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Near-Total Laryngectomy in Advanced Laryngeal and Pyriform Cancers

Sultan A. Pradhan, FRCS, MS, FACS, FCPS; Anil K. D'Cruz, MS, DNB;
Prathamesh S. Pai, MS, DNB, DORL; Azeem Mohiyuddin, MS

Objective: **To demonstrate the oncologic and physiological safety of near-total laryngectomy (NTL), its success in voice conservation, and its versatility for use in extensive resections that necessitate pharyngoplasty, and even in post-radiation recurrences.** ***Study:*** **In this study of 137 cases of NTL for cancer of the larynx (45 cases) and pyriform (92 cases), 86.9% were stage T3/T4 and 60.6% were N+. A total of 8.8% had extended pharyngeal resections necessitating patch pharyngoplasty (ENTLP). In 10.9% cases, NTL was used as salvage of post-radiation failures. Concurrent neck dissection was performed in 99 cases.** ***Results:*** **A total of 70.1% was alive and disease-free at the last follow-up ranging from 12 months to 104 months (median, 35 mo). A total of 7.3% had local/locoregional recurrences and 11.7% had purely regional recurrences. The local control rate for post-radiation salvage with NTL was 93.3%. A total of 88.6% developed communicable speech, and the speech success rate was 100% in 12 cases of ENTLP. Complications included major wound dehiscence with total shunt breakdown in 2 cases (1.5%), pharyngeal leak requiring surgical intervention in 7 cases (3.6%), significant aspiration through the shunt necessitating completion laryngectomy in 1 case (0.7%), and complete shunt stenosis in 9 cases (6.6%).** ***Conclusion:*** **The study shows that NTL is an oncologically safe voice conservation procedure in advanced, lateralized laryngeal and pyriform cancers treated not only per primum, but also in carefully selected post-radiation failures. It has a high success rate of speech development even in those cases requiring extensive pharyngeal resections. Major complications were acceptably low.** ***Key Words:*** **Near-total laryngectomy, pyriform, larynx, cancer.**

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INTRODUCTION

Conventional partial laryngectomy procedures for cancer of the larynx preserve voice as well as nasal respiration. A wide range of these procedures has been described.[1–3] All of these procedures require the preservation of at least one functioning arytenoid and an intact cricoid ring. This limits their use to relatively early cancers. In more advanced cancers in which there is subglottic spread requiring resection of the cricoid cartilage, a near-total laryngectomy can be performed as a voice-conserving procedure. Because a segment of the cricoid ring is resected, a permanent tracheostomy becomes mandatory, and nasal respiration is sacrificed. However, speech is possible through the formation of an innervated myomucosal shunt constructed from the remnant uninvolved mucosa between the trachea and the pharynx (Fig. 1). Thus, near-total laryngectomy is a procedure that bridges the gap between the conventional voice conservation procedures that preserve both nasal respiration and speech and a total laryngectomy in which both these functions are sacrificed.

The procedure is feasible in advanced but lateralized cancers of the larynx and pyriform fossa in which the interarytenoid and retro-arytenoid regions are normal (Fig. 2). A radical excision is possible on the side of the lesion, which includes even a segment of the ipsilateral cricoid cartilage to allow for an adequate lower clearance. Normal supple tissues on the contralateral side are preserved to form a voice shunt between the trachea and the pharynx. The biological shunt thus formed from the patient's own tissues is maintenance-free and has several advantages, vis-à-vis speech rehabilitation, over the more widely practiced tracheo-esophageal puncture and prosthesis.

METHODS

Between July 1989 and July 1999, near-total laryngectomy was performed on 144 patients with laryngeal/pyriform fossa cancers. Of the 144 patients, 7 were lost to follow-up within 6 months after surgery; therefore, results are presented for the remaining 137 patients. All the patients who were lost to follow-up were alive and free of disease at their last visit. There were 34 glottic, 11 supraglottic, and 92 pyriform fossa lesions. Of the 137 patients, there were 131 men and 6 women ranging in age from 29 years to 79 years (Table I). Most of the patients had locally advanced disease. One hundred fourteen patients had T3/T4 disease, whereas 83 patients had clinically positive cervical nodal metastases (Table II). Surgery was performed per primum

From Head and Neck Services, Tata Memorial Hospital, Parel, Mumbai, India.

