

# Surgical Management of Supraglottic Laryngeal Carcinoma in Patients with Special Emphasis on Functional Preservation

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**OBJECTIVE** To explore the surgical methods and evaluate the long-term results of laryngectomy in patients with supraglottic laryngeal cancer.

**METHODS** A total of 182 patients with supraglottic laryngeal carcinoma underwent an operation from 1979 to 1999. These cases comprised 11 in stage I, 45 in stage II, 49 in stage III and 77 in stage IV. The choice of surgical procedure was decided based on the condition of the diseased larynx. The surgical procedures proposed by TD Wang were adhered to as follows: minor partial laryngectomy 36, major partial laryngectomy 85, subtotal partial laryngectomy with laryngoplasty 22 and total laryngectomy 39.

**RESULTS** The final rate of larynx preservation was 78.6% (143/182) and 69.8% (88/126) in patients with stage III and IV diseases. The extubation rate was 81.8% in cases with preservation of laryngeal function. The overall 3- and 5-year survival rates were 82.9% and 67.3%, with 76.88% and 57.4% in the advanced (stage III and IV) cases who survived with preserved laryngeal function, and 82.5% and 67.0% in similar advanced cases who were treated by total laryngectomy. The difference in the survival rates between these 2 groups was not statistically significant.

**CONCLUSION** It is suggested that preservation of the laryngeal function is possible for advanced supraglottic laryngeal carcinoma without compromising the long-term survival rate. To improve the rate of larynx preservation, one should follow the surgical methods suggested.

**KEYWORDS:** laryngeal neoplasms/surgery, laryngectomy, surgical flaps, survival rates.

**B**ecause functions of the larynx including speech, breathing and eating etc., are of paramount importance, their preservation postoperatively is of great significance to the quality of life for patients with laryngeal neoplasms.<sup>[1-3]</sup> Since the early 1970's, we have conducted partial laryngectomy for patients with laryngeal cancer using different techniques to functionally preserve the larynx for supraglottic laryngeal cancer. We retrospectively analysed and summarized the data for this report.

## MATERIALS AND METHODS

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### Clinical data

From 1979 to 1999, we received and treated 182 cases of supraglottic laryngeal cancer including 142 males and 40 females, of ages 33 to 75 years (mean of 57.7 years). All the patients had squamous cell carcinoma pathologically diagnosed according to 1997 UICC staging resulting in 11 cases in stage I (T1N0), 45 in stage II (T2N0), 49 in stage III (1 case of T1N1, 3 cases of T2N1, 39 cases of T3N0 and 6 cases of T2N1), 77 in stage IV (4 cases of T2N2, 11 cases of T3N2, 1 case of T3N3, 34 cases of T4N0, 10 cases of T4N1, 16 cases of T4N2 and 1 case of T4N3).

### Surgical methods

#### Resection of tumors

Radical neck dissection might not be performed to treat patients with T1~2N0 cancer but exploratory operation alone may be necessary. Selective radical dissection on the affected side was performed in patients with T3~4N0 supraglottic carcinoma. Recently, we first explored the carotid triangle in the affected side and incised a few sentinel lymph nodes for biopsy; if the result of the biopsy was negative, a radical neck dissection would not be conducted, but if positive, a modified radical neck dissection of the affected side would be executed. The patients with a unilateral N+ cancer were treated by a modified radical homolateral-neck dissection, and if there were contralateral N0 lymph nodes the patients were treated by the same method as above.

For patients with bilateral N+ cancer, a bilateral modified radical neck dissection was the proper method. The types of incision such as "L", "H" or "1/2 H" varied with the pattern or the radical neck dissection. The general procedure was as follows: we first incised the skin and opened the platysmal flap and then we performed the radical neck dissection. If we estimated that the internal bilateral jugular veins could not be maintained in the preoperation, we would strive to preserve the anterior and external jugular veins in order to ease the postoperative intracranial hypertension and craniofacial edema. After the radical neck dissection, we transected the whole sternohyoid

muscle in the affected side and part of the sternohyoid muscle in the normal side between the bilateral sternohyoid muscles. Then we detached the superior semilamina of the thyroid cartilage under the periosteum, resected it, and then removed the greater horn of the hyoid bone on the affected side. According to the preoperative diagnosis of the tumor range, next, we explored into the pharyngeal cavity through the epiglottic vallecula or inferior pharyngeal lateral wall. Finally, under direct vision, we dissected the tumor at the safety borderline which was over 0.5 cm away from the edge of the tumor and resected it. If the tumor deviated to one side and invaded the glottis, we would continue to dissect downward and excise the major part of the affected thyroid cartilage lamina and the minor part of the thyroid cartilage lamina in the normal side until the inferior margin of the tumor could be clearly exposed. If the tumor extended downward to the bilateral subglottic region, we would use an operation manner via the cricothyroid membrane and at the same time split the thyroid cartilage lamina to perform a subtotal laryngectomy. A total laryngectomy was performed when the prelaryngeal soft tissue was seriously involved, the cricoid cartilage lamina could not be preserved, and it was difficult to reconstruct the larynx.

