ORIGINAL ARTICLE

The impact of vocal rehabilitation on quality of life and voice handicap in patients with total laryngectomy

Cristina Țiple, Tudor Drugan[1], Florina Veronica Dinescu, Rodica Mureşan[2], Magdalena Chirilă, Marcel Cosgarea
Department of Otorhinolaryngology, Iuliu Hatieganu University of Medicine and Pharmacy, Cluj-Napoca, [1]Department of Otorhinolaryngology, Emergency County Hospital, Cluj-Napoca, [2]Department of Medical Informatics and Biostatistics, Iuliu Hatieganu University of Medicine and Pharmacy, Cluj-Napoca, Romania

Background: Health-related quality of life (HRQL) and voice handicap index (VHI) of laryngectomies seem to be relevant regarding voice rehabilitation. The aim of this study is to assess the impact on HRQL and VHI of laryngectomies, following voice rehabilitation. **Materials and Methods:** A retrospective study done at the Ear, Nose, and Throat Department of the Emergency County Hospital. Sixty-five laryngectomees were included in this study, of which 62 of them underwent voice rehabilitation. Voice handicap and QOL were assessed using the QOL questionnaires developed by the European Organisation for Research and Treatment of Cancer (EORTC); variables used were functional scales (physical, role, cognitive, emotional, and social), symptom scales (fatigue, pain, and nausea and vomiting), global QOL scale (pain, swallowing, senses, speech, social eating, social contact, and sexuality), and the functional, physical, and emotional aspects of the voice handicap (one-way ANOVA test). **Results:** The mean age of the patients was 59.22 (standard deviation = 9.00) years. A total of 26 (40%) patients had moderate VHI (between 31 and 60) and 39 (60%) patients had severe VHI (higher than 61). Results of the HRQL questionnaires showed that patients who underwent speech therapy obtained better scores in most scales ($P = 0.000$). Patients with esophageal voice had a high score for functional scales compared with or without other voice rehabilitation methods ($P = 0.07$), and the VHI score for transesophageal prosthesis was improved after an adjustment period. The global health status and VHI scores showed a statistically significant correlation between speaker groups. **Conclusion:** The EORTC and the VHI questionnaires offer more information regarding life after laryngectomy.

Key words: Quality of life, voice handicap index, voice rehabilitation

How to cite this article: Țiple C, Drugan T, Dinescu FV, Mureşan R, Chirilă M, Cosgarea M. The impact of vocal rehabilitation on quality of life and voice handicap in patients with total laryngectomy. J Res Med Sci 2016;21:127.

INTRODUCTION

The larynx is a central organ of the respiratory system playing an important role in respiration, phonation, and olfaction. T1 and T2 laryngeal cancers are generally considered "early" tumors, while T3 and T4 laryngeal cancers are seen as "advanced" tumors.[1] Total laryngectomy is still considered the gold standard for advanced laryngeal cancer treatment despite the new acquisitions in radiotherapy, chemotherapy, and conservative laryngeal surgery.[2] Larynx loss results in various physical and functional changes that can affect psychosocial well-being and some of the most basic life functions.[3] Quality of life (QOL) is strongly impaired in patients suffering from voice loss, smell loss, respiratory tract changes, changes in lung function, weak cough reflexes, and complications associated with permanent tracheostomy.[4] Voice disorders and subsequent communication problems are perhaps the most obvious problems, and the rehabilitation process focuses on reestablishing functional communication.[3] There are several voice rehabilitation options available following total laryngectomy, including esophageal speech (ES) with air injected into and then expelled from the esophagus in a controlled way, tracheoesophageal voice prosthesis (TEP) using air inhaled during breathing or using the reconstructed pharynx as the new sound source (pharyngoesophageal [PE] segment),

Access this article online

Quick Response Code:

Website: www.jmsjournal.net

DOI: 10.4103/1735-1995.196609

Address for correspondence: Dr. Magdalena Chirilă, Iuliu Hatieganu University of Medicine and Pharmacy, 13 Emil Isaac, 400023, Cluj-Napoca, Romania. E-mail: chirila_magda@yahoo.com
Received: 12-04-2016; **Revised:** 13-07-2016; **Accepted:** 09-08-2016

and electrolaryngeal speech.[1,5] The use of TEP after total laryngectomy has recently increased as a method of vocalization, following laryngeal cancer.

