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Comprehensive esophageal speech training for laryngectomees: Substantial benefits

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ABSTRACT

Background: Head and neck cancer is one of the major cancer burdens in Thailand and Southeast Asia. Most patients with laryngeal cancer present at an advanced stage and require laryngectomy. Esophageal speech (ES) is an option for effective communication.

Objectives: To determine the effectiveness of comprehensive esophageal speech under the "Training for The Trainer" project.

Materials and methods: Ninety-four laryngectomees (patients with laryngeal cancer undergoing total laryngectomy) received esophageal speech training by speech and language pathologists (SLPs) and the trainers or laryngectomee volunteers. ES was instructed on a monthly for 4 years. Project "Camp of Hope and Spirit for Laryngectomees", which provides support to improve quality of life by integration of music, art, nutrition, and dharma with healthy activities, was also conducted.

Results: Thirty-six patients who attended ES classes for 6 sessions (1 session compose of 5 periods) had an average improvement in their level of ES of 3.27 levels and 19 laryngectomees who attended ES classes for 12 sessions had average improvement of their level of ES of 4.74 levels. The success rate for ES at level 1 (belch 1-5 times in 10 attempts) was 72% and level 5 (2-syllable words/phases for 1-5 times in 10 attempts) was 34 of 94 (36%) within 12 sessions. Srinagarind ES score was found improved significantly between the 1st and 6th visit (MD=4, 95%CI=2-4); the 1st and 12th visit (MD=6 , 95%CI=2.5-7). Twenty-eight of a total 34 patients (82.35%), who could use ES at level 5, did not require an electrolarynx. Therefore, a saving of the cost of electrolarynx purchase of 896,000 Baht (32,000 Baht/case). Satisfactions with ES training and "Camp of Hope and Spirit for Laryngectomees" were scored as good to excellent.

Conclusion: The success rate for ES at level 1 was 72% and level 5 was 36% within 12 sessions. A saving of the cost of electrolarynx purchase of 896,000 Baht (32,000 Baht/case) within 4 years. Satisfactions with ES training and "Camp of Hope and Spirit for Laryngectomees" were scored as good to excellent.

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Introduction

Head and neck cancer is one of the major cancer burdens in Thailand and Southeast Asia. The estimated incidence of head and neck cancer in Thailand is 15.7 per 100,000 in males and 10.7 per 100,000 in females.[1] Among these, laryngeal cancer is known to have the greatest negative impact on survivors, both from cancer per se, and its treatment.[2] The majority of patients with laryngeal or hypopharyngeal cancer in the northeast of Thailand are diagnosed at an advanced disease stage[3] and most cases end up having their larynx totally removed (total laryngectomy). Those who undergo this surgery, so called "laryngectomees", they need to breathe through their tracheostoma and swallow through their neopharynx. Normal speech is lost, and there is a permanent stoma in the middle of the neck. Even though the survival rate after surgery is acceptable after surgical treatment,[4] several functional deficits including speech, swallowing, breathing, and physical disabilities around the head and neck region, not to mention the disfiguring effects of surgery and emotional and behavioral disturbances, result in negative effects on daily living.[5]

One of the most critical disabilities is aphonia.[5] This is the most important social problem that the patients face.[6] As a consequence, many patients develop emotional and psychological problems and some of them need psychological management. Voice rehabilitation (esophageal speech, electrolarynx and tracheoesophageal prosthesis) is a challenge that these patients must overcome.

The electrolarynx is the easiest vocal rehabilitation method for total laryngectomy patients to use, as it hardly requires training, but patients' satisfaction rates were lower because of the mechanical, low frequency, monotonous and unnatural voice that it produces.[7] A tracheoesophageal prosthesis is most commonly used for voice rehabilitation in developed countries. It is a surgical method that could be performed as either a primary or secondary procedure. Reported patient quality of life and satisfaction data following tracheoesophageal puncture are the best[8, 9] because the tracheoesophageal prosthesis significantly contributes to the acquisition of speech and intelligibility in alaryngeal speakers.[8] However, complications may occur in as many as 42.6% of cases[10] and the frequent need for replacement of the prostheses is a major burden for patients. Esophageal speech (ES) is one of voice rehabilitation that might cost and safe benefit, however, it might take long duration for training success.

