Near-Total Laryngectomy for Laryngeal Carcinomas With Subglottic Extension

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Objective: To investigate whether Pearson classic near-total laryngectomy is a sensible surgical treatment modality for laryngeal carcinomas with subglottic extension.

Design: Retrospective analysis of patients treated by near-total laryngectomy in a university hospital that is an academic tertiary health care center.

Participants and Intervention: Medical and computer records of 135 patients who were treated by near-total laryngectomy for laryngeal and hypopharyngeal carcinomas between April 1, 1989, and June 30, 2000, were searched thoroughly, and the final outcomes were confirmed by telephone contact.

Main Outcome Measures: Survival rates of the patients with laryngeal carcinomas with subglottic extension treated by near-total laryngectomy were compared with those of the patients with malignancies of other laryngeal regions given the same treatment.

Results: Of the 135 patients in the study, 74 were available for determination of 5-year survival. The rate was 65.8% (27/41) for transglottic tumors, 53.8% (7/13) for supraglottic tumors, and 20.0% (4/20) for tumors with subglottic extension. Only 3 of 16 patients with laryngeal carcinomas with supraglottic or transglottic localization died of local recurrence; the rest of the deaths were from regional recurrence or distant metastasis. However, 6 of 13 patients with subglottic extension died of local recurrence, 5 of peristomal recurrence, and only 2 of distant metastasis.

Conclusions: Success was directly related to adherence to precise indications in cancer surgery. While near-total laryngectomy is an effective and reliable treatment modality in laryngeal cancer surgery, its effectiveness in laryngeal cancers with subglottic extension is debatable. These subglottic lesions should be treated by total laryngectomy, which is a more radical surgery.


Near-total laryngectomy was described by Pearson as an alternative treatment for patients with T3 and T4 laryngeal carcinomas. With this treatment, these patients would be spared a life without speech, which is the main consequence of total laryngectomy. Initially described as “extended vertical hemilaryngectomy” or “subtotal laryngectomy,” this technique was developed over time; “near-total laryngectomy with partial pharyngectomy” was developed to include the base of the tongue and the hypopharynx, and “near-total laryngopharyngectomy” was developed to take advantage of pedicled flap reconstruction.

The aphonie condition that the patient has to face after total laryngectomy has deep psychological and debilitating effects on the human psyche. For this reason, extensive work has been carried out on alaryngeal voice production since the beginning of the century. Complications of adynamic tracheoesophageal shunt methods have been described mainly as aspiration, stenosis, and difficulty with hygiene. Near-total laryngectomy is a surgical treatment modality that was specially designed to overcome these serious complications of adynamic tracheoesophageal shunt methods.

Near-total laryngectomy has not gained widespread approval, and few series have been published in the English-language literature. The perception of the operative technique as complicated by many surgeons and the widespread and convenient application of tracheoesophageal puncture procedure are among possible causes for this reluctance to perform near-total laryngectomy.

The subglottis is defined as the laryngeal subdivision bounded superiorly by the junction of squamous and respiratory epi-
PATIENTS AND METHODS

Between April 1, 1989, and June 30, 2000, 135 near-total laryngectomies were performed in the Department of Otorhinolaryngology of the Istanbul University Faculty of Medicine, Istanbul, Turkey, according to the technique of Pearson. \(^1\) \(^1\) Cases were evaluated according to tumor location and the operative technique used.

In this study, survival rates of patients undergoing near-total laryngectomy with different locations of cancer were compared according to preoperative variables of T and N stages. In cases of treatment failure, reasons were evaluated according to location of the primary tumor.

Patients were divided into 3 groups according to the surgery performed. Classic near-total laryngectomy (104 patients [77.0%]) is the technique described by Pearson. Near-total laryngectomy with partial pharyngectomy (28 patients [20.7%]) was performed for advanced laryngeal carcinomas with pharyngeal and tongue base involvement being prepared to be reconstructed primarily. Near-total laryngopharyngectomy (3 patients [2.2%]) was performed for advanced laryngeal tumors that could not be reconstructed primarily but with the aid of pedicled flap reconstruction (pectoralis major). The operations were performed in accordance with the original technique described by Pearson. \(^1\) \(^1\)

The cases were classified into 6 groups according to the location of the tumors (Table 1). Within this classification, the term advanced refers to pharyngeal or tongue base extension for transglottic and supraglottic tumors. The main indications for near-total laryngectomy for supraglottic carcinoma were advanced age and poor cardiopulmonary status of patients for whom a classic supraglottic laryngectomy could cause significant postoperative problems. The patients in the subglottic extension group were those with tumors extending to the subglottis to an extent that precluded the use of any partial laryngectomy technique. This is accepted as subglottic extension more than 10 mm anteriorly and 5 mm posteriorly. The majority of cases were within the range of 10 to 20 mm of subglottic extension.

