Chapter 5

The Role of Esophagus in Voice Rehabilitation of Laryngectomees

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Additional information is available at the end of the chapter

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Abstract

The total laryngectomy is a standard procedure of laryngeal carcinoma treatment which leaves multiple persistent consequences on a laryngectomized person. After laryngectomy, all of patients cannot speak loudly, and 10–58% patients have a dysphagia. In such changed anatomical condition, the esophagus has a key function in two of three primary approaches to voice—speech rehabilitation of laryngectomized patients: esophageal and tracheoesophageal speech therapy method because one of these is the only acceptable solution of substitute alaryngeal speech. In esophageal speech, the esophagus has the role of speech air reservoirs since the respiratory and digestive pathways are permanently separated after the procedure. In the production of tracheoesophageal speech, the tracheoesophageal fistula and the esophagus allow the recommunication of these pathways and the use of air from the lungs for speech. There are several prerequisites for successful esophageal and tracheoesophageal speech. After tracheoesophageal puncture and insertion, the tracheoesophageal prosthesis may occur different complications in the early or late postoperative period in 10–60% of patients. The quality of alaryngeal voice is very different from the quality of laryngeal voice, but allows communication to laryngectomees.

Keywords: esophageal speech, laryngectomy, tracheoesophageal speech, voice prosthesis, voice rehabilitation

1. Introduction

The esophagus is a long, flexible muscular tube that starts as the continuation of the pharynx with the upper esophageal sphincter and ends with the lower esophageal sphincter as the junction with the stomach. Topographically, it is divided into three regions: cervical, thoracic and abdominal [1].

The function of the upper esophageal sphincter is to prevent breathed air from entering into the esophagus and to stop reflux of esophageal content into the pharynx to prevent airway aspiration, and the function of lower esophageal sphincter is to prevent gastroesophageal reflux.

The function of the esophagus is very simple: to actively transport solids and liquids from the pharynx to the stomach. It has no digestive, absorptive, metabolic, or endocrine functions, but in some people, esophagus takes another very important function [2]. These people are laryngectomized persons. Namely, after total laryngectomy, the lower respiratory tract is permanently separated from the upper respiratory tract. The breathing function begins and ends in the permanent tracheostoma, and the upper respiratory tract loses its function [3]. In such anatomical condition, the esophagus has a key function in two of three primary approaches to speech rehabilitation of laryngectomized patients: esophageal and tracheoesophageal speech therapy method. The upper part of the esophagus gets the function as some kind of air activator, and the pharyngoesophageal segment gets the function of the voice generator, thus allowing the function of the voice resonators.

2. Total laryngectomy

The standard options of laryngeal carcinoma treatment are surgery, radiotherapy, chemotherapy, or a combination of these modalities. When a conservation surgery is not indicated due to the tumor stage and localization, or due to patient's general medical condition, then total laryngectomy is considered. This surgical procedure implies a surgical removal of the entire larynx, from the hyoid bone to the second tracheal ring, and the lymph nodes on the ipsilateral or bilateral side. After removal of the larynx, the circular defect in the anterior wall of the pharynx is reconstructed and sutured to the base of the tongue. Inferiorly, resected distal part of trachea is brought forward and sutured to the skin edges forming permanent tracheostoma. Postoperative care after total laryngectomy includes nasogastric tube feedings and maintenance of tracheostoma. If the tracheostoma is satisfactory in size and shape, it is preferable not to use laryngectomy tube in the tracheostoma. Alaryngeal speech training may begin as early as 3 weeks after operation. Postlaryngectomy aphonia is one of the most devastating outcomes of total laryngectomy, and effective voice is critical to the successful prevention of psychological, social and economic consequences of totally laryngectomized individuals [4].

After total laryngectomy, there is a defect of hypopharynx that needs to be reconstructed. The base of tongue then makes anastomosis with neopharynx. Sometimes there is a retraction of the base of tongue, changed tonus of the pharyngoesophageal segment, an extension of a part of pharynx and esophageal stenosis, which can cause dysphagia in 10–58% of cases [5]. Reconstruction of the upper esophageal segment and the hypopharynx is essential for the swallowing function and alaryngeal phonation. In addition, radiotherapy and postoperative infection increases the risk of occurrence of scarring and stenosis of the oropharyngeal segment, causing dysphagia and odynophagia. Postoperative radiotherapy causes other problems such as reduced sense of taste, xerostomia, muscle fibrosis and tooth loss, which increases dysphagic disorders. Therefore, laryngectomees often need to modify their way of nutrition [6].