In our institution, the primary modality for speech rehabilitation is esophageal speech (ES), which is more natural, cost effective and does not require a device for electrolaryngeal speech, or surgery to facilitate esophageal speech.[8] The disadvantage of ES is mainly the long time taken to achieve a communicable level of speech, and it is not feasible in some cases due to a poor anatomical structure or rigidity of the neopharynx. The success rate of ES is reported to be 6-32%.[11, 12]

Most laryngectomees in the northeast of Thailand are in low socioeconomic status with limited access to speech services because of a shortage of professional speech and language pathologists (SLPs) in the country [13] and because they are unable to afford living expenses and travel. Srinagarind Hospital, Faculty of Medicine, Khon Kaen University, serves as a super tertiary center for cancer treatment in this region covering approximately one-third of the population of Thailand. Therefore, a multidisciplinary team for a comprehensive rehabilitation for laryngectomees was developed. Besides speech rehabilitation, all other aspects of their quality of life were taken into account.

The purpose of this study was: 1) to determine the effectiveness of a comprehensive ES training program before and after at 6 and 12 sessions of training, respectively; and 2) to investigate the costs and benefits of comprehensive ES training.

Materials and methods

This research was a retrospective descriptive study. Data were retrieved from 1) medical records, Department of Medical Records and Statistics, Srinagarind Hospital; 2) 4 annual reports of comprehensive esophageal speech training in 2010- 2013; and 3) 2 reports of the Art 4' Mee camp in 2011 and 2013.

Subjects recruited for this study were the patients who had undergone laryngectomy for laryngeal or hypopharyngeal cancer treatment and were enrolled in ES training at Srinagarind Hospital between January 2010 and December 2013. Three cases who did not participate ES program were excluded. Ninety-four of 97 laryngectomees were included in this study. Following to objective of this study, laryngectomees who attended ES training for less than 6 sessions were also excluded. At the end of the study 56 laryngectomees continued with ES while 38 of them chose electrolarynxes.

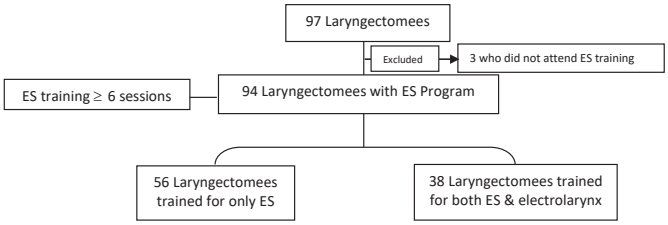

Figure 1. *Flow chart of subjects.*

Comprehensive ES training

The comprehensive ES training was a program for training in ES integrated with establishing hope, spirit and support to promote quality of life. The program composed of activities as follows:

ES training

The ES training was conducted by speech and language pathologists (SLPs), as well as speech assistants (SAs), volunteers who were laryngectomees and had finished a course entitled "Training for the Trainer". They spoke by ES fluently. In the training program, the laryngectomees were divided into 5 groups according to their level of ES ability follow to Srinagarind ES Levels. Srinagarind ES Levels have done and used for clinical outcomes and accepted among

multidisciplinary approaches for more than 20 years. It's composed of 17 levels of ES as follows:

Groups	**Srinagarind ES Levels**
I	0 = cannot belch or make any sound after swallowing air;
	1 = belch 1-5 times in 10 attempts;
	2 = belch 6-10 times in 10 attempts;
II	3= speak 1-word 1-5 times in 10 attempts;
	4 = speak 1-word for 6-10 times in 10 attempts;
	5 = speak 2-words for 1-5 times in 10 attempts;
	6 = speak 2-words for 6-10 times in 10 attempts;
III	7 = speak 3-words for 1-5 times in 10 attempts;
	8 = speak 3-words for 6-10 times in 10 attempts;
	9 = speak 4-words for 1-5 times in 10 attempts;
	10 = speak 4-words for 6-10 times in 10 attempts;
IV	11 = speak 5-words for 1-5 times in 10 attempts;
	12 = speak 5-words for 6-10 times in 10 attempts;
	13 = speak 6-words for 1-5 times in 10 attempts;
	14 = speak 6-words for 6-10 times in 10 attempts;
V	15 = fluently read or speak approximately 50%;
	16 = fluently read or speak approximately 51-100%;
	17 = fluently speak or sing songs.

Three groups were trained by 3 SAs and 2 groups were trained by 2 SLPs. Each group was trained ES 5 30-minute periods in 1 session/month. SAs and SLPs rotated to other groups every session. Therefore, each SA and SLP trained ES for every laryngectomee group. ES training compose of 5 steps:

Step 1: belch and 1-syllable word
- Open mouth and take a breath into the mouth and nose
- Close mouth, then raises the tongue to the palate and pushing the air to upper esophagus or swallow air (try to hold the air at the upper esophageal sphincter)
- Open mouth and then belch
- Repeat several attempts until belch with /a/ sound
- Repeat several attempts until produce monothongs
- Repeat several attempts until produce simple 1-word sentences

Step 2: 2-syllable words/phrases/sentences
- Belch 2 syllables of monothongs such as /a-a/, /u-u/, /u-a/, /u-i/
- Repeat several attempts until produce 2-syllable words/phrases/sentences

Step 3: 3-syllable words/phrases/sentences
- Belch 3 syllables of monothongs such as /a-a-a/, /u-u-u/, /u-a-i/, /u-i-e/
- Repeat several attempts until produce 3-syllable words/phrases/sentences

Step 4: 4-syllable words/phrases/sentences
- Belch 4 syllables of monothongs such as /a-a-a-a/, /u-u-u-u/, /u-a-i-e/
- Repeat several attempts until produce 4-syllable words/phrases/sentences

Step 5: 5-syllable words/phrases/sentences
- Belch 5 syllables of monothongs such as /a-a-a-a-a/, /u-u-u-u-u/, /u-a-i-e-o/
- Repeat several attempts until produce 5-syllable words/phrases/sentences

Step 6: reading and conversation
- Reading practice
- Conversation practice

Step 7: Singing
- Singing practice

The Art 4'Mee Camp

The Art 4'Mee Camps (the arts for the laryngectomees) were held in 2011 and 2013. They were two-day programs designed specifically for the laryngectomees and their caregivers and aimed to support and empower them in order that they might regain their normal livelihoods. Music, dance, and art in this camp were encouraged to promote internal connection between their body and mind, and external connection between the participants. Besides music, dance, and art; the program included meditation, yoga based exercise, and a workshop for self-care.[14]

A music therapy program was integrated with the ES training. This hospital-based program was conducted by musicians, physiotherapists, SLPs, and laryngectomee volunteers. The music therapy was aimed to support the ES training, including creative music making, music and movement and music and breathing. Music was also used to promote esophageal voice projection and concluded with singing and dancing to traditional songs by esophageal voice (depending on their ability).

The main outcome was graded by the 1st author, a senior SLP. This level was identified based on the Srinagarind ES Levels, which was consensus of grading criteria and was established by a group of SLPs who have worked more than 20-year experiences with laryngectomee and esophageal speech for quantitative and subjective assessment of ES in the Speech Clinic at Srinagarind Hospital, Faculty of Medicine, Khon Kaen University.