Six of the 135 patients who underwent near-total laryngectomy were unavailable for follow-up. Two additional patients died of postoperative complications: 1 patient of a pulmonary embolus and 1 patient of a presurgical chemotherapy complication. Chemotherapy was not routinely used in this cohort of patients treated surgically by near-total laryngectomy. The 1 patient who died of a preoperative chemotherapy complication was the only one who belonged to a distinct study group subjected to a neoadjuvant chemotherapy protocol consisting of methotrexate and fluorouracil. In 3 cases, near-total laryngectomy was performed not for oncologic reasons but for functional indications of other surgical approaches that were complicated by aspiration (2 cases of three-quarters horizontal-vertical partial laryngectomy, 1 case of commande resection for a retromolar trigone carcinoma). After exclusion of all cases unavailable for follow-up, the statistical calculations were performed on 124 cases.

Statistical calculations were performed with the SPSS 10.0 for Windows software program (SPSS Inc, Chicago, Ill). Survival evaluation between different surgical groups was performed by Kaplan-Meier life table method, and monthly survival values were accepted. Local and regional recurrences according to tumor location were evaluated by the nonparametric Kruskal-Wallis test. Preoperative variables were age, sex, preoperative characteristics of the tumor (tumor stage, neck stage, histologic findings, and location), and reason for operation (functional, primary curative, or salvage). The only operative variable was the type of procedure performed. Postoperative variables were reasons for death and use of radiotherapy.

The median age of the 135 patients in the study was 56.2 years (range, 33-80 years). Table 2 summarizes the main reasons for each type of operation.

Seventy-two patients did not receive postoperative radiotherapy; in 2 patients radiotherapy had failed, and, omitting the 2 patients who died during the perioperative period, the remaining 59 patients (43.7%) received postoperative radiotherapy. All patients with advanced laryngeal carcinoma with pharyngeal and/or tongue base involvement and all patients with glottic tumors with subglottic extension were subjected to postoperative radiotherapy. The postoperative radiotherapy protocol consisted of conventional fractionated radiotherapy (5000 rad [50 Gy], 25 fractions) for 6 weeks, with the coverage of stoma and upper mediastinum in all patients with subglottic extension.
tic extension. Indications for postoperative radiotherapy were cervical metastatic disease in more than 1 lymph node, periganglionic soft tissue invasion, perineural and perivascular infiltration, high tumor grade, and advanced T4 stage, with the exception of limited cartilage invasion.

Existence of tumor cells in the surgical margins was not accepted as an indication for postoperative radiotherapy. Our policy for positive margins has been to reoperate with a more radical technique, which is usually total laryngectomy or watchful waiting. The efficacy of radiotherapy for positive margins is a matter of debate, since it has been shown that tissue alterations induced by surgical trauma significantly reduce the efficacy of radiotherapy.19

Three patients who underwent near-total laryngectomy for functional reasons, 2 who died during the perioperative period, and 6 who were unavailable for follow-up were excluded from the series of 135 cases. Twenty-eight patients with disease that extended out of the endolarynx were also excluded from the series; therefore, the survival evaluation was performed on 54 cases of transglottic, 18 cases of supraglottic, and 24 cases of subglottic tumors that were limited to the endolaryngeal region. Of 54 patients with transglottic laryngeal carcinomas, 41 completed the 5 years of follow-up, and 27 (65.8%) had no evidence of disease. Thirteen of 18 patients with laryngeal carcinomas with supraglottic location completed the 5 years of follow-up, and 7 (53.8%) were free of disease. Of 24 patients with laryngeal carcinomas with subglottic extension, 20 completed the 5 years of follow-up, and only 4 (20.0%) were free of disease. Tumors that were located solely in the subglottic region were treated by total laryngectomy in our clinic.

Kaplan-Meier life table analysis showed the cumulative survival of patients with transglottic tumors to be 119.1 months; that for supraglottic tumors, 99.5 months; and that for laryngeal cancers extending to subglottic region, 63.6 months. A statistically significant decrease in survival was observed by Kaplan-Meier life table analysis for laryngeal carcinomas extending to subglottic region when treated by near-total laryngectomy (Figure).

Significant differences were observed between the causes of death when the cases were compared according to the location of the primary tumor. While regional recurrences and distant metastasis were the main causes of death of the patients with laryngeal carcinomas of glottic and supraglottic regions, only 3 patients died of local recurrence. On the other hand, local recurrences predominated as the primary cause of death for tumors extending down to the subglottic region; of 13 patients with laryngeal carcinomas with subglottic extension who died, 6 died of local recurrence and 5 of peristomal recurrence. Nonparametric Kruskal-Wallis testing demonstrated the statistical significance of local recurrence as the main cause of death for tumors extending to the subglottis (local recurrence: $\chi^2=21.72, P = .001$; regional recurrence: $\chi^2=3.92, P = .56$).