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Send Correspondence to Sultan A. Pradhan, FRCS, MS, FACS, FCPS, Chief, Head & Neck Services, Tata Memorial Hospital, Dr. Ernest Borges Marg, Parel, Mumbai 400012, India. E-mail: pradhansultan@hotmail.com

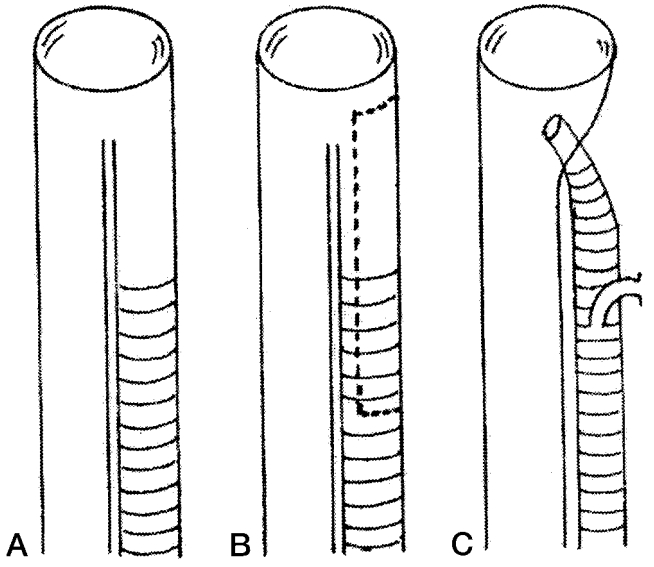

Fig. 1. The concept of near-total laryngectomy. (**A**) Normal trachea and esophagus. (**B**) Excision of the larynx and part of the upper trachea. (**C**) Formation of a voice shunt between the trachea and the pharynx.

in 119 patients as a salvage procedure for radiotherapy failure in 15 patients and after previous laser excision in 3 patients (Table III). Forty-one patients underwent a near-total laryngectomy (NTL), 84 had a near-total laryngopharyngectomy (NTLP) in which a part of the pharyngeal wall was excised but closure was achieved primarily, and 12 patients underwent an extended near-total laryngopharyngectomy (ENTLP) that required a myocutaneous flap for pharyngeal closure (Table IV). Appropriate node dissection was carried out as judged by the extent of node involvement clinically and on frozen section sampling at the time of surgery. The majority of patients (72.3%) underwent some form of unilateral or bilateral concurrent neck dissection (Table V). Postoperative radiotherapy was advised in 106 patients of whom 12 patients failed to complete the scheduled dose.

RESULTS

NTL is a generic term used for the procedure of near-total laryngectomy and its extensions such as near-total laryngopharyngectomy and extended near-total laryngopharyngectomy, which were alluded to earlier.

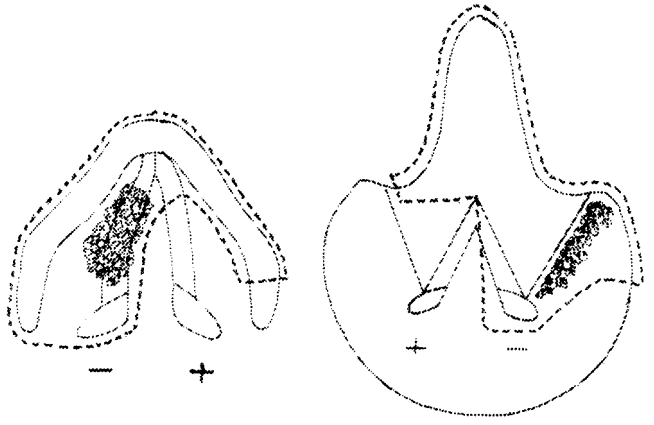

Fig. 2. Advanced but lateralized lesion of the larynx and pyriform fossa with cord fixity and normal inter- and retroarytenoid region.

