Management of Aphonic Patients following Total Laryngectomy and Trachea Esophageal Puncture

Limor Benyamini MD MSc, Ziv Gil MD PhD and Jacob T. Cohen MD

Department of Otolaryngology Head and Neck Surgery, Rambam Health Care Campus, affiliated with Rappaport Faculty of Medicine, Technion-Israel Institute of Technology, Haifa, Israel

ABSTRACT: **Background:** Trachea esophageal puncture (TEP) is performed following total laryngectomy to allow speech and communication. The most common reason for long-term speech failure in this population is hypertonicity of the constrictor muscle.

Objectives: To present our experience with the treatment of aphonic patients after total laryngectomy and TEP and suggest a protocol for treatment.

Methods: Of 50 patients who underwent total laryngectomy and TEP, 6 suffered from aphonia after surgery. All patients underwent radiotherapy with or without chemotherapy. Delay in speech continued for more than 6 months after surgery. The patients received percutaneous lidocaine injection to the neopharynx in different locations around the stoma in order to map the hypertonic segments in the neopharynx.

Results: Lidocaine injection immediately enabled free speech in five patients. One patient (patient 6) suffered from aphonia and from severe dysphagia and required a feeding tube. This patient succeeded to pronounce abbreviations after lidocaine injection. Another (patient 4) gained permanent ability to speak following a single lidocaine injection; this patient was not injected with botolinium toxin (BTX). For the other five, lidocaine had a transient effect on speech. These patients received BTX percutaneous injections. After BTX injections four regained free speech within 14 days. The fifth patient (patient 6) gained a conversational voice and his swallowing improved only after additional intensive speech therapy.

Conclusions: Percutaneous lidocaine and BTX injections represent first-line treatment in this population, with good success and minimal complications.

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KEY WORDS: laryngectomy, trachea esophageal puncture (TEP), voice, Botulinum toxin type A (BTX), botox, lidocaine

Most defects that present after total laryngectomy are closed primarily to create a neopharynx from the base of the tongue to the cervical esophagus. The reconstructed pharynx and the cricopharyngeal muscle constitute the pharyngoesophageal (PE) segment. Vibration of this segment is important in tracheoesophageal speech after total laryngectomy [1]. Failure of tracheoesophageal speech can be attributed to persistent tumor, scarring, and radiation fibrosis. Voice restoration by tracheoesophageal puncture (TEP) and insertion of a one-way valve is currently performed in most patients who undergo laryngectomy [2]. The TEP is performed either as a primary procedure during total laryngectomy or as a secondary procedure after total laryngectomy [3]. The most common cause for trachea esophageal speech failure is hypertonicity, spasm or uncoordinated muscle activities of the constrictor muscle and the neopharynx [4]. This can be partially explained by a reflex caused by the airflow in the neopharynx that restricts the egress of air from the esophagus, resulting in TE speech failure [5-7]. Reported incidence rates of tracheoesophageal voice failure due to pharyngoesophageal spasm vary considerably, from 7 to 79% [2,6,8].

Hypertonicity of the neopharynx has been traditionally managed with mechanical dilation, cricopharyngeal myotomy, or pharyngeal plexus neurectomy [1]. Controversy regarding the role of PE spasm in TE speech failure has largely dissipated with the demonstration of effective restoration of speech by means of chemical denervation of this segment. The possibility of chemical denervation of the pharyngeal constrictor muscles with botulinum toxin has been explored as a means to enable a fluent voice without the potential complications of a surgical procedure [2]. Botulinum toxin type A (BTX) blocks the release of acetylcholine at the neuromuscular junction and subsequently prevents neuromuscular transmission [8]. The effect of BTX is temporary, with return of nerve impulse transmission and normalization of muscle function occurring several weeks to 9 months after the initial injection [1,9]. We report here the use and effectiveness of lidocaine injection for evaluation and mapping prior to BTX injections to treat aphonia following laryngectomy and trachea esophageal puncture.

