of the locoregional recurrence after primary surgery. Differences between Kaplan Maier estimates were compared by log-rank test. Differences in the distribution of patient characteristics were analyzed by \( \chi^2 \) test. Events are described as significant when the event achieved a \( P \) value of \( \leq 0.05 \).

RESULTS

Figure 1 compares the probabilities of 5-year DSS between patients submitted to laser CO2 cordectomy and those treated by external cordectomy. The cumulative probabilities were 0.94 and 0.84, respectively, in the 1st and in the 2nd groups (Table 1). The log rank test revealed that the 5-year probability for DSS was
significantly higher in the 1st than in the 2nd group \((P = 0.04)\). The mean DSS, with a follow-up at 5 years, was 59 months in the 1st group and 56 in the 2nd group.

Figure 2 compares the DFS between the 1st and 2nd groups. The probabilities of locoregional control for the 2 groups are presented in Table 1. The 5-year locoregional control probabilities were 0.85 in the 1st and 0.77 in the 2nd group. However, log rank test revealed that these differences did not reach the level of significance \((P < 0.05)\). The mean disease-free survival, with a follow-up at 5 years, was 55 months in the 1st and 52 months in the 2nd group.

Of the 132 patients treated by laser CO₂ cordectomy, local failure occurred in 13 (9.8%) patients, whereas locoregional failure occurred only in 3 (2.3%) (Table 2). In the 16 patients with recurrent disease, at the preoperative staging, 13 were T1a and 3 were T2; therefore, we observed failure in 13 (11.01%) of 118 patients staged T1a and 3 (21.42%) of 14 staged T2. In 10 (62.5%) of 16 patients, failure occurred within 60 months, whereas in 6 (37.5%) of 16 patients recurrence occurred between 3 and 5 years after surgery. Of these 16 patients, 6 showed a local recurrence susceptible to a new laser CO₂ treatment (1 to cordectomy type Vb, 1 to type Vc, and 4 to type Vd); all of these were salvaged and are alive. Of the other 10 patients who were affected by laryngeal cancer recurrence, 1 was surgically untreatable (at the time of the recurrence diagnosis) because of the involvement of extralaryngeal tissues and underwent radiochemotherapy, but all died; and 14 had a recurrence that required total laryngectomy because of the deep involvement of the paraglottic spaces. Of those last 9, 5 died because of neck relapse, and 4 were salvaged. Therefore, of the 16 laryngeal cancer recurrences in this group, 6 died because of the tumor, and 10 (62.5%) were salvaged, 4 by total and 6 by partial laryngectomy, remaining disease free (Table 3).

Of the 66 patients submitted to external cordectomy, local failure occurred in 13 (19.6%), and locoregional failure occurred in 5 (7.5%) (Table 2). In the 18 patients with recurrent disease, at the preoperative staging, 16 were T1a and 2 were T2; therefore, we observed failure in 16 (26.66%) of 60 patients staged T1a and 2 (33.33%) of 6 staged T2. In 10 patients, failure occurred within 60 months, whereas in 8 cases, failure occurred between 3 and 5 years. Of the 18 patients with recurrent disease, 4 were not surgically treatable (at the time of recurrence diagnosis) because of the involvement of extralaryngeal tissues and underwent radiochemotherapy, but all died; and 14 had a recurrence that required total laryngectomy because of the deep involvement of the paraglottic spaces and laryngeal skeleton (6 of them died from regional relapse, whereas 8 were salvaged). Therefore, of this group of 66 patients, 18 had recurrence; 8 (44.4%) of them were salvaged by total laryngectomy, and 10 (55.6%) died from the tumor (Table 4).
Our data showed better DSS in group 1 than in group 2 ($P < 0.05$) and showed no significant differences in locoregional control ($P > 0.05$). Furthermore, they revealed a different salvageability of recurrences; in fact, in the laser surgery group, 10 (62.5%) of 16 patients were salvaged, whereas 8 (44.4%) of 18 patients in open surgery were salvaged (Table 2). In addition, in group 2 we found a significantly higher number not only of total laryngectomies, 14/18 (77.7%) versus 9/16 (56.2%) in group 1, but also of inoperable patients, 4/18 (22.2%) versus 1/16 (6.25%; $P < 0.05$).

No significant difference was observed concerning the outcome of total laryngectomies: 5 (55.5%) of 9 patients died in group 1, and 6 (42.8%) of 14 died in group 2.