TABLE I.
Age and Sex Distribution.*

Age (y)	Sex		Total
	Male	Female	
<40	8	2	10
41–50	35	3	38
51–60	57		57
61–70	25	1	26
>71	6		6
Total	131	6	137

*Age ranging from 29–79 years.

Complications

There was one postoperative death 7 months after salvage surgery for post-radiation recurrence. There was major wound dehiscence resulting in pharyngeal fistula and pneumonitis and ultimately leading to death.

Pharyngeal fistula, aspiration on swallowing, and shunt stenosis were the main complications following NTL (Table VI).

Twelve patients (8.7%) developed a major pharyngeal leak/fistula. One died as mentioned above. Four healed spontaneously with conservative treatment. Seven required surgical intervention for closure with a flap. In the latter, one patient had a complete breakdown of the voice shunt as well with resultant loss of speech.

Seventeen (12.4%) patients developed minor degrees of aspiration in the immediate postoperative period. This was transient in nature and settled down in a few weeks without any specific treatment.

One patient developed persistent aspiration on swallowing, necessitating a completion laryngectomy. In this patient, there was injury to the recurrent laryngeal nerve resulting in an adynamic shunt.

Nine patients (6.6%) developed severe shunt stenosis in which dilatation was not possible with resultant failure to develop speech.

TABLE II.
Stage Distribution.

T-Stage	N-Stage								Total
	N0	N1	N2a	N2b	N3	N2c	Nx	Non Sq.	
T1		1							1
T2	5	1	2						8
T3	31	11	6	16	9	3			76
T4	10	9	2	17	5				43
Tx	4	1					3		8
Non Sq									1
Total	50	23	10	33	14	3	3	1	137

Non Sq = non-squamous.

TABLE III.
Preoperative Treatment.

	No.	Percent
Nil	119	86.9
Radiation	15	11.0
Laser	3	2.2
Total	137	100.0

Of the 15 patients who underwent NTL as a salvage procedure for radiotherapy failure, 2 patients developed major pharyngeal leak, ultimately leading to death in 1 and loss of voice shunt in the other.

Control Rates

Of the 137 evaluable patients, 96 (70.1%) are alive and free of disease at the time of the last follow-up, which ranges from 12 months to 104 months (median, 35 mo) (Table VII). Seven patients developed local recurrence, 3 had locoregional recurrence, and 16 patients had pure regional recurrence. Most patients with regional failure (12 of 16) had advanced nodal disease at presentation (N2 or N3) and had undergone neck dissection for the same. Nine patients developed distant metastasis and 4 patients developed a new primary in the head and neck (Table VIII). Two local, 1 locoregional, and 2 regional failures could be salvaged successfully. Of the 4 patients who developed second primaries, 1 was salvaged (Table IX). Thirty-one patients died of cancer and 3 patients died of other causes.

Speech

One hundred twenty-one (88.3%) patients developed communicable lung-powered speech (Table X), which was graded as excellent in 104 (full sentences spoken effortlessly), fair in 11 (short sentences with some effort), and poor in 6 (a breathy whisper that required considerable effort and was associated with bouts of coughing) (Table XI). The onset of speech after surgery varied from patient to patient. Although an occasional patient developed speech as early as the second postoperative week, the majority picked up speech after the completion of radiotherapy when the acute reaction settled down. In 17 patients, the development of speech was delayed postoperatively. All these patients, however, responded to simple dilatation of the shunt with a regular 14 Fr esophageal elastic boogie. This maneuver restored the patency of the shunt, which may have gotten blocked as a result of inspissated secretions or minor degrees of stenosis.

TABLE IV.
Type of Surgery and Primary Site.

	Surgical Type			
Site	NTL	NTLP	ENTLP	Total
PF		81	11	92
GL	32	2		34
SG	9	1	1	11
Total	41	84	12	137

PF = pyriform fossa; GL = glottis; SG = supraglottis; NTL = near-total laryngectomy; NTLP = near-total laryngopharyngectomy; ENTLP = extended near-total laryngopharyngectomy.

