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An Evaluation Pertaining to Esophageal Speech Outcomes in Alaryngeal Patients

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Background: Previous studies have reported on the treatment of alaryngeal patients in order to improve their speech in several ways, but little focus was placed on esophageal speech.

Objectives: To determine the time duration of esophageal speech training after which alaryngeal patients can speak, and to analyze the factors affecting esophageal speech training outcomes.

Methods: A retrospective study, 29 alaryngeal patients who visited the Speech Clinic at Ramathibodi Hospital participated in the study. Data were collected from patients' medical records after speech therapy with the esophageal speech and the combination of esophageal speech and electrolarynx. Data was analyzed by descriptive and inferential statistics.

Results: Of 29 alaryngeal patients, 7 patients from the esophageal speech group and 6 patients from the combination of esophageal speech and electrolarynx training group could produce a first speech sound. The median duration of time that alaryngeal patients needed to speak after esophageal speech training was 11 weeks. Chemotherapy and the frequency of speech training sessions were factors that significantly affected the time durations needed by alaryngeal patients who succeeded in speaking because of esophageal speech training ($P < .05$). Alaryngeal patients who were not treated with chemotherapy and attended speech training sessions more than once per month had shorter time durations for esophageal speech training than the others.

Conclusions: Alaryngeal patients could speak after esophageal speech training for at least 11 weeks. Chemotherapy and frequency of speech training sessions impacted esophageal speech training outcomes.

Keywords: Alaryngeal, Esophageal, Speech therapy

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Introduction

Alaryngeal patients comprise patients who have had all of their larynx removed, including hyoid bone, thyroid cartilage, strap muscles, epiglottis, cricoid cartilage, and the upper 2 or 3 rings of the trachea.[1-3] The major causes that required surgery were severe laryngeal trauma and laryngeal cancer.[2] When patients had their entire larynx removed, their respiratory tract was impacted as well. These patients cannot breathe through their nose or mouth, but can exhale and inhale utilizing a stoma on the neck. Moreover, the most important change was that these patients did not have a voice source. Consequently, they had aphonia, a condition that adversely affected their communications in daily life. Therefore, they were trained to use the air in their mouth or other organs to function vocally in order to replace their vocal cords.[1, 4]

Speech and language pathologists (SLPs) have an important role in the rehabilitation of alaryngeal patient's communication skills, especially speaking skills, so they are as close to normal as possible.[5] There are 3 common procedures used in the rehabilitation of alaryngeal patient's speech, including electrolarynx, tracheoesophageal puncture (TEP), and esophageal speech. In the Speech Clinic at Ramathibodi Hospital, Thailand, SLPs train their patients using 3 methods; electrolarynx, esophageal speech, and a combination of electrolarynx and esophageal speech.

An electrolarynx vibrates air movement instead of vocal cords. When alaryngeal patient speaks, he/she places a vibrator on the skin near his/her neck area and presses a button to vibrate. The vibrations from the electrolarynx go through their skin to a vocal tract that initiates sound waves. These sound waves occur together with the movements of articulators that produce speech sounds. On the contrary, alaryngeal patients who speak with esophageal speech use esophageal vibrations instead of vocal cords. They inhale or swallow air into one-third of the esophagus, and the injected air rapidly passes the cricopharyngeal sphincter, which causes the production of esophageal vibrations and sound waves. When sound waves occur along with the movements of the articulators, speech sounds are produced in the same way as the electrolarynx. In the first step of esophageal speech training, SLP trains his/her patient to consistently control the air for esophageal vibration for some time. For the next step, SLP trains his/her patient to move the articulators while the esophagus is vibrating to produce the first sounds. Commonly, the first sounds that patients produce are vowels or vowels in combination with consonants. After that, they are trained to produce words, phrases, and sentences.[1-6]

Speech using electrolarynx and esophageal speech has certain advantages and disadvantages. The advantages of electrolarynx are that it is easy to use and control volume. If patients can use an electrolarynx, they can speak. The disadvantages of electrolarynx include the unnatural sound and high cost. If alaryngeal patients enrolled in government public health, cost of electrolarynx was free. Moreover, it is inconvenient for patients with motor disabilities because they have to hold the device while speaking, thus exhibiting their handicap. The benefits of esophageal speech are natural sound and not having to use any device. The training required to use the esophageal speech method may be difficult for some patients to learn, and take more time than other methods depending on an individual patient's limitations.[1-2] In addition, the loudness of esophageal speech was limited because air volume from esophagus was less than air volume from lung in normal voice.