All the cases were classified based on Wang Tianduo's partial-laryngectomy classification <sup>[4]</sup> resulting in 36 minor partial-laryngectomy cases, 85 major partial-laryngectomy cases, 22 subtotal laryngectomy cases and 39 total laryngectomy cases.

#### Laryngoplasty

In this study, 143 patients were treated with partial laryngectomy and of these 39 patients received combined treatment with two kinds of plastic surgery. The methods of laryngoplasty performed included reconstruction with the thyroid bone directly anastomosing to the radix linguae or hyoid bone (54 cases), reconstruction with the bi-pedicle sternohyoid muscle flap with fascia (28 cases), lowering the epiglottis <sup>[5]</sup> (24 cases), platysmal musculotaneous flap (15 cases), reconstruction of the radix lingua with the sternohyoid muscle flap with fascia <sup>[6]</sup> (14 cases),

bi-pedicle relay muscle membrane of the thyroid cartilage flap (9 cases), cricothyroid immobilization (9 cases), lowering the tongue root<sup>[7,8]</sup>(8 cases), phonatory tube plastic surgery<sup>[9]</sup>(8 cases), uni-pedicle sternohyoid muscle flap with fascia (6 cases), platysmal flap with fascia (4 cases), cricothyroid epiglottic fixation (2 cases) and thyroid cartilage membrane flap (1 case).

## RESULTS

### Prevention of laryngeal function

In our research, 143 cases were treated with partial laryngectomy accounting for 78.6%. Eighty-eight out of 126 cases in stage III and IV received partial laryngectomy, 117 out of 143 cases (81.8%) had extubation. All patients recovered by oral eating without obvious cough in eating or dysphagia. For the patients receiving partial laryngectomy, the speech was successful and voice function recovered, and none of them failed in speaking due to laryngeal atresia.

### Cervical lymph nodes metastasis

In the total of 182 patients, 71 patients received unilateral radical neck dissection and 36 patients received bilateral dissection. Postoperation pathological diagnosis demonstrated 53 patients had lymphatic metastasis with a metastatic rate of 49.5%.

### Survival rates

Survival was less than 3 years for 26 cases, 156 survived 3 years and 128 for 5 years. The survival rates were obtained through the life-table method with results as follows: the 3-year survival rate for all the patients, patients with partial laryngectomy, patients with total laryngectomy, patients in stage III and IV with partial laryngectomy, patients in stage III and IV, with total laryngectomy were 82.9%, 83.7%, 80.1%, 76.9% and 82.5%, and their corresponding 5-year survival rates were 67.3%, 68.0%, 65.1%, 57.4%, and 67.0%, respectively.

The difference in the survival rates of the advanced (stage III and IV) cases between two groups (cases who survived with preserved laryngeal function and cases who were treated by total laryngectomy) was not

statistically significant.

## DISCUSSION

### Indications for partial laryngectomy for late supraglottic cancer

For T3 supraglottic cancer, involvement of the anterior space or deep part of the tongue base are not contraindications for total laryngectomy. After complete resection of the anterior space of the epiglottis, even at the total base of the tongue, use of the sternohyoid muscle flap with fascia to repair and extend the base of the tongue is a good method to perfectly rehabilitate laryngeal function.<sup>[6,10,11]</sup> If the postcricoid region were comprehensively involved, it is very difficult to reconstruct the larynx, so total laryngectomy would be a proper selection. In order to preserve laryngeal function for T4 supraglottic cancer, the conditions of the case must be considered carefully. If the tumor involves the superior part of the thyroid, thyrohyoid muscle or minor part of the sternohyoid muscle through the anterior space of the epiglottis, if the tumor hasn't involved the postcricoid region and the posterior wall of larynx or involved the thyroid cartilage, thyrohyoid muscle and part of the sternohyoid muscle would be resected to preserve the posterior-superior part of the thyroid cartilage and the cricoid cartilage or cricoid cartilage alone: if the postcricoid region or the laryngeal posterior wall is involved, it is suitable to perform total laryngectomy because of the difficulty of laryngoplasty. The laryngeal function can not be preserved in such conditions as: the extensive involvement of sternohyoid muscle or stiffness in the anterior cervical muscle, or the thyroid gland or esophagus is involved by the tumor. From the analysis of patients in stage III and IV, we can infer that the survival rates of total and partial laryngectomy have no significant differences. It suggests that partial laryngectomy is a feasible procedure for patients with late supraglottic laryngeal cancer and has the same therapeutic effect as total laryngectomy. Therefore, under the premise of strict selection indications, partial laryngectomy should be advocated for patients with advanced supraglottic

laryngeal cancer because it can preserve laryngeal function and very significantly improve the postoperative quality of life.