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2.1. Voice rehabilitation after laryngectomy

Total laryngectomy leaves a number of significant and permanent anatomic and physiological-functional changes. One of them is the impossibility of loud laryngeal speech. Laryngectomy is the removal of vocal cords which are the vibrating source of sound, and it causes changes in the anatomic structures of the resonator, whereas tracheotomy prevents the use of the lungs as a physiological source of energy for the phonation. Patient is temporarily socially deprived which diminishes the quality of life and brings with it the limitations in other life spheres. Postoperatively, achieved by rehabilitation, a future alaryngeal voice will be created in the area where esophagus transitions into hypopharynx, under the influence of the airflow that causes the mucosa vibration [5]. This area is called neoglottis or pseudoglottis, and it is a pharyngoesophageal segment, anatomical structure in the area of the upper aerodigestive tract [7].

Rehabilitation of voice after removal of larynx has been known for more than 150 years [8]. The first well-known description of the possible way of producing alaryngeal voice was given by Czermak in 1859. He established an alaryngeal voice by redirecting the airflow from the endotracheal tube through a tube into the mouth of the laryngectomized patient [9]. After Billroth performed his first laryngectomy in 1873, his assistant, Gussenbauer, equipped the patient with a pneumatic device which had the function of a speech machine [8, 10, 11]. In the mid-nineteenth century, rehabilitation was discovered by establishing an esophageal voice. At the same time, various mechanical devices were used to transmit vibrations and thus allowed loud speech [12, 13]. In the mid-twentieth century, the first tracheoesophageal fistula was made, which allowed the air stream to reach the upper part of the esophagus and the pharynx [14]. A few years later, a voice prothesis was developed according to the principle of a one-way permeable valve that allows the airflow from the trachea into the esophagus and prevents the passage of food and fluid from the esophagus into the trachea.

Back a few decades, the world trend is the earliest possible rehabilitation of voice and speech after laryngectomy. The beginning and type of rehabilitation depend on the health, psychosocial and socioeconomic status of the patient [15].

Patients have three methods of substitute voice and speech:

1. Production of tracheoesophageal voice by insertion of a tracheoesophageal prosthesis.
2. Production of an esophageal voice.
3. Use of mechanical generators of acoustic vibrations [16].

3. Esophagus and esophageal speech

3.1. History of the esophageal speech

The use of esophagus as a speech tank for the purpose of rehabilitation of laryngectomized persons first occurs during the nineteenth century. In 1909, Gutzmann called this rehabilitation

method an esophageal speech [17]. The method is the most natural way for the laryngectomized persons to have the alaryngeal phonation, which has made it the most commonly used method for many years. Although satisfying a number of factors is a prerequisite, Seeman considers the appropriate level of motivation to be the key factor for mastering the esophageal speech, and that most motivated patients successfully adopt this mode of substitution [17].

3.2. Prerequisites for successful esophageal speech

This method creates a new air reservoir used for speech within the esophagus of a lower capacity than the physiological one, which is the source of the sound wave. The capacity of the upper part of the esophagus after surgery is 60–80 ml of air [18], and the sound wave is generated by vibrations of the pharyngoesophageal segment in neoglottis, which allows the production of the esophageal voice. The exact localization of the pharyngoesophageal segment vibrations differs from author to author, and vibrations are possible from the base of the tongue to the upper esophageal sphincter, but most authors suggest that the most common vibrations of the pharyngoesophageal cavity vibration are at the level of the fifth, sixth and seventh cervical vertebrae, while Seeman feels that vibrations are at the level of the cricopharyngeal muscle at the height of the fifth cervical vertebra or where the pharyngoesophageal obstruction is the greatest [17].

In order for alaryngeal phonation to be possible (production of speech without the larynx), an appropriate tonus of pharyngoesophageal segment, more precisely the cricopharyngeal muscle, is needed. In determining the degree of tonus available, today there are two evaluation tools:

- Taub's insufflation test.
- Modified Taub's test.

When using Taub's Insufflation Test, the examiner places the nasal catheter into the esophagus, using the Polyzer balloon to insufflate the air to the catheter. If the tonus is appropriate, the patient will be able to phonate, and the test will then record a positive result. The reference limit of the phonation pressure is 22 mmHg, which allows the 10 s alaryngeal phonation, or speech production in the range of 10–15 syllables in one inspiration. The phonation pressure is measured with a manometer. In cases where there is hypertonicity, the patient is not able to produce an alaryngeal voice, and the test registers a negative result [19].