TEP rehabilitation has been applied in our institution since 2011. Until then, voice rehabilitation was only made using ES, electrolarynx (EL), and surgical voice restoration. In 1998, a team of Ear, Nose, and Throat (ENT) and microvascular surgeons performed a technique of laryngeal reconstruction using the fasciocutaneous radial free flap in three cases in our institution. Good speech fluency and intensity were achieved by the procedure only in one case, but surgeons quit this technique as the patient still underwent tracheostomy and reconstruction surgery lasted for approximately 17 h.[6]

We found no studies on the impact of voice rehabilitation on QOL and voice handicap, following laryngectomy in Romanian scientific publications. To the best of our knowledge, this is the first Romanian report of the impact on health-related QOL (HRQL) and voice handicap index (VHI) of laryngectomies regarding voice rehabilitation. Therefore, the aim of this study was to assess the impact on QOL (HRQL) and VHI of laryngectomies regarding voice rehabilitation.

MATERIALS AND METHODS

Study design and participants

This retrospective study was conducted at the ENT Department of the Emergency, County Hospital, between October 2013 and November 2014. The study included patients diagnosed with laryngeal or hypopharyngeal cancer and they underwent total laryngectomy. Demographics and medical history, such as histological diagnosis, tumor stage, tumor location, surgery type and date, and voice rehabilitation method, were recorded for each patient. The QOL and voice handicap scales and items were calculated as variables: Functional scales – physical, role, cognitive, emotional, and social – symptom scales – fatigue, pain, nausea and vomiting – global QOL scale; European Organisation for Research and Treatment of Cancer (EORTC) Quality of Life Questionnaire (QLQ-H) and N35 symptom scales (pain, swallowing, senses, speech, social eating, social contact, and sexuality); and the functional, physical, and emotional aspects of the voice handicap. More than half of the patients underwent voice rehabilitation, and during the interview, they were able to express themselves via esophageal voice (ES), tracheoesophageal voice (TEP), and EL. The other part of the patients did not undergo voice rehabilitation. Patients who refused to participate in the study, patients with associated neurological disorders, and patients lacking communication skills were excluded from the study.

Procedures and variables assessment

All participants were asked to answer three questionnaires; the VHI, the EOTRC core QOL questionnaire 30 (QLQ-C30 version 3), and the EOTRC head and neck cancer module (QLQ-H and N35) questionnaires applied in the same day. These questionnaires were mailed to patients with voice prosthesis 6 months after the first application of the questionnaires, and patients were asked to fill them again to assess patient speech success.

The VHI is a 30-item self-administered questionnaire that was developed by Jacobson *et al*. to quantify the patient's perception of disability resulted from voice disorder.[7] The items represent functional, physical, and emotional aspects of the voice handicap. The functional subscale refers to patient communication problems. The emotional subscale describes patient affective responses to voice disorder. The physical subscale relates to patient perception of his or her voice.[8] Scores range from 0 to 120. The VHI score between 0 and 30 reflects a minimal/mild VHI, a score between 31 and 60 reflects a moderate VHI, and a severe voice handicap is reflected by a total VHI score between 61 and 120 (maximum).[9,10]

The EORTC QLQ-C30 questionnaire consists of five functional scales (physical, role, cognitive, emotional, and social), three symptom scales (fatigue, pain, nausea and vomiting), one global QOL scale, and six independent items (dyspnea, insomnia, appetite loss, constipation, diarrhea, and financial problems).[11-13]

The specific head and neck cancer module, EORTC QLQ-H and N35, includes 35 items, grouped into 7 symptom scales (pain, swallowing, senses, speech, social eating, social contact, and sexuality) and 11 independent items.[11,12,14]

Patients were informed about the purpose of the study and information confidentiality. All patients included in the study signed informed consent form. The study was approved by the Ethics Committee of "Iuliu Hatieganu" University of Medicine and Pharmacy, Cluj-Napoca, Romania (Reference number: 419/17.12.2014).

Statistical analysis

Statistical analysis was performed using MedCalc Statistical Software version 16.8 (MedCalc Software bvba, Ostend, Belgium; https://www.medcalc.org; 2016). Quantitative data were characterized as mean and standard deviation (SD) (Kolmogorov–Smirnov test for normality). Qualitative data were expressed as absolute and relative frequency. Comparisons between groups were made using ANOVA *post-hoc* Tukey test. Variable differences between two repeated measurements were evaluated using the paired *t*-test. The relationship between scores was assessed

using Pearson's correlation. A $P < 0.05$ was considered statistically significant.

