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The Quality of Life in the Elderly with Acquired Single-Sided Deafness

S. A. Karpishchenko[a], * and Ya. L. Shcherbakova[a]

[a] *St. Petersburg Research Institute of Ear, Throat, Nose, and Speech, St. Petersburg, 190013 Russia*

**e-mail: karpischenkos@mail.ru*

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Abstract—This study was aimed at assessing the negative impact of an acquired single-sided deafness on quality of life of the elderly. Prospective analysis of outpatient records was carried out to identify elderly patients with single-sided deafness using pure tone audiometry. The main inclusion criteria were age over 60, a 90 dB or higher threshold of an affected ear, a 30 dB or less threshold of an intact ear, and an acquired single-sided hearing loss with sudden onset and a deafness duration of less than 5 years. Taking the inclusion criteria into account, two groups were formed: the main group with single-sided deaf patients ($n = 25$) and the control group of patients with normal hearing ($n = 25$). All participants were surveyed with the PSQ, HHIE, and THI questionnaires. Some changes in psychological status in the group of patients with single-sided deafness in comparison with the group of normal hearing participants were revealed. The scores of the questionnaires showed increased stress and anxiety levels and deterioration in their quality of life. Patients with single-sided deafness complained about severe tinnitus in an affected ear, worse intelligibility of speech in a noisy environment and a constant need to adapt to the different acoustic situations that in turn affected psychoemotional homeostasis badly, intensifying the severity of stress, and their quality of life.

Keywords: single-sided deafness, psychoemotional status, survey, rehabilitation, quality of life, tinnitus

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INTRODUCTION

Hearing loss is one of the most common sensory impairments [15]. Age-related hearing loss (Presbycususis) is the second most common disease in the geriatric population and the third most common disease in the world [24].

According to a WHO study (2012), 328 million adult patients in the world suffer from hearing loss with hearing thresholds over 40 dB. Considering the trend towards an increase in life expectancy and an aging population, the number of people over 60 years old will be 1.2 billion by 2025, and more than 500 million of them will suffer varying degrees of hearing loss [23]. Age-related hearing loss is diagnosed on average in 37% of patients aged 61–70 years, in 71% of patients over 70 years old, and in more than 80% of cases in patients over 85 years old [17, 20].

Unilateral deafness is characterized by profound hearing loss of 90 dB or more in the affected ear with age norm hearing thresholds (≤25 dB) on the opposite ear [8, 11].

In the structure of ear diseases/hearing disorders/otologic disorders, unilateral hearing loss occurs on average from 12 to 20 people per 100000 (3–6%), and in the case of the congenital form of the disease, from 0.4 to 3.4 per 1000 newborns [8, 25]. Annually, 200 people per million of the world's population have newly diagnosed one-sided deafness [11].

The etiology of acquired one-sided deafness is very diverse [7, 11]. According to the results of the study by Usami et al., in most cases (54.6%) there is a sudden idiopathic hearing loss, which also correlates with the data of other authors [11, 12]. Known etiological factors leading to the development of unilateral deafness are chronic otitis media (6.4%), cerebellopontine angle tumors (5.2%), perilymphatic fistula (2.3%), and traumatic brain injury (1.7%) [23].

Despite the fact that in unilateral deafness, as a classic example of partial auditory deprivation [13], the function of the intact ear is not impaired, patients complain of deterioration in intelligibility of speech, inability to localize sound, and the need to adapt to certain acoustic situations [9, 10]. Difficulties in auditory perception in this group of patients are primarily associated with the loss of the binaural hearing effects and limitation of the functional capabilities of the healthy ear [4], for example, if the signal/sound is on the side of the affected ear (head shadow effect). The healthy ear perception decreases by 6 dB, mainly in the high frequency range, which may explain the deterioration in speech intelligibility [22].

The inability to localize the sound, which creates a real threat to the patient's life in some situations, unsatisfactory intelligibility of speech, especially in a noisy environment and intense tinnitus in the affected ear can affect the patient's daily life, leading to exhaustion, despair, physical, social and psychological stress, and cognitive impairment, which significantly worsens mental health [2, 18, 19] and quality of life [21].

It is necessary to define what quality of life means to understand the influence of the presented pathological condition on an individual, it is necessary to define the latter concept. Quality of life is a set of parameters that reflect the measurement of the course of life with an assessment of physical condition, psychological well-being, social relations, and functional abilities. Thus, the quality of life is an optimal combination of parameters of health, leisure, employment, education, professional and social growth, protection of rights and freedoms, safety, and Environmental purity [3].

Therefore, to prevent the negative impact of one-sided deafness on an individual's functioning (physical, mental, and social), it is necessary to create\make an algorithm for more effective rehabilitation to restore binaural hearing.

In case of ineffective medical treatment for sudden hearing loss along with\in conjunction with severe psychoemotional-social disorders, the modern methods of binaural hearing restoration are available and may be offered to the elderly (elderly patients).

The aim of the study was to assess the negative impact of acquired one-sided deafness on the quality of life of elderly patients for the further development of an algorithm for effective rehabilitation measures.

MATERIALS AND METHODS

Since 2019, on the basis of the St. Petersburg Research Institute of Ear, Throat, Nose, and Speech in the Department of Diagnostics and Rehabilitation of Hearing Disorders, a study has been conducted to analyze the effect of acquired single-sided deafness on the quality of life.

All patients underwent a comprehensive examination of the hearing: acumetry, pure tone audiometry, impedancemetry and otoacoustic emission tests. To determine the compliance of patients with the main audiological selection criteria, pure-tone audiometry threshold score was used to determine if patients match the main audiological selection criteria (the arithmetic mean of the thresholds at 0.5, 1, 2, and 4 kHz) were used.