The self-blowing test (modified Taube test) has been used for 33 years and was invented by Blom and Singer. The difference is that the other end of the nasal catheter is introduced into the tracheostoma and in this way allows an independent insufflation of the air from the tracheostoma to the esophagus. The result is recorded as positive when the patient can alaryngeally phonate for at least 8 s [20].

The negative result in these tests indicates undesirable hypertonicity of the muscle which prevents the phonation, and requires surgical intervention in the form of cricopharyngeal myotomy [20]. Muscle hypotonicity is also undesirable because it may interfere with alaryngeal

phonation, but it often results in a very weak intensity of the alaryngeal voice. As the voice of low intensity does not meet the daily communication requirements, the hypotonicity can be compensated by external compression or surgical intervention.

In addition to the appropriate muscular tonus of the pharyngoesophageal segment, the person who will be rehabilitated with the esophageal speech must have a satisfactory level of certain cognitive abilities. Considered among the most important cognitive abilities are the appropriate intellectual status and the motivation of a person, but the conative factors are also significant. When choosing modality, psychosocial and socioeconomic factors are also important. The person who will learn the esophageal speech should be highly motivated for the process of rehabilitation, be patient enough, cognitively superior, and live in an empathetic and supportive family and social environment. Socioeconomic status should be as high as necessary for regular attendance at a speech-language therapy in continuity. Regarding the health status, people who will learn the esophageal speech should be of a good general health and somatic status, and the primary disease should be under good local control, which means removing any suspicion of local recurrence. Certainly, a significant influence on the possibility of this modality has the auditory status of the patient, and the level of hearing should be appropriate to the chronological age of the person, at the hearing level of 20–55 dB [5]. Any hearing impairment above 55 dB affects the communication function significantly and disables the adequate reception of the information from the speech-language therapist, thereby making it difficult and slowing down the process of rehabilitation.

Doyle classified contraindications for the learning of the esophageal speech in four categories [17, 21, 22]:

1. Certain physical factors
   - local recurrence of illness.
   - extensive reconstruction operation.
2. Certain psychological status
   - the presence of psychological problems and psychopathology.
3. Socioeconomic factors
   - inability to attend a therapy at least three times a week.
4. The necessity of speaking
   - immediately after laryngectomy, the necessity to speak loudly for a certain reason.

3.3. Functional features of the esophageal speech

The acoustic parameters of the esophageal voice in the literature vary depending on the researchers, the selected research method, the measuring instrument, the measuring criteria, the sample of subjects, and the environmental and computer program conditions in which the measurement was performed. The fundamental frequency, or the height of the esophageal

voice, is reduced, the frequency range is reduced, and the acoustic parameters determining the timbre of the voice also differ significantly from the regular laryngeal voice [5, 23, 24]. Such values of acoustic parameters form a rough and breathy voice, subjectively experienced. In addition, the time for turning on the voice is prolonged and the maximum time of the phoning is significantly reduced. According to prosodic features, the melody of the esophageal voice is more uniform and variable, lexical stress is not realized or is partially realized, frequent undesirable respiratory pauses are often present and the tempo of speaking is slower [5].

Sociofunctional features of the esophageal voice, which also make the advantage of this rehabilitation modality are: both hands free during speech and being less noticeable to the environment during speech, spontaneous and natural way of alaryngeal speech without additional surgery and insertion of foreign bodies, independence of prosthetic aids, the ability to speak without high consumption of material resources. On the other hand, the features that make up its shortcomings are: long periods of rehabilitation, lack of regular and continuous attendance at rehabilitation, discontinuous speech and additional undesirable noise during speech, especially tracheal noise during inspiration, which interfere with the intelligibility of the pronounced words [25].

3.4. Rehabilitation: educational process of learning the esophageal speech

The rehabilitation and education process starts with an individual preoperative counseling and patient preparation for a postoperative rehabilitation. A duration of the preoperative patient preparation varies depending on the individual's needs. During this period, the patient is given education on all the consequences of tracheotomy and total laryngectomy, pulmonary and speech aids for laryngectomized persons and modalities of speech-language rehabilitation. In addition, an oncological team of experts together with the patient decides on a single rehabilitation method.

