Kulak Burun Bogaz Ihtis Derg 2012;22(3):129-135 doi: 10.5606/kbbihtisas.2012.025

Original Article / Çalışma - Araştırma

Oncologic and functional outcomes of open surgery in early supraglottic tumors: is it still a valid technique?

Erken evreli supraglottik tümörlerde açık cerrahinin onkolojik ve fonksiyonel sonuçları: Hala geçerli bir teknik mi?

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Objectives: In this study, we aimed to analyze the oncologic and functional outcomes of supraglottic laryngectomy.

Patients and Methods: Medical records of 91 cases (85 males, 6 females; mean age 55.4 years; range 30 to 75 years) who underwent surgery due to early supraglottic laryngeal cancer in our clinic were retrospectively analyzed. Statistical analysis was performed using chi-square test and Fisher's exact test. Mean values were estimated by means of t-test, while survival curves were drawn using Kaplan-Meier method.

Results: With respect to oncologic assessment, disease-free survival rate was 81%, the rate of regional recurrence was 6%, the rate of local recurrence was 8%, the rate of distant metastasis was 7% and the rate of occult neck metastasis was 25%. Metastatic neck disease and extracapsular invasion in the lymphatic ganglia were found to be the most critical parameters in terms of survival. With respect to functional assessment, the mean time of decannulation was 41 days, while the mean time of nasogastric tube removal was 19 days. It was observed that cases with a Forced Expiratory Volume in 1 second (FEV-1) of <75% experienced more aspiration-related problems. The functional outcomes were worse in the cases who underwent bilateral neck dissection and postoperative radiotherapy.

Conclusion: Open surgery is a more effective treatment modality in the early supraglottic tumors in terms of oncologic and functional outcomes. It should be continued to be use as an alternative method to the novel and expensive technologies including transoral robotic surgery or transoral laser surgery.

Key Words: FEV-1; functional results; oncological results; supraglottic laryngectomy.

Amaç: Bu çalışmada supraglottik larenjektominin onkolojik ve fonksiyonel sonuçları analiz edildi.

Hastalar ve Yöntemler: Erken evreli supraglottik yerleşimli larenks kanseri nedeniyle kliniğimizde ameliyat edilen 91 olgunun (85 erkek, 6 kadın; ort. yaş 55.4 yıl; dağılım 30-75 yıl) tıbbi kayıtları retrospektif olarak incelendi. İstatistiksel analiz, ki-kare ve Fisher kesin testleri kullanılarak yapıldı. Ortalama değerler t-testi ile hesaplanırken sağkalım eğrileri de Kaplan-Meier yöntemi ile çizildi.

Bulgular: Onkolojik değerlendirmede hastalıksız sağkalım oranı %81, rejyonel rekürens oranı %6, lokal rekürens oranı %8, uzak metastaz oranı %7 ve okült boyun metastaz oranı %25 olarak bulundu. Boyunda metastatik hastalık ve lenf gangliyonunda ekstrakapsüler yayılım varlığı, sağkalım açısından en önemli parametreler olarak bulundu. Fonksiyonel değerlendirmede ortalama dekanülasyon süresi 41 gün, ortalama nazogastrik tüp çekilme zamanı ise 19 gün olarak saptandı. Aspirasyona bağlı sorunların birinci saniye zorlu ekspiratuar volüm (FEV-1) oranı <75 olan olgularda daha sık görüldüğü gözlendi. İki taraflı boyun diseksiyonu yapılan ve ameliyat sonrası radyoterapi alan olgularda fonksiyonel sonuçlar daha kötüydü.

Sonuç: Erken evre supraglottik tümörlerde açık cerrahi onkolojik ve fonksiyonel açıdan oldukça etkin bir tedavi yöntemidir. Transoral robotik cerrahi veya transoral lazer cerrahisi gibi yeni ve pahalı teknolojilerin alternatifi olarak kullanımına devam edilmesi gereklidir.

