The Journal of Laryngology and Otology
July 1997, Vol. **111**, pp. 659–662

Tracheoesophageal speech following transmucosal pharyngeal myotomy with the potassium-titanyl-phosphate laser

DAVID J. HALVORSON, M.D., FREDERICK A. KUHN, M.D.*

Abstract
Successful communication following laryngectomy usually involves an electrolarynx or oesophageal speech. Only within the past decade has tracheoesophageal puncture been advocated for alaryngeal speech and evolved into the procedure of choice. Successful production of speech after total laryngectomy using tracheoesophageal speech may be impaired secondary to anatomical and functional difficulties. The primary limitation of tracheoesophageal speech is pharyngoesophageal spasm occurring in the upper oesophageal sphincter impeding airflow through this segment. Our report presents four patients who underwent a pharyngeal myotomy with the potassium-titanyl-phosphate (KTP) laser. Post-operatively, each patient was able to communicate with functional alaryngeal speech. A transmucosal pharyngeal myotomy may represent an alternative for patients with speech failure after tracheoesophageal puncture.

Key words: Tracheoesophageal fistula; Surgery

Introduction

Vocal restoration following laryngectomy has always been an important goal of head and neck surgeons. Following the first laryngectomy by Bilroth in 1874, Gussenbauer reported creating a prosthesis for voice restoration (Singer and Blom, 1985). As the technique of total laryngectomy has evolved, the need for functional alaryngeal speech has been advocated. With the introduction of primary pharyngeal closure, oesophageal speech was popularized by Seeman in 1919. However, only 50 to 60 per cent of patients were able to develop functional oesophageal speech (Winans, 1974). With the pioneering work of Singer and Blom, the development of a valved voice prosthesis and a controlled fistula between the trachea and oesophagus to generate oesophageal speech has become the preferred method of speech rehabilitation (Singer and Blom, 1980). The prosthesis has been documented as being effective in up to 90 per cent of patients whether the insertion occurs during laryngectomy or as a secondary procedure (Panje, 1981; Wetmore *et al.*, 1981; Hamaker *et al.*, 1985; Trudeau *et al.*, 1986).

Regardless of the timing of tracheoesophageal puncture or the type of prosthesis, a significant minority of patients may fail to acquire tracheoesophageal speech secondary to a number of anatomical, physiological or psychological factors (Callaway *et al.*, 1992). Limited patient comprehension, poor motor skills or lack of motivation can impair tracheoesophageal speech. Even by overcoming these obstacles, the majority of patients who cannot maintain satisfactory tracheoesophageal speech are limited by pharyngospasm or stricture of the cricopharyngeus and pharyngeal constrictor muscles of the upper oesophageal sphincter. In this select group, pharyngeal myotomy of the inferior and middle constrictors has been advocated for the development of alaryngeal speech (Singer and Blom, 1981; Henly and Souliere, 1986).

The recent success of a transmucosal cricopharyngeal myotomy with the potassium-titanyl-phosphate (KTP) laser in patients with significant dysphagia (Halvorson and Kuhn, 1994) has led to the application of patients with failed tracheoesophageal speech. We present our experience with a transmucosal pharyngeal myotomy using the KTP laser for improving tracheoesophageal speech in those patients who demonstrate pharyngoesophageal spasm or stricture.

Case reports

Case 1 A 50-year-old white male presented with a six-month history of progressive hoarseness and dysphagia. He had a smoking history of two packs per day for a total of 25 years. Examination showed a fungating lesion of the right true vocal fold and also involving the left true vocal fold and an initial TNM staging was $T_4N_0M_0$. Diagnostic laryngoscopy confirmed the diagnosis and biopsy revealed a moderately well-differentiated squamous cell carcinoma. The patient underwent total laryngectomy with an eventful post-operative course. He failed to develop oesophageal speech and therefore underwent a tracheoesophageal puncture six months after the laryngectomy with placement of a Blom-Singer voice prosthesis. Six weeks later he was unable to develop tracheoesophageal speech and underwent a transmucosal KTP laser pharyngeal myotomy. He has subsequently developed functional speech.

Case 2 A 54-year-old female presented with a two-month history of hoarseness. She had a smoking history of two packs per day for a total of 20 years. Examination revealed

From the Department of Surgery, Division of Otolaryngology, University of Alabama at Birmingham, Birmingham, Alabama and the Georgia Ear Institute*, Savannah, Georgia, USA.
Accepted for publication: 10 April 1997.

