

SUPRA-CRICOID PARTIAL LARYNGECTOMY: EVALUATION OF THE TECHNIQUE AND FUNCTIONAL RESULTS

By

Ahmed Helmy*, Hatem Aboul Kassem*, Magdy El-Sherbiny*, Soliman El-Shakhs**, Ayman Amin*, Sameh El-Bosraty***, Yasser Khalil****

National Cancer Institute, Cairo University*, Surgical Oncology Dept., Minoufiya University**, E.N.T. Dept., Cairo University***, E.N.T. Dept., Minoufiya University****

Introduction: Cancer of the larynx is a disease of central importance in head and neck surgery, due to its impact on human dignity and self presentation. Total laryngectomy deprives the patient permanently from functions of the larynx.

Purpose: The aim of this study is to evaluate the technique of supra-cricoid laryngectomy as a method of reconstruction of the larynx after resection, and study the results as regards laryngeal functions and control of cancer.

Patients and Methods: Twenty one patients with squamous cell carcinoma of the glottis and/or supraglottis underwent this procedure during the period from January 1999 till December 2000 at the National Cancer Institute, Kasr El-Eini and Minoufiya University Hospitals. Supra-cricoid partial laryngectomy was done in 21 patients. The mean age of the patients was 57.8 years; twenty were males and one was female. Reconstructive techniques included were crico-hyoido-epiglottopexy (CHEP) in 13 patients, and crico-hyoidopexy (CHP) in 7 patients. In one patient supracricoid laryngectomy was planned but during surgery there was a major subglottic extension of the tumor, so total laryngectomy was done and it was excluded from the study. Evaluation of deglutition, phonation, time of decannulation and nasogastric tube removal occurred. The minimum follow up period was 2 years.

Results: All patients except one resumed physiologic deglutition and none required permanent tracheostomy. Swallowing was excellent, only 4 patients assumed a certain posture during meals. The average period for decannulation and nasogastric tube removal was 16.35 and 20 days; respectively. Phonation was good enough for easy communication with others. Tumor recurrence occurred in three patients. One patient underwent total laryngectomy due to serious aspiration and pneumonia.

Conclusion: For properly selected patients with supra-glottic and/or glottic carcinoma, supracricoid laryngectomy is a reasonable alternative to horizontal laryngectomy and total laryngectomy.

INTRODUCTION

The larynx serves three basic functions in humans, they are protective, respiratory, and phonatory. Accordingly, cancer of the larynx is a disease of central importance in head and neck surgery, not only for its variety of treatment methods but also for its impact on human dignity and self-presentation. Language expressed through the speech is the fundamental characteristic of our intellect, separating us from other species⁽¹⁾.

The therapeutic goals in treating laryngeal cancer are first to achieve a maximal cure rate, second to obtain maximal preservation of laryngeal functions with minimal

morbidity⁽²⁾. Total laryngectomy deprives the patient permanently from the three basic functions of the larynx⁽³⁾.

Multiple techniques were described for removal of laryngeal tumors with preservation of the laryngeal functions, however, few have survived the test of time. Each of these techniques has well defined indications and limitations. Supraglottic laryngectomy, for instance, can not be used for supraglottic tumors involving the glottis. Extended hemi-laryngectomy is limited by risks of glottic incompetence or glottic stenosis. Meanwhile, well suited for lesions confined to the anterior commissure, frontal hemi-laryngectomy with epiglottic reconstruction leaves a potential avenue for the tumors to spread throughout the

posterior part of the thyroid laminae and paraglottic spaces⁽²⁾.

Vertical partial laryngectomy can result in satisfactory cure rates for glottic carcinoma limited essentially to one vocal cord. However, when extended vertical partial laryngectomy is performed for more extensive tumors, inadequate airway can result in permanent tracheostomy and multistaged reconstruction is often necessary. Also the two-year survival rate may be as low as 60%⁽⁴⁾.