RESULTS

The study consisted of 65 patients who had undergone total laryngectomy for laryngeal or hypopharyngeal cancer. Sixty-two patients (95, 3%) were male and three (4, 61%) were female. Mean age was 59.22 years (SD = 9.00). The youngest group was represented by TEP speakers, with a mean age of 55.29 years (SD = 9.6); the oldest group was represented by those with EL, with a mean age of 64.12 years (SD = 5.96). We included 40 patients undergoing voice rehabilitation, and we also followed 25 patients without voice rehabilitation. The types of laryngeal communication were heterogeneously distributed. Among patients who underwent voice rehabilitation therapy, 14 (21, 5%) had tracheoesophageal voice (TEP), 9 (13, 8%) esophageal voice (ES), and 17 (26, 1%) EL. Thirty-nine (60%) of them underwent adjuvant radiotherapy (aRT), 23 (35, 38%) underwent adjuvant chemotherapy, and 21 (32.31%) underwent concomitant chemoradiotherapy. The most prevalent tumor site was the larynx (glottis = 41 and supraglottis = 13), and T-stage was usually advanced (T3 = 33.85% and T4 = 47. 69%). Fourteen patients presented postoperative complications – pharyngocutaneous fistula – and required additional treatment. The interval between surgery and the completion of the questionnaire varied from 1 month to more than 5 years: less than 1 year in 23 cases (35.4%), 1 year to 5 years in 33 patients (50.8%), and over 5 years in 9 cases (13.8%). Provox voice prosthesis was placed during surgery (primary puncture) in 6 patients and after surgery (secondary puncture) in 8 patients.

The results of EORTC QLQ-C30 showed a difference close to the threshold of statistical significance between group with voice rehabilitation and the group without voice rehabilitation in terms of scale scores: physical functioning, emotional functioning, and pain, with statistically significant difference in fatigue. The functional scale showed a better score for esophageal speakers than for TE speakers, those with EL, and patients who did not undergo voice rehabilitation. Symptom scale showed that patients who did not undergo voice rehabilitation experienced fatigue and pain problems. The global health status (QOL) score was higher in the esophageal group than in the others groups. The results of the EORTC QLQ-C30 questionnaire are shown in Table 1.

The most common problems reported for the QLQ-H and N35 questionnaire were pain, trouble with social contact, trouble with social eating, teeth, sticky saliva, and feeling of illness. A higher symptom score reflects stronger symptoms and more serious problems. Patients without voice rehabilitation were affected significantly stronger than those who underwent voice rehabilitation therapy.

Table 1: Results obtained from European Organisation for Research and Treatment of Cancer-Quality of Life Questionnaire C30 scales in patients regarding vocal rehabilitation

EORTC scales/items	Vocal rehabilitation				
	Esophageal voice	Electrolarynx voice	Tracheoesophageal voice prosthesis	No vocal rehabilitation	*P*
Global health status QLQ30	10.44±1.23	8.41±3.24	9.79±2.11	8.92±2.51	0.19
Physical functioning QLQ30	86.66±12.01	74.11±15.96	80.00±15.24	69.86±19.91	0.06
Role functioning QLQ30	64.81±38.59	69.60±31.86	70.23±33.44	50.00±31.91	0.17
Emotional functioning QLQ30	84.25±9.72	71.56±27.80	75.00±16.66	62.00±24.65	0.07
Cognitive functioning QLQ30	96.29±7.34	77.45±26.31	86.90±14.87	80.66±26.21	0.19
Social functioning QLQ30	70.37±18.21	74.50±27.71	76.19±25.07	69.33±26.21	0.83
Fatigue QLQ30	16.04±12.55	35.29±26.12	23.80±17.89	38.66±25.07	0.04
Nausea and vomiting QLQ30	1.85±5.55	5.88±11.69	5.95±10.55	14.00±21.87	0.15
Pain QLQ30	9.25±12.10	18.62±23.48	14.28±19.45	28.00±20.25	0.06
Dyspnea QLQ30	11.11±16.66	27.45±26.96	19.04±31.25	34.66±32.60	0.15
Insomnia QLQ30	29.62±38.88	31.37±34.29	40.47±32.49	40.00±31.91	0.74
Appetite loss QLQ30	7.40±14.69	27.45±35.81	9.52±20.37	25.33±32.31	0.16
Constipation QLQ30	7.40±14.69	21.56±31.04	14.28±28.38	18.66±28.99	0.63
Diarrhea QLQ30	-	1.96±8.08	7.14±14.19	6.66±13.60	0.29
Financial difficulties QLQ30	37.03±42.30	39.21±41.22	40.47±35.03	53.33±36.00	0.54

One-way ANOVA test was used. Results are presented as means±SD. Significance levels are indicated with $P<0.05$. A higher score in a functional scale and for global QOL scale reflects a higher QOL. A higher score in a symptom sale/item reflects a higher level of symptom (higher degree of problems). SD=Standard deviation; QOL=Quality of life; EORTC=European Organisation for Research and Treatment of Cancer; QLQ=Quality of Life Questionnaire

The latter showed a better symptom score in patients with esophageal voice. The results of the EORTC QLQ-H and N35 questionnaire are shown in Table 2.