Because of the advantages of esophageal speech, many alaryngeal patients choose esophageal speech as a method of rehabilitation and use it to communicate in daily life, even though they selected other methods previously.[7-11] In Thailand, many alaryngeal patients are trained to use esophageal speech.[12] The time durations for alaryngeal patients to produce words after speech training tends to vary. In the past, Thai researchers reported that the time needed for training ranged from 3 to 24 months with a mean time duration of 8 months.[1, 4, 12] These research studies were conducted with small samples and were long-term. Furthermore, there are many factors affecting esophageal

speech training outcomes such as surgery procedure, age, gender, education level, occupation, number of years since surgery, length of esophageal speech training, and patient motivation. The factors affecting the esophageal speech outcome may be different from each research study or individual cases.[13-16] For example, Keith et al[13] found that initial speech proficiency rating, educational level, and depression factors related to esophageal speech outcomes but Kresić et al[16] found that only patient's motivation factor affecting to esophageal speech outcome. Therefore, information about esophageal speech outcomes in alaryngeal patients will help speech pathologists to choose an appropriate speech rehabilitation method.

The purposes of this study were to determine the training time durations for alaryngeal patients who could speak after esophageal speech training and to analyze the factors affecting esophageal speech training outcomes.

Methods

Study Design and Participants

This research was conducted as a retrospective study in order to determine the time durations necessary for teaching patients who had undergone a total laryngectomy to speak their first speech vowel sounds after esophageal speech training, as well as to analyze the factors affecting their esophageal speech training outcomes.

There were 32 alaryngeal patients attended speech training at the Speech Clinic, Ramathibodi Hospital, Thailand from 2016 to 2019. All alaryngeal patients who were trained with only esophageal speech or with combination of esophageal speech and electrolarynx were included in this study but patients who were trained with only electrolarynx were excluded. Therefore, 29 alaryngeal patients participated in this study.

Ethics

This study was approved by the Human Research Ethics Committee of the Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Thailand (No. MURA2020/661 on May 12, 2021).

Procedures

SLPs reviewed the physical data of alaryngeal patients based on the Thai Speech-Language and Hearing Association protocol[17] and medical records pertaining to their history of laryngeal diseases, treatments, and esophageal speech training, during the first training session and subsequent sessions until patient could speak a first speech vowel sound with esophageal speech. SLPs recorded the time durations for their training sessions to teach alaryngeal patient to speak the first speech vowel sounds. The period for collecting data was from May to June 2020.

Statistical Analysis

Data analysis were conducted in SPSS version 18 (PASW Statistics for Windows, Version 18.0. Chicago: SPSS Inc; 2009). Data concerning the physical characteristics was analyzed using descriptive statistics. Data regarding the time durations necessary for alaryngeal patients to speak after esophageal speech training was analyzed using descriptive statistics and Mann-Whitney U test. Data pertaining to the factors affecting esophageal speech training outcomes were analyzed using chi-square test. The level of significance was P less than .05 ($P < .05$).

Results

Physical Characteristics of Participants

Of 29 alaryngeal patients participated in this study, 27 patients (93.10%) were male and 2 patients (6.90%) were female. Fifteen patients (51.72%) were elderly (≥ 65 years of age). Twenty-four patients (82.76%) had an undergraduate educational level. Twenty-four patients (82.76%) had underlying diseases such as hypertension, dyslipidemia, diabetes mellitus, obstructive sleep apnea, and thyroid abnormalities, while 12 patients (41.38%) had a history of drinking alcohol and 23 patients (79.31%) had a history of smoking (Table 1).