**COMMENT**

Careful determination of tumor dimensions and its spread is the key determinant of success in conservative laryngeal cancer surgery. Despite the high success rates of conservative partial surgery performed for more limited lesions, near-total laryngectomy is usually performed for more extensive laryngeal or hypopharyngeal cancers. As the tumor mass grows and its stage increases, deep submucosal invasion, rather than mucosal borders, becomes the main determinant of real tumor boundaries. This critical submucosal border cannot always be determined definitively in the preoperative period and during the operation, even with frozen-section analysis.11,17

The lymphatic drainage of the larynx is usually separate for the 2 sides and seldom crosses. However, the existence of lymphatic channels crossing the midline has been shown in the supraglottic and infraglottic regions.15 The

<table>
<thead>
<tr>
<th>Original Location of Primary Tumor</th>
<th>No. (%) of Cases</th>
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<tbody>
<tr>
<td>Pyriform sinus</td>
<td>8 (6.1)</td>
</tr>
<tr>
<td>Transglottic</td>
<td>56 (42.4)</td>
</tr>
<tr>
<td>Advanced transglottic</td>
<td>7 (5.3)</td>
</tr>
<tr>
<td>Supraglottic</td>
<td>20 (15.2)</td>
</tr>
<tr>
<td>Advanced supraglottic</td>
<td>16 (12.1)</td>
</tr>
<tr>
<td>Glottic with subglottic extension</td>
<td>25 (18.9)</td>
</tr>
<tr>
<td>Total</td>
<td>132 (100.0)</td>
</tr>
</tbody>
</table>

*Near-total laryngectomy was performed for functional issues in 3 cases of the series; therefore, only 132 cases are included here.

<table>
<thead>
<tr>
<th>Reason</th>
<th>No. (%) of Patients</th>
</tr>
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<tbody>
<tr>
<td>Functional issues</td>
<td>3 (2.2)</td>
</tr>
<tr>
<td>Salvage for surgical failures</td>
<td>8 (5.9)</td>
</tr>
<tr>
<td>Salvage for radiotherapy failures</td>
<td>2 (1.5)</td>
</tr>
<tr>
<td>Primary curative surgery</td>
<td>122 (90.4)</td>
</tr>
<tr>
<td>Total</td>
<td>135 (100.0)</td>
</tr>
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probability of spontaneous appearance of contralateral lymphatic drainage is higher in the region below the glottis, and, therefore, prediction of metastatic patterns of tumors originating in the subglottis is much more difficult.\textsuperscript{15} An even more important issue is the invasion of the upper tracheal rings, since circular lymphatic drainage of this region precludes the determination of any tumor spread.\textsuperscript{21}

The largest series of near-total laryngectomy for laryngeal cancers is that of Pearson et al.,\textsuperscript{22} and in that study no local recurrences were encountered in cases with subglottic extension. The outcomes of patients with subglottic extension of their tumors in Pearson and coworkers’ series contradict ours. In our series, 20 of 24 patients undergoing near-total laryngectomy who had laryngeal tumors extending to the subglottis completed the 5-year survival evaluation period, and only 4 of the 20 completed this period without any evidence of disease. We saw 6 cases of local recurrence in this laryngeal region, whereas Pearson et al observed no local recurrences in their series. The local recurrences were usually located at the inferior extent of the speaking shunt. Furthermore, 5 patients died of peristomal recurrence. The other studies of near-total laryngectomy do not contain an adequate number of cases for a reliable evaluation of results for tumors extending to the subglottic region.\textsuperscript{11,12,23} In addition to providing an oncologic success rate similar to that of total laryngectomy in glottic and supraglottic laryngeal tumors, near-total laryngectomy also prevents a major problem by providing phonation. On the other hand, success of near-total laryngectomy for tumors extending to the subglottis is limited.

In light of this study, the surgical treatment of subglottic laryngeal tumors should not use the same surgical technique with millimetric resection margins as is performed for other laryngeal-region tumors. The aggressiveness or intrinsic insidiousness of tumors located in the subglottic region or the difficulty of determining the true surgical margins despite the safe appearance of the mucosa precludes such an approach in this region. It may not be logical to relate the surgical treatment failure of laryngeal tumors extending to the subglottic region only to the surgical technique used, since many other factors exist (eg, degree of cellular differentiation and biological factors bound to the tumor-host relationship) that are influential in tumor spread.\textsuperscript{24} However, surgical treatment as aggressive as possible is the approach that many investigators agree on for laryngeal carcinomas extending to the subglottis.\textsuperscript{13,25} Wide-field laryngectomy instead of simple total laryngectomy, lower-than-usual tracheostomy instead of normal tracheostomy, and more extensive thyroidectomy instead of hemithyroidectomy are the surgical strategies that should be applied.\textsuperscript{26} Use of near-total laryngectomy in such a critical region puts the patient at risk of treatment failure.

**CONCLUSIONS**

According to the results of this study, near-total laryngectomy is an alternative surgical modality that also carries significant risk of failure for laryngeal tumors extending to the subglottic region. Near-total laryngectomy should not be undertaken for patients with subglottic extension; instead, these patients should be treated with total laryngec-

tomy, since the local recurrence rate is higher with the former technique. The results of this study are informative for anyone who is interested in laryngeal cancer surgery and are cautionary, given the lack of other literature that evaluates the success of near-total laryngectomy for laryngeal tumors extending to the subglottic region.

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**REFERENCES**