Laser Surgery for the Treatment of Glottic Carcinomas

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Purpose: The standard treatment for patients with early glottic carcinoma in Israel has been radiotherapy. In recent years, encouraging results with laryngo-microscopic carbon dioxide laser surgery as a treatment for early glottic carcinoma has changed our treatment strategy. We conducted a retrospective study to investigate the results of carbon dioxide laser excisional technique for early glottic carcinoma (T1, T2).
Materials and Methods: Twenty-six had squamous cell carcinoma (SCC), (21 patients with T1 and 5 patients with T2 lesions), 3 had carcinoma in situ, (CIS) and 3 had verrucous carcinoma (VC).
Results: All patients were free of disease after salvage treatment at the most recent follow-up.
Conclusions: Careful patient selection with endoscopic staging and strict follow-up are essential to secure good results in the treatment of carbon dioxide laser for early laryngeal carcinoma.

Endoscopic carbonic dioxide (CO_2) laser surgery as a treatment of laryngeal carcinomas has gained gradual acceptance since its introduction by Strong and Jako[1] in 1972. It has some well-known advantages over radiotherapy or open surgical procedures. These advantages include only 1 to 2 sessions of therapy, fewer side effects, lower morbidity, and higher cost-effectiveness. Without tracheostomy, deglutition and integrity of the cartilaginous skeleton are usually not disturbed. The hospitalization is shorter, and there are more options for salvage therapy (surgery and/or radiotherapy).[2-4] As glottic carcinoma spreads gradually from its site of origin to the deep structures and to the anterior commissure, it is very important to extend the vocal cord resection to the anterior commissure and deep into the vocalis muscle up to the thyroid cartilage perichondrium. These extensive resections of the T1 vocal cord carcinomas have been justified by frozen section of the margins.[3-5]

The use of the laser has lately found wider acceptance in the treatment of laryngeal carcinomas, as pointed out by Motta et al,[2] Rudert and Werner,[6] Steiner,[7] and Zeitels et al.[8] Our present indications for laser surgery of laryngeal carcinomas include CIS, T1, T1b, selected cases of T1 with involvement of anterior commissure, and T2. The present study aims to establish indications and type of surgical excision for using the CO_2 laser as well as the follow-up strategy.

MATERIALS AND METHODS

From 1997 to 2001, 32 patients were treated by laser excisional technique, 26 had invasive squamous cell carcinoma (SCC), 3 had carcinoma in situ (CIS), and 3 had verrucous carcinoma (VC). Twenty-nine patients were men and 3 were women (ratio, 9.7:1) between the ages of 42 to 75 (mean, 61); 23 patients were heavy smokers, and 3 of them were also alcohol consumers. Tables 1 and 2 summarize the clinical and pathological data of the patients with T1 and T2 lesions.

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TABLE 1. Clinical and Pathological Data of T1 Lesions