FIG. 1
Holinger-Benjamin Zenker's diverticuloscope with slotted end for sectioning of upper pharyngeal sphincter.

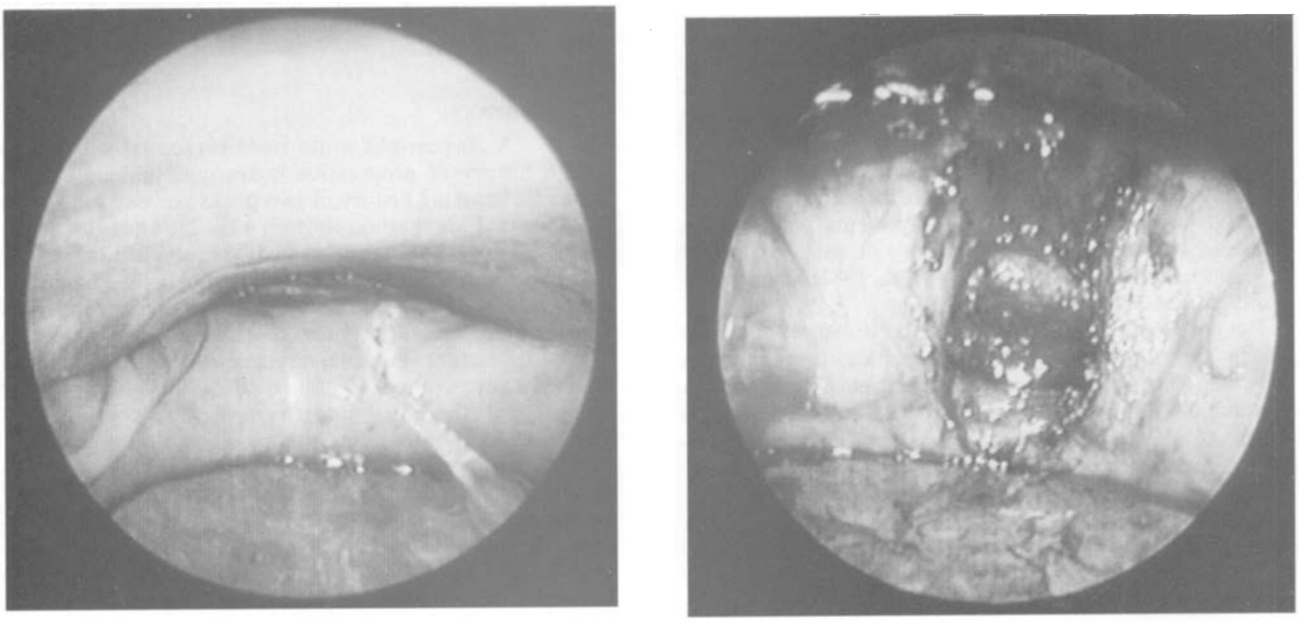
a left true and false fold lesion with vocal fold paralysis and an initial TNM staging was $T_3N_0M_0$. Diagnostic laryngoscopy and biopsy revealed a moderately well-differentiated squamous cell carcinoma. The patient underwent a total laryngectomy followed by a tracheoesophageal puncture one year after laryngectomy. She failed to develop tracheoesophageal speech despite three months of intensive speech therapy and underwent a transmucosal KTP laser pharyngeal myotomy. She has subsequently developed successful tracheoesophageal speech.

Case 3 A 64-year-old black male presented with a four-month history of progressive hoarseness and a one-month history of stridor. He had a smoking history of two packs per day for a total of 30 years. Examination revealed a left true vocal fold lesion with complete vocal fold paralysis. He also had a one cm jugulodigastric node palpable on the left and TNM staging was $T_3N_1M_0$. Diagnostic laryngoscopy and biopsy revealed a well-differentiated squamous cell carcinoma. He underwent a total laryngectomy and left modified neck dissection and post-operative radiation therapy. He subsequently was lost to follow-up and presented to the clinic six years after his laryngectomy unable to develop any oesophageal speech. Although the patient complained of dysphagia, physical examination did not reveal any recurrent disease. A barium swallow revealed moderate upper oesophageal narrowing. He underwent a transmucosal KTP laser pharyngeal myotomy with complete resolution of dysphagia. He has subsequently developed functional oesophageal speech.