Supracricoid partial laryngectomy consists of resection of the glottis in a single block in continuity with the paraglottic spaces, the thyroid cartilage, and the lower part of the epiglottis (type 1). Also, the supraglottic larynx with the pre-epiglottic space could be resected in continuity with the glottis (type 2). Reconstruction of the larynx in type 1 resection occurs by crico-hyoido-epiglottopexy (CHEP), while in type 2 by crico-hyoidopexy (CHP)^(5,6). The CHEP and CHP essentially preserve the cricoid cartilage and consequently maintain the integrity of the laryngeal circumference, thus sparing the patient a permanent tracheostomy. The cricoid cartilage, hyoid bone, and at least one arytenoid cartilage are conserved⁽⁵⁾. The success relies on the dynamic nature of the anastomosis performed avoiding aspiration by means of activity of arytenoid from the retained recurrent laryngeal nerve. Preservation of the epiglottis in indicated cases provides a further help for the patient to encompass the aspiration problem. Vibration of the arytenoid by incoming air current allows phonation⁽⁷⁾.

In this study the authors presented their experience using supracricoid laryngectomy for 20 selected patients with carcinoma of the larynx. The operative technique, as well as, functional and oncologic results will be discussed.

PATIENTS AND METHODS

Twenty-one patients with squamous cell carcinoma of the glottis and/or supra-glottis were operated upon during the period from Jan. 1999 to December 2000 at the National cancer Institute, Kasr El-Eini Hospitals and Minoufiya University Hospitals. They were 20 males and one female. Their ages ranged from 37 to 70 years with the mean of 57.8 years. Patients older than 70 years or intellectually unable to attain deglutition rehabilitation were considered ineligible for this surgery. Preoperative evaluation was done by assessment of both the general and local condition of the patient. The general condition was assessed by chest X-ray, routine labs for liver and renal functions, blood picture, electro-cardiogram, and pulmonary function tests. Local evaluation was done by clinical examination of the neck, indirect laryngoscopy, direct laryngoscopy, hypopharyngoscopy and CT scan. In local evaluation, it is important to evaluate mobility of the cords and arytenoids

in addition to determining the extent of the tumor (Table 1). The staging was established according to the 1983 American Joint Committee for Cancer Staging (Table2)

Ipsilateral radical neck dissection occurred in cases of palpable neck nodes (5 patients), while bilateral functional neck dissection (sparing the spinal accessory nerve, the internal jugular vein, and the sterno-clidomastoid muscle, taking nodes level II to V) was performed in supraglottic carcinoma (7 patients). No neck dissection was done in N0 glottic carcinoma.

Postoperative radiotherapy was given to the neck in cases of positive nodes by histopathologic examination and to the neolarynx in cases of positive safety margin. The minimal follow up in the present series was 2 years. Eight patients were followed up for at least 3 years.

RESULTS

Twenty-one patients with squamous cell carcinoma of the glottis and/or supraglottis underwent supracricoid partial laryngectomy. One patient had major subglottic extension more than 1 cm, so total laryngectomy was done and he was excluded from the study. Reconstruction was done by cricohyoidoepiglottopexy (CHEP) in 13 patients (65%) and by cricohyoidopexy in 7 patients (35%). The ages of the patients ranged from 37 to 70 years with a mean of 57.8 years. They were 19 males and one female.

Both arytenoid cartilages were preserved in 10 patients (50%) and only one cartilage was resected in the other 10 patients. Safety margin was positive in 2 patients; one was a case of recurrent T1 glottic carcinoma, 5 years after treatment with radiotherapy. This patient developed pharyngeal fistula and wound gap in the early postoperative period, so total laryngectomy was done. Radical radiotherapy was given to the other patient, but he developed local tumor recurrence 6 months after surgery and was salvaged with total laryngectomy.

As regards the oncologic results, one patient had local tumor recurrence (5%) and was treated by total laryngectomy, two patients developed nodal recurrence (10%) and were treated by radical neck dissection, and one patient developed distant metastasis (5%). Four patients died (20%), one from local recurrence, one from distant metastasis, and two from intercurrent disease (Table 3)

As regards the functional results, the decanulation time ranged from 3 to 40 days with a mean of 16.35 days. The nasogastric tube was removed and deglutition usually resumed on an average of 20 days with a range of 7 to 50 days. Initiation of deglutition was characterised by some degree of aspiration, which was usually mild and improve by time. All patients recovered normal swallowing by the

second month except one patient who had serious pneumonia, so total laryngectomy and permanent tracheostomy was done. Physiologic phonation was achieved by all patients. Fifteen patients were phonating within the first month. The quality of voice allowed for normal social interaction.