		Site				Treatment				Follow-up (mo)		
No	Age/ Sex	Vocal Cord	Extension	TMN	Diagnosis	Laser	Radiation	Complication	Second Look	Local Recurrence	Failure Treatment	NED
1	75/M	Lt	No	T1	WSCC	Lt Cord	No	No	No Ca			16
2	47/M	Rt	Ant com	T1	WSCC	Rt cord, ant com	No	No	No Ca	12	Revision by laser	24
3	42/F	Rt	No	T1	WSCC	Rt Cord	No	No	No Ca			8
4	70/M	Lt	No	T1	WSCC	Lt Cord	No	WEB	No Ca			11
5	64/M	Rt	No	T1	WSCC	Rt Cord	No	No	No Ca			36
6	72/M	Lt	No	T1	WSCC	Lt Cord	No	No	No Ca			5
7	51/M	Rt	No	T1	WSCC	Rt Cord	No	WEB	No Ca			6
8	58/M	Rt	No	T1	WSCC*	Rt Cord	No	No	No Ca	9	Total laryngectomy	16
9	74/M	Rt	No	T1	WSCC	Rt Cord	No	No	Residual Ca			6
10	54/M	Lt	No	T1	WSCC	Lt Cord	No	No	No Ca			18
11	68/M	Rt	No	T1	WSCC	Rt Cord	No	No	No Ca			16
12	51/M	Lt	No	T1	WSCC	Lt Cord	No	No	No Ca			48
13	72/M	Rt	No	T1	WSCC	Rt Cord	No	No	No Ca			6
14	57/M	Rt	No	T1	WSCC	Rt Cord	No	No	No Ca			28
15	56/F	Rt	No	T1	WSCC	Rt Cord	No	No	No Ca			24
16	71/M	Rt⩽	No	T1b	WSCC	Rt cord, ant com, Lt cord part	Yes	Dyspnea	No Ca			16
17	68/F	Rt⩽	No	T1b	WSCC	Lt cord, ant com, Rt cord part	No	Dyspnea	No Ca			24
18	61/M	Lt	No	T1	W+MSCC	Lt Cord	No	No	No Ca			30
19	72/M	Rt	Ant com	T1	W+MSCC	Rt cord, ant com	No	No	No Ca			18
20	64/M	Rt	Ant com	T1	MSCC	Rt cord, ant com	No	No	No Ca			18
21	57/M	Rt	No	T1	MSCC	Rt Cord	No	WEB	No Ca			5

Abbreviations: Rt, right; Lt, left; WSCC, Well-differentiated squamous cell carcinoma; MSCC, moderately differentiated squamous cell carcinoma; ant com, anterior commissure; WEB, sinechia; NED, no evidence of disease.
*Failure of radiotherapy.

The 3 patients with carcinoma in situ underwent resection of the mucosa of the vocal cord with free surgical margins. Table 3 summarizes the clinical and pathological data of the patients with T1 VC. All patients with T1 and T2 carcinomas underwent a second look and biopsy between 4 to 8 weeks after operation; 1 patient with T2 supraglottic extension was lost to follow-up, and 2 patients with verrucous carcinoma and 3 with carcinoma in situ did not have a second look procedure. One patient with involvement of 2 vocal cords receives radiotherapy postoperatively because the posterior surgical margin was close to the tumor (1 mm). Another 3 patients with T2 preferred radiotherapy postoperatively. During a follow-up of 3 months to 4 years, (mean, 17.5 months) none of our patients had neck or distance metastases.

Anesthesiology

Transoral laser surgery was performed under general anesthesia. Protection of the endotracheal tube from the laser beam is an important factor in the prevention of airway fires.

Surgical Technique

Endoscopic transoral surgery was performed under general anesthesia, with carbon dioxide (CO_2) laser (Topaz 30, Israel), which was coupled to a Zeiss (Carl Zeiss, USA) operating microscope, and was set to an output power of between 5 to 10 watts. The laser was mainly used in the pulse mode, at a spot size of 250 μm diameter.

Patient's eyes were taped closed and covered with wet gauze. Medical precaution mea-

TABLE 2. Clinical and Pathological Data of T2 Lesions

		Site			Treatment			Follow-up (mo)		
No	Age/ Sex	Vocal Cord	Extension	Diagnosis	Laser	Radiation	Second Look	Local Recurrence	Failure Treatment	NED
1	54/M	Lt	Supra GL inv	WSCC	Lt cord,Lt ventriculotomy	Yes	No Ca	4	Radiation	4
2	61/M	Lt	Sub GL inv	WSCC	Lt cord, subglottic	Yes	No Ca			11
3	64/M	Lt	Supra GL inv	WSCC	Lt cord, subglottic	No	Refused	4	Total laryngectomy*	12
4	67/M	Rt	Sub GL inv	WSCC	Rt cord,ant com	Yes	No Ca			6
5	52/M	Rt	Supra GL inv	MSCC	Rt cord,Rt ventriculotomy	No	Residual Ca			5

Abbreviations: M, male; Lt, left; Rt, right; WSCC, well-differentiated squamous cell carcinoma; Ca, carcinoma; MSCC, moderately differentiated squamous cell carcinoma; GL inv, glottic involvement.
*Failure of radiotherapy.

sures with protective glasses effective against the laser beam were used for protection of the cornea of the auxiliary personal. We introduced a laser laryngoscope (Storz, Germany). Telescopes 0^0 and 70^0 (Storz) were inserted through the laryngoscope to examine the size and the extension of the tumor to establish its stage. After taking a biopsy (for histological confirmation of the diagnosis) laser resection was performed, care was taken to include at least a 2 to 3 mm of free margins around the tumor.

