Treatment Outcome and Prognostic Factors of CO₂ Laser Cordectomy for Early Glottic Cancer

Kwang Hyun Kim¹
Myung-Whun Sung¹
Chung-Hwan Baek²
Young-Ik Son²
Sang Yoon Kim³
Seung-Ho Choi³
Kang Dae Lee⁴
Sang Joon Lee⁵
Phil-Sang Chung⁵

¹Department of Otolaryngology-Head and Neck Surgery, Seoul National University College of Medicine, Seoul, Korea

²Department of Otolaryngology-Head and Neck Surgery, Sungkyunkwan University School of Medicine, Seoul, Korea

³Department of Otolaryngology-Head and Neck Surgery, University of Ulsan, College of Medicine, Seoul, Korea

⁴Department of Otolaryngology-Head and Neck Surgery, Kosin University College of Medicine, Busan, Korea

⁵Department of Otolaryngology-Head and Neck Surgery, Dankook University, Medical College, Cheonan, Korea

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Correspondence

Phil-Sang Chung
Department of Otolaryngology-Head and Neck Surgery, Dankook University, Medical College, 16-5, Anseo-dong, Cheonan 330-715, Korea
Tel: +82-41-550-3975
Fax: +82-41-556-1090
E-mail: pschung@dankook.ac.kr

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Background and Objectives

Laser cordectomy is now a popular method and is one of the treatments of choice for patients with early glottic carcinoma. Transoral laser microsurgery provides many advantages compared to conventional open surgery or radiation therapy. In this study, we examined the oncologic results of laser cordectomy for the treatment of early glottic cancer and analyzed its prognostic impact on the survival of the several tumor-related and treatment-related factors.

Materials and Methods

Data of 202 patients from five hospitals who were diagnosed with early glottic squamous cell carcinoma and treated with curative intent by laser cordectomy from June 1988 to March 2005 were used for the analysis (174 T1, 28 T2). Patients who underwent radiation therapy previously were included.

Results

The five-year overall survival and disease-free survival rates were 98.4% and 84.9%, respectively. Twenty-two patients developed local recurrence. Total laryngectomy was performed in 6 patients and the laryngeal preservation rate in these patients was 97%. Recurrence was higher in the patients with anterior commissure involvement (9/39) than in those without anterior commissure involvement (13/163). Recurrence was higher in T1b (4/15) patients than those with T1a (13/159). Previous radiation was also found to be highly related to recurrence (7/20 vs 15/182). Twenty patients with local recurrence after radiation therapy were treated by salvage laser cordectomy. Of them, 7 patients developed local recurrence and the five-year disease-free survival rate was 57% in them. Complication was rare with just one case of hemorrhage. Tracheostomy was not necessary in all the patients.

Conclusion

Laser cordectomy for the treatment of early glottic carcinoma resulted in high survival, laryngeal preservation rate and low complication rate. The prognostic factors were anterior commissure involvement, vocal fold involvement and previous radiotherapy.

Key words

Early glottic cancer; Laser cordectomy

INTRODUCTION

The treatment goal for early glottic cancer is to remove the tumor completely preserving the laryngeal functions. To do this, conservation laryngeal surgery, laser cordectomy or radiation therapy has been conducted. Among them, laser cordectomy shows excellent local control and disease-specific survival rate in many literatures.¹⁻⁴ In addition, laser cordectomy has low morbidity and high cost-effectiveness compared to radiation therapy or conservation laryngeal surgery. It does not need tracheostomy and preserves the laryngeal framework.³⁻⁶ In surgical prospective, disease extent and depth is well appreciated during laser surgery and so resection margin is ideally controlled.^{4,7} In these reasons, laser cordectomy was applied to the small lesions at the membranous vocal fold in early days but now extended into T1 or T2 early laryngeal cancer and some cases of higher T stages.

In this study, we examined the oncologic results of laser cordectomy for early glottic cancer and analyzed the prognostic impact on the survival of the several tumor-related and treatment-related factors.

MATERIALS AND METHODS

We retrospectively analyzed 202 patients who diagnosed as glottic cancer and underwent laser cordectomy from Jun. 1988 to Mar. 2005. We sent fill-up sheet to five hospitals, which was department of Otolaryngology-Head and Neck Surgery, College of Medicine, Seoul National University, Sungkyunkwan University, Ulsan University, Kosin University, Dankook University. Each center collected the cases, reviewed the chart retrospectively and filled up the sheet. We included only the cases operated in curative intention and followed up for more than 12 months. The patients who underwent suspension biopsy by laser or underwent open surgery or radiation therapy immediately after laser cordectomy were excluded.

