CARTILAGINOUS TUMORS OF THE LARYNX: ENDOSCOPIC LASER MANAGEMENT USING YAG/KTP

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Abstract: Background. The objective of this study was to analyze results of endoscopic YAG laser management as a treatment of chondroma and/or low-grade laryngeal chondrosarcoma.

Methods. Between 1996 and 2006, 13 patients were included, 11 men and 2 women with a median age of 69.7 years at diagnosis. Primary treatment included endoscopic laser resection in all cases. All tumors were diagnosed as cricoid cartilaginous tumor by histopathologic examination: 6 chondromas and 7 chondrosarcomas grade 1.

Results. The global actuarial survival rate was 95% for 5 years. The 5-year Kaplan-Meier disease-free survival and overall recurrence rate estimates were 72% and 54%, respectively. With a median follow-up time of 5 years, 12 of 13 patients were without recurrence. Nine were alive and 4 died during follow-up, and only 1 patient died from disease. Three patients required definitive cricoidotomy. None had required it for endoscopic laser complications.

Conclusion. Laser endoscopic surgery is 1 of the conserva
tive surgical ways to manage laryngeal chondroma especially in cases of elderly patients with poor health status. It permits adequate removal of the tumor and still maintains structural and functional integrity and preserves possibilities of subtotal or total salvage surgery.  

Keywords: chondroma; chondrosarcoma; laryngeal tumor; laser; cricoid

Primary cartilaginous neoplasms of the larynx include chondromas and chondrosarcomas. Although most of the previously described laryngeal cartilaginous tumors originally were reported as chondromas, true laryngeal chondromas are considered extremely rare, and a number of authors consider all laryngeal chondromas to be erroneous descriptions of low-grade chondrosarcoma.  

Chondrosarcoma is a rare tumor of the head and neck accounting for 0.2% of all head and neck malignancies and 1% of all laryngeal tumors. These tumors are considered to be a low-grade neoplasm, both clinically and histologically. Because of the indolent behavior of these tumors, the diagnosis may easily be overlooked, and symptoms may persist for many years before the correct diagnosis is made. Surgical management is difficult, because it is necessary to find a compromise by having a low rate of recurrence with restoration of all laryngeal

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Endoscopic YAG Laser of Cartilaginous Laryngeal Tumors  

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functions (swallowing, voice, and respiration without a tracheostomy).

The aim of this study was to analyze clearly the results of endoscopic management using YAG laser in primary treatment of cricoid cartilaginous tumors.

PATIENTS AND METHODS

Over a period of 10 years between 1996 and 2006, 13 patients with cricoid chondroma or low-grade chondrosarcoma were seen at the Department of Otorhinolaryngology and Head and Neck Surgery of the Croix-Rousse Hospital, Lyon.

General data relating to the characteristics are summarized in Table 1. Most of patients were men, with a median age at presentation of 69.7 years, and they had several comorbidities associated (eg, cardiac failure, chronic respiratory affection).

Three patients underwent previous treatment procedures before coming into our department. Two of these patients had received treatment for chondrosarcoma grade 1: a partial laryngeal surgery was achieved 10 years previously in 1 case, and the other 16 years previously had endoscopic laser surgery with postoperative neutron therapy procedure for local recurrence (17.5 Gy). A tracheotomy was performed on the third because of severe dyspnea following thyroidectomy.

Typical radiologic studies (CT scan) for a laryngeal cartilaginous tumor were evaluable in all cases with a calcified tumor involving 1 or more cartilages. Cartilaginous tumors of the larynx were small lesions, measuring less than 2 to 3 cm in maximum dimension. Two of them exceed 3 cm in greatest dimension (Figures 1 and 2).

Nine of 13 patients (61%) had dysphonia or dyspnea as the primary presenting symptom. The average time from first symptoms to diagnosis was 9 months: dysphonia was present in 16 months (range, 3–60) and dyspnea 2.5 months (range, 3–8) before diagnosis. In all cases, a flexible endoscopic laryngoscopy was performed. Unilateral vocal-fold hypomobility was seen in 7 patients and bilateral in 1 in 2 others. One patient had arytenoid mass and 1 had a submucosal hypopharyngeal unilateral deformation secondary to extralaryngeal growth.

Seven patients had a low-grade chondrosarcoma and 6 patients had a chondroma.

FIGURE 1. CT scan shows calcified tumor involving cricoid cartilage.

FIGURE 2. CT scan shows tumor arising from the laryngeal cartilage projecting into the lumen.
Primary treatment included endoscopic laser excision in all cases, using KTP in 7 cases (Figure 3) and YAG in 6 cases (Figure 4).