TABLE V.
Neck Dissection.

	No.	Percent
Nil	9	6.6
Sampled	4	2.9
Vein to vein	25	18.2
MND	13	9.5
RND	25	18.2
Bil. MND	12	8.8
MND + RND	49	35.8
Total	137	100.0

MND = modified neck dissection; RND = radical neck dissection.

DISCUSSION

Near-total laryngectomy is feasible in locally advanced laryngeal cancers, even when there is subglottic spread or involvement of the apex of the pyriform sinus as the resection provides adequate clearance by going well beyond the cricoid in its lowest extent (Fig. 3A, B). The lesion, however, must be lateralized and the interarytenoid tissue must be supple and free of disease. The resection is radical on the side of the tumor, allowing the contralateral, disease-free, supple tissues to be used for the formation of a myomucosal shunt.[4]

Direct laryngoscopy performed preoperatively to judge the feasibility of the procedure is of greater value than sophisticated imaging with computerized tomography (CT) or magnetic resonance imaging (MRI), although it has its own limitations. At times a bulky lesion or lax laryngeal tissues may give an impression of involvement of the contralateral side. The exact extent of the disease can only be judged at the time of surgery. This being so, all surgically treated advanced laryngeal cancers should be finally assessed at surgery for the possibility of performing an NTL. This allows many patients scheduled for total laryngectomy to have the benefit of this voice-conserving procedure. With such a policy in our service, approximately 20% of advanced laryngeal and pyriform sinus cancers are now treated with a near-total laryngectomy.

The authors use a modification of the original Bruce Pearson technique[4] by making a suprahyoid transvallecular entry into the larynx and delivering and pulling the

TABLE VI.
Major Complications.

	No.	Percent
Large pharyngeal leaks	12	8.8
Persistent aspiration	1	0.7
Shunt dehiscence	2	1.5
Complete shunt stensosis	9	6.6

TABLE VII.
Last Follow-Up Status.

	No.	Percent
Alive disease free*	96	70.1
Alive with disease	1	.7
Dead of cancer	31	22.6
Dead other cause	6	4.4
Dead cause unknown	3	2.2
Total	137	100.0

*Range 12 months–104 months; median = 35 months.

TABLE VIII.
Recurrence.

	No.	Percent
Local	7	5.1
Regional	16	11.7
Locoregional	3	2.2
Distant metastasis	9	6.6
Second primary	4	2.9
Total	137	100.0

epiglottis downward and forward. This not only provides better exposure to the interior of the larynx, but also makes the laryngeal tissues taut and defines the tumor limits more clearly, enabling a better assessment of the extent of the disease and of the feasibility or otherwise of a near-total laryngectomy.[5] In this study of 137 cases, 119 (86.9%) had T3/T4 disease, 8 had T2 tumors, 1 patient had T1 disease, 8 patients had Tx tumors, and 1 patient had non-squamous tumor. The relatively early cancers (T1 and T2 tumors) were either recurrences after RT (11) or following laser surgery (3), or had disease extending beyond the cricoid but had mobile vocal cords (3). The prime concern should therefore be the oncologic soundness of the procedure. The results should measure up to the gold standard of total laryngectomy. In properly selected cases, NTL is an oncologically sound procedure, as is seen from the present study, which records 10 cases of local and locoregional recurrences out of a total of 137 evaluable cases (7.2%). This is comparable to the results of other series with local recurrences ranging from 7% to 8.4%.[6–8]

The procedure allows concurrent neck dissection to be performed at surgery. In 99 (72.3%) cases, a concurrent cervical lymph node dissection was performed. This is important given the fact that NTL is resorted to in advanced laryngeal and pyriform sinus cancers, in which the incidence of cervical node metastasis is high. In the present series, 83 cases had histologically proven neck nodes.