The onset of postoperative speech-language therapy depends on a number of factors, such as further oncological treatment (primarily the need for radiotherapy), general health condition, psychological condition, and neuromotor capabilities of the patient. The optimal time to start postoperative rehabilitation is considered 40 days (approximately 6 weeks after surgery) unless postoperative radiotherapy is indicated [26]. However, Remacle and Demard state that rehabilitation can be started earlier, immediately after cicatrization, usually 3 weeks after the operation [17]. If postoperative radiotherapy is indicated, rehabilitation is delayed as long as acute consequences of radiation that hamper the process of rehabilitation are present. Of course, rehabilitation should begin within 6 months of surgery [26]. The total duration of rehabilitation is different and individual.

Early postoperative rehabilitation phase lasts 1 month from the onset of therapy, and primary focus of the therapy is on relaxation techniques and respiratory - rehabilitation operators in physiological breathing onto a tracheostoma to avoid, initially always present, tracheal noise at later phonation.

At this stage, the patient is also educated on how to achieve a ructus. Achieving a ructus is taught by two basic principles in one of three available methods. The first principle is based

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on the correct technique of injecting speech air into the esophagus, and the other is based on the proper technique of eructation of speech air. **Figure 1** shows the scheme of esophageal voice production.

There are several different methods of introducing speech air into the esophagus used in clinical speech therapy, namely: deglutition, inhalation, injection, blocking, Portman's, Tartapan's, and their combinations [5, 17, 22].

In 1900, Gottstein created and described the deglutition/swallowing method, and Gutzmann supplemented and propagated it. The method requires inserting the required air for the alaryngeal phonation according to the principle of swallowing or air ingestion as a bolus which causes eructation. This is considered the initial method because it allows a volitional ructus, but it affects the rhythm of speech and substantially slows it down, which is its disadvantage. As air swallowing, that is, "dry swallowing" is limited, it is recommended to consume the fluid during therapy [17].

In 1922, Seeman described the inhalation method, also referred to as aspirational or suctioning method. It requires a few swift inhalations that cause a sudden drop in intraoral pressure, which allows aspiration of air from the oral cavity into pharynx, and into the esophagus and relaxation of the pharyngoesophageal segment. When the pressures get equal, the air suction is stopped, the aspirated air is eructated and sounded through the pharyngoesophageal segment. Initially, the vocals are articulated, followed by the syllables made of a combination of gutural/h/ and vocals. Sometimes, the use of the method is followed by hyperventilation. There are several modifications of this method in the world.

The injectable or occlusive method was formed by collecting the experiences of patients who noticed that the easiest way for them to loudly articulate occlusives and syllables combined from occlusives and vocals is alaryngeally. The method requires sufficient pressure of the tongue which causes air compression in the oral cavity and pharynx and is injected into the

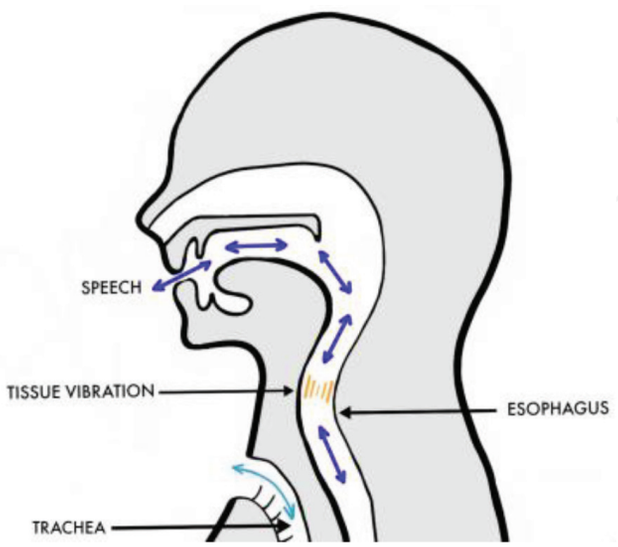

Figure 1. Esophageal voice production.

esophagus, and in the articulation of the labial, alveolar and guttural occlusive the air is liberated and affects the achievement of a satisfactory tonus of the pharyngoesophageal segment. In 1966, Diedrich and Youngstrom created a variation of this method by introducing certain modifications [17].

The blocking method was accomplished by performing several procedures of injectable method followed by specific articulator's movements and by changing the head position. The method involves injecting air from the oral cavity to the esophagus by lip occlusion causing anterior blockage with simultaneous posterior repositioning of the base of the tongue and inferior mandibular repositioning.