In our institution, the 2 lasers used for cartilaginous tumors of the larynx are the laser Nd YAG, which emits in infrared with 1064 nm, and the laser KTP, which is an Nd YAG doubled in frequency and which emits in the green with 532 nm. They are useful because of degree of penetration of the laser, absorption by tissues or hemoglobin, the possibilities of coagulation, carbonization, or vaporization according to the mode of use (continuous or pulsed). KTP is absorbed by hemoglobin, and it does not penetrate deeply but coagulates well. It permits a good electrocoagulation if bleeding and is very useful if chondroma presents essentially a development through the lumen. When it is developed with a major extension into the cricoid, Nd YAG, which is absorbed by tissues, carbonizes and permits deep resection even in cases of chondroma with ossification (mode continuous). Moreover, laser’s fiber should permit resection that CO₂ laser cannot (even with Acublade mode) because of angle’s trajectories. Nevertheless, multiple changes of the position of the laryngoscope are necessary to achieve good visualization of the tumor and the surrounding healthy tissue during the entire operation. Optimum exposure and visualization of the larynx are crucial for a safe tumor resection. Very close cooperation between surgeons and anesthesiologists is needed to avoid rapidly occurring hypoxemia, because such patients had a poor respiratory status, and the long periods of desaturation could lead to iterative orotracheal intubations that would complicate the resection. Transoral resection is performed under microlaryngoscopy without intubation with constant monitoring of cardiopulmonary data. Oxygenotherapy was delivered by a nasopharyngeal tube with pure air when the laser was being used. When needed,
intubation was performed under optical control using a small-diameter catheter. We did not use jet ventilation because of the risks of alveolar blast with suffocating pneumomediastinum, which is often lethal in patients with a fragile bronchopulmonary status.

These tumors may be hemorrhagic during the beginning of the resection; that is why we first use laser to control bleeding by section and electrocautery. The surgical and oncologic principles are the same for laser microsurgery as for conventional resection, but even with an accurate preoperative CT scan, it is difficult to resect all the tumor in only 1 resection. Therefore, we estimate the depth and the lateral extension of tumor penetration before and after resection using optique control and palpation. The lesion is resected until healthy tissue is found, which can be seen more easily in previously untreated tumors on the cut surface under high magnification. Excision is stopped when it persists only of nonfriable solid cartilaginous tissues to palpation and control with optic 30°. Then we achieve laser vaporization on operative setting to control bleeding and regularize cartilage. Postoperative nursing care consisted in aerosoltherapy (corticoids and adrenalin) and pulmonary physiotherapy if necessary many times. A nasofibroscopic examination of swallowing for testing reflex with and without food is done 1 day after transoral laser resection. Oral feeding is started if there is no major abnormalities and minor aspiration’s risks.

We use CO2 laser for the treatment of stenosis as we do in other laryngeal pathologies (eg, vocal cord immobility, laryngeal cyst, or laryngeal stenosis).

We have put together chondroma and chondrosarcoma low grade for analysis. Statistical analysis was performed using a computerized software package (Statview, SAS Institute, Cary, NC). The global actuarial survival, the 5-year disease-free survival, and overall recurrence rates estimates were calculated using Kaplan-Meier19 life-table method.

RESULTS
The global actuarial survival and disease-free survival rates were 95% and 72% for 5 years, respectively. The overall recurrence rate estimate was 54%. With a median follow-up of 5 years, 12 of 13 patients were without recurrence. At the time of writing, 9 were alive and 4 had died during follow-up, and only 1 patient had died from disease.

Data from initial laser endoscopic procedure are summarized in Table 2. Five patients (2 chondrosarcomas grade 1, 3 chondromas) are alive without clinically significant disease after the first operative way (1 laser resection) with a median follow-up of 5 years (range, 4–7 years). In 8 cases, a second treatment procedure was performed after 7.5 months (range, 1–21) because of recurrence of symptoms (dyspnea). Among these, 2 patients have developed laryngeal stenosis without histological recurrence.

Seven of 13 patients were disease-free after exclusive laser surgery in less than 3 procedures. Endoscopic resections were without any major postoperative complication. No patient had developed swallowing disorders during follow-up, and all had normal eating (solid and liquid). From a vocal point of view, we have not achieved any

<table>
<thead>
<tr>
<th>Patient no.</th>
<th>Histology</th>
<th>Primary results</th>
<th>DRAL, mo</th>
<th>Total no. of laser resection</th>
<th>Results</th>
<th>DFLR, mo</th>
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<td>21</td>
<td>3</td>
<td>Recurrence</td>
<td>35</td>
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Abbreviations: DRAL, delay for recurrence after first laser; DFLR, delay between first and last resection; CS grade 1, chondrosarcoma grade 1 or low grade.
phonoacoustic evaluation, but only 1 patient had persistent complaints about her voice.