Medical History of Participants

Twenty-four patients (82.76%) were diagnosed with laryngeal cancer, and 5 patients (17.24%) were diagnosed

with other types of cancer including pyriform, tracheas, and thyroid cancer. All participants had undergone a total laryngectomy. After surgery, some patients were treated with radiotherapy, chemotherapy, or other surgery methods (thyroidectomy, pharyngectomy); 23 patients (79.31%) were treated with radiotherapy, but 6 patients (20.69%) were not treated; 6 patients (20.69%) were treated with chemotherapy, but not for 23 patients (79.31%); 24 patients (82.76%) were treated with other surgeries, but 5 patients (17.24%) were not treated. Five patients (17.24%) had stoma conditions (bleeding, contraction), but not for 24 patients (82.76%). Eight patients (27.59%) had disorders related to swallowing, but 21 patients (72.41%) did not (Table 2).

Speech Therapy

A speech therapy session was an individual training for 30 minutes for each session. Patients chose only one speech training option (only esophageal speech or combination of esophageal speech and electrolarynx) in a session. Regarding the speech training options, 10 patients (34.48%) chose esophageal speech, while 19 patients (65.52%) chose the combination of esophageal speech and electrolarynx. Fifteen patients (51.74%) attended speech training sessions more than once per month. After speech training, 13 patients (44.83%) could speak; 7 patients from the esophageal speech group, and 6 patients from the combination of esophageal speech and electrolarynx group. Regarding the frequency of speech training, 4 patients who attended speech training sessions equal to or less than 1 time per month and 9 patients who attended speech training sessions more than once per month could speak (Table 3).

The median (range) duration of time alaryngeal patients needed to speak after esophageal speech training was 11 (1 - 52) weeks. Patients who were trained with esophageal speech needed less time to speak than patients who chose the combination of esophageal speech and electrolarynx. The differences in the time durations for patients with only esophageal speech and patients trained with esophageal speech and electrolarynx, after esophageal speech training, were statistically insignificant ($P > .05$). However, patients who used only esophageal speech spoke

Table 1. Physical Characteristics of Patients

Characteristic	No. (%)
Gender	
Female	2 (6.90)
Male	27 (93.10)
Age, y	
18 - 64	14 (48.28)
≥ 65	15 (51.72)
Education	
Undergraduate	24 (82.76)
Graduate	4 (13.79)
Unknown	1 (3.45)
Underlying disease	
No	4 (13.79)
Yes	24 (82.76)
Unknown	1 (3.45)
Drinking alcohol	
No	17 (58.62)
Yes	12 (41.38)
Smoking	
No	6 (20.69)
Yes	23 (79.31)

Table 2. Medical History of Patients

Medical History	No. (%)
Causes	
Laryngeal cancer	24 (82.76)
Other causes	5 (17.24)
Radiotherapy	
No	6 (20.69)
Yes	23 (79.31)
Chemotherapy	
No	23 (79.31)
Yes	6 (20.69)
Other surgeries	
No	5 (17.24)
Yes	24 (82.76)
Stoma condition (stenosis/irritation)	
No	24 (82.76)
Yes	5 (17.24)
Swallowing condition (aspiration/dysphagia)	
No	21 (72.41)
Yes	8 (27.59)

successfully in less time than patients who used both esophageal speech and an electrolarynx (Table 4).

Many factors were taken into account in this study such as age, education level, underlying diseases, drinking alcohol, smoking, causes of diseases, radiotherapy, chemotherapy, other surgeries, stoma condition, swallowing condition, type of speech training, and frequency of speech training. The results showed that chemotherapy and frequency of speech training significantly affected the time durations needed by alaryngeal patients who succeeded in esophageal speech training ($P < .05$) (Table 5).

Alaryngeal patients who were not treated with chemotherapy and/or attended speech training more than once per month had lower time durations for esophageal speech training than alaryngeal patients treated with chemotherapy and/or attended speech training equal to or less than once time per month.