Male was 191 patients (94.5%) and female was 11 patients (5.5%). Median age was 63 years old (31-85) in male and 57 years old (42-81) in female. Patients were restaged according to the 2002 American Joint Center Committee (AJCC) staging system, in which 174 patients were T1 and 28 patients were T2. Involvement of anterior commissure was found in 39 patients, in whom 13 patients was T1a, 10 patients T1b, 16 patients T2.

Extent of cordectomy was classified again according to the European Laryngologic Society Classification

Table 1. Type of laser cordectomy by classification of European Laryngological Society (2000)

Type	En bloc	Blockwise
Subepithelial cordectomy (Type I)	3	2
Subligamental cordectomy (Type II)	4	6
Transmuscular cordectomy (Type III)	132	34
Total cordectomy (Type IV)	1	2
Extended cordectomy (Type V)	0	18
Total	140	62

(2000). Resection method was divided into En bloc resection which remove the tumor in one piece and blockwise resection which remove the tumor into 2 or 3 pieces. En bloc resection was performed in 140 patients and blockwise in 62 patients. As the extent of resection enlarged, the blockwise resection was more often applied (Table 1).

Disease-free survival was measured by the period from treatment to recurrence, and overall survival was defined as the period from treatment to last follow-up or death. SPSS 13 for windows was used for statistical analysis. We analyzed the 5-year overall and disease-free survival by Kaplan-Meier method. Statistical significance for supposed risk factors related to the recurrence was evaluated by log-rank test.

Postoperative voice evaluation was performed by voice score suggested by Sittel et al.⁸ In this 5 grading system, grade 1 is defined as very poor voice, grade 2 as poor but understandable voice, grade 3 as fair voice, grade 4 as good but still pathologic voice, and grade 5 as normal voice.

RESULTS

Five-year overall and disease-free survival were 98.4% and 84.9%. Twenty two patients developed local recurrence. Total laryngectomy was done in 6 patients and laryngeal preservation rate was 97% (Fig. 1). We analyzed the prognostic factors related to the disease-free survival. The analyzed factors were T stage, tumor morphology, anterior commissure involvement, vocal fold mobility, subglottic extension, resection methods, and history of previous radiotherapy.

Five-year disease free survival was 90.6% in T1a unilateral vocal fold cancer and 73% in T1b bilateral vocal fold cancer. There was statistically significant difference between T1a and T1b. When compared between T1 and T2, T2 stage cancer showed tendency of poor disease-free survival. However, there was no statistical significance.

Fig. 1. Overall survival (OS) and disease-free survival (DFS) of 202 patients treated by laser cordectomy. Five-year OS and DFS were 98.4% and 84.9%.

Table 2. Analysis of prognostic factors related to disease-free survival

		No. of patients	No. of recurrence	5-yr DFS (%)	Log-rank test (p-value)
T stage	T1a	159	13	90.6	< 0.05
	T1b	15	4	73.3	
	T1	174	17	89.1	0.06
	T2	28	5	78.6	
Telescopic findings	Fungating	100	7	93.0	< 0.05
	Superficial	34	0	100	
	Ulcerative	45	12	71.1	
AC involvement	–	163	13	90.8	< 0.05
	+	39	9	74.4	
Vocal fold mobility	Mobile	193	21	87.6	0.89
	Impaired	9	1	88.9	
Resection methods	En bloc	139	13	89.2	0.16
	Blockwise	63	9	84.1	
RT history	–	182	15	90.7	< 0.05
	+	20	7	60.0	
Subglottic extension	–	193	20	88.6	< 0.05
	+	9	2	66.7	

AC, anterior commissure; RT, radiotherapy.

Among 39 patients with anterior commissure involvement, recurrence occurred in 9 patients. T stage of recurrence was 2 patients in T1a (2/13), 3 in T1b (3/10), and 4 in T2 (4/16). The 5-year disease-free survival of the patients with anterior commissure involvement was 74.4%. This result showed statistically significant difference compared to that of the patients without anterior commissure involvement, in which 13 recurrences occurred among 163 patients.

Twenty patients had history of previous radiotherapy. Recurrence occurred in 7 patients and 5-year disease-free survival was 90.7%. On the other hand, 15 patients experienced recurrence among 182 patients who underwent laser cordectomy as primary treatment

modalities and 5-year disease-free survival was 60.0%. Previous radiotherapy history was also important poor prognostic factor. Preoperative T stage of patients with previous radiotherapy history was 12 patients in T1a, 2 in T1b, and 6 in T2. The type of laser cordectomy performed was 1 type I cordectomy, 1 type II, 14 type 3, 1 type IV, and 3 type V.

Tumor morphology could be classified as fungating, superficial, or ulcerative type in 179 patients. Tumor with ulcerative morphology by telescopic examination showed poor survival than fungating or superficial tumor with statistical significance. Subglottic extension was also significant prognostic factor. Five-year disease-free

survival was 89% in patients without subglottic extension. But with subglottic extension, survival rate was 66%. Vocal fold mobility and resection method did not make statistically significant difference in disease-free survival. The analysis of prognostic factors was summarized in Table 2.