Regarding the complications, pharyngeal fistula occurred in two patients (10%), one closed spontaneously within 2 weeks, while the other patient had positive margins and underwent total laryngectomy. Crico-hyoid separation occurred in two patients and it manifested as air extrusion under the cutaneous flap during coughing, compressive dressing proved adequate control for both patients. Aspiration pneumonia occurred in 9 patients, it was mild and treated by endotracheal suction, antibiotics and chest physiotherapy in 8 patients, while it was severe and necessitated total laryngectomy in one patient. Laryngeal stenosis due to redundant mucosal pad occurred in one patient and was treated by laser excision. Wound sepsis occurred in one patient (Table 4).

Operative technique

The larynx is exposed by an anterior flap from above the hyoid bone down to the supra-sternal notch. The strap muscles, cut at the inferior aspect of the hyoid bone and at the inferior part of the neck, were removed with the specimen. A thyroid isthmectomy was performed without lateral dissection of the lobes to maintain the blood supply to the cricoid and trachea. A tracheostomy was then performed as low as possible. The cricothyroid membrane was transected immediately above the superior aspect of the cricoid, up to the inferior cornu of the thyroid cartilage. The inferior cornue were cut, carefully preserving the recurrent laryngeal nerves behind them to ensure arytenoid mobility. Laterally, the inferior constrictor was cut along the thyroid cartilage and the pyriform sinuses were freed up. In glottic carcinoma, even with the invasion of the paraglottic space and/or thyroid cartilage, the thyrohyoid membrane was horizontally transected above the upper border of the thyroid cartilage, the pre-epiglottic space was crossed and the the epiglottis was cut 1 cm above the anterior commissure. Direct inspection of the lesion dictates the choice of lines of resection. The aryepiglottic

folds were transected, followed by vocal cords either in front of or through the vocal processes, depending on the extension (Fig. 1). The scissors were then directed toward the previous cricothyroid section for liberation of the specimen (Fig. 2&3). For single arytenoid resection, the section passes through the cricoarytenoid joint, preserving as much of the posterior arytenoid mucosa as possible.

Reconstruction was to begin after meticulous hemostasis by flexing the patient's head and by anterior fixation of the inferior part of the remaining epiglottis under the hyoid bone to the cricoid cartilage. This is called the crico-hyoido-epiglottopexy. Mucosal sutures are not required except when a single arytenoid is removed, in this case, aspiration is prevented through reconstruction of the posterior laryngeal wall by creating a mucosal pad by suturing the posterior arytenoid mucosal flap to the posterior subglottic mucosa with vicryl 3/0.

In supraglottic carcinoma extending to the glottis even with pre-epiglottic space invasion. The superior cut differs in that the inferior and posterior aspects of the hyoid bone were to be freed by subperiosteal dissection for complete removal of the pre-epiglottic space. The pharynx was opened through the valleculae. The epiglottis was grasped and retracted to expose the lesion completely and to determine resection lines. Reconstruction occurred by anterior fixation of the hyoid bone to the cricoid cartilage. This is called cricohyoidopexy.

Five strong absorbable threads (vicryl 1) were passed, entering above the hyoid bone and coming out under the cricoid (Fig. 4&5). The two parts were brought together by traction, while the hyoid was pulled forward with forceps to overlap the anterior part of the cricoid. The threads were then tied. Blunt dissection could be performed along the anterior wall of the cervico mediastinal trachea to the level of the carina with a finger. Care was taken to stay anterior and close to the trachea to avoid vascular injury. This allows upward mobility of the trachea and eliminates tension at suture lines. The wound was dressed with the head maintained in flexion for 3 days.