By combining several specific procedures from the deglutition and inhalation method, a new method was created by Portman, and was named after him as Portman's method. It requires a few fast-paced air inspirations that are followed by "edacious" deglutition of the air bolus to make speech air flow into the esophagus [22].

In addition, there is Tartapan's method, which is seldom used in clinical speech therapy practice, as well as other possible combinations of existing standard methods that are not specifically described.

4. Esophagus and tracheoesophageal speech

4.1. Tracheoesophageal puncture and tracheoesophageal prosthesis placement

Tracheoesophageal puncture is a surgical method of voice restoration after total laryngectomy that implies creation of a fistulous tract in tracheoesophageal wall—the wall that separates the trachea and esophagus, in the level of tracheostomy. This surgically created fistula which may be formed at the time of the total laryngectomy (primary tracheoesophageal puncture) or after the laryngectomized person has healed from surgery (secondary tracheoesophageal puncture). For satisfactory performance of the tracheoesophageal puncture, an adequate tracheostoma is preferable. The location of puncture is positioned in the midline, 5–10 mm below the mucocutaneous junction. A tracheoesophageal prosthesis is inserted into a fistula, as shown in **Figure 2** [4].

The prosthesis is an artificial device, mostly made of silicone. The purpose of the prosthesis, which is practically "one-way" valve is to allow air to be delivered from the lungs into the esophagus (**Figure 3**). At the same time, the leak of saliva and food in trachea is undesirable and prevented [27]. For this passage of air, good occlusion of the tracheostoma during phonation is necessary. During phonation, high intrathoracic pressure forces the valve to open and directs the air into the upper part of esophagus. Passing of this air into the pharynx and mouth produces vibrations in the mucosal wall of the pharyngoesophageal segment which generates sound. Resonation of the sound occurs in the pharynx, mouth and nose, with simultaneous articulation using the tongue, lips, and teeth.

The most important anatomical part responsible for alaryngeal voice formation is pharyngoesophageal segment. The vibrating pharyngoesophageal segment is the source of sound production and performs vocal cord function. The state of pharyngoesophageal segment made

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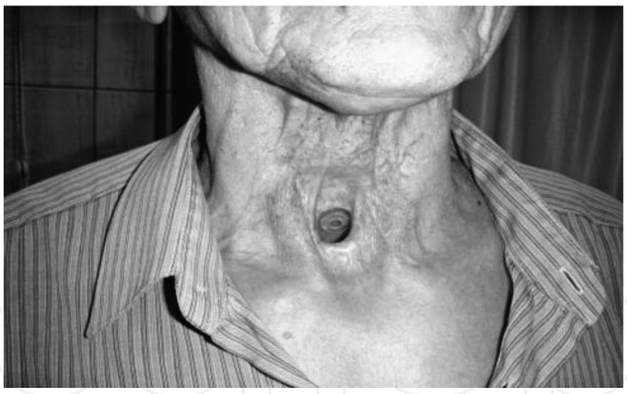

Figure 2. Tracheoesophageal fistula with inserted prosthesis.

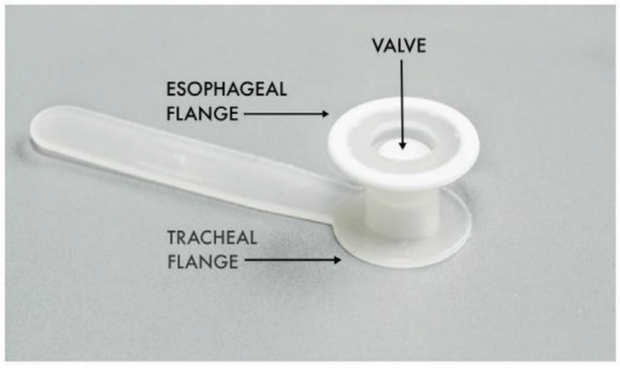

Figure 3. Tracheoesophageal prosthesis.

by the mucosa and surrounding fibers of the repaired cricopharyngeal, thyropharyngeal and the upper esophageal sphincter muscles is very important in voice production, and because of that it is important to preserve as much pharyngeal mucosa as possible at the time of laryngeal surgery [28]. Sometimes PE segment may be hypertonic, spastic or hypotonic. In case that hypertonicity or spasticity is a problem, cricopharyngeal myotomy, pharyngeal neurectomy, PES dilatation or botulinum toxin injection may be beneficial [29].