Postoperative radiation has little impact on the functional outcome of the shunt created for speech.[6] One hundred four patients were advised radiation postoperatively, 94 patients completed the radiation schedule, and among these, 88 (93.7%) patients had no adverse effect on the shunt whereas 6 (6.3%) patients developed shunt stenosis.

Although NTL was feasible as a salvage procedure after prior radiotherapy, the complication rate was marginally higher in these patients. Fifteen (10.8%) cases were taken up as salvage procedures. Thirteen (86.6%) cases had uneventful postoperative recovery. Two patients had a major pharyngeal leak ultimately leading to death in 1 and loss of the voice shunt in the other. Thirteen patients are alive and disease-free and 1 died as a result of cancer. Pearson's series showed a 20% recurrence among those taken for post-radiation salvage.[6] NTL can be considered as a salvage procedure after radiation therapy failure, but caution must be exercised at case selection. Not only should the interarytenoid and retro-arytenoid tissues be free of disease, they should also be supple and free of post-radiation edema.

In the evaluation of the overall safety of the procedure, physiological safety is also an important consideration, because a shunt is being created between the tra-

TABLE IX.
Salvage of Recurrences.

		Type of Salvage							
Salvage Status	Recurrence	RT	TL	RND	RT + TL	Pall Rx	Metastectomy	Wide Excision	Total
YES	Local		2		1				3
	Regional	1		1					2
	Locoregional				1				1
	Second primary							1	1
	Total	1	1	1	2			1	7
NO	Local					4			4
	Regional	1				12	1		14
	Locoregional					2			2
	Distant					9			9
	Second primary	2				1			3
	Total	3				28	1		32

RT = radiation therapy; TL = total laryngectomy; RND = radical neck dissection; Pall Rx = palliative treatment.

TABLE X.
Speech.

	No.	Percent
Successful	121	88.3
Shunt stenosis	9	6.6
Shunt breakdown	2	1.5
Adynamic tone	1	.7
NK	4	2.9
Total	137	100.0

chea and the pharynx. While a minor degree of aspiration is not infrequent, it is transient and does not lead to any serious complications. Only one patient had to have completion laryngectomy for persistent aspiration. It was because of injury to the recurrent laryngeal nerve. To create a dynamic myomucosal shunt, preservation of the contralateral recurrent laryngeal nerve is of the utmost importance. The nerve is likely to be damaged as it enters the larynx just behind the cricothyroid joint. To prevent injury to the nerve, the plane of division of the thyroid cartilage, the thyrocricoid membrane, and the cricoid cartilage should be anterior to the cricothyroid joint. If this caution can be exercised, aspiration can be minimized. In fact, near-total laryngectomy is considered a safe alternative to a supraglottic laryngectomy, which is fraught with the complication of aspiration pneumonitis in elderly individuals with compromised respiratory functions.[8]

As a voice conservation procedure, near-total laryngectomy has a high rate of success in the development of intelligible lung-powered speech, ranging from 79% to 90% in most series.[6–8] Moreover, restoration of speech does not require prolonged sessions with a speech pathologist. In this series, 122 (88.4%) patients developed communicable speech, which was graded as excellent in 105, fair in 11, and poor in 6. The ease and fluency of speech depends on the patency and competence of the voice shunt.[9] As outlined earlier, competence of the shunt can be maintained by avoiding damage to the uninvolved recurrent laryngeal nerve. A shunt is created over a 14 Fr catheter, and if required, the lumen should be augmented with the uninvolved mucosa from the pyriform sinus, as described by Pearson.[4]

The most widely used method of speech rehabilitation after a total laryngectomy is the tracheo-esophageal (TE) puncture using the TE prosthesis.[10] Like near-total laryngectomy, the TE prosthesis allows lung-powered speech with comparable success rate. However, it has several disadvantages. The TE prosthesis is expensive,

TABLE XI.
Speech Quality.

