

laryngectomized patients and to evaluate characteristics of esophageal voice and speech.

METHODS

The study was conducted at the Clinic of Otorhinolaryngology and Maxillofacial Surgery, at the Clinical Center of Serbia (CCS) in Belgrade, during the period from March 2012 to March 2015. The study included 223 patients who were diagnosed with laryngeal cancer and endured total laryngectomy at the Clinic of Otorhinolaryngology and Maxillofacial Surgery, who then underwent phoniatric rehabilitation that was conducted at the Phoniatric Department. In the study, patients were divided into two groups. The first group consisted of 168 laryngectomized patients who underwent all planned phases of phoniatric rehabilitation. The second group consisted of 55 laryngectomized patients who did not undergo the phoniatric rehabilitation because of their lack of motivation or inability to attend rehabilitation. The study was approved by the Ethics Committee of the Faculty of Medicine, University of Belgrade. All participants were provided with written participation consent for this research study.

The following procedure was performed to all patients: detailed case history, audiometry, phoniatric rehabilitation, psychological treatment, group rehabilitation, and multidimensional computer analysis of voice and speech.

Phoniatric rehabilitation, in form of outpatient treatment or hospital treatment, was carried out by a phoniatric team, establishing an esophageal voice and speech.

Multidimensional computer analysis of voice and speech was recorded in a silent room with ambient noise under 50 decibels with Electret Condense Meeting Microphone CM 903, placed 30 centimeters in front of the patients mouth while entire signal was analyzed for 5 seconds. The commercial software package of Dr Speech (Tiger) was used, which includes Real Analysis, Vocal Assessment and Phonetogram. The signals used were the continuous vocal, the original sentence and the text, which were formulated in such a way that they phonetically and syntactically best represented the Serbian language. The analysis of the phoniatric results was carried out according to the proposals of the European protocol for the analysis and evaluation of the results of the rehabilitation of the voice [3].

Laryngectomized patients completed the following questionnaires: structured questionnaire of demographic and clinical parameters; EORTC QLQ-C30 and QLQ-H&N43; Voice Handicap Index-10 (VHI-10); Patient Health Questionnaire (PHQ-9) and Questionnaire of generalized anxiety (GAD-7).

Serbian version of the questionnaire QLQ-H&N43, used in this study, has been developed in cooperation with EORTC Quality of life and EORTC Head and Neck Cancer group, following EORTC standards for translation and cultural validation [4, 5].

Subjective assessment of voice handicap was measured by questionnaire Voice Handicap Index-10 (VHI-10) [6].

The presence of depressed and generalized anxiety symptoms was measured by questionnaires Patient Health Questionnaire (PHQ-9) and Questionnaire of Generalized Anxiety (GAD-7) [7].

Statistical analysis

Pearson's chi-squared test was used to determine the differences between respondents in relation to the dichotomous markers. The distinctions between the topical questionnaires of two groups of respondents were compared using the T-test. The internal consistency of the scale with three or more questions was tested by Cronbach's alpha coefficient. Spearman's ρ correlation coefficient was used to test the relationship between questionnaire scores.

All the scores on the questionnaires were analyzed individually, not as a set of questionnaires, which means that we only included adequately completed questionnaires. All analyses were processed in the PASW Statistics for Windows, Version 18.0 (SPSS Inc., Chicago, IL, USA) software package.

RESULTS

In our study, subjects were predominantly male (84.3%). The youngest laryngectomized patient was 28 while the oldest was 82 years old, meaning that the average age was 63.24 (8.1%) years, with most patients in their 60s.

Laryngectomy patients from this study were mostly retired (87.1%) either in the invalidity retirement due to malignancy or retirement age at the time of testing. A small number of laryngectomized patients were still actively working.

After examining the habits of laryngectomized patients before and after surgery, it was concluded a significant reduce in the percentage of smokers after total laryngectomy and slightly fewer number of alcohol consumers. Before surgery, 93.7% of patients smoked compared to 3.1% of patients postoperative. Before surgery, the percentage of alcohol consumers was 21.5% and 7.2% after surgery.