4.2. History of tracheoesophageal speech

The first experimental prostheses appeared in the second half of the last century, but due to initial structural defects, they could not be cleansed in detail from the secretion, resulting in an infection of the trachea and esophagus [30]. The first silicone tracheoesophageal prosthesis for commercial use was constructed in 1979 and its creators were Blom and Singer [31]. Due to its specific appearance, the prototype of the prosthesis was named duckbill. At the rounded esophageal end, an opening was located with the aim of one-way airflow from the trachea to the esophagus, and at the tracheal end, there was a rim with the extension and the possibility of sticking to the skin to prevent prosthesis from falling out. The second prototype of the prosthesis was created by introducing a one-way valve with a hinged door shape and reduced air resistance. The prostheses were built in secondarily, anterogradely through tracheostoma under general anesthesia. After this, other types of prostheses are created and developed, such as Hermann's prosthesis, Henley-Cohn's prosthesis, Staffieri's prosthesis, Traissac's prosthesis,

Nijdam's prosthesis, Ultra Voice prosthesis, Algaba prosthesis, and Provox prostheses [22]. The primary goal of the prosthesis development was to improve its structural and construction properties with the aim of achieving proper, safe and reliable use, adequate fixation of prosthesis within tracheoesophageal fistula, better prosthesis functionality in terms of low air resistance and greater resistance to fungal and bacterial infections. To date, different manufacturers' tracheoesophageal prostheses of perfected construction and design are available.

4.3. Prerequisites for successful tracheoesophageal voice and speech

The basic requirement for tracheoesophageal prosthesis is the absence of distant metastases or local recurrence [22]. The ability to produce tracheoesophageal voice implies the formation of tracheoesophageal fistula and the insertion of the prosthesis within the tracheoesophageal fistula, which is the surgical method of voice rehabilitation [5].

Andrews, according to Kazi, provides the following indicative criteria of patient's status for inserting the tracheoesophageal prosthesis: motivation, mental stability, sufficient level of comprehension and understanding of the changes in anatomy and functional mechanism of prosthesis and its use, appropriate manual and motor skills, the adequate vision status necessary for the maintenance of the prosthesis, the adequate tonus of hypopharynx, i.e., the absence of stenosis of the hypopharynx, the positive insufflation Taub's test, the tracheostoma of a neat appearance, i.e., the appropriate shape (minimum diameter of 15 mm) and depth, and sufficient lung capacity [32].

4.4. Functional characteristics of tracheoesophageal speech

The tracheoesophageal fistula allows communication between the trachea and esophagus, which is important for the speech because the patient uses the lungs as the air reservoir required for the phonation, which makes the speech more fluent [33], of more appropriate melody and pace with better achieved stresses and fewer respiratory pauses. Although, by acoustic measurements, the fundamental frequency is lowered, and the values of the parameters that determine the timbre are elevated, unlike the esophageal voice, the intensity or volume is greater, and the maximum time of the phonation is longer [5, 24]. If a tracheostoma is occluded manually, patient's hand will be occupied, but this is not necessary because an automatic speech valve can be used for occlusion. The advantage of this method is the duration of rehabilitation, which is considerably shorter than the esophageal speech learning process. The greatest disadvantages of the method are the need to replace prosthesis over a certain period of time and the possibility of developing various speech prosthesis complications or tracheoesophageal fistulas. The average life of the prosthesis is 3–6 months [34].

4.5. Rehabilitation: educational process of learning the tracheoesophageal speech

The rehabilitation process varies depending on the type of prosthesis insertion, whether it is primary, primary postponed or secondary, but the overall process lasts shorter than the esophageal speech learning process. During the tracheoesophageal voice production, it is necessary to occlude the tracheostoma. At the beginning of the rehabilitation, the tracheostoma is occluded with a non-dominant hand, usually by a thumb, to achieve the best occlusion. The complete occlusion of tracheostoma allows the air from the lungs to be directed through the