	No.	Percent
Good	104	75.9
Fair	11	8.0
Poor	6	4.4

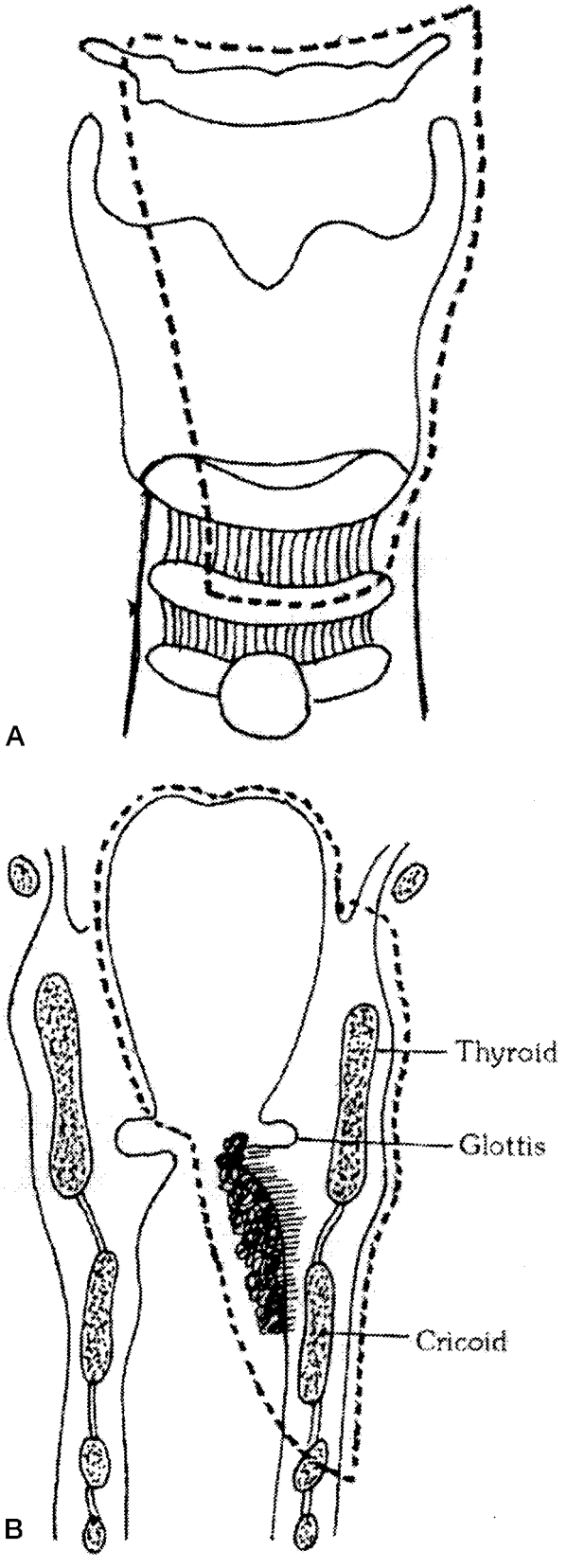

Fig. 3. (**A**) Cartilage cuts. Note the line of division of thyroid cartilage safeguarding the contralateral recurrent laryngeal nerve. (**B**) NTL. Dotted line denoting resection extending below to include a segment of the cricoid ring.

needs to be replaced every few months, and causes tracheal and pharyngeal irritation resulting in a disturbing cough. The TE prosthesis also needs regular maintenance and cleaning, and when replaced needs to fit the puncture site snugly. This is often difficult for the patient or his attendants and usually requires the help of trained personnel. This is the major drawback of the TE prosthesis, particularly in a developing country like India where domiciliary care is totally lacking and patients have to travel long distances for medical help. On the other hand, the near-total laryngectomy provides a maintenance-free biologic shunt that is permanent and once successful, stays so for life.

CONCLUSION

Near-total laryngectomy is an oncologically sound and physiologically safe voice-conserving procedure for locally advanced but lateralized cancers of the larynx and pyriform fossa. It has a high success rate for speech that is lung-powered, which requires no prosthesis, and is possible through a maintenance-free biological shunt. Intraoperative assessment for the feasibility of a near-total laryngectomy in all patients scheduled for total laryngectomy allows many more patients to take advantage of this procedure and retain their voice.

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