Table 3. Type and Frequency of Esophageal Speech Training

Esophageal Speech Training	No. (%)
Type of speech training	
Only esophageal speech	10 (34.48)
Unsuccess	3 (30.00)
Success	7 (70.00)
Esophageal speech and electrolarynx	19 (65.52)
Unsuccess	13 (68.42)
Success	6 (31.58)
Frequency of speech training	
Equal to or less than 1 time per month	14 (48.26)
Unsuccess	10 (71.43)
Success	4 (28.57)
More than 1 time per month	15 (51.74)
Unsuccess	6 (40.00)
Success	9 (60.00)

Table 4. Analysis of Time Durations for Alaryngeal Patients Needed to Speak After Speech Training

Training Option	Time Duration, wk		Mann-Whitney U Test	*P* Value*
	Median	Range		
Only esophageal speech (n = 7)	7	1 - 28	-1.791	.07
Esophageal speech and electrolarynx (n = 6)	15	11 - 52		

* $P < .05$ indicates statistical significance.

Table 5. Factors Affecting the Time Durations for Alaryngeal Patients Needed to Speak After Speech Training

Factor	No. (%)	*P* Value*
Age, y		
18 - 64	4 (30.8)	.85
≥ 65	9 (69.2)	
Education level		
Undergraduate	10 (76.9)	.23
Graduate	2 (23.1)	
Underlying disease		
No	3 (23.1)	.61
Yes	10 (76.9)	
Drinking alcohol		
No	2 (15.4)	.91
Yes	11 (84.6)	

Table 5. Factors Affecting the Time Durations for Alaryngeal Patients Needed to Speak After Speech Training (Continued)

Factor	No. (%)	*P* Value*
Smoking		
No	2 (15.4)	.91
Yes	11 (84.6)	
Causes of diseases		
Laryngeal cancer	10 (76.9)	.61
Other causes	3 (23.1)	
Radiotherapy		
No	1 (7.7)	.34
Yes	12 (92.3)	
Chemotherapy		
No	10 (76.9)	.03
Yes	3 (23.1)	
Other surgeries (thyroidectomy)		
No	3 (23.1)	.42
Yes	10 (76.9)	
Stoma condition (stenosis/irritation)		
No	11 (84.6)	.10
Yes	2 (15.4)	
Swallowing condition (aspiration/dysphagia)		
No	11 (84.6)	.10
Yes	2 (15.4)	
Type of speech training		
Only esophageal speech	4 (30.8)	.31
Esophageal speech and electrolarynx	9 (69.2)	
Frequency of speech training, time/mo		
≤ 1	4 (30.8)	.01
> 1	9 (69.2)	

* Data was analyzed by using chi-square test and $P < .05$ indicated statistical significance.

Discussion

This study found that alaryngeal patients could speak after esophageal speech training for 11 weeks. These results were different from previous studies[1, 4, 12, 18] in that patients who succeeded in esophageal speech in those studies had a wide range of time durations for esophageal speech training because different studies used different esophageal speech training programs. The minimum duration of esophageal speech training was reported to be 4 weeks, while patients were required to attend these programs for 3 hours and 30 minutes, 5 days a week.[18] In contrast, the maximum time duration for esophageal speech training was 1 to 2 years [1, 19] because it depended on a patient's opportunity for communication by speaking.[1] These results were similar to the results of this research in that patients who used only esophageal speech had lower time durations for esophageal speech training

before speaking effectively than patients who used both esophageal speech and an electrolarynx because they had a better chance of using this method than the latter patients.

Many factors in this study were similar and different compared to the past, such as age, education level, underlying diseases, drinking alcohol, smoking, causes of diseases, radiotherapy, chemotherapy, other surgeries, stoma condition, swallowing condition, type of speech training, and frequency of speech training. The results of this study were similar to those of Kresić et al[16] in that age and education level were not significant factors that affected the success of esophageal speech training but depended on a patient's motivation. On the contrary, chemotherapy and frequency of speech training were 2 factors that significantly affected the time durations for alaryngeal patients who succeeded in esophageal speech training.