Anahtar Sözcükler: FEV-1; fonksiyonel sonuçlar; onkolojik sonuçlar; supraglottik larenjektomi.

Received / *Geliş tarihi:* February 26, 2012 Accepted / *Kabul tarihi:* March 20, 2012

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The larynx has three main functions: phonation, breathing and the prevention of aspiration. In the past, most cases with laryngeal cancers underwent total laryngectomy (TL), which led to the loss of phonation with permanent tracheotomy. Later studies focused on the preservation of function without decreasing survival. In this way, the popularity of radiotherapy and partial laryngectomy techniques increased and new endoscopic techniques like laser and robotic surgery developed. Nowadays the preference for open surgical techniques has decreased. The balance between survival and function has shifted in favor of increasing function. Despite medical advances, laryngeal cancer is the only type of cancer with a decreasing survival rate.[1] We believe that supraglottic laryngectomy (SGL) is still the treatment of choice in early-stage supraglottic tumors, which enables excellent oncological and functional results. In this paper, we analyze our SGL results and compare them with the literature.

PATIENTS AND METHODS

The medical records of 91 cases (85 males, 6 females; mean age 55.4 years; range 30 to 75 years) with early-stage supraglottic laryngeal cancers that underwent surgery with SGL and extended SGL (ESGL) technique between 1993 and 2006 in a tertiary referral center were retrospectively reviewed. Routine preoperative head and neck examinations, neck computed tomographies (CT's) or magnetic resonance imaging (MRI)'s, chest high-resolution computed tomography (HRCT)'s and pulmonary function tests were performed on all cases. The exclusion criteria were as follows: insufficient data on charts, a follow-up time of <5 years, a history of head and neck radiotherapy, distant metastasis or synchronous tumors at the time of diagnosis and tumor pathology other than squamous cell carcinoma. Extended supraglottic laryngectomy was performed for supraglottic tumors invading one arytenoid or medial wall of the pyriform sinus or tumors with limited tongue base involvement. Contraindications for the surgery were: invasion of the vocal cords, anterior commissure, posterior commissure, apex of the pyriform sinus, thyroid cartilage, cricoid cartilage, paraglottic space and bilateral arytenoid cartilages, true vocal cord fixation, poor pulmonary status and advanced neck disease. Unilateral neck dissection was performed if the tumor was lateralized and the neck was staged clinically and radiologically as N_0 and bilateral neck dissections were done in other cases. Tumors were graded histopathologically as grade 1 (well differentiated), grade 2 (moderately differentiated) and grade 3 (poorly differentiated). Indications for postoperative radiotherapy were: extracapsular nodal spread (ECS), more than one metastatic lymph node ($N_{2/3}$) and T_4 primary tumor stage.

Statistical analysis was performed using Chi-squared and Fisher's exact tests. Mean values were compared using t-tests. Survival curves were calculated with a Kaplan-Meier survival analysis. $P<0.05$ was accepted as statistically significant. Tumors were staged according to American Joint Committee on Cancer (AJCC) tumor, node, metastasis (TNM) classification 2002.[2]

RESULTS

Supraglottic laryngectomy was performed on 82 cases, and ESGL was performed on nine cases (5 arytenoid, 3 tongue base and 1 pyriform sinus medial wall). Bilateral neck dissections were performed on 56 cases, and unilateral neck dissections were performed in 35 cases. The final histopathological examination was reported as squamous cell carcinomas in all of the cases, where 17 of the tumors were classified as grade 1, 46 were grade 2 and seven cases were grade 3. In 21 cases we could not find the exact differentiation pattern of the tumors (Postoperative TNM classifications are shown in Table 1). During the reconstruction stage thyrohyoidopexy was used in 83 of the cases, and thyroglossopexy was used in eight cases. Postoperative radiotherapy was performed in 24 cases.