Satisfaction and evaluation of program

Questionnaires were filled by laryngectomees who enrolled program and caregivers on topics based on 5- category scores from 1-5 (1= should be revised or not good; 2= fair; 3= moderate; 4= good; 5= very good).

Regarding to The Art 4'Mee Camp, similarity score was rated based on the same category as good – excellent for each item including activities in the camp, duration,

accommodation, coordination, food. The Art 4'Mee Camp was established every 2 years (2011 and 2013). The number of laryngectomees and caregivers who responded questionnaire for 2011, and 2013 were the same group to number of participants who responded to questionnaires for satisfaction and evaluation of program.

Descriptive analysis was used to assess the laryngectomee's characteristics and general information about their esophageal speech level. The comparison of ES level before and after training for 6 and 12 sessions was analyzed using The Wilcoxon Signed-Rank Test.

Results

This was a retrospective study from 2010-2013. Patients were recruited in the study in each year displayed as Table 1. New cases were enrolled in the study any time that they were consulted from physician for speech rehabilitation. The ES program was begun within the 1st visit and number of ES training counted from the number of visits (not counted from the number of months after enrollment). The participants were 91 males and 3 females, average age 61.6 (39-87) years old. The general characteristics of the laryngectomees are displayed in Table 2.

Table 1 Number of patients in this study.

Date	Old Case	New Case	Total
2010	20	10	30
2011	19	11	30
2012	27	20	42
2013	29	22	51

Table 2 General characteristics of laryngectomees.

Characteristics		Number (N=94)	Percentage
Diagnosis	Larynx	73	77.66
	Hypopharynx	20	21.28
	Undetermined	1	1.06
Stage	Stage I	3	3.19
	Stage II	5	5.32
	Stage III	36	38.30
	Stage IV	46	48.94
	Unknown	4	4.26
Neck Dissection	Unilateral	35	37.23
	Bilateral	30	31.91
	No dissection	26	27.66
	Unknown	3	3.19

Table 2 General characteristics of laryngectomees. (continued)

Characteristics		Number (N=94)	Percentage
Reconstruction	Regional flap	8	8.51
	Gastric pull-up	3	3.19
	No reconstruction	80	85.11
	Unknown	3	3.19
Post-operative Radiotherapy	Yes	91	96.81
	No	2	2.13
	Unknown	1	1.06
Laryngectomy as a salvage	Yes	11	11.7
	No	81	86.17
	Unknown	2	2.13

ES level was assessed every time that patients attended ES program and displayed data on the 6th and 12th sessions. New laryngectomees could access ES program any time that they were consulted. Therefore, assessment level depends on the number of times that they attend.

Some laryngectomees could not visit ES program monthly, therefore, the ES training was counted from the number of sessions. Thirty-six of them, who had attended six sessions of ES training had average progression of Srinagarind ES levels = 3.27 levels, while 19, who had 12 sessions, had progression of Srinagarind ES levels = 4.74 levels. Sixty-eight of 94 laryngectomees (72%) achieved ES scores of at least level 1 within 12 sessions (Figure II). Thirty-four of 94 laryngectomees (36%) achieved ES scores of at least level 5 within 12 sessions (Figure III).

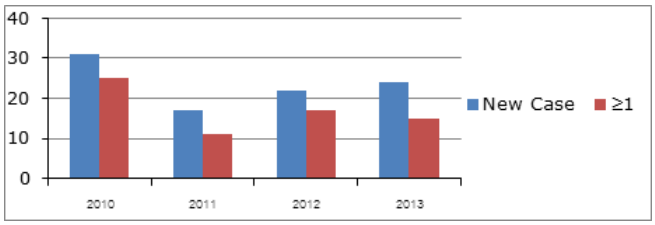

Figure 2. *Number of laryngectomees who succeeded in developing ES at least to level 1 within 12 sessions.*