A total of 26 (40%) patients had the VHI score between 31 and 60 (moderate voice handicap) and 39 (60%) patients had the VHI score over 61 (severe voice handicap). We compared the total VHI score and the three subscales for different methods of voice rehabilitation with the group who did not undergo voice rehabilitation. Patients who underwent voice rehabilitation therapy had a better total VHI score (55.85 ± 23) than those who did not (60.71 ± 25.99), with statistically significant differences between groups (P = 0.05). For the functional subscale, esophageal speakers had the lowest score (best function) and those who did not undergo voice rehabilitation had the highest score (worst function), the difference being very close to the threshold of statistical significance (P = 0.07). The functional subscale refers to patient communication problems related to the difficulty of being understood as a result of voice changes. Regarding the physical subscale, patients with esophageal voice had the lowest score and patients who did not undergo voice rehabilitation had the highest score. Regarding the emotional subscale, patients using EL had the best score while patients with esophageal voice had the highest score (worst function) [Table 3].

We assessed the three subscales and total VHI scores regarding aRT and adjuvant chemotherapy in patients with voice rehabilitation, obtaining differences in mean score

Table 2: Results obtained from European Organisation for Research and Treatment of Cancer-Quality of Life Questionnaire H&N35 scales in patients regarding vocal rehabilitation

EORTC scales/items	Vocal rehabilitation				
	Esophageal voice	Electrolarynx voice	Tracheoesophageal voice prosthesis	No vocal rehabilitation	*P*
Pain H&N35	3.70±8.44	21.07±20.64	12.50±16.26	21.66±15.02	0.02
Swallowing H&N35	16.66±33.33	21.56±34.7	10.71±19.17	34.00±35.18	0.15
Senses problems H&N35	57.40±26.49	58.82±19.64	45.23±15.23	43.33±30.04	0.15
Speech problems H&N35	72.22±49.12	80.88±47.21	92.86±43.22	107.00±48.15	0.17
Trouble with social eating H&N35	7.40±11.36	22.05±22.42	14.88±14.31	32.33±29.19	0.02
Trouble with social contact H&N35	11.11±14.52	23.52±26.78	15.71±16.86	44.53±31.78	0.00
Less sexuality H&N35	12.96±23.24	46.07±37.97	26.19±35.03	39.33±39.05	0.11
Teeth H&N35	18.51±33.79	54.90±38.98	23.80±24.20	34.66±33.99	0.02
Opening mouth H&N35	11.11±23.57	7.84±22.14	9.52±20.37	9.33±18.05	0.98
Dry mouth H&N35	14.81±33.79	25.49±36.38	19.04±25.19	22.66±30.00	0.84
Sticky saliva H&N35	18.51±33.79	41.17±41.71	16.66±17.29	41.33±33.71	0.06
Coughing H&N35	29.62±26.05	47.05±31.31	40.47±32.49	33.33±30.42	0.42
Felt ill H&N35	-	33.33±40.82	9.52±15.62	20.00±25.45	0.01
Pain killers H&N35	22.22±44.09	41.18±50.73	35.71±49.72	24.00±43.58	0.61
Nutritional supplements H&N35	0.00±0.00	5.88±24.25	7.14±26.72	12.00±33.16	0.70
Feeding tube H&N35	22.22±44.09	29.41±46.96	21.43±42.58	44.00±50.66	0.43
Weight loss H&N35	11.11±33.33	29.41±46.96	28.57±46.88	52.00±50.99	0.12
Weight gain H&N35	33.33±50.00	23.53±43.72	35.71±49.72	16.00±37.41	0.52

One-way ANOVA test was used. Results are presented as means±SD. Significance levels are indicated with P<0.05. A higher score in a symptom scale/item reflects a higher level of symptom (higher degree of problems). SD=Standard deviation; EORTC=European Organisation for Research and Treatment of Cancer

Table 3: Comparative statistical analysis of the voice handicap index questionnaire items according to the study group

