

Secondary Tracheoesophageal Puncture With In-Office Transnasal Esophagoscopy

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Objective: To evaluate the outcomes of voice restoration using office-based transnasal esophagoscopy (TNE) to guide placement of the secondary tracheoesophageal puncture (TEP).

Design: Retrospective chart review.

Setting: Two tertiary care medical centers.

Patients: The study included 39 patients who underwent the TNE-TEP procedure from January 2004 to December 2008.

Main Outcome Measures: Clinical, demographic, and TE speech-related data were recorded to examine the ease, efficiency, complications, and speech-related outcomes.

Results: Among 39 patients identified, the average age was 65 years (age range, 47-83 years), with 32 male (82%) and 7 female (16%) patients. Twenty-five patients (64%) underwent total laryngectomy; 8 (21%) underwent total laryngectomy with partial pharyngectomy; and 14 (36%)

underwent microvascular flap reconstruction. The overall success rate of secondary TNE-assisted TEP placement was 97% (n=38), with 1 unsuccessful attempt. There was no statistically significant correlation found between patients having undergone radiation therapy (either before or after oncologic resection) or a cricopharyngeal myotomy and successful TEP placement, type of reconstruction used to close the pharyngeal defect when compared with the difficulty in the placement of the TEP, development of complications associated with TEP placement, use of the TEP prosthesis, or speech intelligibility at the last follow-up visit. Thirty-one patients (79%) were still using their TEP prosthesis for speech at the last follow-up visit. Of the patients reviewed, 28 (72%) had understandable TE speech.

Conclusions: In-office TNE-assisted TEP placement can safely be performed, with excellent speech outcomes. Reconstruction with musculocutaneous or microvascular free-tissue transfer did not limit our ability to place secondary TEPs with TNE.

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THE PROBLEM OF RESTORING voice in patients after laryngeal surgery has been a daunting task that has challenged surgeons since Billroth performed and described the first laryngectomy in 1873. The human voice serves not only as a means of communication but also as a crucial means of self-expression. Therefore, restoration of speech after total laryngectomy has been an active area of investigation and evolution over the past 30 years. In 1983, Singer et al¹ described the tracheoesophageal puncture (TEP), which ushered in a new mechanism with which to restore voice in laryngectomees. The TEP may be performed primarily at the time of ablative surgery and is usually accompanied by a concurrent cricopharyngeal myotomy. Alternatively, it can be performed second-

arily as an elective procedure after the initial laryngeal cancer resection and/or treatment. Traditionally, secondary TEP is performed with rigid esophagoscopy for direct visualization of the proposed TEP site with the patient under general anesthesia. While effective, this technique has its drawbacks, including the need for general anesthesia, the difficulty associated with exposure of the TEP site using rigid scopes in some patients after radiation therapy, and the technical challenges and complications that are associated with rigid esophagoscopy.¹⁻⁴ An alternative to TEP with rigid endoscopy is the use of oral flexible esophagoscopy, but this technique requires intravenous sedation to reduce the discomfort caused by oral insertion of the large-caliber (9.8-12.3 mm) esophagoscope for visualization during the procedure.^{5,6} Tracheoesophageal puncture with

transnasal esophagoscopy (TNE) has the same advantages and functions of a flexible esophagoscope; however, the smaller-caliber (5.1-5.3 mm) scope and the transnasal route allow esophagoscopy to be performed without the need for intravenous sedation, using only local anesthesia. We describe our experience with TNE and placement of a TEP prosthesis as an office-based procedure using only local anesthesia. Our aim was to determine the efficacy and outcomes of the procedure, complications rate, and speech-related outcomes, with TE speech as the primary form of communication and TE speech intelligibility.

METHODS

A retrospective chart review of patients who underwent TNE-assisted TEP at Louisiana State University Health Sciences Center, New Orleans; Our Lady of the Lake Regional Medical Center-Voice Center, Baton Rouge, Louisiana; and The University of Texas M. D. Anderson Cancer Center, Houston, from January 2004 to December 2008 was conducted as an institutional review board-approved study. Any patients who underwent TNE-assisted TEP placement at those institutions between January 2004 and December 2008 were included in the study. The patients' charts were reviewed by both medical and speech doctorates to document answers to clinical questions regarding the ease, efficiency, and complications of the procedure as well as to evaluate communication-related outcomes. Communication outcomes, which were assessed by a speech pathologist (M.K., J.S.L., K.A.H., or D.A.B.) at the patient's last follow-up visit before disease progression, included speech intelligibility that was rated categorically according to the Performance Status Scale for Head and Neck Cancer (PSS-HN) Understandability of Speech Subscale (100 indicates understandable all the time; 75, understandable most of the time, occasional repetition necessary; 50, usually understandable, face-to-face contact necessary; 25, difficult to understand; and 0, never understandable, may use written communication)⁷ and primary means of communication (TE voice, gestures, and handwriting or artificial larynx).