Most of laryngectomized patients were in stage III of malignant disease, which suggests the severity of the disease and justifies total laryngectomy; 81.6% of laryngectomized patients from this study had postoperative radiotherapy.

In this study, 23.8% of laryngectomized patients had hearing loss: mild hearing impairment 59% of respondents, moderate or severe hearing impairment 28%, and profound hearing impairment 13% of respondents.

48% of laryngectomized patients had some related chronic disease: 34.6% of patients had chronic respiratory disease, 37.4% had reflux disease, 28% had cardiovascular disease, and 23.4% of respondents had diabetes mellitus and hypothyroidism.

Out of the total 223, 168 patients (75.3%) underwent phoniatric rehabilitation. Among patients who lived outside Belgrade, 100/168 (59.9%) were hospitalized for the purpose of conducting phoniatric rehabilitation for two

weeks at the Clinic of Otorhinolaryngology and Maxillo-facial Surgery, CCS. According to the therapists, phoniatric rehabilitation was successful in 145 (86.3%) patients and 135 (80.4%) of respondents were satisfied with the results of their rehabilitation. Rehabilitation was more successful for those patients who did not have a hearing problem, who did not have associated chronic disease and who were not treated with postoperative radiotherapy. With intensive phoniatric rehabilitation, esophageal voice and speech were established in 86.3% of laryngectomized patients, which is registered by objective acoustic analysis (Table 1) (Figure 1).

Table 1. Multidimensional characteristics – objective acoustic analysis of esophageal voice and speech

Characteristics	M	SD	Min.	Max.
AVE.FO Hz	126.44	32.32	76.22	189.03
SD.FO Hz	30.74	24.07	0.00	83.83
Max.FO Hz	184.62	67.24	28.02	306.25
Min.FO Hz	78.17	20.80	0.00	164.55
PERC.SPEECH TIME	56.82	15.80	25.24	99.88
PERC.SILENCE TIME	42.11	16.93	0.12	74.76
PERC.VOICE TIME	8.57	12.28	0.12	70.56
PERC.VOICELESS TIME	50.51	13.88	24.52	92.39
FO.RANGE Hz	117.26	69.30	0.00	235.58
AVE.Int dB	59.45	4.35	50.32	69.92
SD.Int dB	7.29	1.97	3.02	11.18
Max.Int dB	81.53	5.77	66.44	88.41
Min.Int dB	47.74	2.76	44.03	54.03
FO.RANGE2 Hz	172.30	64.87	58.00	358.00
Max. Hz	277.40	73.75	156.00	554.00
Min. Hz	107.32	26.82	92.00	196.00
SPL.RANGE dB	25.62	21.06	7.90	147.00
MAX2.dB	63.41	7.49	50.80	79.10
MIN2 dB	40.35	5.13	10.06	46.40
AREA dB	135.41	91.17	0.00	396.60

AVE.FO – average frequency; Hz – hertz; Int. – intensity of basic tone sound; dB – decibel; FO.RANGE – frequency range; SPL.RANGE – sound pressure level; AREA – speech area

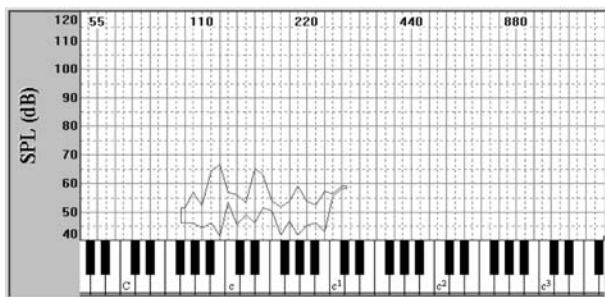


Figure 1. Phonetogram of esophageal voice

The quality of life of laryngectomized patients is severely affected in various degrees by different domains. Laryngectomized patients have a low level of social functioning and business capabilities, lower physical and emotional functioning, as well as global health and quality of life. Very influential domains of the quality of life are general symptoms such as fatigue, presence of pain, loss of appetite, insomnia and specific symptoms which include problems with speech, coughing, problems with senses of smell and taste, dry mouth and secretion, problems with teeth,

problems in social contact and sexual problems. Financial difficulties due to reduced working ability of laryngectomized patients represent a significant prediction for most aspects of daily life. Different demographic and clinical parameters affect the quality of life of laryngectomized patients. Demographic parameters of importance are age, place of residence, level of education and habits; clinical parameters of importance are the age when one underwent total laryngectomy, postoperative radiotherapy and chemotherapy, hearing impairment, comorbidity, phoniatric rehabilitation, and psychological support.