In the 3 cases with carcinoma in situ, small mucosal excisional biopsies were done with free margins. This procedure allowed the establishment of the final diagnosis and was therapeutic at the same time. Small mucosal lesions of SCC in the middle of the vocal fold that did not reach the anterior commissure were removed as excisional biopsy specimens with margins free of tumor. Partial cordectomy was performed, and additional specimens were taken from the margins of the excisions (anterior, posterior, superior, and inferior) to be examined histopathologically. The specimen was oriented with small pins (anterior and posterior margins). Tumor involving the anterior commissure was excised radically with the internal perichondrium of the thyroid cartilage and at least 0.5 cm excision of the subglottic area and also of the anterior third of the other vocal fold.

In (T1b) tumors we excised 1 vocal fold completely, including the anterior commissure, and part of the second vocal fold. Most of our patients had a second examination under general anesthesia between 4 to 8 weeks after laser treatments. Biopsies were taken from the bed of the tumor and from any suspected lesion. Further follow-up consisted of a monthly laryngeal examination during the first year with rigid and flexible endoscope and with video stroboscope (Atmos) examination and once in 3 months in the second and third year and after that every 6 months. After the second look, the patients were sent to speech therapy.

TABLE 3. Clinical Data of VC

		Site					Follow-up (mo)		
No	Age/Sex	Vocal Cord	Extension	TMN	Laser treatment	Second Look	Local Recurrence	Failure Treatment	NED
1	60/M	Rt	No	T1	Rt Cord	—	12	Revision by laser	32
2	60/M	Rt	Ant com	T1	Rt Cord + ant com	—			24
3	53/M	Rt	No	T1	Rt Cord	No Ca			24

Abbreviations: M, male; Rt, right; Ant com, anterior commissure; Ca, carcinoma.

Pathology

Thirty-two specimens of malignant tumors were examined by frozen section. After this examination, tissues were fixed in buffered formalin. Embedded in paraffin, sectioned into 5 μm thickness, and stained with hematoxylin and eosin.[9]

RESULTS

Tables 1, 2, and 3 summarize the follow-up of all patients.

Complications

Two patients developed dyspnea during the first 24 hours after the operation and were treated by steroids inhalation. Three patients developed small anterior web.

Second Look Procedures

Twenty-six of the thirty-two patients had a second-look procedure (except 3 with CIS, 2 with VC, and 1 with SCC-T2, who refused the second look); of the 26 patients who underwent second look, only 2 had residual of carcinoma that was re-excised by laser with free margins (1 had SCC-T1 and the other SCC-T2). Laser also excised the anterior webs of 3 patients.

Videostroboscopy

After the cordectomy, laryngo-videostroboscopy showed loss of vibration and stiffness at the site of laser resection with a normal mucosal wave observed at the opposite healthy vocal fold in all cases.

Local Recurrence

Five patients developed local recurrence after 4 to 12 months; of them, 2 did not have second look, and 2 had T2 carcinomas (1 received radiotherapy and the other underwent total laryngectomy and radiotherapy for extensive recurrent carcinoma). One was treated for failure of radiotherapy (underwent total laryngectomy). The other 2 patients with T1 glottic carcinoma (one had verrucous carcinoma) underwent re-excision of the tumor by laser.