Table 1. Clinicopathologic characteristics of the cases

Parameter	n	%
Sex		
Male	85	
Female	6	
Operation		
Supraglottic laryngectomy	82	
Extended SGL	9	
T Classification		
T_1	29	31.9
T_2	59	64.8
T_3	3	3.3
N Classification		
N_0	58	63.7
N_1	20	22
N_2	12	13.2
N_3	1	1.1

SGL: Supraglottic laryngectomy.

Table 2. Pearson aspiration scale

Aspiration	Definition	n	%	FEV1 (%)		
				<75	75-90	>90
Grade 0	No aspiration	30	32.9	1	10	19
Grade 1	Mild cough, no clinical problem	43	47.2	2	19	22
Grade 2	Progressive cough with swallowing	13	14.2	6	5	2
Grade 3	Pulmonary complications	5	5.4	4	–	1

FEV1: Forced expiratory volume in 1 second.

The most frequent sites of tumor origin were the suprahyoid epiglottis (31%) and infrahyoid epiglottis (30%).

Regional metastasis

Lymph node (LN) metastasis was detected in 33 cases (36.2%). Bilateral neck metastasis was seen in 11 cases (12%). In three cases (3.2%), contralateral neck metastasis existed in the absence of ipsilateral neck disease. Occult neck metastasis was seen in 15 cases (25%). In five cases that had occult metastasis, extracapsular spread (ECS) was detected. Overall, ECS was found in 17 cases (18.6%). The important point here is that approximately half of the neck metastases exhibited ECS.

Loco-regional control

Local recurrence was seen in eight cases (8.7%). Six of them experienced SGL, and two-experienced ESGL, but there was not any statistically significant relationship between operation type and local control (p=0.21) (Table 2). Total laryngectomy was performed in seven of the cases. One of them also had lung metastases and instead of surgery, radiotherapy (RT) was preferred. Among cases of recurrent tumors, four lived without disease and three died due to recurrent tumors. One case was lost in a manner not related to disease (Table 3). Salvage rate due to recurrence was 71.4%.

Regional recurrence was observed in six cases (6,6%). In the bilateral neck dissection group, only one neck recurrence was seen. However, in the unilateral neck dissection group, five regional recurrences were seen, three of which were found in contralateral non-dissected necks. Despite this, there was no statistically significant difference between regional recurrence and unilateral/bilateral dissection (p=0.56) (Table 4). Two of the regional recurrences had ECS in previously dissected necks. Surgical treatment was performed on three cases, RT was performed in one case and no treatment could be performed in two of the cases. As a result, three of the cases lived without disease, and three cases died related to the disease. The contralateral failure rate was 8.5% in unilateral neck dissection cases. Overall, the contralateral neck failure rate in our series was 3%.

Three of the cases that experienced locoregional recurrence had a history of smoking and alcohol consumption after the operation.

Table 3. Treatment results of cases with local recurrence

Treatment	LWD	DRD	DNRD	*Total*
Total laryngectomy	4	2	1	7
Radiotherapy	–	1	–	1

LWD: Live without disease; DRD: Disease related death; DNRD: Disease not related death.

Distant metastasis

Distant metastasis was seen in seven cases (7.7%), six of them in the lungs and one is both lungs and the brain. Three of them were ECS-positive, and two of them had N_2-N_3 neck disease.

Survival

The Five-year survival rate was 81.3%. If we examine them separately, 67 (81%) SGL cases and seven (77%) ESGL cases lived without disease. In the SGL group, 10 (12%), and in the ESGL group, two cases (22%) died from causes related to their tumors. Five cases died for reasons that were not related to their illness. Statistically, no significant difference existed between SGL and ESGL survival rates. Survival decreased in N^+ cases (p=0.04) (Figure 1) and in ECS + cases (p=0.02) (Figure 2). Postoperative survival (p=0.06) according to T-classification is shown in Figure 3.

Functional results

The mean oral feeding time of the overall series was 19 days. When we remove the postoperative RT group, it was decreased to 16 days. In the ESGL group, it was 23.5 days. In the unilateral neck dissection group, the mean oral feeding time was 20 days. On the other hand, this was 45 days in the bilateral neck dissection group.