Being a member of the Association of Laryngectomized Patients is a very important social parameter.

The quality of life of laryngectomized patients who underwent phoniatric rehabilitation is notably better than those who did not have phoniatric rehabilitation (Table 2).

Laryngectomized patients who were rehabilitated have a significantly better global health and quality of life as well as a remarkably higher level of physical, business, social, emotional and cognitive functioning compared to those who were not rehabilitated.

Laryngectomized patients who were exposed to phoniatric rehabilitation had a significantly lower level of general and specific symptoms such as fatigue, pain, loss of appetite, problems with speech and swallowing, coughing, problems with the sense of smell and taste, dental problems, problems with socially contact and sexuality. Rehabilitated laryngectomy patients had a significantly lower presence of voice handicap sense and expressed significantly lower symptoms of depression and anxiety.

The subjective experience of voice handicap of laryngectomized patients drastically impacts their quality of life. Laryngectomized patients in which phoniatric rehabilitation was conducted have significantly lower score values in the questionnaire VHI-10, which measures voice handicap index (Table 3).

Our study has confirmed the presence of high-level depression and anxiety symptoms in laryngectomized patients. Laryngectomized patients in which phoniatric rehabilitation was conducted have significantly lower scores values in the questionnaire PHQ-9 and GAD-7, which indicates that depression and anxiety symptoms are less pronounced in the rehabilitated patients (Table 4).

DISCUSSION

The predominant number of laryngectomized male patients is noted in the literature, however the surge of female patients can be explained by growing number of women smokers and alcohol consumers, as well as their increased exposure to carcinogens. In our study, the ratio of female to male sex was 1:5. In their own research, Woodard and Berlin found the same ratio represented among sexes [8, 9]. The majority of our patients were in their sixties and seventies. The situation is similar in other studies [1, 2]. Laryngectomized patients in our study were mostly retired people with disabilities due to malignant disease or people retired due to age, like in some other reports [10].

Table 2. Scores QLQ-H&N43 questionnaire in relation with phoniatric rehabilitation (n = 223)

Symptoms/problems	Phoniatric rehabilitation				M. Dif.*	t-test value	p-value
	NO, n = 55		YES, n = 168				
	M	SD	M	SD			
Fatigue	35.15	19.45	19.84	17.67	15.31	5.43	< 0.001
Nausea and vomiting	9.39	12.73	4.76	9.68	4.63	2.83	0.005
Pain	19.09	20.39	8.23	16.21	10.85	4.03	< 0.001
Dyspnea	11.73	18.49	5.99	19.12	5.74	1.93	0.055
Insomnia	24.24	22.64	16.27	21.88	7.97	2.32	0.021
Loss of appetite	27.88	23.80	15.28	21.54	12.60	3.66	< 0.001
Constipation	12.12	17.41	8.13	18.05	3.98	1.43	0.153
Diarrhea	3.03	9.67	2.58	10.32	0.45	0.28	0.775
Financial problems	41.82	26.62	32.74	29.52	9.08	2.02	0.044
H&N Neurological problems	12.73	19.76	10.12	19.22	2.60	0.86	0.387
H&N Wound healing problem	4.85	11.86	5.16	18.95	-0.31	-0.11	0.909
H&N Loss of weight	20.00	21.85	12.50	23.55	7.50	2.08	0.038
H&N Neck edema	19.14	23.88	12.90	23.34	6.23	1.69	0.091
H&N Cough	43.03	28.45	27.38	27.38	15.64	3.64	< 0.001
H&N Mouth opening	9.26	18.79	3.99	15.87	5.26	2.02	0.044
H&N Social contact	54.55	37.61	25.79	32.36	28.75	5.48	< 0.001
H&N Head and neck pain	19.24	17.63	9.03	12.11	10.21	4.81	< 0.001
H&N Swallowing problems	22.42	18.69	6.25	13.49	16.17	6.97	< 0.001
H&N Senses problems	42.42	25.42	34.33	22.76	8.09	2.22	0.027
H&N Speech problems	75.39	31.99	51.27	24.77	24.12	5.81	< 0.001
H&N Eating problems	23.03	18.70	8.88	16.65	14.15	5.30	< 0.001
H&N Sexuality	60.00	37.21	49.31	31.66	10.69	2.079	0.039
H&N Teeth problems	28.48	20.37	17.80	20.90	10.68	3.30	0.001
H&N Dry mouth / Sticky saliva	40.12	23.69	27.64	19.25	12.47	3.90	< 0.001
H&N Body image	33.74	22.93	23.41	23.14	10.32	2.87	0.004
H&N Shoulder problem	15.45	19.99	9.82	22.36	5.63	1.66	0.098
H&N Skin problem	12.12	12.52	8.33	11.39	3.78	2.08	0.038
H&N Tension	41.52	26.62	34.42	22.94	7.09	1.91	0.057