	Vocal rehabilitation				*P*
	Esophageal voice	Electrolarynx voice	Tracheoesophageal voice prosthesis	No vocal rehabilitation	
Emotional subscale	23.22±9.78	14.76±9.35	19.21±7.36	20.20±10.56	0.15
Functional subscale	10.11±8.56	15.47±9.92	17.71±12.72	21.64±12.79	0.07
Physical subscale	19.33±3.96	22.59±9.06	24.64±6.54	26.64±8.95	0.10
Total VHI	52.67±19.32	52.82±24.20	61.57±24.28	68.48±28.91	0.19
Total VHI (for all rehabilitation methods)		55.85±23		68.48±28.91	0.05

One-way ANOVA test was used. Results are presented as means±SD. Significance levels are indicated with P<0.05. The VHI score minimal/mild VHI, a score between 31 and 60 reflects a moderate VHI, and a severe voice handicap is reflected by a total VHI score between 61 and 120. VHI=Voice handicap index; SD=Standard deviation

but no statistically significant differences. The total VHI, the emotional VHI subscale, and functional VHI subscale scores showed the lowest values (best function) in patients without aRT (total VHI 58.49 [SD = 24.80]), with emotional VHI of 17.95 (SD = 8.14), and with functional VHI of 16.32 (SD = 12.08), as compared to patients with aRT (total VHI 64.50 [SD = 28.05]), with emotional VHI of 20.75 (SD = 11.94), and with functional VHI of 19.75 (SD = 11.73).

Regarding the tracheoesophageal speech, VHI results at the first application of the questionnaires (VHI 1) and at the second application of the questionnaires after 6 months (VHI 2) showed a lower total VHI 2 (best function) (59.58 ± 16.33), which was statistically significant when compared to VHI 1 (64.25 ± 20.39, $P = 0.02$) (paired t-test). There was also a better VHI 2 score for the functional subscale (19.17 ± 5.58) and the physical subscale (20.83 ± 5.37) as compared to VH 1 functional (24.08 ± 6.03) and VH 1 physical (21.67 ± 6.66) but without any statistically significant difference. VHI results also showed that functional subscale scores were worse for the second application (19.58 ± 10.62) than for the first application of the questionnaire (18.50 ± 11.24), recording statistically significant differences ($P = 0.007$).

There was a statistically significant indirect correlation (Pearson's correlation) between voice handicap and QLQ-C30 in what concerns functional scales (physical, role, emotional). There was a statistically significant direct correlation between symptom scales, such as fatigue, pain, appetite loss, diarrhea, and financial problems and voice handicap [Table 4]. There was a statistically significant direct correlation between VHI and QLQ H and N35, which means higher symptom scores (worst) and more serious voice disorder [Table 5].

Table 4: Correlations (Pearson correlation) between voice handicap index total score and between the scales and items of European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire-C30

EORTC QLQ-C30	Total VHI	
	r	*P*
Global health status QLQ30 QL2	−0.373	0.002
Physical functioning QLQ30 PF2	−0.282	0.023
Role functioning QLQ30 RF2	−0.355	0.004
Emotional functioning QLQ30 EF	−0.336	0.006
Cognitive functioning QLQ30	−0.215	0.085
Social functioning QLQ30	−0.175	0.164
Fatigue QLQ30 FA	0.473	0.000
Nausea and vomiting QLQ30 NV	0.117	0.351
Pain QLQ30 PA	0.266	0.032
Dyspnea QLQ30 DY	0.151	0.231
Insomnia QLQ30 SL	0.201	0.108
Appetite loss QLQ30 AP	0.296	0.017
Constipation QLQ30 CO	0.133	0.292
Diarrhea QLQ30 DI	0.340	0.006
Financial difficulties QLQ30 FI	0.252	0.043

Pearson correlation was used. Significant levels are indicated with $P<0.05$.
VHI=Voice handicap index; QLQ=Quality of Life Questionnaire

Table 5: Correlations (Pearson correlation) between voice handicap index, total score and between the scales and items of European Organisation for Research and Treatment of Cancer H&N35

EORTC QLQ-H&N35	Total VHI	
	r	*P*
Pain H& N35 HNPA	0.263	0.034
Swallowing H& N35 HNSW	0.183	0.144
Senses problems H& N35 HNSE	0.384	0.002
Speech problems H& N35 HNSP	0.506	0.000
Trouble with social eating H& N35 HNSO	0.326	0.008
Trouble with social contact H& N35 HNSC	0.470	0.000
Less sexuality H& N35 HNSX	0.183	0.000
Teeth H& N35 HNTE	0.089	0.480
Opening mouth H& N35 HNOM	0.363	0.003
Dry mouth H& N35 HNDR	0.195	0.120
Sticky saliva H& N35 HNSS	0.189	0.133
Coughing H& N35 HNCO	0.208	0.096
Felt ill H& N35 HNFI	0.245	0.049
Pain killers H& N35 HNPK	0.173	0.168
Nutritional supplements H&N35	−0.010	0.936
Feeding tube H& N35 HNFE	0.035	0.784
Weight loss H& N35 HNWL	0.385	0.002
Weight gain H& N35 HNWG	−0.108	0.390