SURGICAL TECHNIQUE

A witnessed informed consent that discussed the advantages, disadvantages, alternatives, and potential complications that included but were not limited to pain, bleeding, infection, esophageal perforation, failure of the procedure, and need for further or repeated procedures was obtained from the patients. The procedure was performed with the patient in a sitting position in a procedure room.

PROTOCOL FOR LOCAL ANESTHESIA

Oxymetazoline hydrochloride (Neo-Synephrine) and tetracaine (Pontocaine) were sprayed into the most patent nare. Up to 1.0 mL of lidocaine, 1%, with a 1:100 000 solution of epinephrine was injected into the posterior tracheal wall at the intended TEP site via the permanent tracheostoma. Pledgets soaked in lidocaine, 4%, or lidocaine jelly, 2%, were placed in the nasal cavity. Ten minutes were allowed to elapse to achieve optimal anesthesia. The distal aspect of the TNE was coated with viscous lidocaine jelly, 2%, before insertion. The steps of the procedure are described in detail in the **Figure**. The technique can also be supplemented using a Seldinger technique with a needlestick and guidewire-assisted placement of a dilator followed by placement of the red rubber catheter.

- The flexible endoscope is advanced through the most patent nostril into the nasopharynx, which is then examined for strictures, masses, and ulcerations as well as symmetrical palatal elevation.
- The scope is then advanced into the oropharynx, past the base of the tongue, and into the hypopharynx to reach the upper esophageal inlet; the anatomical subsites are evaluated for the presence of abnormal masses and for function.
- At this point, the patient is asked to flex his or her head anteriorly and to swallow to assist in the advancement of the scope into the esophagus.
- The length of the esophagus is examined under direct visualization, and operative view is maintained by air insufflation as needed; for this indication, the lower esophageal sphincter is considered to be the lower extent of endoscopy.
- The endoscope is slowly withdrawn until the light at the tip of the scope transilluminates the desired site of puncture on the anterior esophageal wall.
- The scope can be further used to confirm appropriate selection of the TEP site by visualization of the indentation of the posterior tracheal wall by ballottement.
- A No. 11 blade is then used to incise the posterior tracheal wall through the previously injected site; the esophageal lumen is entered under direct visualization followed by hemostat dilation of this puncture site.
- A dilator is introduced to stretch the new TEP site and is then removed.

Figure. The surgical procedure of transnasal esophagoscopy for placement of secondary tracheoesophageal puncture (TEP).

STATISTICAL ANALYSIS

Descriptive statistics for scaled values and frequencies of study patients within the categories for each of the parameters of interest were enumerated with the assistance of commercial statistical software. Correlations between parameters and end points were assessed by a Pearson χ^2 test or, where there are fewer than 10 subjects in any cell of a 2×2 grid, by the 2-tailed Fisher exact test. These statistical tests were performed with the assistance of a Statistica statistical software application (StatSoft Inc, Tulsa, Oklahoma).

RESULTS

A total of 39 patients met the criteria for inclusion in the study. The average age was 65 years (age range, 47-83 years). Thirty-two (82%) were male and 7 (16%) were female. Squamous cell carcinoma was the most common histologic diagnosis ($n=35$ [90%]), followed by papillary thyroid carcinoma ($n=3$) and spindle cell carcinoma ($n=1$). Of 27 patients for whom clinical T staging was recorded, 10 (37%) presented with early T-stage disease (T1-2) and 17 (63%) presented with advanced T-stage disease (T3-4). Eighteen of the 39 patients (46%) underwent radiation therapy before surgical treatment. Total laryngectomy was the most common surgical procedure ($n=25$). The types of surgical procedure, the closure technique to recreate the neopharynx, and the clinical and demographic data are presented in **Table 1**.