Patients who were treated with chemotherapy needed long durations for speech training to successfully speak compared to patients who were not treated with chemotherapy because the side effects of chemotherapy adversely affected their physical (fatigue, insomnia) and mental (anxiety, depression) characteristics.[20-22] During and after chemotherapy treatment, patients felt very weak and tired. They tended to do everything slowly and wanted to rest for relieve their fatigue.[23] These patients might be absent from work and skip follow-up speech training sessions, which has an adverse effect on the frequency of speech training factor. The results of this study showed that patients who attended speech training sessions more than one time per month completed their speech training successfully in a shorter time than patients who attended speech training sessions equal to or less than once per month. The results of this study were related to those of Gilmore[22] in that the factor affecting the effectiveness of esophageal speech training was the training factor because patients who had intensive and continuous training were more successful in using esophageal speech than patients who had speech training sessions both individually or in a group.[16]

This study did not cover all speech rehabilitation method. The further study should include all speech training methods especially a training with electrolarynx in order to obtain some information for progress prediction and helping alaryngeal patients to make a decision to choose an appropriate speech rehabilitation method.

Conclusions

Alaryngeal patients could speak after esophageal speech training for 30 minutes once a week for 11 weeks. Chemotherapy and infrequent speech training sessions adversely affected the time durations needed by alaryngeal patients to successfully use esophageal speech training to speak due to lack of continuity in training.

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การประเมินผลการพูดด้วยหลอดอาหารในผู้ป่วยไร้กล่องเสียง

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[1] ภาควิชาวิทยาศาสตร์สื่อความหมายและความผิดปกติของการสื่อความหมาย คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล กรุงเทพฯ ประเทศไทย

บทนำ: ในอดีตการรักษาการพูดในผู้ป่วยไร้กล่องเสียงมีหลายวิธี แต่มีส่วนน้อยที่สนใจการฝึกพูดด้วยหลอดอาหาร

วัตถุประสงค์: เพื่อศึกษาช่วงระยะเวลาที่ผู้ป่วยไร้กล่องเสียงพูดได้หลังจากฝึกพูดด้วยหลอดอาหาร และปัจจัยที่ส่งผลต่อการฝึกพูดด้วยหลอดอาหาร

วิธีการศึกษา: การศึกษาข้อมูลย้อนหลังในผู้ป่วยไร้กล่องเสียง จำนวน 29 คน ที่คลินิกฝึกพูด โรงพยาบาลรามาธิบดี เก็บข้อมูลจากเวชระเบียนของผู้ป่วยหลังจากฝึกพูดโดยใช้หลอดอาหารเพียงอย่างเดียวและใช้หลอดอาหารร่วมกับเครื่องช่วยพูด การวิเคราะห์ใช้สถิติเชิงพรรณนาและสถิติเชิงอนุมาน

ผลการศึกษา: ผู้ป่วยไร้กล่องเสียง จำนวน 29 คน พบว่า ผู้ป่วยที่พูดโดยใช้หลอดอาหารเพียงอย่างเดียวและใช้หลอดอาหารร่วมกับเครื่องช่วยพูดสามารถพูดคำแรกได้ จำนวน 7 คน และ 6 คน ตามลำดับ ระยะเวลาในการฝึกจนพูดได้เท่ากับ 11 สัปดาห์ ปัจจัยด้านการรักษาโดยใช้เคมีบำบัดและความถี่การฝึกพูดส่งผลต่อการฝึกพูดด้วยหลอดอาหารอย่างมีนัยสำคัญ ($P < .05$) ผู้ป่วยที่ไม่ได้รักษาด้วยเคมีบำบัดและมีความถี่การฝึกพูดมากกว่าเดือนละครั้งสามารถพูดได้เร็วกว่าผู้ป่วยที่รักษาด้วยเคมีบำบัดและฝึกพูดน้อยกว่าเดือนละครั้ง

สรุป: ผู้ป่วยไร้กล่องเสียงสามารถพูดได้หลังจากใช้ระยะเวลาฝึกพูดอย่างน้อย 11 สัปดาห์ โดยปัจจัยด้านการรักษาด้วยเคมีบำบัดและความถี่การฝึกพูดส่งผลต่อการฝึกพูดด้วยหลอดอาหาร

คำสำคัญ: ผู้ป่วยไร้กล่องเสียง พูดด้วยหลอดอาหาร ฝึกพูด

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