Pearson correlation was used. Significant levels are indicated with $P<0.05$.
VHI=Voice handicap index; EORTC=European Organisation for Research and Treatment of Cancer; QLQ=Quality of Life Questionnaire

DISCUSSION

The goal of voice rehabilitation is to gain good quality voice. In our study, QOL was better in patients submitted to voice rehabilitation than in the other group. The results support previous findings stating that QOL was worse in laryngectomees who were not submitted to voice rehabilitation.[15,16]

There were statistically significant differences between the group that underwent voice rehabilitation and the group that did not, with a better total VHI score for the first group.

According to Rossi *et al.*, the results regarding QOL and voice indicate that the treatment method used is not the only one that matters as the presence of voice rehabilitation following total laryngectomy is as important.[17] Adequate speech restoration following laryngectomy is one major aim of the therapy. Different speech options such as TEP speech, ES, or EL are in use.[2]

Esophageal speech

In 1922, Seeman found that the cervical esophagus could act as neoglottis and the stomach and distal esophagus could act as an air reservoir.[17] ES is a learned ability that requires speech training and much practice. The speech produced is of low volume and low pitch.

Electrolarynx

The most common device is a hand-held, battery-powered device placed under the mandible, which produces vibrations and allows speech. The substitute voice is monotonous and mechanical.[15]

Tracheoesophageal voice prosthesis

In 1978, Eric Bloom and Mark Singer secondarily inserted special valve prostheses into a surgically created tracheoesophageal fistula, allowing thousands of patients worldwide to regain their ability to speak.[18] Until then, ES and EL were the most popular methods of voice rehabilitation.[19] TEP can be inserted during surgery or as a secondary procedure. The Provox voice prosthesis is a low-resisting indwelling device developed within the Netherlands Cancer Institute in 1988, and it is currently one of the most widely used devices.[20-23] The use of TEP has clearly improved QOL in patients with total laryngectomy.[22]

The EORTC QLQ-C30 results in the present study demonstrated that all groups presented changes in QOL, but ES patients had a better score for the functional scale compared with nonvocal patients. These results are similar to those of the study conducted by Ana Pereira da Silva *et al*., showing that patients with ES have higher functional capacity compared with TEP patients and the nonvocal group.[15] The nonvocal group complained more often about pain and dyspnea, and the EL group had more problems with fatigue compared with the other groups. Lundström *et al*. found the same result, emphasizing that laryngectomees did not have very serious symptom problems.[10]

The results of the QLQ-H and N35 questionnaire showed that patients attending speech therapy did better in most scales. Patients who remain nonvocal had a higher perception of their dysfunction in communication than those rehabilitated with ES, EL, or TES. The QLQ-H and N35 questionnaire in our study reported that patients without voice rehabilitation were significantly more affected than the other groups. These findings are similar to those from the study conducted by Fahsl *et al*.[24] We reported the same problems: pain, trouble with social contact, trouble with social eating, teeth, feeling of illness, and sticky saliva. Patients with pharyngocutaneous fistula had a feeding tube which made them feel ill. The presence of the feeding tube made patients feel uncomfortable eating in public and interacting with people. These results could explain some of the problems observed in these patients.

Comparisons between the global health status (QLQ), QLQ-C30, H and N35, and VHI scores for TEP speakers, esophageal speakers, and speakers who use an EL showed statistically significant correlations between these groups. Correlation coefficients are negative for the functional scales of EORTC QLQ-C30 because high scores on the functional scales indicate good status and high scores on the VHI indicate poor status. Correlation coefficients are positive for the symptom scales and items of QLQ-C30 and QLQ H and N 35 because high scores on the symptom scales, as well as on the VHI, indicate poor status.

VHI comparisons between oncological treatments showed that patients with aRT achieved higher scores (highest voice handicap) when compared with those without aRT, and the best score (lowest voice handicap) was recorded in patients without adjuvant chemotherapy when compared with those with adjuvant concomitant chemotherapy, with differences in mean score but without any statistically significant difference. Our study results indicate that the voice rehabilitation method can be influenced by the addition of radiotherapy and chemotherapy.