Table (1) True vocal cord and arytenoids cartilage mobilities:

	<i>True vocal cords</i>		
	Mobile	Impaired	Fixed
Arytenoid cartilage			
Mobile	2	1	7
Impaired	0	0	10
Fixed	0	0	1

Table (2): Staging of patients by 1983 AJCC classification

	<i>T1</i>	<i>T2</i>	<i>T3</i>	<i>T4</i>
N0	0	2	12	2
N1	0	1	2	0
N2	0	0	2	0
N3	0	0	0	0

Patients with T3 N0 M0 constituted the largest group (12/21)

Table (3): Oncologic results at 2 years

	<i>Number</i>	<i>Percent</i>
Alive	16	80%
Free	14	70%
Nodal recurrence	2	10%
Dead	4	20%
Local recurrence	1	5%
Metastasis	1	5%
Inter current disease	2	20%
Total	20	100 %

Table (4) Immediate complications

	<i>Number</i>	<i>Percent</i>
Pneumonia	9	45%
Pharyngeal fistula	2	10%
Cricohyoid separation	2	10%
Wound sepsis	1	5%
No complication	6	30%
Total	20	100 %

Delayed complications

	<i>Number</i>	<i>Percent</i>
Laryngeal stenosis	1	5%
Local recurrence	1	5%
Nodal recurrence	2	10%
Distal metastasis	1	5%
No complications	15	75%
<i>Total</i>	20	100%

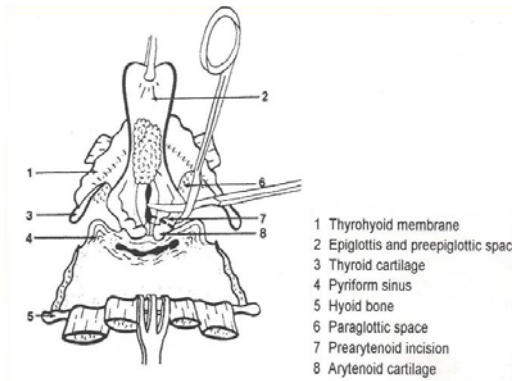


Fig (1): Resection of aryepiglottic fold

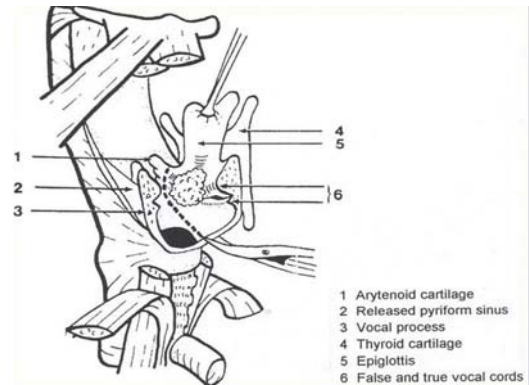
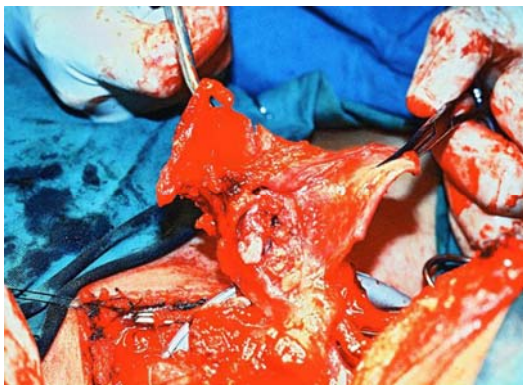


Fig. (2): Final resection margin

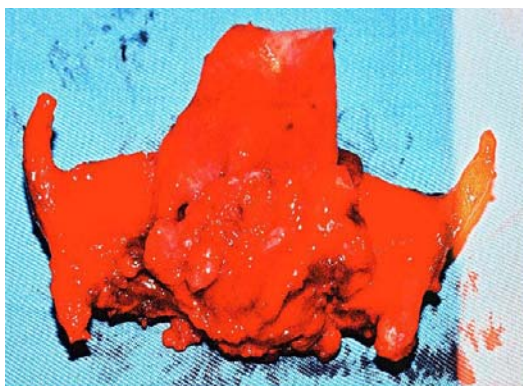


Fig. (3): The resected specimen showing the epiglottis, thyroid cartilage and the tumor

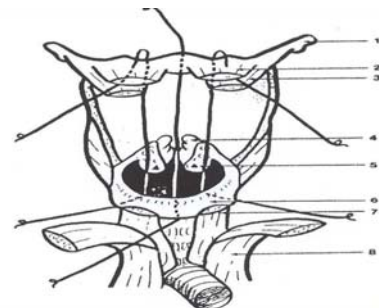


Fig.(4): Fixation of hyoid bone on cricoid [Cricohyoidopexy]