Table 4. Operation type recurrence relation

	Local recurrence	Regional recurrence	
	n	n	*p*
Operation type			
Supraglottic laryngectomy	6		0.21
Extended SGL	2		0.21
Operation type			
Bilateral neck dissection		1	0.56
Unilateral neck dissection			
• Ipsilateral failure		2	0.56
• Contralateral failure		3	0.56

SGL: Supraglottic laryngectomy.

The decannulation mean of the entire series was 41 days. Without the postoperative RT group, it was 27 days. In the ESGL group, decannulation was also 27 days. In unilateral neck dissection, the decannulation mean was 35 days, and in the bilateral neck dissection group, it was 70 days. Decannulation could not be achieved in two cases (2.1%).

Aspiration

For the evaluation of aspiration, we used the Pearson aspiration scale (Table 2);[3]

The majority of our cases had grade 0 or grade 1 aspiration. Only in five cases were pulmonary complications related to aspiration. Two of these cases were lost due to aspiration pneumonia, and in the other two intractable aspiration cases TL was performed. Among ESGL cases, only one case had grade 3 aspiration. The mean age of cases that had grade 2 or 3 aspiration was 59 years. Forced expiratory volume in the first second (FEV-1) of cases that had grade 3 aspiration was below 75. Postoperative RT increased the aspiration scores (p=0.02). Between aspiration and FEV-1 values, there was a statistically significant relation. As FEV-1 values decreased below 75, there were more grade 2 and grade 3 aspiration cases (Table 2).

Larynx preservation rate

The larynx preservation rate was 86.8%. In seven cases TL was performed due to local recurrence and in two cases, due to intractable aspiration.

DISCUSSION

The treatment of early-stage supraglottic tumors is controversial. Although in recent years, functional parameters have become more pronounced due to the development of RT, laser surgery and robotic surgery, open SGL competes with them because of its solid oncologic and functional results. In this paper, we reviewed the results of this technique and the parameters affecting its results.