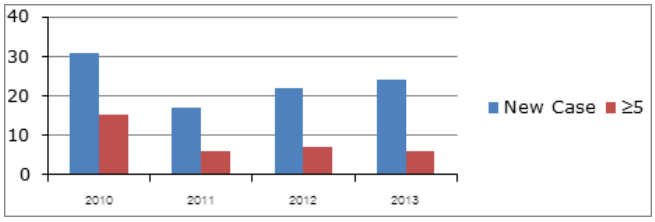

Figure 3. *Number of laryngectomees who succeeded in developing ES at least level 5 within 12 sessions.*

Twenty-eight of 34 laryngectomees (82%) who achieved Srinagarind ES level 5 within 12 sessions did not request an electrolarynx.

Some laryngectomees could not visit the esophageal speech program every month for personal reasons, such as financial problems, sickness or unavailable caregivers, etc. Therefore, the success rates for 6 and 12 visits were analyzed. The Srinagarind ES score was found to improved significantly between the 1st and 6th visit; the 1st and 12th visit; and the 6th and 12th visit for training (Table 3 –5).

Table 3 Comparison of Srinagarind ES Levels between the 1st and 6th sessions.

Parameter	Before	After	n	Median difference	Z	*p* value*	95% Confident interval
Median	0	4	37	4	3	<0.001	2-4
Maximum	15	16					
Minimum	0	0					

** The Wilcoxon Signed Rank Test*

Table 4 Comparison of Srinagarind ES Levels between the 1st and 12th sessions.

Parameter	Before	After	n	Median difference	Z	*p* value*	95% Confident interval
Median	0	4	19	6	4.5	0.009	2.5-7
Maximum	15	16					
Minimum	0	0					

** The Wilcoxon Signed Rank Test*

Table 5 Comparison of Srinagarind ES Levels between the 6th and 12th sessions.

Parameter	Before	After	n	Median difference	Z	*p* value*	95% Confident interval
Median	4	6	19	2	15	0.0498	0-3
Maximum	16	16					
Minimum	0	0					

** The Wilcoxon Signed Rank Test*

The existing data of laryngectomees who attended ES program presented the improvement of ES level varied to the number of visits showed as Table 6.

Table 6 ES Level improvement.

Number of ES program	Number*	ES Level improvement		
		min	max	mean
1	20	-	-	-
2-5	32	-1	8	1.81
6-11	18	0	14	4.28
≥12	19	0	16	6

** Not included SAs*

It was surprising that 2/3 of laryngectomees who were underwent gastric pull up reconstruction had progression of the ES level from 4 and 6 levels with 5 ES visits.

Patients' satisfaction with the ES training program was assessed. Most laryngectomees gave average scores of good – excellent for each item as 94-100%, 88.24-100%, 82.76-100% and 90-100% in 2010, 2011, 2012, and 2013, respectively (Table 7).

For satisfaction with the 2-day Art 4'Mee Camps, score was ranged 91.43-100% and 88-100% in 2011 and 2013, respectively. The existing data on each topic are available only in 2013 which are presented in Table 8.

Table 7 Satisfaction of ES program.

Topics	Satisfaction of ES program			
	2010 N=23 (L=19: C=4)	2011 N=28 (L=19: C=9)	2012 N=48 (L=27: C=21)	2013 N=34 (L=25: C=9)
Interesting activities	4.76	4.53	4.41	4.60
Interesting lectures or descriptions	4.82	4.65	4.31	4.45
Duration of program	4.35	4.05	3.76	3.90
Activity demonstration	4.88	4.76	4.34	4.40
Place or meeting room	4.64	4.71	4.28	4.55
Meterials	4.59	4.76	4.31	4.45

N=Number, L: Laryngectomy, C: Caregivers.

Table 8 Satisfaction of Art 4'Mee Camps.

Topics	Satisfaction of Art 4'Mee Camps in 2013 N=34 (L=25: C=9)
Interesting activities	4.70
Accommodation	4.38
Food	4.44
Place or meeting room	4.85
Coordination	4.52
Duration of program	4.54

N=Number, L: Laryngectomy, C: Caregivers.