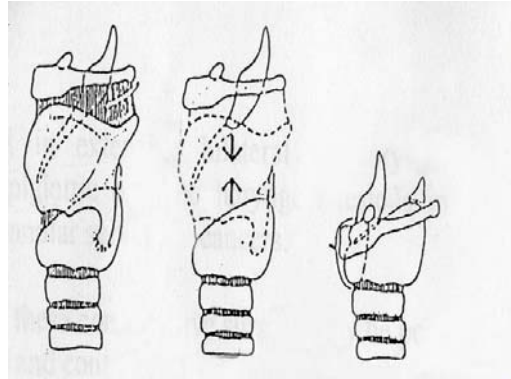


Fig.(5): Diagram showing resection of thyroid cartilage, thyrohyoid membrane, cricothyroid membrane and reconstruction by cricohyoido-epiglottopexy

DISCUSSION

Conservative laryngeal surgery and radiotherapy had been advocated for treatment of early stages of laryngeal carcinomas. This is an attempt to preserve the functions of the larynx while still achieving the same local control of a traditional radical surgery. Vertical partial laryngectomy (VPL) was the first technique of partial resection described to excise glottic tumors with preservation of laryngeal functions⁽⁸⁾. Widely used and studied, this operation has not always shown satisfactory oncological results in more advanced glottic cancers, mainly because of the restrictive excision of the paraglottic spaces⁽⁹⁾. Radiotherapy is less effective with conditions such as verrucous carcinomas, cancers associated with diffuse insitu carcinomas, severe dysplasia and major chronic laryngitis. Efficiency is also diminished with infiltrating tumors, bulky tumors and significant invasion of deep laryngeal structures as pre-epiglottic and paraglottic spaces⁽²⁾.

The first description of a partial laryngeal resection for carcinoma in which the final reconstruction was accomplished by suturing the hyoid bone to the cricoid cartilage was reported in 1959 by Majer and Rieder⁽¹⁰⁾. The procedure was further refined by Labayle and Bisthuth in 1971⁽³⁾ and by Piquet et al. in 1974⁽¹¹⁾. It allows the removal of the glottis in a single bloc in continuity with the paraglottic spaces and the thyroid cartilage and also the supraglottic larynx with the pre-epiglottic space. The antrolateral portion of the cricoid cartilage could be removed in continuity with the glottis⁽¹¹⁾.

Compared to total laryngectomy, this procedure preserves most of the laryngeal functions, but has a more difficult postoperative course characterised by deglutition problems and some degree of aspiration. Therefore, it should be reserved for patients in good general condition

and with good pulmonary function. Highly motivated patients can tolerate aspiration and resume physiologic swallowing more rapidly with less incidence of pneumonia⁽¹²⁾.

Tumor extension has to be accurately evaluated when such a surgery is considered. This was done in the present study by direct laryngoscopy, indirect laryngoscopy, fiberoptic laryngo-pharyngoscopy and computerized tomography.

Accordingly, Supracricoid partial laryngectomy is indicated in T1&T2 supraglottic tumors extending to the ventricle, the infrahyoid epiglottis, the posterior third of the false vocal cord, the glottis and the anterior commissure. It is also indicated in T1 & T2 glottic tumors whether unilateral or bilateral, in T3 transglottic and selected cases of T4 supraglottic and transglottic carcinomas invading the thyroid cartilage⁽²⁾.

This technique is contraindicated in tumors with massive invasion of pre-epiglottic space, subglottic extension to the cricoid cartilage, fixation of arytenoid cartilage and invasion of posterior commissure, pharyngeal wall, vallecula, base of the tongue and postcricoid region. It is also forbidden in poor medical condition, poor pulmonary function and in poorly motivated patients⁽²⁾.

After resection, the proper reconstructive procedure was done according to the tumor extent. Frozen section examination of all mucosal lines is of vital importance to be sure that safety margins are negative, otherwise local tumor recurrence would probably occur inspite of post-operative radiation therapy to the neolarynx⁽¹³⁾.

Speech is resumed in the first postoperative days, despite its low pitch and narrow range of frequency, the

resultant voice is acceptably loud and easily understood. All patients except two were decanulated by the end of the first month with a range of 3 - 40 days, and a mean time of about 16.35 days. A non-cuffed tracheostomy tube is better placed at the end of the procedure. This preserves the active cough reflex from the earliest postoperative period onward. It also reduces trachietis and localized tracheomalacia⁽¹⁴⁾.