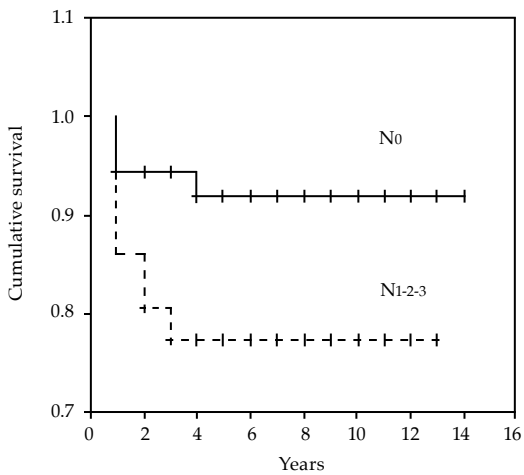

Figure 1. *The relation of postoperative N to 5 year survival (p=0.04).*

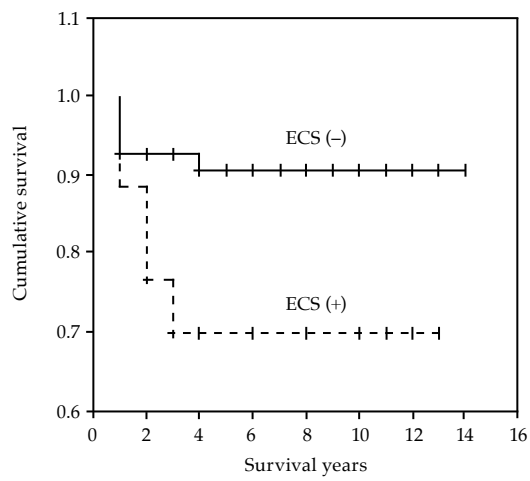

Figure 2. *Extracapsular nodal spread (ECS)-survival relation (p=0.02).*

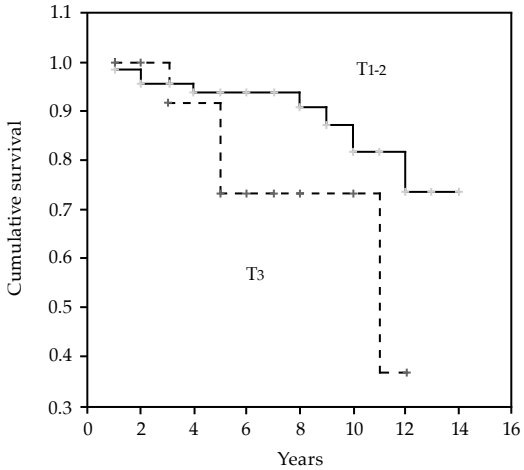

Figure 3. *Five year survival according to T classification (p=0.06).*

With appropriate indications, SGL has a survival rate similar to that of TL. In the literature, overall survival rates range from 68% to 90% (Table 5). Our five year survival rate is 81%, and the disease-specific survival is 85%. In oncological terms, SGL is a very effective treatment modality, which also give us the opportunity to stage and treat the neck in the same session. For endoscopic laser surgery, the five-year survival rate for cases of TİS-T3 supraglottic tumors was reported as 84%. The disease-specific survival rate was shown to be 97% in a recent study.[4] But laser surgery requires very expensive hardware and special training of the surgeon; so widespread use of the laser is limited.

Regional metastases and ECS decrease a cases chances for survival more than other factors, so decisions regarding the treatment of the neck are crucial. In our series, half of the cases of nodal disease also exhibit ECS. If we leave a clinical and radiological N_0 neck untreated, in the presence of an occult metastasis it will be a disaster. On the other hand, performing routine bilateral neck dissections will be overtreatment in most cases, which will increase morbidity and have adverse affects on functional parameters. Session[5] notes 19% bilateral metastases and 5.6% contralateral metastases in supraglottic tumors. In our series, bilateral metastases occurred at a rate of 11% and the rate of failure in undissected necks was even less high. Especially in lateralized tumors with ipsilateral N_0 neck, only unilateral neck dissection was oncologically accurate.[6,7] DeSanto et al.[8] followed up cases with supraglottic tumors that had experienced unilateral neck dissection for three years; among 98 cases, contralateral recurrence occurred in only one case. In a study consisting of 11 epiglottic cancer cases, a peritumoral radioisotope was injected into the peritumoral region; no radioisotope was observed in the contralateral neck in the absence of tumors in the main lymphatic route or ipsilateral lymphatic's.[9] However, many studies in the literature advice routine bilateral neck dissection no matter where the tumor is located.[10-12] The critical point that will end this confusion is diagnosing occult metastases. In the literature, the existence of epilaryngeal or deep invasion and T_{3-4} primary tumor is associated with a high rate of occult metastases.[11,13] In supraglottic tumors, the deletion of the microsatellite 9p21 part of the D98S 171 gene has a relationship with occult nodal metastasis.[14]

Extracapsular spread decreases survival by 50%.[15,16] The ECS rate was 18% in our series, equivalent one half of the cases with neck metastases. Morales found a survival rate of 31% for the cases with neck metastases and the survival rate decreased to 11% if an ECS was observed and noted that the grade and the ECS were the most important prognostic factors affecting survival.[16]

In the literature the local failure rate following supraglottic laryngectomy was between 5-15% (Table 6).[17-19] Detailed preoperative and postoperative evaluation is crucial in partial laryngeal surgery. To avoid local recurrence, the anterior commissure, the paraglottic space and the tongue base should

Table 5. Comparison of functional results of supraglottic laryngectomy with those in the literature

Literature	Oral feeding (day)	Decannulation (day)	Decannulation (%)
Bron et al.[10]	16	17	80 (in 1 month)
Prades et al.[19]	11-40	–	93
Scola et al.[11]	20	30	92
Sevilla et al.[18]	–	–	85
Our series	19	41	98