Case 4 A 58-year-old white male presented with a six-month history of progressive hoarseness and dysphagia. He had a history of smoking of two packs per day for a total of 25 years. Physical examination revealed a large endolaryngeal lesion involving both true vocal folds and left false fold cord. No adenopathy was palpated and TNM staging was $T_4N_0M_0$. Diagnostic laryngoscopy revealed a moderately-differentiated squamous cell carcinoma. He underwent a total laryngectomy and post-operative radiation therapy. One year following laryngectomy, the patient presented for tracheoesophageal puncture. He was unable to develop functional speech three months after tracheoesophageal speech and underwent a transmucosal KTP laser pharyngeal myotomy. He subsequently developed successful tracheoesophageal speech.

Surgical technique

After induction of general anaesthesia via the laryngeal stoma, direct rigid oesophagoscopy is performed to examine the diameter of the oesophageal lumen. The tracheoesophageal puncture site is identified and the Holinger-Benjamin Zenker's diverticuloscope (Figure 1) is inserted just superior to the TEP and placed in suspension. A pharyngeal myotomy is performed with the KTP laser utilizing a 600μm fibre under direct vision (Figures 2 and 3). The fibres of the inferior constrictor and the inferior portion of the middle constrictor are divided with a vertical incision through the posterior pharyngeal mucosa in the midline through the median raphe to the level of the prevertebral fascia. The incision measures approximately 3 cm extending superiorly from the tracheoesophageal puncture site. The patient is observed overnight and a clear liquid diet is initiated on post-



(a) (b)

FIG. 2
Intra-operative endoscopic view of pharyngeal constrictors; a) prior to myotomy; b) sectioning of the fibres to the level of the prevertebral fascia.

https://doi.org/10.1017/S0022215100138253 Published online by Cambridge University Press

operative day one. The diet is advanced as tolerated over the next 24 hours. The patient is encouraged to start tracheoesophageal speech immediately post-operation.

Discussion

Tracheoesophageal puncture following total laryngectomy is one of many modalities for voice rehabilitation after surgery. Most patients who attain tracheoesophageal speech are highly motivated and have access to intensive speech therapy. Those individuals who have an unsuccessful tracheoesophageal puncture are usually frustrated with the procedure despite patient motivation. Pharyngeal incoordination and spasm has long been recognized as a major stumbling block to the development of tracheoesophageal speech. The area of the upper oesophageal sphincter formed by the cricopharyngeus muscle and inferior constrictor must relax accordingly as air is passed through this segment to provide speech. Failure of relaxation will result in aphonia following tracheoesophageal puncture.

The inferior portion of the upper oesophageal sphincter has been demonstrated as the area of constriction with radiographic studies in patients with good oesophageal speech. Although the upper oesophageal sphincter is functional following a laryngectomy, it is weaker and fails to relax normally. Patients having a normal functioning upper oesophageal sphincter have not been identified as better speakers and those patients with extremely weak sphincters have been found to have excellent speech (Kirchner *et al.*, 1963). In patients with failure of tracheoesophageal speech, pharyngeal pressure is higher than in those with fluent speech and approximates the non-laryngectomy upper oesophageal sphincter. This protective effect of the elevated pharyngeal pressure with increasing oesophageal pressure serves to prevent reflux of oesophageal contents into the larynx and airway. This protective effect is not important in the laryngectomy patient and negatively influences the development of tracheoesophageal speech.

The role of cricopharyngeal myotomy at the time of laryngectomy would appear to influence tracheoesophageal speech positively although each patient in the current study underwent a myotomy during the laryngectomy. Failure to perform a myotomy or recognize anatomical constriction within the oesophagus may adversely affect tracheoesophageal speech. In addition, the multiple-layer pharyngeal closure employed to support the mucosal suture line is created with the pharyngeal constrictors and strap muscles. This results in significant limitation in oesophageal diameter and may limit a patient's ability to develop voice restoration. In this series, all patients underwent a cricopharyngeal myotomy at the time of laryngectomy and a multiple layer closure over the mucosal suture line. Some physicians may argue that this method of closure increases the possibility for tracheoesophageal puncture failure. The current failure rate at our institution is less than five per cent which is well within the reported failure rate (Singer and Blom, 1981).

Patients who may develop good tracheoesophageal speech are not always identified with objective oesophageal insufflation testing, and the majority of patients with poor pre-operative tracheoesophageal insufflation testing will obtain successful tracheoesophageal speech. Patients who may develop pharyngospasm will tend to maintain nutrition following laryngectomy and rarely report dysphagia. These patients do not have an anatomical stricture demonstrated by video fluoroscopy and oesophageal dilation has been uniformly ineffective in correcting the spasm. In light of poor prognostic identifiers, a pharyngoesophageal myotomy has been introduced to diagnose and treat those individuals with failed voice rehabilitation.