**DISCUSSION**

Tis, T1a, and T2a carcinomas of the vocal cords are the most frequent forms of cancer encountered in the glottic regions. The treatment is successful in the majority of patients both because symptoms usually appear early and because the lymphatic networks of the glottic area are poor, rarely causing an involvement of regional lymph nodes (<1% of cases). Furthermore, distant metastases are extremely rare. As a result, glottic carcinoma is a highly curable tumor when it is in its early stage. Surgical treatment includes an external approach or laser CO$_2$ transoral surgery. During the past 3 decades, laser excision has gained large acceptance among head and neck surgeons, as demonstrated by the widespread use of the technique, because of a similar cure rate, better functional results, and a lower morbidity and a lower cost–benefit ratio when compared with the external approach. However, even though many studies in the literature refer to the rates of disease control and total survival after primary laser or external cordectomy, few compare oncologic results of the 2 different surgical approaches, in terms of number of cases requiring salvage treatment of the recurrence and their outcome.

In our series, statistic analyses did not reveal significant differences concerning the locoregional control between the 2 groups, confirming the results of several other studies. On the other hand, we found a significant difference in DSS between the 2 groups. These divergences could be explained by the different salvageability of recurrences obtained in the 2 groups, as demonstrated by our data showing more patients salvaged in the 1st group than in the 2nd (Table 2). Our data agree with those of De Campora et al, who found higher possibilities of salvage from local recurrence in patients who underwent laser CO$_2$ cordectomy (70.8%) than in those submitted to an external approach (53.5%).

Moreover, we observed differences between the 2 groups regarding the salvage modalities: in fact, although in laser CO$_2$ cordectomy, there were patients still salvaged with a partial laser laryngectomy and some salvaged with a total laryngectomy, in those treated with an external approach, all patients needed total laryngectomy. These results are probably due to the issue that during laser CO$_2$ cordectomy, laryngeal cartilages are left intact; these confine the recurrence within the organ, whereas when cartilages are opened, as in laryngofissure cordectomy, the cancer can easily reach the extralaryngeal tissues through the weak point. In fact, we found not only a significantly higher number of total laryngectomies but also of inoperable patients at the time of recurrence diagnosis in patients who underwent laser CO$_2$ cordectomy (70.8%) than in those submitted to an external approach (53.5%).

**Table 3.** Salvage treatment in patients affected by laryngeal cancer recurrence after laser CO$_2$ cordectomy

<table>
<thead>
<tr>
<th>Inoperable</th>
<th>Partial laryngectomy</th>
<th>Total laryngectomy</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Frontolateral laryngectomy (laser)</td>
<td>Without neck dissection</td>
</tr>
<tr>
<td>16 (6.25); died</td>
<td>16 (6.2); alive</td>
<td>5/16 (31.2); all alive</td>
</tr>
</tbody>
</table>

All data are n (%).

**Table 4.** Salvage treatment in patients affected by laryngeal cancer recurrence submitted to external cordectomy

<table>
<thead>
<tr>
<th>Inoperable</th>
<th>Total laryngectomy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without neck dissection</td>
</tr>
<tr>
<td>18 (22.2); all died</td>
<td>11/18 (61.1); 3 died</td>
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All data are n (%).
We believe that early detection, requiring a close follow-up policy, increases the probability of partial laryngectomy. This is particularly important for the first 2 years after the primary treatment, during which the highest recurrence rate is observed. For this reason, we performed a fiberoptic examination of the larynx every 2 months for the first 3 years, every 6 months for the next 2 years, and once a year thereafter, as well as a CT scan 3 months after surgery and on any clinical suspicion of recurrence.

CONCLUSION

The results achieved in this study confirm the validity of laser CO₂ excision in the treatment of early glottic cancer. Our data suggest that laser treatment not only allows an excellent plasticity and precision in the management of malignancy but also offers a better local control and survival in comparison with open surgery; furthermore, it expands the options for an eventual retreatment because of persistent or recurrent disease, increasing salvageability.

Furthermore, we believe that the concept of a salvage surgery after a possible recurrence must influence the choice of the primary surgical treatment of glottic carcinoma. In fact, the differences in organ preservation rates, in quality of life after salvage, and in number of patients yet susceptible to radical surgery represent important issues that must be considered in the choice of the surgical treatment of glottic tumors.

REFERENCES