OUTCOMES OF THE TECHNICAL PROCEDURE

The overall success rate of secondary TNE-assisted TEP placement was 97% ($n=38$), with 1 unsuccessful attempt. There was no statistically significant correlation found between receiving radiation therapy (either before or after oncologic resection) or having a cricopharyngeal myotomy and a successful TEP placement, difficulty in placing the TEP, complications associated with

Table 1. Demographic and Clinicopathologic Data (N=39)

Variable	No. (%)
Histologic diagnosis	
Squamous cell carcinoma	35 (90)
Papillary thyroid carcinoma	3 (8)
Spindle cell	1 (3)
Site	
Hypopharynx	6 (15)
Larynx	19 (49)
Thyroid	3 (8)
Subglottis	1 (2)
Unknown	10 (26)
Staging	
TX	1 (2)
T1	6 (15)
T2	4 (10)
T3	5 (13)
T4	12 (31)
Not recorded	11 (28)
Salvage vs primary	
Primary surgery	13 (33)
Salvage after radiation therapy	18 (46)
Salvage after chemotherapy and radiation therapy	5 (13)
Salvage after previous surgery	3 (8)
Surgery	
Total laryngectomy	25 (64)
Total laryngectomy with partial pharyngectomy	8 (21)
Total laryngopharyngectomy	5 (13)
Unknown	1 (2)
Neck dissection	
Yes	26 (67)
No	6 (15)
Unknown	7 (18)
Closure/reconstruction	
Primary closure	19 (49)
Pectoralis major myocutaneous flap	2 (5)
Unknown	4 (10)
Free flap	
Radial forearm	5 (13)
Anterolateral thigh	8 (21)
Unspecified	1 (2)

TEP, using the TEP prosthesis, and speech intelligibility at the last follow-up visit ($P > .05$). Seventeen patients (44%) had undergone previous TEP. They required a second puncture for reasons that varied from accidental extrusion of the prosthesis to enlarged fistula formation. Technical difficulty in performance of the puncture was encountered in 6 patients owing to scar formation ($n=4$), nasopharyngeal stenosis ($n=1$), and cervical esophageal stenosis ($n=1$), with an aberrant course of the cervical esophagus that was difficult to cannulate ($n=1$). There were no major complications associated with TNE-assisted TEP placement (**Table 2**). After TEP, the average length of time to placement of TEP prosthesis was 4.3 days. At the institutions where these procedures took place, the speech pathologists prefer delayed placement of the TE voice prosthesis to allow the TE tract to mature and to decrease the incidence of resizing of the prosthesis. The prosthesis can safely be placed at the time of the puncture in some patients at the discretion of the surgeon and the speech pathologist.

Table 2. Secondary Tracheoesophageal Puncture: Outcomes Data

Variable	Yes	No
Successful placement, No. (%)	38 (97)	1 (3)
No. of complications during placement	0	39
Graded as difficult by surgeon, No. (%)	7 (18)	32 (82)

Table 3. Speech Outcomes at Last Clinic Visit for 31 Patients Using Tracheoesophageal Puncture as the Primary Mode of Communication

PSS-HN Understandability of Speech Subscale Score	No. (%)
100	20 (64)
75	8 (26)
≤50	3 (10)

Abbreviation: PSS-HN, Performance Status Scale for Head and Neck Cancer (100 indicates understandable all the time; 75, understandable most of the time, occasional repetition necessary; 50, usually understandable, face-to-face contact necessary; 25, difficult to understand; and 0, never understandable, may use written communication).

FUNCTIONAL (TE SPEECH-RELATED) OUTCOMES

Thirty-one of the 39 patients (79%) were still using their TEP for speech, and 20 of these 31 patients (64%) were rated as understandable all the time (PSS-HN Understandability of Speech Subscale score, 100) by a speech pathologist at their last clinic visit (**Table 3**). The average length of follow-up since TEP prosthesis placement in our study was 7.5 months (range, 5-43 months). Eight patients were not using their TEP for speech: 2 used the artificial larynx, and 6 depended on writing and gestures as their primary means of communication.

COMMENT

Multiple studies have proved that TEP is an excellent means of restoring voice in patients after laryngectomy, with success rates of 80% to 92%.⁸⁻¹¹ Primary TEP is the preferred option at most institutions. However, some patients are not good candidates for primary TEP. Patients who have been heavily irradiated, have had complex or bulky reconstructions (often with separation of the common parting wall), or have other risk factors that may be considered contraindications to primary puncture are better treated with secondary TEP. Transnasal esophagoscopy-guided TEP placement is a relatively new procedure, and there are few studies that have addressed this subject. In 2007, Doctor¹² published a study involving 11 patients that reported a success rate of secondary TNE-assisted TEP placement of 91%. To our knowledge, no study using TNE-assisted TEP placement has investigated the role of previous radiation therapy or complex reconstruction with myocutaneous or free-tissue transfer reconstruction of the neopharynx and successful secondary TEP.