Age and postoperative period did not have a significant influence on voice handicap scores. These findings differ from those obtained by Kazi *et al*., who reported that only age, radiation, and chemotherapy influence voice handicap scores.[22]

Our results regarding voice handicap demonstrated that the group who underwent voice rehabilitation had a greater voice handicap score than patients who did not undergo voice rehabilitation. Interestingly, patients with tracheoesophageal prosthesis had greater voice handicap scores than patients who did not undergo voice rehabilitation but lower than the group with esophageal voice. This probably explains why patients with TEP need an adjustment period as they had less time to integrate back into society and adapt to the new conditions of life. Most of our ES patients were evaluated longer after the end of voice rehabilitation therapy, and patients had adapted to the new conditions of life and learned to live with the inevitable consequences of laryngectomy. Further, the patients who express themselves through esophageal voice does not require surgical intervention.[25] This means that the patient is mostly independent of medical support and avoid the financial costs. However, learning to use this type of speech is much more difficult than talking with a voice prosthesis. Although the reason for this is not clear, data in the literature show that fluent, conversational speech may be acquired within just a few days with TEP, which is helpful for the patient's psychological state.[21] However, despite the new design of devices in recent years, obstruction of the prostheses and leakage through the devices are still the most frequent complications.[20]

The paired *t*-test and Pearson's correlation coefficient were used to compare voice handicap in patients with TEP rehabilitation between the first and the second (after 6 months) administration of the VHI questionnaire.

The first use of the VHI questionnaire in patients with TEP was initially associated with severe voice handicap in our patients; however, during follow-up, voice handicap score had improved. Patients described a significant improvement in voice production with the voice prosthesis. The impact of voice disability from the patient's functional point of view showed the best function for this subscale, with significant statistical differences. VHI scores improved following voice restoration using TEP after an adjustment period.

This procedure is preferable to others due to advantages such as clearer speech and long phonation time.[2,22] However, voice restoration using TEP is not yet common in Romania. Despite the small sample size, this study enabled the opportunity for a preliminary observation regarding the impact on QOL and voice handicap of laryngectomees with different types of voice rehabilitation in Romania.

TL patients should start rehabilitation and speech therapy as soon as possible during postoperative care for social reintegration, an important aspect of QOL.

CONCLUSION

This study demonstrated that QOL was better in patients who underwent voice rehabilitation therapy than in those who did not. The EORTC QLQ-C30, EORTC QLQ-H and N35, and VHI questionnaires help getting information regarding the way life is affected in laryngectomees after treatment. These data give us the opportunity to adjust rehabilitation and support programs to improve patient QOL.

Acknowledgments

This paper was published under the frame of the European Social Fund, the Human Resources Development Operational Programme 2007–2013, Project no. POSDRU/159/1.5/S/138776 and SWARA Project, PN-II-PT-PCCA-2013-4-1660, Contract no. 6/2014. Part of the data was presented earlier at the Third European Congress of ORL-HNS 2015, Prague, and at the Fifth IEEE International Conference on E-Health and Bioengineering EHB-2015 Iasi, Romania.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

AUTHORS' CONTRIBUTION

CȚ and FVD: Collected data, interpreted data, wrote article; MCh: Surgeon,conceived and designed study, interpreted data, wrote article, revised article; RM: Phoniatric analysis,interpreted data, revised article; TD: Statistical analysis, interpreted data, revised article; MC: Surgeon, interpreted data, revised article.

