En Bloc Resection of Supraglottic Carcinomas with Transoral Laser Microsurgery

Original Investigation

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Abstract

Objective: Complete en bloc supraglottic tumor excision with transoral laser microsurgery (TLM) can be achieved with good postoperative outcomes. We report surgical feasibility and the postsurgical outcomes of en bloc resection of supraglottic laryngeal squamous cell carcinomas (LSCC) with TLM.

Methods: Seventeen patients who underwent TLM for supraglottic laryngeal cancer were included in the study. Demographic and pathological data, clinic and follow-up outcomes of the patients were reviewed and analyzed.

Results: Type 1 TLM was performed in three patients, type 2a in one patient, type 3b in 12 patients, and type 4b in one patient. Negative surgical margins were achieved in all of the cases. Re-excision or any adjuvant treatment for positive resection margins was not required in any of the cases. Eight patients received adjuvant radiotherapy due to lymph node metastasis. Mean follow-up time was 33.8±15.7 months (range: 10–65 months). None of the patients had recurrence or distant metastasis.

Conclusion: The transoral approach with the use of CO_2 laser and microscopy offers complete tumor excision for treating supraglottic LSCC. The three-dimensional structure of the supraglottis can be achieved with adequate exposure. En bloc resection is possible with safe margins.

Keywords: Larynx carcinoma, partial laryngectomy, supraglottic carcinoma, transoral laser microsurgery, squamous cell carcinoma

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Introduction

The most crucial goals in treating supraglottic laryngeal squamous cell carcinomas (LSCC) involve oncological and functional outcomes. Recently, however, the preservation of laryngeal functions has come to influence the decision of treatment modality. There are many treatment options, and supraglottic LSCC can be effectively treated with an open partial horizontal laryngectomy (OPHL), transoral laser microsurgery (TLM), transoral robotic surgery (TRS), or radiotherapy (RT).

In 1990 Zeitels et al. (1) published the first LSCC case series treated with TLM.

Thirty years on TLM has proven to be an excellent option, especially for supraglottic and glottic carcinomas (2, 3). Additionally, many studies reported that better functional outcomes were obtained with TLM compared to other modalities (4, 5). In a recent study TLM was reported to be less invasive than OPHL (6).

TLM is a good option for early-stage supraglottic LSCC and offers similar survival rates and decreased morbidity compared to OPHL (7). However, there are still controversies about using TLM for the treatment of advanced stage supraglottic LSCC. In principle, en bloc tumor resection with safe margins is the standard treatment method in the surgery of all laryngeal cancers; however, many surgeons can regard multi-bloc or piecemeal resection of tumors as an option to achieve better visualization (8).

En bloc transoral tumor resection is considered challenging and piecemeal resection is contentious in the surgery of advanced stage supraglottic LSCCs (8-10). This study reports the post-surgical outcomes and surgical feasibility of en bloc resection of supraglottic LSCC with TLM.

Methods

The study was designed as a retrospective one, and all data were retrospectively collected. Data include the medical records of patients diagnosed with supraglottic LSCC and treated with TLM in April 2016 to July 2020. Demographic data, tumor stage, histopathological grade, nasogastric tube (NG) removal and decannulation time, as well as video laryngoscopic records were reviewed and analyzed. The laryngeal cancer staging designated by the American Joint Committee on Cancer was used for tumor staging (11).

Seventeen patients who had undergone TLM for supraglottic laryngeal cancer were included. All patients had biopsy-proven laryngeal squamous cell cancer. Sizes and localizations of the tumors, and the mobility of the vocal folds were noted in preoperative video laryngoscopy examination. Positron emission tomography (PET/CT) or neck and chest computed tomography (CT) scans were done during preoperative oncological evaluation, also to exclude distant metastases.

Procedure and Instrumentation

European Laryngological Society (ELS) classification system was used to classify resections (12). The same senior surgeon (KÖ) performed all tumor excisions under general anesthesia. A carbon dioxide laser (Lumenis Acupulse Duo®, Yokneam, Israel) was used with AcuBlade equipment. The power was set to 10 watts in the continuous super-pulse mode. Steiner's distending operating laryngoscope obtained laryngeal exposure with a Storz suspension device (Karl Storz®, Tuttlingen, Germany). The laryngoscope's upper blade was placed in the vallecula, and the lower blade displaced the endotracheal tube. The en bloc resection technique was successfully performed in all cases.