The mean decanulation time obtained in the present series was shorter than that reported by Charlin et al. (1988), which was 23 days, but it is longer than that reported by Laccourreye et al. (1990) which was seven days.

Resumption of physiologic swallowing occurred by the end of the first postoperative month in 78% (14/18), with a mean time of about 20 days. This timing is shorter than that reported by Charlin et al. (30 days) but is longer than that reported by Laccourreye et al. which was 12 days and in their series deglutition was achieved by the first postoperative month in 97% (35/36) of the patients.

Laccourreye reported better functional results due to early rehabilitation of the patients in special rehabilitation centers. It is important that intensive rehabilitation is mandatory for these patients to resume normal swallowing and to avoid aspiration. It is also observed that highly motivated and educated patients became accustomed more rapidly to the neolarynx and that by sparing both arytenoids, recovery of laryngeal functions was much easier.

Sparing both the recurrent laryngeal and the superior laryngeal nerves bilaterally maintains the sensation and mobility of the remaining laryngeal structures. The recovery of laryngeal sphincteric function is achieved by active apposition of the arytenoid cartilages with suprahyoid epiglottis, if it is present, or with the base of the tongue if the epiglottis was removed forming a transverse neoglottic chink replacing the normal antero-posterior lumen between vocal cords^(5,6,15).

The most common complications of conservative laryngectomy were aspiration and pneumonia. Pneumonia occurred in nine patients in the present series (45%). It was found that practically it is better to classify aspiration into four categories mild (30%), moderate (10%), serious (5%) and fatal (0%). The first two categories constituted the majority of the present patients (40%), that were tolerable and treatable cases. Serious aspiration is life threatening and completion to total laryngectomy is mandatory, otherwise, fatal pneumonia would occur. It is needless to say that resultant aspiration consumes part of the pulmonary reserves, so candidates must have good pulmonary functions with adequate pulmonary reserves to combat the expected aspiration and to guard against developing serious pneumonia⁽²⁾

Cricohyoid separation occurred in two patients (10%) who had cricohyoidopexy. It was found that taking a hypnotic stitch to maintain flexion of the neck for three days for these cases is very helpful to overcome this problem.

In the present series, the complication rate was 70% with no mortality. Most of these complications were not serious and treated conservatively except in two cases (10%) where total laryngectomy was done. This rate is not so high compared to the results of total laryngectomy obtained by Weems et al (1987), which was 23%. Thus, the complications can be minimized by the good selection of cases as regard good general condition, good pulmonary functions, preoperative chest exercises and early postoperative pulmonary physiotherapy and rehabilitation.

The oncologic results obtained were encouraging as these were nearly similar to total laryngectomy for those patients with T2, T3 and selected T4 cancer larynx. The local control rate obtained at two years was 85% with only one local tumor recurrence (5%). Also the resulting overall two-year survival was 80%. The present results are comparable favorably with other studies. The local control rate by irradiation alone reported by Weems et al. in [1987], ranged from 31% to 81% according to the stage of the tumor, with the highest control rate (81%) in T2 cases and the lowest rate (31%) in T4 cases.

Weems et al. also reported a local control rate ranging from 83% to 100% by total laryngectomy and adjuvant radiotherapy. The highest control rate (100%) in T2 cases and the lowest rate (83%) in T4 cases⁽¹⁶⁾.

Accordingly, the results of supracricoid laryngectomy in indicated cases is nearly similar to that of total laryngectomy; as regard postoperative complications, two-year local control rate and survival with the advantage of preserving laryngeal functions such as phonation, respiration and protection against aspiration.

Conclusion: The supracricoid partial laryngectomy with cricohyoido-epiglottopexy or cricohyoidopexy is a valuable procedure for selected patients with glottic and/or supraglottic carcinoma not amenable to other conservative laryngectomies. The operation allows for satisfactory maintenance of phonation, deglutition, respiration, and a cure rate higher than radiotherapy alone and nearly similar to total laryngectomy. It has a more difficult postoperative period characterised by deglutition problems and some degree of aspiration, so candidates must have good preoperative condition with good pulmonary functions.

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