Singer, Chodesh, Henly and Mahieu have all advocated open pharyngeal myotomy with marked improvement in tracheoesophageal speech (Singer and Blom, 1981; Henly and Souliere, 1986). The myotomy consists of sectioning the inferior constrictor and a portion of the middle constrictor. This requires a second open procedure that has a reported fistula rate of 19 per cent (Singer and Blom, 1981). The introduction of the KTP laser for a transmucosal pharyngeal myotomy allows for a simpler and effective technique for improving tracheoesophageal speech.

Our technique presents many advantages over the open technique. The post-operative course is reduced with quick advancement to oral intake and minimal post-operative pain. All of the patients were able to tolerate a regular diet within a 48-hour-period. In addition, visualization of the pharyngeal mucosa and muscle fibres enables the surgeon to obtain a direct view of intraluminal compression and intrinsic diameter. Patients are able to know immediately if the procedure was successful and the patient avoids the complications associated with an open procedure. The effectiveness of a transmucosal cricopharyngeal myotomy and lack of post-operative complications (Halvorson and Kuhn, 1997) has encouraged the extension of this procedure to a pharyngeal myotomy. Limiting the incision to the pharyngeal constrictors and direct endoscopic visualization allows for a safe procedure with minimal morbidity.

In summary, patients who fail to acquire tracheoesophageal speech present frustrated and aphonic. The introduction of an endoscopic pharyngeal myotomy with the KTP laser may provide assistance to those patients who cannot attain successful tracheoesophageal speech.

References

Callaway, A., Truelson, J. M., Wolf, G. T., Thomas-Kincaid, L., Cannon, S. (1992) Predictive value of objective esophageal insufflation testing for acquisition of tracheoesophageal speech. *Laryngoscope* **102:** 704–708.

Halvorson, D. J., Kuhn, F. A. (1994) Transmucosal cricopharyngeal myotomy with the potassium-titanyl-phosphate laser in the treatment of cricopharyngeal dysmotility. *Annals of Otology, Rhinology and Laryngology* **103:** 173–177.

Halvorson, D. J., Kuhn, F. A. (1997) Treatment of cricopharyngeal dysmotility with a transmucosal cricopharyngeal myotomy with the potassium-titanyl-phosphate laser. A series of 16 patients. *Endoscopy, (in press).*

Hamaker, R. C., Singer, M. I., Blom, E. D., Daniels, H. A. (1985) Primary voice restoration at laryngectomy. *Archives in Otolaryngology–Head and Neck Surgery* **111:** 182–186.

Henley, J., Souliere, C. (1986) Tracheoesophageal speech failure in the laryngectomy: The role of constrictor myotomy. *Laryngoscope* **96:** 1016–1020.

Kirchner, J. A., Dey, F. L., Shedd, D. P. (1963) The pharynx after laryngectomy. *Laryngoscope* **73:** 18–33.

Panje, W. E. (1981) Prosthetic vocal rehabilitation following laryngectomy: the voice button. *Annals of Otology, Rhinology and Laryngology* **90:** 116.

Singer, M. I., Blom, E. D. (1980) An endoscopic technique for restoration of voice after laryngectomy. *Annals of Otology, Rhinology and Laryngology* **89:** 529.

Singer, M. I., Blom, E. D. (1981) A selective myotomy for voice restoration after total laryngectomy. *Archives of Otolaryngology–Head and Neck Surgery* **107:** 670–673.

Singer, M. I., Blom, E. D. (1985) Vocal rehabilitation with prosthetic devices. In *Surgery of the Larynx.* (Bailey, B. J., Biller, H. F., eds.) W. B. Saunders Co., Pennsylvania, pp 367–384.

Trudeau, M. D., Hirsch, S. M., Schuller, D. E. (1986) Vocal restorative surgery: why wait? *Laryngoscope* **96:** 975–977.
Wetmore, S. J., Johns, M. E., Baker, S. R. (1981) The Singer-Blom voice restoration procedure. *Archives of Otolaryngology–Head and Neck Surgery* **107:** 674.
Winans, C. S., Reichbach, E. J., Waldrop, W. F. (1974) Esophageal determinants of alaryngeal speech. *Archives of Otolaryngology–Head and Neck Surgery* **99:** 10.

Address for correspondence:
David J. Halvorson, M.D.,
Department of Surgery, Division of Otolaryngology.
1501 5th Avenue South,
University of Alabama at Birmingham,
Birmingham, Alabama 35233, USA.

Fax: (205) 934-3992