*Mean scores difference (M. Dif.)

Table 3. Scores VHI-10 questionnaire in relation with phoniatric rehabilitation (n = 223)

Score	Phoniatric rehabilitation				M. Dif.*	t-test value	p-value
	NO, n = 55		YES, n = 168				
	M	SD	M	SD			
VHI-10 Total	28.25	9.60	19.57	7.35	8.68	7.02	< 0.001

*Mean scores difference (M. Dif.)

Table 4. Scores PHQ-9 and GAD-7 questionnaires in relation with phoniatric rehabilitation (n = 223)

Score	Phoniatric rehabilitation				M. Dif.*	t-test value	p-value
	NO, n = 55		YES, n = 168				
	M	SD	M	SD			
Depressive symptoms (PHQ-9)	6.7	6.0	3.8	4.2	2.88	3.94	< 0.001
Anxiety symptoms (GAD-7)	7.0	4.9	3.4	4.2	3.55	5.14	< 0.001

*Mean scores difference (M. Dif.)

Postoperative radiation has been carried out with 81.8% of our patients. In other studies, the percentage of irradiated patients ranges 27–85%, which depends on the number of

patients involved in the study and the stages of malignant disease [11].

Phoniatric rehabilitation was successful in establishing esophageal voice and speech in 86.3% of our laryngectomized patients, which was registered by objective acoustic analysis. Esophageal voice has the most humane and similar to the normal, healthy human voice. Frequency, intensity, and voice restoration are significantly different from laryngeal voice. The rhythm of esophageal voice is slower. The range of this voice is very small. Esophageal voice is deep with very characteristic voice color. The intensity of this voice has been significantly reduced, but high-quality esophageal voice has satisfactory height for communication.

Multidimensional characteristics of esophageal voice and speech among the respondents who speak the Serbian language are the objective indicators of communication skills of the laryngectomized patients. The impact of vocal rehabilitation on quality of life and voice handicap in laryngectomized patients is noticed in another study [12].

The evidence from this study indicates that questionnaires EORTC QLQ-C30 and QLQ-H&N43 could be used to evaluate the quality of life of laryngectomized patients.

The results of this study agree with the similar research, which have used EORTC QLQ-C30 and QLQ-H&N35 questionnaires with laryngectomized patients [13, 14]. Meanwhile, it was suggested that further research should be carried out, because there are no studies that have used QLQ-H&N43 questionnaire, in order to develop the norms for use of this questionnaire for the population in Serbia. The analysis of domain questionnaires EORTC QLQ-C30 has shown significant variations in the quality of life of laryngectomized patients. It has been observed that our patients have a high level of cognitive functioning, lower physical and emotional functioning, low level of social functioning and business ability, as well as overall health and quality of life. The continuous findings in different studies have shown changes in quality of life, especially in the domain of overall health [15, 16]. Some authors have reported lower functioning in the cognitive domain, as well as emotional and social functioning [17].