Medial supraglottic laryngectomy (SGL) with resection of the preepiglottic space was performed for the medially located lesions extending to the infrahyoid epiglottis. Lateral SGL was performed for the tumors located on the lateral or posterior supraglottic space, and aryepiglottic folds, ventricular folds, arytenoids, pharyngo-epiglottic folds or anterior wall of pyriform fossa were resected based on tumor location. Limited excisions were performed only for small T1 tumors located in the free edge of aryepiglottic folds or epiglottis. Resection was started with the dissection of the preepiglottic area from the vallecula until the hyoid bone was reached. The preepiglottic space was dissected, and glossoepiglottic ligament was divided. The aryepiglottic fold was cut, and the false vocal fold was separated from the arytenoid cartilage. Dissection was continued posterior to anterior on each side to release the supraglottic structures and the tumor from the thyroid cartilage. At the end of the procedure, the whole epiglottis, the preepiglottic space, the aryepiglottic folds, the false vocal folds, and the laryngeal ventricles had been resected in en bloc fashion. Figures 1 and 2 show the surgical specimens that were resected with TLM. Super-selective or selective neck dissection was performed in clinically lymph node-negative necks. In clinically lymph node-positive necks, modified radical neck dissection was performed. Tumor positive lymph node and resection margins in postoperative histopathology were indications for adjuvant therapy.

Postoperative follow-up routine was every two months in the first year, every three months in the second year, every four to six months until the fifth year and annually thereafter. Patients underwent full head and neck examination, and ultrasound was performed at every visit, and a chest X-ray or CT was taken annually. CT scan, magnetic resonance imaging, and positron emission tomography were done when necessary.

Ethical Considerations

The study was conducted in line with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki guidelines and its amendments (ethics committee approval IRB no: 20-7.1T/5). Informed consent was obtained from all patients for their respective surgical procedures.

Statistical Analysis

The SPSS computer software (SPSS version 22.0, SPSS Inc. Armonk, NY, USA) was used for statistical analysis. Descriptive statistics of the patients were expressed as mean ± standard deviation.

Figure 1. Surgical specimen of patient number 3. The tumor was located on the left side of the infrahyoid epiglottis. Type 3b transoral supraglottic laryngectomy (SGL) was performed

Figure 2. Surgical specimen of patient number 16. The tumor was on the laryngeal surface of the infrahyoid epiglottis, extending to the petiole

Results

Seventeen patients were included in the study. Sixteen were male, and one was female, and their mean age was 66.5±5.7 years (range: 57–79 years). Tumor stage was T1 in four patients, T2 in ten, and T3 in three patients. In all patients, supraglottic LSCC was resected with clear margins. Resections were type 1 in three patients, type 2a in one patient, type 3b in 12 patients, and type 4b in one patient. Nine patients had bilateral selective and eight had unilateral neck dissection. There were 8 (47%) patients with loco-regional lymph node metastases. Lymph node metastasis with extranodal spread and perineural invasion was found in one patient. The summary of patient outcomes is given in Table 1.

Two patients required prophylactic tracheostomy after extended supraglottic resection. Decannulation times for these two patients were 13 and 16 days, respectively. Three patients suffered from dyspnea during/after adjuvant RT due to laryngeal edema, and one of them required a tracheostomy. One patient developed anterior glottic stenosis and was successfully managed with TLM. All patients were successfully decannulated. There were no early postoperative complications.

Median NG tube removal time was ten days (IQR=7, range: 1–26 days). In three patients who had T1 supraglottic LSCC, oral feeding was started on the second postoperative day without NG tube placement. Mean hospitalization time was 12 days (range: 3–34 days) Gastrostomy tube was used in one patient due to chronic aspiration and dysphagia after adjuvant RT.

Tumor histopathology was well-differentiated LSCC in nine and moderately differentiated in seven patients. Basaloid LSCC was found in one patient. Mean tumor size was 2.8±1.4 cm (range: 1.5–4.5 cm). Negative surgical and pathological resection margins were achieved in all patients. Re-excision or any adjuvant treatment for positive resection margins was not required in any of the cases. Lymph node metastasis was the primary indication for adjuvant treatment. Postoperative RT was performed in eight patients, one with extra nodal tumor extension also received concurrent platinum-based chemotherapy. Mean follow-up time was 33.8±15.7 months (range: 10–65 months). None of the patients had local or regional recurrence, or distant metastasis during this period.

Discussion

Transoral resection of supraglottic tumors by preserving glottic functions has become possible and widespread in the last three decades with the ongoing development of laser and endoscope technology (8). The three-dimensional structure of the supraglottis can create challenges for complete resection of the tumors. In conventional SGL, the horizontal part of the supraglottis above the vocal cords on which the tumor is located is resected. This method is considered a safe and successful oncological surgery in selected patients. It may require initial tracheostomy. Also, dysphagia and aspiration can be problematic in some patients because of the resection of the supraglottic structures (13, 14).