We analyzed the results of laser cordectomy as salvage treatment in 20 patients with previous radiotherapy. 13 patients were successfully salvaged and 7 patients recurred again. Among 7 patients, 3 patients underwent total laryngectomy, 1 patient supracricoid partial laryngectomy, 1 patient laser cordectomy with neck dissection, 2 patients received chemotherapy or radiotherapy. Local control rate was 65%.

There was no intraoperative complication. Postoperative complication developed in only one patient with bleeding. Oral feeding could be started before postoperative 1 day and possible in all patients. Tracheostomy was unnecessary in all patients.

Evaluation of voice outcome after laser cordectomy was performed in 127 patients. Three patients was estimated as grade 1, 10 patients grade 2, 34 patients grade 3, 57 patients grade 4, and 23 patients grade 5. Fair or good voice more than grade 3 was possible in 89.8% (114/127) of the patients.

DISCUSSION

Laryngeal carcinoma is second most common epithelial malignant tumor. Glottic cancer occupies slightly more than half of the laryngeal carcinoma and usually diagnosed as early stage because it accompanies voice change. Cervical lymph node metastasis is also infrequent due to lack of lymphatic drainage in glottis area. Laryngeal carcinoma is closely related to the quality of life because of phonation, respiration, and swallowing function of the larynx.⁵

Early glottis cancer is treated by single modality. Excellent local control and survival rate has been reported by radiotherapy, transoral laser microsurgery, or open partial laryngectomy.¹⁻⁵ Local control rate of radiotherapy was 82-94% in T1 and 70-87% in T2.^{9,10} Open partial laryngectomy such as supracricoid partial laryngectomy or vertical partial laryngectomy showed slightly higher local control rate.¹¹ Local control rate of laser cordectomy has been reported approximately 80-95% for early glottic cancer. Rudert and Werner reported that local control rate of laser cordectomy was 100% for Tis, 92% for T1a, 96.5% for T1b, and 88% for T2.² Motta and colleagues reported local control rate of 94.5% for T1a, 96.5% for T1b, 77% for T2a, and 90% for T2b.³

Involvement of anterior commissure is related to higher

failure rate for radiotherapy and laser cordectomy due to understaging, difficulty in endoscopic exposure, and problems of adequate dosing of radiotherapy.¹² Nozaki and colleagues reported that involvement of anterior commissure increased local recurrence after radiotherapy.¹³ Mendenhall and colleagues reported higher local recurrence in laser cordectomy.¹⁴ In our study, 9 patients recurred among 39 patients with anterior commissure involvement and 5-year disease-free survival was significantly lower than the patients without anterior commissure involvement. To reduce the recurrence, sufficient exposure and removal of perichondrium of this area are needed.^{4,12}

Previous radiotherapy had a negative impact on treatment outcomes. Early detection of recurrence and determination of the precise extent of the lesion is difficult after radiotherapy. However, successful salvage by laser cordectomy was possible in 60-70% of the patients with adequate selection.^{15,16} In our study, 13 among 20 patients were salvaged and local control rate of salvage laser cordectomy was 65%.

The principle in cancer surgery is en bloc resection. If a scalpel penetrates tumor, viable cells may adhere to the blade, and be spread to the adjacent site of surgical wound. However, laser is light scalpel without carrying viable cells and cutting surface was thermocoagulated.¹² Clinical trials supported the safety of blockwise resection in laryngeal carcinoma.^{17,18} In our study, there was no difference of disease-free survival between en bloc resection and blockwise resection.

Voice quality is impaired after treatment of larynx carcinoma. Voice impairment is caused by removal of adjacent healthy tissue to provide clear margin in surgery and loss of vocal fold bulk from tumor necrosis or fibrosis in radiotherapy. The comparison of voice outcome between radiotherapy and laser cordectomy is controversial. The voice quality after laser cordectomy is variable according to the extent and depth of resection. Early postoperative voice feels poor due to abrupt anatomical change unlike radiotherapy. However, final voice quality is similar between laser cordectomy and radiotherapy about 6 months after treatment.¹⁹ Especially, good voice comparable to radiotherapy is expected in T1a tumor without anterior commissure involvement.²⁰ When we evaluated the voice in terms of communication, comfortable communication was possible in 89.7% (114/127) of the patients.

In conclusion, Laser cordectomy for early glottic cancer provided excellent local control, overall survival and laryngeal preservation rate. The poor prognostic factors were the anterior commissure involvement, bilateral vocal fold involvement, subglottic extension, ulcerative tumor, and previous radiotherapy. Laser cordectomy could be

used as salvage treatment for recurrent glottic cancer after radiotherapy in selected cases.

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