Our study documented that the general symptoms such as fatigue, insomnia, and appetite loss are dominant in laryngectomized patients, as noted by some other studies [18, 19]. The most expressive and specific symptoms of our patients were cough, dry mouth and sticky saliva, speech problems, social contact problems and sexual problems. These results are consistent with previous studies [20, 21]. In our study, there was no significant statistical difference in the assessment of quality of life between men and women. One of the previous studies has shown that women have lower emotional and social functioning [22]. Our patients had a high level of financial problems, as well as others [23]. Laryngectomized patients have significant psychological problems such as: difficult adaptation to the new situation, mood changes, lost confidence, feeling of loneliness, depression, anxiety disorders, posttraumatic

stress syndrome [24–27]. Studies have shown that laryngectomized patients have more severe psychological problems than patients with other types of cancer and surgeries [28, 29, 30].

Our study has confirmed the high level of depression and anxiety symptoms in laryngectomized patients.

Our study is unique because it examined the quality of life of laryngectomized patients before and after phoniatric rehabilitation. The quality of life of laryngectomized patients in which was conducted phoniatric rehabilitation is significantly better than those who did not have phoniatric rehabilitation. Laryngectomized patients after phoniatric rehabilitation had significantly lower presence of voice handicap and less expressed symptoms of depression and anxiety.

CONCLUSION

Significantly improving the quality of life of laryngectomized patients was achieved by a multidisciplinary rehabilitation of patients as well as their families. Return to the family, profession, and social environment requires organized work of rehabilitation teams, which are not all sufficiently engaged. Phoniatric team has to be the moderator of rehabilitation of laryngectomized patients.

Rehabilitation of laryngectomized patients includes phoniatric rehabilitation, which must be carried out in a planned and systematic way in order to be the most efficient. Esophageal voice and speech are the most human form of communication for laryngectomized patients. Phoniatric rehabilitation success of 87% of patients testifies to the importance of learning the esophageal voice and speech, which was confirmed by this study.

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Квалитет живота ларингектомисаних болесника у Србији

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САЖЕТАК

Увод/Циљ Тотална ларингектомија, као веома мутилантна операција, доводи до драстичних промена у квалитету живота. Циљ ове студије је да истражи факторе од значаја за квалитет живота ларингектомисаних болесника и да процени карактеристике езофагусног гласа и говора.

Метод Истраживање је спроведено у Клиници за оториноларингологију и максилотофацијалну хирургију Клиничког центра Србије у Београду, у периоду од марта 2012. до марта 2015. године. Испитивањем је било обухваћено 223 болесника којима је због верификованог карцинома ларинкса учињена тотална ларингектомија и спроведена фоњотријска рехабилитација код 168 ларингектомисаних болесника.

Резултати Квалитет живота ларингектомисаних болесника код којих је спроведена фоњотријска рехабилитација је значајно бољи од оних који нису имали фоњотријску рехабилитацију. Интензивном фоњотријском рехабилитацијом

је успостављен езофагусни глас и говор код 86,3% ларингектомисаних болесника, који је регистрован објективном акустичком анализом. Рехабилитовани ларингектомисани болесници имају значајно ниже присуство хендикепа због гласа ($VHI: 19,57 \pm 7,35$) и значајно ниже изражене симптоме депресије и анксиозности ($PHQ-9: 3,8 \pm 4,2$; $GAD-7: 3,4 \pm 4,2$). Кронбахов α коефицијент је био изнад 0,7 на три скале упитника *EORTC QLQ-C30*: физичко функционисање, емоционално функционисање и умор, као и код пет скала *QLQ-H&N43* упитника: бол у глави/врату, проблеми са гутањем, проблеми са говором, проблеми при јелу и слика о себи.

Закључак Значајно побољшање квалитета живота ларингектомисаних болесника постиже се мултидисциплинарном рехабилитацијом. Фоњотријска рехабилитација, која се спроводи плански и систематично, представља најјекономичнији начин рехабилитације ларингектомисаних болесника.

Кључне речи: квалитет живота; тотална ларингектомија; езофагусни глас и говор; фоњотријска рехабилитација