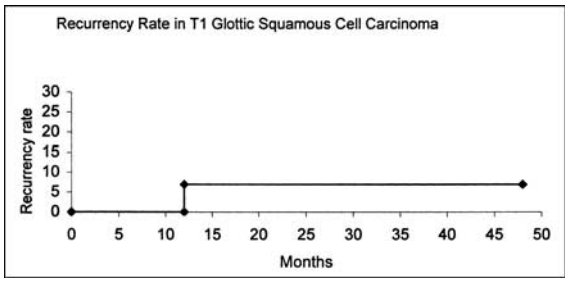

Fig 1.

Recurrence rate was calculated by the Kaplan-Meier[10] method only for the 20 patients with primary T1 glottic SCC because the other groups of patients were small to calculate recurrence rate (Fig 1). The 6-month recurrence rate was 0%; the recurrence rates for 12 and 48 months were 7%. No patient developed regional or distant metastases.

Survival

All the patients are alive and well without evidence of carcinoma after the follow-up (3-48 months).

DISCUSSION

Transoral laser surgery is a therapeutic modality that has yet to find its position in the treatment of glottic carcinomas, especially in early stages.[7,11-13] Adequate biopsy specimens are necessary to establish the diagnosis of carcinoma, allowing the pathologist to examine the deeper layers of the specimen to better understand the relationship between tumor and its invasion. Laser surgery provides advantages over other surgical modalities related to its hemostatic effects and the precision of tissue ablation.[3,8,14,15]

It must be noted that endoscopic surgery of glottic tumors performed by CO_2 laser offers relevant benefits when compared with traditional surgery and radiotherapy including rapidity of operation and reduced surgical trauma, the possibility of avoiding tracheotomy, the respect of the integrity of the cartilaginous skeleton, short postoperative course and low incidence of complication, better functional results, a shorter stay in hospital

with positive psychologic effects on the patients, and lower social costs.[2] It has been reported to cause minimal morbidity, provides good functional results, and provides a cost-effective alternative to open surgical procedures and to radiotherapy.[4,16,17] As reported in the literature, local recurrence of glottic SCC treated by laser was between 6% to 14% for T1. These results are nearly the same after treatment with radiotherapy or surgery.[3] Our results showing a 7% recurrence rate for T1 after 3 years are similar to the results of Eckel's[3] series in 2001.

Carcinoma in situ has mostly been treated with radiotherapy.[18,19] In recent years, encouraging results have been reported for the minimally invasive surgical approach using microlaryngoscopic removal of the diseased mucosa with the help of surgical lasers.[20,21] Our study includes only 3 patients with carcinoma in situ treated by mucosal excision; all are successful and without local recurrence.

VC is a low-grade malignant tumor. Treatment strategies of VC of the larynx are a subject of the ongoing discussion, and the role of the carbon dioxide laser therapy in the management remains unclear to date. Damm et al[22] in 1997 reported 21 cases with VC and recommended laser surgery for T1 and also for T2 tumors. A meticulous follow-up for early recognition of local recurrence was recommended.

Our study includes 3 patients with VC. One needed re-excision after 12 months. He is with no evidence of disease after 32 months.

The anterior commissure is most frequently affected when local recurrences occurred in the larynx.[5] Therefore, the endoscopic laser resection of the tumor must be very precise, when there is involvement of the anterior commissure, and must include the anterior commissure until the thyroid cartilage and resection of the tumor subglotticly are at least 0.5 cm along the Broyel's ligament.

The quality of voice depends on the development of the fibrous fold and the absence of the anterior synechia in the healing larynx.[21] Almadori et al[23] reported in 1998 that the quality of voice is better after laser surgery than laryngofissure; this may be explained by the fact that such procedures results in a better and more rapid healing process.

CONCLUSIONS

Based on the results of this study, we recommend endoscopic laser excision in CIS, T1 glottic SCC, and VC and in selected cases of T1-SCC with involvement of the anterior commissure and selected cases of T2-SCC (with good exposure of the anterior commissure and the tumor and individual preferences). The follow-up should be meticulous to detect a recurrence as soon as possible. Endoscopic laser excision offers an oncologically adequate alternative to surgery and radiotherapy.

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