Table 1. Summary of demographic, surgical, pathologic and clinical data of the patients

Patient no	Age/Sex	Surgical treatment		Tumor histopathology	Postoperative pathologic stage[#]	Tumor diameter	Adjuvant treatment	Nasogastric tube removal time (day)
		Transoral supraglottic laser laryngectomy type[α]	Neck dissection					
1	64/Male	3B	Bilateral selective	Well-differentiated LSCC[*]	T2N0M0	3 cm	-	6
2	65/Male	2A	Bilateral selective	Well-differentiated LSCC	T1N0M0	3 cm	-	1
3	69/Male	3B	Bilateral selective	Well-differentiated LSCC	T2N0M0	3 cm	-	6
4	79/Male	3B	Left modified radical type 3	Moderately differentiated LSCC	T3N2BM0	3 cm	Radiotherapy	15
5	62/Male	3B	Bilateral selective	Well-differentiated LSCC	T2N0M0	1.5 cm	-	7
6	58/Male	3B	Bilateral selective	Moderately differentiated LSCC	T2N1M0	3 cm	Radiotherapy	6
7	63/Male	3B	Bilateral selective	Well-differentiated LSCC	T3N0M0	4.5 cm	-	21
8	70/Male	1	Left modified radical type 3	Basaloid LSCC	T1N2bM0	3 cm	Radiotherapy	2
9	75/Male	3B	Right modified radical type 3	Moderately differentiated LSCC	T2N2bM0	3 cm	Radiotherapy	7
10	57/Male	3B	Left modified radical type 3	Moderately differentiated LSCC	T2N1M0	2.1 cm	Radiotherapy	7
11	67/Male	1	Bilateral selective	Well-differentiated LSCC	T1N0M0	1.6 cm	-	2
12	62/Female	3B	Right modified radical type 3	Moderately differentiated LSCC	T2N1M0	2 cm	Radiotherapy	26
13	63/Male	4B (lesion extends to pyriform fossa)	Right modified radical type 3	Well-differentiated LSCC	T2N0M0	2 cm	-	12
14	70/Male	3B	Right modified radical type 3	Moderately differentiated LSCC	T2N3bM0	2 cm	Radio chemotherapy (Extranodal tumor extension +)	9
15	70/Male	1	Bilateral selective	Well-differentiated LSCC	T1N0M0	2 cm	-	7
16	62/Male	3B	Bilateral selective	Well-differentiated LSCC	T2N0M0	2.3 cm	-	10
17	59/Male	3B	Left modified radical type 3	Moderately differentiated LSCC	T3N1M0	2 cm	Radiotherapy	8

[*]: Laryngeal squamous cell carcinoma

[#]: Laryngeal cancer staging designated by the American Joint Committee on Cancer

[α]: European Laryngological Society Classification System for transoral supraglottic laryngectomy

TLM is considered a good option for treating early-stage glottic carcinomas (15). It offers favorable results similar to RT without harming the glottic functions. The anatomy and histology of the glottic site are suitable for transoral procedures. Resection can be made with smaller safe margins, and lymphatic and arterial/venous microvessels are less common compared to the supraglottic site (16).

Early-stage supraglottic LSCCs are also good candidates for TLM. In the classification of the ELS, Type 1 TLM in supraglottic LSCC is described as the limited excision of small superficial lesions with only one supraglottic subsite (11). T1 tumors can be resected safely without harming uninvolved supraglottic structures with a CO_2 laser. Laryngeal functions such as phonation and swallowing can also be protected. In our study, three patients were diagnosed with T1 supraglottic tumor. Tumors were located on the aryepiglottic fold without glottic extension in two patients. The other patient had a small-sized tumor located on the free edge of the epiglottis. En bloc complete tumor resection was performed in these patients, and none of them had disease recurrence, dysphagia, or aspiration.

The extension of the bulky supraglottic tumor to the infrahyoid epiglottis, epiglottic petiole, preepiglottic space, or ventricular fold makes en bloc transoral resection difficult. The accessibility of the inferior margin and the dissected tumor tissue's traction can be hard without resecting a part of the tumor. Piecemeal resection is an option for these tumors. This technique was favored by Rudert et al. (10) who described the laser resection lines in supraglottic structures for bisecting the tumor tissue.