Discussion

Examination of data from 2010-2013 shows that most laryngectomees were able to achieve Srinagarind ES Level 1 (72%) and level 5 (36%) within 12 sessions (Figure 1 and 2), respectively. It was interesting to find that those undergoing regional flap or gastric pull up for reconstruction could produce ES, although the pharyngeal tissue was distorted by the surgical reconstruction. It is possible that sphincter pressures and/or esophageal motility patterns do not have any predictive for ES.[6] Comparison of data after 6 and 12 sessions for ES showed significant improves in Srinagarind ES Levels. The longer the laryngectomee attended, the greater the outcome of ES. These results can be used for counseling new laryngectomees who enroll into the ES training program.

Twenty-eight of 34 laryngectomees (82%), who achieved ES Score 5 (2-syllable meaningful word), did not request an electrolarynx. It appeared that they were motivated to persist with ES. This saved the cost of an electrolarynx, which needs to be claimed from the Thai National Security Office. An electrolarynx cost 32,000 Baht (US $ 1,000). The cost of 28 electrolarynxes is 896,000 Baht or US $ 28,000 (approximately 32,000 Baht/electrolarynx, 32 Baht=1 US$) in 4 years. Besides improving the speech capacity from the ES training program, the patients' satisfaction was found to be achieved.

For satisfaction for enrolling the program, the scores were range good to very good or excellent activities (82.76-100%) on items of 1) interesting activities; 2) interesting lectures or descriptions; 3) duration of program; 4) activity demonstration; 5) place or meeting room; 6) materials. Most of the participants were happy to join activities in each year. Participants' impressions were e.g., professionals were very kind and good instructors; good friends and society; very good and interesting activities etc. Regarding to participants' suggestion, included more often sessions from once a month to be every week, providing more transportation compensation for participants who had low economic status, more soft diet for aging laryngectomee etc. These suggestions were information to providing better care in the future.

Even though ES is the most challenging method for vocal rehabilitation, with a long period of time to gain the skills,[9] and has limited voice quality, such as a restriction in F_0, increase in Jitter and Shimmer, decreasing of HNR values, and reduced intensity compared to the voice of normal laryngeal speakers,[15] the results of this study, unlike those of a previous one,[10] indicate a reasonable success rate, good patient satisfaction and cost benefits. The Voice-Related Quality of Life measure is needed for further assessment of this technique comparing to other speaking device or normal laryngeal voice; and to determine the perceived level of influence on vocal communication[10] and the self-assessed vocal handicap.[10] No single method is considered to be the best for all patients. Selection of a method should be based on the patient, the surgeon and the SLPs.[16]

Healthcare workers should understand the advantages and disadvantages of each voice rehabilitation method to assist people with total laryngectomy in making the most appropriate decision, taking into consideration their age, sex, physical condition, job, economic status and other relevant factors.[10]

Although this study was primary report in Thailand and summarized that the comprehensive ES training program might be an effective program in terms of communication in daily, there were some limitations including individual background and characteristics of participants such as stage of cancer, areas of cancer invasion, surgery size, as well as reconstruction, type of treatments (surgery, surgery with radiation or chemotherapy or surgery with both radiation and chemotherapy etc). These factors might affect clinical outcome of ES. It needs to carefully interpret and the further study might be more concern about these factors.

Conclusion

The success rate of ES was 72% for laryngectomees who achieved ES at level 1 within 12 sessions; 36% for laryngectomees who achieved ES at level 5 within 12 sessions. The comprehensive ES training program is an effective program in terms of both speech and economic benefits. This program can be applied in practice for developing to gain their capacity to live in their society. Participants' suggestions should be considered for the further program.

Conflicts of interests

This study has no conflicts of interest.

Acknowledgements

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