REFERENCES

1. Timmermans AJ, Krap M, Hilgers FJ, van den Brekel MW. [Speech rehabilitation following a total laryngectomy]. Ned Tijdschr Tandheelkd 2012;119:357-361.
2. Polat B, Orhan KS, Kesimli MC, Gorgulu Y, Ulusan M, Deger K. The effects of indwelling voice prosthesis on the quality of life, depressive symptoms, and self-esteem in patients with total laryngectomy. Eur Arch Otorhinolaryngol 2015;272:3431-7.
3. Attieh AY, Searl J, Shahaltough NH, Wreikat MM, Lundy DS. Voice restoration following total laryngectomy by tracheoesophageal prosthesis: Effect on patients' quality of life and voice handicap in Jordan. Health Qual Life Outcomes 2008;6:26.
4. Kapila M, Deore N, Palav RS, Kazi RA, Shah RP, Jagade MV. A brief review of voice restoration following total laryngectomy. Indian J Cancer 2011;48:99-104.
5. Moukarbel RV, Doyle PC, Yoo JH, Franklin JH, Day AM, Fung K. Voice-related quality of life (V-RQOL) outcomes in laryngectomees. Head Neck 2011;33:31-6.
6. Cosgarea M, Maniu Alma, Voinea R, Dincă Magdalena. Fasciocutaneous radial free flap for laryngeal reconstruction. Romanian Journal of Reconstructive Microsurgery 1998;3(I): 21-24.
7. Sanz L, Bau P, Arribas I, Rivera T. Development and validation of a short version of the Spanish pediatric voice handicap index (P-VHI-10). Int J Pediatr Otorhinolaryngol 2016;88:113-6.
8. Kandogan T, Sanal A. Voice handicap index (VHI) in Laryngectomy patients. KBB-Forum 2005;4Ş15-17.
9. Jacobson BH, Johnson A, Grywalski C, Silbergleit A, Jacobson G, Benninger MS, *et al*. The voice handicap index (VHI): Development and validation. Am J Speech Lang Pathol 1997;6:66-702.
10. Lundström E, Hammarberg B, Munck-Wikland E. Voice handicap and health-related quality of life in laryngectomees: Assessments with the use of VHI and EORTC questionnaires. Folia Phoniatr Logop 2009;61:83-92.
11. Fayers PM, Aaronson NK, Bjordal K, Groenvold M, Curran D, Bottomley A, on behalf of the EORTC Quality of Life Group. The EORTC QLQ-C30 Scoring Manual. 3rd ed. Brussels: European Organization for Research and Treatment of Cancer; 2001.
12. EORTC Quality of Life Group. Available from: http://www.groups.eortc.be/qol/eortc-qlq-c30. [Last accessed on 2014 Dec 12].
13. Zotti P, Lugli D, Vaccher E, Vidotto G, Franchin G, Barzan L. The EORTC quality of life questionnaire-head and neck 35 in Italian laryngectomized patients. European organization for research and treatment of cancer. Qual Life Res 2000;9:1147-53.
14. Singer S, Wollbrück D, Wulke C, Dietz A, Klemm E, Oeken J, *et al.* Validation of the EORTC QLQ-C30 & EORTC QLQ-H and N35 in patients with laryngeal cancer after surgery. Head Neck 2009;31:64-76.
15. Pereira da Silva A, Feliciano T, Vaz Freitas S, Esteves S, Almeida E Sousa C. Quality of life in patients submitted to total laryngectomy. J Voice 2015;29:382-8.
16. Rossi VC, Fernandes FL, Ferreira MA, Bento LR, Pereira PS, Chone CT. Larynx cancer: Quality of life and voice after treatment. Braz J Otorhinolaryngol 2014;80:403-8.
17. Seeman M. Speech and voice without larynx. Cas Lek Cesk 1922;61:369-72.

18. Singer MI, Blom ED. An endoscopic technique for restoration of voice after laryngectomy. Ann Otol Rhinol Laryngol 1980;89 (6 Pt 1):529-33.
19. Jassar P, England RJ, Stafford ND. Restoration of voice after laryngectomy. J R Soc Med 1999;92:299-302.
20. Hilgers FJ, Schouwenburg PF. A new low-resistance, self-retaining prosthesis (Provox) for voice rehabilitation after total laryngectomy. Laryngoscope 1990;100:1202-7.
21. Hilgers FJ, Cornelissen MW, Balm AJ. Aerodynamic characteristics of the Provox low-resistance indwelling voice prosthesis. Eur Arch Otorhinolaryngol 1993;250:375-8.
22. Nij dam HF, Annyas AA, Schutte HK, L ever H. A new prosthesis for rehabilietation after laryngectomy. Arch Otorhinolaryngol 1982;237:27-9.
23. Kazi R, De Cordova J, Singh A, Venkitaraman R, Nutting CM, Clarke P, *et al.* Voice-related Quality of Life in laryngectomees: Assessment using the VHI and V-RQOL symptom scales. J Voice 2007;21:728-34.
24. Fahsl S, Keszte J, Boehm A, Vogel HJ, Völkel W, Meister EF, *et al.* Clinical relevance of quality-of-life data in laryngectomized patients. Laryngoscope 2012;122:1532-8.
25. Tiple C, Matu S, Dinescu FV, Muresan R, Sofl au R, Drugan T, *et al*. Voice-related quality of life results in laryngectomies with today's speech options and expectations from the next generation of vocal assistive technologies. E Health Bioeng Conf 2015;1:1-4. [doi: 10.1109/EHB.2015.7391472].