PATIENTS AND METHODS

Of 50 patients who underwent total laryngectomy and TEP and are followed in our outpatient clinic, 6 failed to achieve speech (complete aphonia). Four patients had primary TEP and two had secondary TEP. All six also underwent radiotherapy or chemoradiation. Of the six patients, one was injected with lidocaine only and five were injected with lidocaine and later with BTX.

The age range of the five patients injected with BTX, four men and one woman, was 39 to 70 years. Follow-up time was 6–8 months. Complete aphonia did not resolve in these patients despite intensive speech therapy. Patient characteristics are listed in Table 1.

All six patients had a normal physical examination and a negative imaging (positron emission tomography and computed tomography), ruling out tumor recurrence or persistence. All were evaluated with a tracheoesophageal insufflation test in the form of 30 ml of air injection through the TEP. While under air insufflation the patients were asked to produce voice. Producing voice indicated a positive test. The six patients who could not speak (negative insufflation test) comprised the study group.

LIDOCAINE INJECTION TEST

Percutaneous lidocaine injection (2 ml of lidocaine 2%) was administered to further evaluate the condition of hypopharyngeal hypertonicity and to map the area of muscle spasm for subsequent BTX injections. Lidocain 2% was injected subcutaneously to the neopharynx in an arc-shaped line superior to the tracheostoma. Figure 1 shows the injected area. After every lidocaine injection (maximum 10 injections) the patients attempted to phonate. Every site of injection that improved the voice was marked with an indelible pen. Patients with a positive lidocaine injection test (i.e., produced speech) were referred for a BTX injection.

BTX INJECTION

The patients underwent subsequent percutaneous BTX injections within 7–14 days of the lidocaine injection (BOTOX 100® Botulinum toxin type A, ALLERGAN, UK). Those who acquired speech that lasted > 7 days did not receive BTX injections. BTX was reconstituted in 5 ml of normal saline, yielding a concentration of 20 units/ml of normal saline. This was then equally distributed into five insulin syringes. BTX was injected according to the pen marks on the skin, which indicated improved speech following the lidocaine injections.

RESULTS

For five patients with aphonia, lidocaine injections resulted in immediate ability of free speech. One patient (patient 6) with aphonia and severe dysphagia required a nasogastric tube. This patient succeeded to pronounce abbreviations after the lidocaine injection. Another patient (patient 4, Table 1) gained permanent ability to speak following a single lidocaine injection, which was maintained throughout the follow-up period (> 6 months from the injection). This patient was not treated with BTX. For the other five patients a transient improvement in speech was observed following lidocaine injections, which waned within 1 hour of the injection. These patients were referred for BTX treatment. The sites of the BTX injections were determined by the sites of improvement following the lidocaine injections.

Patients 1 and 2 [Table 1] received 35 units of BTX injection, which did not improve their voice. They underwent another two injection sessions for a total of 100 U within 3 weeks. Patients 3 and 5 [Table 1] had very long-lasting aphonia. After one injection session of 100 U of BTX, they gained a conversational voice. Patient 6 gained a conversational voice and

Table 1. Characteristics of patients with complete aphonia, following total laryngectomy and trachea esophageal puncture, and injection details

Patient	Disease stage	Surgical procedure	RT and/or CRT	Duration of aphonia (months)	Lidocaine	BTX	No. of BTX injections
1	$T_4aN_0M_0$	Total laryngectomy, bilateral lateral ND and secondary TEP	RT	6	+	+	3
2	$rT_3N_0M_0$	Salvage total laryngectomy, bilateral lateral ND with pectoralis major flap and secondary TEP	CRT	17	+	+	3
3	$T_3N_0M_0$	Total laryngectomy and primary TEP	RT	42	+	+	1
4	$rT_4N_0M_0$	Salvage composite resection* and total laryngectomy with lateral thigh free flap and primary TEP	RT	6	+	0	0
5	$T_4N_0M_0$	Total laryngectomy, bilateral lateral ND and primary TEP	RT	24	+	+	1
6	$rT_4N_2cM_0$	Salvage total laryngectomy, bilateral lateral ND with pectoralis major flap and primary TEP	CRT	6	+	+	1

Total dose = 100 U
*Due to stomal recurrence with skin and tracheal involvement
BTX = botox, TEP = trachea esophageal puncture, ND = neck dissection, RT = radiotherapy, CRT = chemoradiotherapy

Figure 1. Marked area after lidocain injection

experienced improvement in swallowing only after additional intensive speech therapy.