Although multiple endoscopic resections (with a delay of 20 months between the first resection and the last), 5 patients required partial laryngeal laryngectomy, total laryngectomy, or external neutron therapy because of local evolution. Histologic analysis revealed negative margins (R0) in the 4 surgical cases with only chondrosarcoma diagnosis. In 1 case, the tumor had a higher differentiation grade (transformation from grades 1 to 2), and in 2 cases, chondromas were pre-existing to chondroma grade 1.

Data on treatment for recurrence are summarized in Table 3. Partial laryngectomy with partial cricoid resection was performed 11 and 37 months after the last endoscopic resection for 2 patients.

The patient 6 with previous laser and neutron-therapy procedures underwent radical surgery just 1 month after YAG laser treatment. He was admitted to the intensive care unit for 4 days because pulmonary infection developed 3 days after starting oral feeding. The 2 other patients (patients 9 and 12) underwent 4 and 3 iterative endoscopic laser procedures before needing radical surgery. They had no postoperative complication. The first 2 patients died 1 month and 20 months after radical surgery without clinically significant disease.

All these 3 patients needed radical surgery at the time of first diagnosis in our department but refused this treatment.

Patient 11, who received neutron therapy (consisting of a total dose of 37.5 Gy to the neck), died 41 months after the first treatment from disease.

Three patients required definitive tracheotomy: 1 total laryngectomy and 2 partial laryngeal surgery. None had required it for endoscopic laser complications.

All of them had oral feeding without food restriction.

DISCUSSION

Primary cartilaginous neoplasms of the larynx include chondromas and chondrosarcomas, which are often considered for low grade as the same histological entity although the criteria for differentiating benign from malignant lesions are well established.20

It does not metastasize but presents clinical aggressiveness.1,6,7,10,12,14,15,21–26 Chondrosarcomas typically affect men ranging in age from 50 to 80 years (69.7 years in our study).5,6,12,14,21,23,25–28 The incidence of chondrosarcoma increases with age. If patients were older than 60 years at initial presentation, there was a negative impact on patient outcome.1,14,23,26

The overall survival rate reported in the literature is about 92% to 95%,1,6,7,10,12,15,21–23,25,26,29 with a mean follow-up of 10 years.6,7 The 5- and 10-year disease-free survival rates reported are about 70% and 50%, respectively.

Therefore, the management of these cartilaginous laryngeal tumors must take into account the clinical background, local evolutivity, and the possibilities of treatment in the event of failure. Minimizing the morbidity of treatment using an efficient and conservative management is an important goal.

Endoscopic laser treatment is 1 of the treatments that answers these requirements, and we propose it first for the following reasons.

Clinical Status. Cartilaginous tumors mostly occur in elderly patient with negative impact (decreasing survival rate), because these patients often have many associated comorbidities, especially poor bronchopulmonary status.26 In our study, 10 patients had a high Charlson index.18

<table>
<thead>
<tr>
<th>Patient no.</th>
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<th>Histology/grading</th>
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<td>Partial surg</td>
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<tr>
<td>13</td>
<td>Recurrence</td>
<td>37,20</td>
<td>Partial surg</td>
<td>CS grade 1/R0</td>
<td>Alive without D</td>
</tr>
</tbody>
</table>

Abbreviations: DLRT, delay between last laser resection and treatment; NeutronT, neutrontherapy; CS grade 1, chondrosarcoma grade 1; R0, resection with negative margins; Alive with/without D, alive with or without disease.
Endoscopic laser resection allows one to preserve physiologic respiratory function with a less average time of hospitalization contrary to open surgery (tracheotomy and its complications for airways tract). Death from disease is very uncommon, particularly in the elderly population. In cases of chondroma occurring in women (about 21.9% in literature), endoscopic treatment is interesting even if partial laryngectomy is feasible because of the risk of laryngeal stenosis. We know that women have a smaller larynx than men and stenotic cicatrisation should compromise functional results. No previous surgical study had analyzed this. Less than 50 chondromas are reported in cases of women, and no specific functional outcome was analyzed.

**Histological Type of Tumor.** Chondroma is a benign tumor, and chondrosarcoma grade 1 is a low-grade neoplasm. Microscopically, distinguishing chondroma from low-grade chondrosarcoma can be difficult, as can distinguishing low-grade chondrosarcoma from intermediate grade. Well-differentiated lesions often only show focal areas that demonstrate the histologic criteria for malignancy, in contrast to moderate- and high-grade tumors in which malignant features are identified in a greater area of biopsy. Laser resection allows us to have an accurate histological diagnosis before considering more aggressive treatment without compromising long-term survival.