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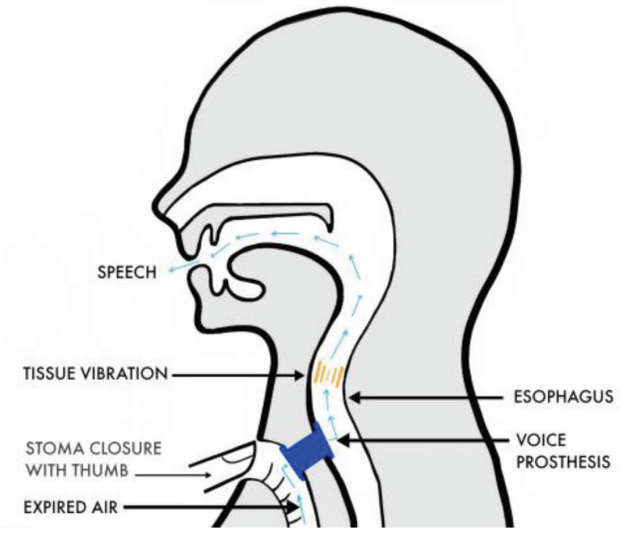

Figure 4. Tracheoesophageal voice production.

trachea and the esophagus into the oral cavity, thereby creating vibration of the pharyngo-esophageal segment and the production of tracheoesophageal speech, while simultaneously preventing undesirable tracheal noise. Rehabilitation begins with rehabilitation-methodical operators of relaxation of the whole body, especially the neck and head, and operators of proper, relaxed, alaryngeal phonation. Once a satisfactory tracheoesophageal phonation is established, the production of this voice articulates the syllables in a combination of silent guttural occlusive and a vocal and then all other sounds. When the patient successfully uses tracheoesophageal voice and speech on a daily basis as the only mean of communication, attention is paid to the details. In order to fix the lack of a free hand, an automatic speech valve is used. The automatic speech valve consists of a plastic casing inside which is located the membrane for controlling the flow of the economical amount of air and the filter for maintaining the temperature and humidity of the air [34].

Rehabilitation ends when a patient can produce spontaneous speech without significant difficulties, that is, when tracheostoma is well-occluded, a voice of satisfactory quality, speech is intelligible, and when the patient uses tracheoesophageal speech as the main mean of communication. **Figure 4** shows the scheme of tracheoesophageal voice production.

The assessment of the performance of voice-speech rehabilitation is performed using the Harrison and Robillard-Schultz scales for assessing tracheoesophageal voice and speech, including a sub-scale for assessing the maintenance of tracheoesophageal prosthesis [35].

4.6. Tracheoesophageal puncture and tracheoesophageal prosthesis complications

Complications may occur in the early or late postoperative period in 10–60% of patients [34, 36, 37] and may be divided into:

1. Complications of tracheoesophageal puncture.
2. Complications of tracheoesophageal fistula.
3. Complications of tracheoesophageal prosthesis.

Complications of tracheoesophageal puncture are complications resulting from the surgical procedure itself, and among them are tracheostoma of inadequate form, size and depth, inadequate tonus of the pharyngoesophageal segment (hypotonicity or hypertonicity) [38] and the formation of pseudoepiglottis or pseudo-vallecula [39].

Complications of tracheoesophageal fistula occur in later postoperative period, most commonly the same patient having several different complications. Among these complications are the atrophy of the tracheoesophageal wall, tracheal mucosa granulation, esophageal mucosa hypertrophy, increase in diameter of tracheoesophageal fistulae, dislocation of the voice prosthesis and leakage of the esophagus from the voice prosthesis into the trachea [40]. Inadequate size of voice prosthesis causes pressure on the esophageal and tracheal mucosa and may result in fibromatous reactions [39]. Several cases of decubitus of the back esophageal wall have been reported due to the incompatibility of the length of the tracheoesophageal fistula with the length of the voice prosthesis.

The complications of the tracheoesophageal prosthesis are the release of one-way prosthesis valves, resulting in leakage of the esophagus through the voice prosthesis into the trachea [41, 42], and the creation of biofilm in the voice prosthesis due to its use during several months [43, 44].

5. Conclusion

The physiological function of the esophagus in healthy people is very simple: to actively transport solids and liquids from the pharynx to the stomach. It has no digestive, absorptive, metabolic, or endocrine functions, but in laryngectomized persons, esophagus takes one more function. In such changed anatomical condition, the esophagus has a key role in voice—speech rehabilitation of laryngectomized patients because the esophageal and tracheoesophageal speech are the only acceptable solution of substitute alaryngeal speech. The esophagus gets very important function at alaryngeal phonation as air reservoir, the upper esophageal sphincter gets the function as air activator and the pharyngoesophageal segment gets the function of the voice generator, thus allowing the function of the voice resonators.

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Notes

The figures are from the author's own source.

Conflict of interest

The authors have no conflict of interest.

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