In our study, 97% of patients underwent successful TNE-assisted TEP placement. The 1 unsuccessful attempt at TEP placement was the first attempt by the surgeon with this technique, and the patient subsequently underwent uneventful traditional flexible esophagoscope-guided TEP placement. This unседated TNE method also avoids several of the reported complications of traditional secondary TEP, such as trauma to the lips and teeth and mucosal lacerations, which have been reported to occur in as many as 7% of cases.¹³ The transnasal route of flexible esophagoscopy also offers an additional advantage to surgeons who routinely conduct flexible fiberoptic laryngoscopy but not flexible esophagoscopy owing to the similarity of technical skills that are required to perform both transnasal laryngoscopy and TNE.

We evaluated factors that could influence TEP outcomes. Of note, in our series, the type of reconstruction that we used to close the pharyngeal defect demonstrated no statistical difference in the success rate of TNE-assisted TEP placement. Although more than one-third of the patients (n=14) underwent total laryngectomy with microvascular reconstruction, there were no complications associated with placement of the prosthesis in this setting. The only difficulty with TNE-guided TEP placement was adequate transillumination of the TEP site through a bulky anterolateral thigh flap. However, this difficulty in visualization did not result in a worse outcome for the patient. The use of the Seldinger guidewire technique in these more challenging cases allows safe TEP. Furthermore, there was no statistically significant correlation found between the patient having undergone previous radiation therapy (either before or after oncologic resection) or a cricopharyngeal myotomy and successful TEP placement, difficulty in placement of the TEP, development of complications associated with performance of TEP, use of the TEP prosthesis, or speech intelligibility at the last follow-up visit ($P > .05$).

Restoration of speech in patients who have undergone a laryngectomy is a major concern for both the otolaryngologist and the patient and can be achieved through several different techniques that vary from TEP placement to use of an artificial larynx. Consequently, speech-related outcomes in patients undergoing TNE-assisted TEP placement is an important end point. A study published from Memorial Sloan-Kettering Cancer Center, New York, New York, analyzed 36 patients who underwent primary TEP and 14 patients who underwent secondary TEP. The investigators found that nearly 80% of patients who underwent primary TEP had excellent voice quality, while only 50% of patients who underwent secondary TEP achieved the same results.⁹ Although our study used a different grading system, at the last follow-up visit 79% of the patients were using TE voice for primary communication, and most of them (64%) were rated understandable all the time (PSS-HN Understandability of Speech Subscale score, 100).

The reasons for TE speech failure were varied and included cognitive limitations, noncompliance with recommended TEP follow-up appointments, recurrence immediately after TEP, difficulty occluding the stoma owing to irregularity, and persistent leakage through the prosthesis. Only 1 patient, the patient with cognitive limita-

tions, failed to receive pre-TEP evaluation by a speech pathologist, demonstrating the benefit of multidisciplinary input. Speech pathologists routinely performed objective air insufflation testing before secondary TEP, with good prediction for TE speech fluency. Patient compliance, refractory leakage through prostheses, and cancer recurrence are difficult to predict. Therefore, 3 of the patients who were identified as good candidates for TE speech restoration failed as a result of problems unrelated to TE speech fluency. One of the 3 patients who were unable to achieve good speech had problems with digital occlusion of the stoma because it was deep-seated and irregularly shaped; however, it was a postoperative anatomical finding that was unrelated to the TEP itself. The patient was offered prosthetic^{14,15} or surgical¹⁶ correction but refused.

Despite the high incidence of previous irradiation and the frequent flap reconstruction of the neopharynx, our TE speech outcomes with TNE-assisted TEP placement are comparable to or better than the previous reports that have documented 50% to 75% successful voice restoration after secondary TEP, which was traditionally performed in the operating room.^{9,17-20} Scar formation and difficulty of puncture did not correlate with successful voice or use.

There are several limitations to our study such as its retrospective nature and a relatively small sample size. We also expect that the results might have been influenced by the variability of operative techniques among surgeons based on surgical experience and individual techniques.

In conclusion, secondary TNE-assisted TEP placement is an effective means to restore speech after total laryngectomy without exposing the patient to the risk of anesthesia or traditional secondary TEP placement using rigid esophagoscopy. The risk of complications is low, and this technique can be used in a wide variety of patients, including those who have undergone previous radiation therapy or free-tissue transfers for pharyngeal closure.

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