The treatment was well tolerated and no complications or adverse reactions were observed immediately after treatment or throughout the follow-up period. One patient required a second injection of BTX 5 months after the first treatment due to deterioration of his voice quality. All the patients achieved a conversational level of TEP voice and by the end of 6–8 months of follow-up were using their valve voice as their only means of communication.

DISCUSSION

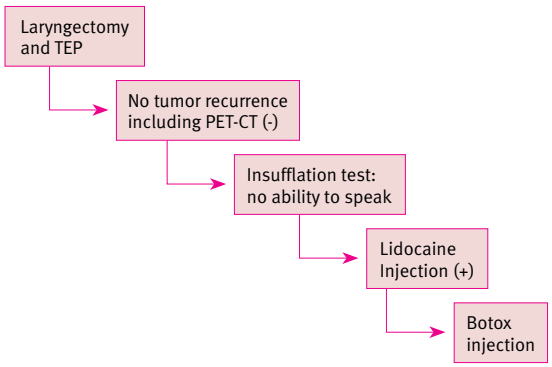
The effects of BTX on muscle contraction and spasm have long been recognized. Hypertonicity as a cause of aphonia post-laryngectomy and TEP was treated primarily by surgery until it was discovered that BTX could be used for neopharyngeal spasm.

This report describes the treatment of five aphonic patients with BTX. Two received three injection sessions within 3 weeks to produce fluent speech and three received one injection. All five reached the total amount of 100 U. We assume that the need for multiple injections was the result of a low dosage in every injection. The patient who received a larger dose of BTX (100 U) tolerated the treatment well and did not require further treatment.

We record for the first time the treatment of aphonia following lidocaine injection. This patient, who had recurrent T4 squamous cell carcinoma of the larynx, required total laryngectomy and free flap reconstruction due to tumor infiltration to the skin. He regained fluent TE speech after the lidocaine injection and did not require BTX treatment. We speculate that the temporary relaxation of the constrictor muscles allowed this patient to train and adapt to TE speech and that this experience with local muscle relaxation enabled him to maintain the ability to speak. Hence we recommend that first-line therapy comprise lidocaine injection, not only for mapping of the spastic region but also to enable easy training of TE speech, which can result in permanent gain of sound, obviating the need for BTX treatment.

The technique of TE speech is different from laryngeal speech and must be learned. Figure 2 summarizes our suggested protocol for treatment of aphonic patients after total laryngectomy and TEP. Patients should be evaluated for all other causes of failed speech, especially tumor recurrence. They should then be evaluated by a speech pathologist and undergo an insufflation test. Those with a negative insufflation test result should receive a lidocaine injection and mapping of the affected area. Patients who produce transient gain of speech after lidocaine injection should be offered BTX treatment. Those who maintain good quality of speech after a lidocaine injection do not need further therapy. Lidocaine injection is a simple and safe technique and the possibility of repeat application makes it an attractive option for this population.

Figure 2. Suggested protocol for treatment of aphonic patients after total laryngectomy



PET-CT = positron emission tomography and computed tomography

Correspondence
Dr. L. Benyamini
Dept. of Otolaryngology Head and Neck Surgery, Rambam Medical Center, Haifa 31096, Israel
email: l_benyamini@rambam.health.gov.il

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"Flags are bits of colored cloth that governments use first to shrink-wrap people's brains and then as ceremonial shrouds to bury the dead"

Arundhati Roy (born 1961), Indian author and political activist best known for the 1998 Man Booker Prize for Fiction-winning novel *The God of Small Things* (1997) and for her involvement in human rights and environmental causes