Table 6. Comparison of open supraglottic laryngectomy oncological results in the literature

Literature		Survival	DSS	LR	RR	Distant metastasis	Larynx preservation
	n	(%)	(%)	(%)	(%)	(%)	(%)
Maurizi et al.[17]	132	86	–	22	22	–	–
Morales-Angulo et al.[16]	85	76	–	11	5	12.9	–
Bron et al.[10]	75	75	92	10	10	–	98
Scola et al.[11]	903	74	–	18	18	–	–
Sevilla et al.[18]	267	–	73	8	17	4	85
Prades et al.[19]	110	63	–	9.7	9.7	27	–
Sessions et al.[5]	403	SGL-71.1	SGL-88.9				
		SGL/ND-66.2	SGL/ND-75				
		SGL/RT-62	SGL/RT-68.9				
		SGL/ND/RT-62	SGL/ND/RT-68.1				
Our series	91	81.7	85.3	8.7	6.6	7.7	86

DSS: Disease-specific survival; LR: Local recurrence; RR: Regional recurrence; SGL: Supraglottic laryngectomy; RT: Radiotherapy; ND: Neck dissection.

particularly be examined in more detail. If there is any suspicion about the surgical margins, more advanced surgical techniques should be preferred, instead of pushing the margins of SGL. The incidence of local recurrence in T_1 and T_2 supraglottic tumors was reported as 10-11%, and 18% for T_3 tumors.[20] Endoscopic laser surgery may be a reliable alternative if the surgeon clearly distinguishes the tumor margins. Local control rates of RT for T_1 supraglottic tumors were around 75-100%, and 70-86% for T_2.[21,22]

Although RT preserves the larynx's anatomy, this does not mean it is functional; hence larynx preservation rates are similar to those of surgery.[23] Our post-surgery laryngeal preservation rate was 86%, which is comparable with that found in the literature. The organ preservation rate of the endoscopic laser approach is higher at 97%.[4]

Oral feeding is usually achieved within two postoperative weeks. However, this may be delayed if bilateral neck dissection was performed. Decannulation is usually achieved within four weeks, but in the adjuvant RT group, this period is prolonged up to five-six weeks. Bilateral neck dissection adversely affects decannulation time as well. Our oral feeding time is similar to the literature, but decannulation time is longer. This is the case with cases who had undergone adjuvant RT, in whom we avoid decannulation until the RT finished due to possible edema-causing effects (Table 5). Decannulation could not be achieved in only 2% of the cases.

In our series aspiration did not present as a serious problem. We saw grade 3 aspirations in only 5% of cases, and TL was performed in only 2% of cases. This low ratio is believed to be due to good preoperative evaluation of pulmonary status by chest medicine specialists. We used pulmonary function tests and a chest evaluation routine in the preoperative period. When FEV-1 decreased to below 75, statistically significant increases in the aspiration grades of cases were seen. Many factors mentioned in the literature, such as age, base of tongue resection, and preservation of hyoid, were shown to affect aspiration.[18,24-27]

In a recent study comparing RT and open SGL, no differences were detected in swallowing and phonation functions.[28] An important advantage of endoscopic approaches is the avoidance of tracheotomy, but comparative studies of open and endoscopic approaches did not show large differences in the manner of functional aspect.[29,30]

In conclusion, the literature shows that the survival rates of laryngeal cancer cases and specifically of early-stage supraglottic tumor cases decreased significantly throughout the last two decades.[1] In our belief this is because more conservative approaches, instead of SGL are preferred today. The behavior of these tumors is sometimes more aggressive than we expect. We believe that it is still too early to make open SGL a secondary choice. Good oncological and functional outcomes and low decannulation failure rates still make open SGL a useful

treatment modality for early-stage supraglottic tumors.

Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding

The authors received no financial support for the research and/or authorship of this article.

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