Previous studies reported TLM success combined with neck dissection and/or RT for treating advanced stage supraglottic LSCC (17-19). It offers good functional and oncologic results. Peretti et al. (9) published the results of eighty cases affected by supraglottic LSCC and treated with TLM. They reported that ten patients required re-excision for residual tumor, and two patients with positive surgical margins in histopathological examination had disease recurrence. They stated that better visualization of surgical margins is possible with piecemeal resection of bulky lesions. They did not report the comparison of outcomes with en bloc resection due to limited patient numbers. There is a lack of data in previous studies comparing the piecemeal and en bloc resection of supraglottic LSCC with TLM.

In our series, 12 patients underwent type 3b, and one patient underwent type 4b supraglottic TLM laryngectomy, and en bloc resection was achieved in all. No residual tumor was present in the postoperative histopathological examination. The differentiation between healthy tissue and tumor can be challenging due to inadequate exposure during resection. Also, appearance of the healthy tissue can be affected by CO_2 laser's hemostatic effect. Piecemeal resection is an option for resection of bulky tumors, but carries the concern of incomplete resection or an increased risk of tumor metastasis (20). Adequate exposure and lighting are essential for optimal microscopic view. Transoral laser resection of the supraglottic tumors in en bloc fashion was feasible and clear margins could be achieved without bisecting the tumor.

Incomplete resections can be catastrophic in the treatment of LSCC (2, 17). Meticulous resection with clear margins is the primary goal of the laryngeal surgery. However, comprehensive pathological examination of the tumor specimen is essential. The orientation of the pathologist to surgical specimens and tumor margins is crucial. Evaluation of all surgical margins may not be possible in the piecemeal technique. This advantage can also be considered a superiority of en bloc resected surgical specimens.

Besides tumor size and patient anatomy, the surgeon's experience in TLM can be another critical factor. In our study, the senior surgeon (KÖ) who operated on all patients has an experience of more than 300 cases in open partial laryngectomy, TLM, and transoral robotic surgery (TORS). The resection of advanced stage supraglottic tumors can be challenging without expertise in oncologic laryngeal surgery. Early-stage supraglottic LSCCs and limited excisions may be more appropriate for inexperienced surgeons.

There are other transoral treatment options, such as TORS, for patients diagnosed with supraglottic LSCC (21). We also have experience in TORS and offer this procedure in our hospital; however, it is not preferred by patients because of its high cost which they have to assume. Primary radio(chemo) therapy as a larynx preservation approach is also an option for the patients with locally advanced disease (22). Comparative studies are mandatory for the best conclusion on the oncologic outcomes. In our study, we mainly focused on the feasibility of the en bloc resection of the tumor and its positive effect on oncologic evaluation. We achieved good clinical and oncological postoperative results in en bloc resection with TLM in supraglottic LSCCs. The small number of patients and the relatively short postoperative follow-up period are the shortcomings of this study. The mean follow-up time was 33.8 months; however, recurrences mostly occur in the first two years in LSCC cases. Prospective controlled studies with larger patient groups and longer follow-up periods are needed to achieve more substantial conclusion.

Conclusion

In this report we presented our results in the en bloc resection of supraglottic LSCC with TLM. In all patients, en bloc tumor resection with safe margins was achieved. The transoral approach with the use of CO_2 laser and microscope offers complete tumor excision for treating supraglottic

LSCC. The three-dimensional structure of the supraglottis can be achieved with adequate exposure. En bloc resection is possible with safe margins without harming healthy laryngeal tissues.

Ethics Committee Approval: The ethics committee approval was received for this study from the Ege University Ethics Committee (IRB no: 20-7.1T/5).

Informed Consent: Informed consent was obtained from all patients for their respective surgical procedures.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and/or Medical Practices: K.Ö., Concept: K.Ö., A.Ö., G.T., Design: K.Ö., A.Ö., G.T., Data Collection and/or Processing: K.Ö., A.Ö., G.T., Analysis and/or Interpretation: K.Ö., A.Ö., G.T., Literature Search: K.Ö., A.Ö., G.T., Writing: K.Ö., A.Ö., G.T.

Conflict of Interest: No conflict of interest was declared by the authors.

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Main Points

- This study aims to report the postsurgical outcomes and the surgical feasibility of en bloc resection of supraglottic carcinomas (SGC) with transoral laser microsurgery (TLM).
- En bloc resection with safe margins was achieved in all patients.
- None of the patients developed local or regional recurrence, or distant metastasis during the mean 33-month follow-up period.
- The transoral approach with the use of CO2 laser and microscope offers complete tumor excision.

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