**Radiological Extension.** Transoral surgery is not a good procedure for lesions involving more than half of cricoid cartilage on CT scan. Three of 13 patients with voluminous cartilaginous tumor refused total laryngectomy as first treatment, and we needed to perform it in 1 month, 8 months, and 3 years later, but none of them are alive. When radical surgery is necessary (massive cricoid invasion and recurrence after radiation), it must be performed without primary endoscopic procedure.

**Surgical Procedure.** Endoscopic resection is a quick and effective procedure, which permits one to immediately restore breath without major complication. At the beginning of the resection, these tumors may be hemorrhagic, and laser is very useful to minimize bleeding. It is difficult having tumor-free margins with this treatment, but this did not represent a guarantee that recurrence will not take place. Recurrence may also occur even with clear margins after conservative open surgery but also after radical surgery.7,26,30

We report an overall recurrence rate of 54% (but we have included the 3 precedent patients who directly needed total laryngectomy), which is similar to previous studies and greater compared with those who had more extensive procedure (subtotal or total laryngectomy) in which local recurrence develops in 16% of the cases.7,10

According to us, endoscopic laser resection is not appropriate when CT scan demonstrates invasion of the surrounding tissue, involvement, and/or interruption of the external perichondrium of the cricoid. Focal expansion and displacement rather than invasion is seen in most cases.1 The use of MRI to evaluate with accuracy perichondrium and/or muscular invasion is necessary even if an open surgery (radical or partial) is considered. It can more sensitively delineate the tumor/soft tissues relations within the larynx. This element must be undoubtedly taken into account to reduce recurrence rate. Piecemeal excisions sparing the external perichondrium predispose to local recurrence.31

In our opinion, partial laryngectomy must be considered a second treatment to use as of the moment when the endoscopic management is not indicated or does not lead to cure in less than 3 procedures.

For some authors,30–32 partial laryngectomy with unilateral hemimicrolaryngectomy should be directly performed when the lesion involves less than 50% of the cricoid, because it allows sufficient tissue for histological confirmation and tumor removal and patients who had an initial limited procedure often preserve their voice.30 It is also an available choice in case of chondrosarcoma with a myxoid component or that is high grade (because of a high risk of recurrence). The limitations of performing such surgery include immobility of both vocal folds and inadequate subglottic airway on the contralateral side.30 Chondromas may pre-exist chondrosarcomas. In a clinicopathologic study of 111 cases,16 60.4% of chondrosarcomas were superimposed on a preexisting benign chondroma. Moreover, ischemic change in a chondroma may contribute to the development of chondrosarcoma. Of the 60.4%, 41 (61.2%) chondromas demonstrated ischemia. In our series, all recurrences were chondrosarcomas grades 1 or 2, 1 with chondroma and another with chondrosarcoma grade 1 at the primary histological diagnosis. Endoscopic laser resection may induce ischemia of residual cricoid cartilage that could explain malignant transformation after iterative procedures. That is why we think that less than 3 resec-
tions are reasonable to permit good local control, and repeated biopsies must always be undertaken.

In cases in which recurrences develop, wide local resection can be used again, especially, laser surgery. Recent reports have described endoscopic CO\textsubscript{2} laser therapy as a procedure to deal with recurrences, or even primary lesions, depending upon the extent of the tumor, until functional compromise and the inability to reconstruct an adequate airway dictate the necessity for total laryngectomy. But only 1 patient in our series was disease free after 4 repeated endoscopic surgeries. Patients with local recurrence and/or persistent disease who needed more than 2 iterative laser treatments had poor results and prognosis: 3 required total laryngectomy (2 died without disease), 1 neuron therapy (death with evolutive tumor), and 2 partial laryngectomies (all are alive but with a definitive tracheotomy).

Because only total laryngectomy insures complete tumor removal (clear margins are almost always accomplished with radical surgery), especially when the cricoid is involved, the local recurrence rate is greater when using endoscopic resection. But this voice-preserving treatment (as other conservative surgeries) allows for an improved quality of life and for a longer morbidity-free survival. Furthermore, persistent disease and/or local recurrence do not negatively impact long-term survival, but we do not forget that repeated treatment may sometimes impose a heavy burden on the patient.

**CONCLUSION**

Conservative surgery is undoubtedly the best form of treatment and is appropriate in most cases. If endoscopic laser management has a greater local recurrence rate than does radical surgery, it could be useful in many cases, especially in elderly patients with poor health status. It preserves possibilities of subtotal or total salvage surgery without jeopardizing patients’ long-term survival.

**REFERENCES**