### **Preservation and reconstruction of laryngeal function**

Partial laryngectomy played a predominant part of our study, which was concerned with mastering many techniques for laryngeal preservation and reconstruction. There are many important factors that influence the rehabilitation of laryngeal function, one of which is management during the operation.

#### ***Factors relating to mis-swallowing***

After resection of the supraglottic region, it is easy to mis-swallow because the laryngeal swallowing protection is significantly influenced, so during the operation one must pay close attention to these aspects:

(1) Make full use of the base of the tongue for swallowing protection. The nearer the orifice of the larynx is from the base of the tongue and the more anterior the orifice of the larynx lies, the fewer will be the incidence of food falling into the laryngeal orifice while swallowing. Thus, when we anastomose the larynx and base of the tongue, we should try our best to make the laryngeal orifice more anterior, and suture multiple times at the site of the posterior border of the thyroid cartilage and base of the tongue to make the posterior part of the laryngeal orifice nearer to the root of the tongue; the hyoid bone can be excised in order to shorten the distance between the laryngeal orifice and the root of the tongue.<sup>[12]</sup> If the root of an involved tongue is resected, the incidence of mis-swallowing is high and the preservation of laryngeal function is difficult; while repairing and extending the tongue root by the sternohyoid muscle flap with fascia we can preserve the laryngeal function even though the incisional line includes the circumvallate papillae<sup>[6]</sup>. The repairing and extending of the lingual base makes it easy to suspend the larynx anterosuperiorly and increases the area of the anastomotic side of the superior pharyngeal mucosa and tongue root, thus this expands the pharyngeal cavity and is helpful to lessen

mis-swallowing. Furthermore, preserving the continuity of the partial sternohyoid muscle in the normal side during the operation is also taken into consideration and we do not amputate it thoroughly; the continuous part preserved pulls the base of the tongue downward and prevents recession of the base. This method is also helpful to lessen mis-swallowing.

(2) Take note of the treatment of the piriform recess. The wider the inferior pharyngeal cavity is, the narrower the laryngeal orifice is, and so this can decrease the incidence rate of mis-swallowing. However, we can not excessively narrow the laryngeal orifice, as this will influence extubation. In order to make the inferior pharyngeal cavity wider, we can make the external wall of the piriform recess suspend anteroexternally from the posterior border of the thyroid cartilage lamina, tongue root or sternohyoid muscle and meanwhile, draw the mucosa of the internal wall of the piriform recess to the laryngeal cavity and suture it to the vocal cord or posterior part of the larynx ventricle. In this way, the orifice of the piriform recess can open wide completely and the food can easily fall into the piriform recess and thereby by pass falling into the inferior pharynx. This reduces the incidence of food entering into the laryngeal orifice. Moreover, when supraglottic cancer tends to be on one side, we can suture the anteroexternal wall of the superior orifice of the piriform recess on the normal side with a major part of the lingual base. If the major part of the piriform recess mucosa and lateral wall of the inferior pharynx on the normal side is preserved when the tumor has been resected, and suture most of the lingual base mucosa with mucosa of the superior orifice of the piriform recess in the normal side thoroughly, but we suture the piriform recess mucosa and lateral wall of the inferior pharynx in the affected side with the minor part of the mucosa of the root of the tongue. So most food can fall into the wide piriform recess in the normal side through the inferior pharynx. This method can also lessen the incidence of mis-swallowing.

#### ***Factors concerning extubation***

It is not difficult to extubate for supraglottic cancer due

to the intact structure of the inferior semilarynx. If we found that the anterior commissure was separated from the lamina of the thyroid cartilage after resection of the tumor during the operation, we can suspend the anterior commissure forward from the thyroid cartilage lamina to keep the anteroposterior diameter of the vocal cord fixed. Although the hyoid bone covering part of the larynx superior orifice after the suspension of the residual larynx can prevent mis-swallowing, in some cases, the anteroposterior diameter of the superior orifice of the larynx would be reduced to influence the extubation. In this condition, the hyoid bone should be resected. The external lamina of the thyroid cartilage elevates, lifts and abducts the vocal cord to make it maintain some degree of tension and prevent vocal cord prolapse from obstructing the laryngeal cavity. This can also help extubating.

#### **Factors concerning articulation**

When a supraglottic cancer hasn't involved the glottis, the articulation function is not influenced apparently due to the complete preservation of the vocal cord function. After the resection of a unilateral vocal cord, if the form of inferior semilarynx and extubation are all normal, the affected-side glottic tissue can be drawn and properly sutured to the opposite side to reduce the distance between it and the normal-side vocal cord. This is a promising measure to improve the glottic closure when the patients talks and is helpful to improve tone quality and mitigate mis-swallowing.

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