All patients had a sudden onset of the disease with 90 dB hearing loss or more in affected ear and 30 dB or less in the intact one and thresholds of perception of 30 dB or less in the intact ear, which corresponded to the diagnosis of unilateral deafness. The control group included patients with normal hearing (according to the age norm), banaural thresholds 30 dB or less.

The main audiological selection criterion was unilateral deafness with average average score 90 dB or more in the bad\poor ear and 30 dB or less in the good one (according to the WHO unified classification of hearing loss, 1997).

PTA thresholds average scores 90 dB or less and 30 dB or more, respectively, were the exclusion criterion. The exclusion criteria were also the age of patients under 60 years, congenital and progressive hearing loss, a period of deafness over 5 years, and non-connected-to-deafness conditions affecting the psychoemotional status, as well as the experiencing of tinnitus in the control group patients in patients of the control group.

The etiology of deafness varied, but the disease was predominantly idiopathic. The established factors that provoked the development of single-sided deafness were a past viral disease (new coronavirus infection COVID-19 (SARS-CoV-2), confirmed by PCR ($n = 1$), traumatic brain injury ($n = 1$), stroke ($n = 3$), and radiosurgical treatment of the cerebellopontine angle tumors ($n = 1$).

All patients, except for the patient with vestibular schwannoma, underwent urgent medical treatment, including systemic glucocorticosteroids, antioxidants, angioprotectors, and nootropic drugs. The radiologic imaging was carried out to all patients. (CT scan of angiography of the cerebral and brachiocephalic vessels).

In accordance with the aim of the study, two groups were formed: the main group included 25 patients with acquired single-sided deafness (duration of deafness from 7 days to 5 years) at a mean age of 63 (median) $\pm$ 4.5 (standard deviation) years; the control group included 25 patients with normal hearing at an average age of 65 $\pm$ 2.7 years (Table 1).

Hearing Handicap Inventory for the Elderly (HHIE) is a questionnaire specially designed for elderly patients with hearing impairments. It was used to assess the quality of life of the elderly with the single-sided deafness [6]. It consists of 25 questions, with three answer options with a maximum number of points equal to 100. When analyzing the results, both the total score and the emotional functioning subscale score and SFS score. An increase in the total total score of the questionnaire indicates a deterioration in the quality of life.

The intensity of tinnitus and its impact on the quality of life were assessed using the THI (Tinnitus Handicap Inventory) questionnaire [16]. It includes 25 questions with three answer options and a maximum number of points equal to 100. When analyzing the results of the questionnaire, we compared the results with the clue to specify the tinnitus intensity reflecting the intensity of ear noise and the degree of its negative impact on the quality of life.

Table 1. The characteristics and results of the questionnaire survey in patients of both groups

Parameter	Main group, $n = 25$	Control group, $n = 25$
Age, years	63 ± 4.5	65 ± 2.7
Gender, m/f	13/12	13/12
Etiology		*N* = 25
idiopathic	19	
CVA	3	
COVID-19	1	
traumatic brain injury	1	
vestibular schwannoma	1	
Localization of deafness	*AD* = 11	*AD/AS*
	AS = 14	*N* = 25
Questionnaire data		
HHIE	27.3 ± 8.8	0
SF	12.6 ± 7.6	0
EF	15.7 ± 9.3	0
THI	29.2 ± 7.9	0
PSQ	0.40 ± 0.13	0.21 ± 0.15

AD, right ear; *AS*, left ear; *N*, norm; HHIE, Hearing Handicap Inventory for the Elderly; SF, Social Functioning (HHIE social subscale); EF, Emotional Functioning (emotional subscale HHIE); THI, Tinnitus Handicap Inventory; PSQ, Perceived Stress Questionnaire.

Psychoemotional status was assessed with PSQ (Perceived Stress Questionnaire) questionnaire. It consists of 30 questions, for which there are four possible answers. The main feature of this questionnaire is that it contains questions both with a direct assessment of the results and with an inverse assessment that has to be considered when interpreting. The results were assessed with a special clue and an increase total score indicated an increase in the level of stress. According to N. Fliege et al., this indicator does not exceed 0.33 for healthy adult patients [8].

The study using the submitted questionnaires was approved by the ethics committee of the St. Petersburg Research Institute of Ear, Throat, Nose, and Speech (protocol of the session of the ethics committee no. 2 dated August 15, 2019).

The data obtained were processed by parametric and nonparametric statistical methods. Statistical processing and systematization of the obtained data was carried out using a personal computer with the determination of average values and a parametric criterion (the Student's *t*-criterion).

For statistical estimation of variables, standard methods of descriptive statistics with the calculation of point and interval (95% confidence intervals) estimates were used. When testing statistical hypotheses for quantitative and ordinal variables, the methods of nonparametric statistics (Wilcoxon test) were used, for categorical variables, the χ^2 test was used. Differences were considered statistically significant at a significance level of $p < 0.05$.

RESULTS AND DISCUSSION

Since September 2019, 618 patients with hearing loss have been examined for the formation of comparison groups.

The survey did not find any significant gender differences in the development of single-sided deafness. This disease was observed in approximately equal proportions in both men and women (13/12), the indicators of mental health and quality of life also did not differ statistically significantly (in women, the indicators of the total scores of all the questionnaires presented were slightly higher), $p > 0.05$.

When analyzing the incidence of unilateral hearing loss, depending on the localization of the pathological process, no statistically significant differences were also found (right-sided/left-sided, 11/14), $p > 0.05$.

Analysis of gender differences and localization features of hearing loss is limited to a small observation group and requires further research.

The average scores of the HHIE, THI, and PSQ questionnaires were statistically significantly ($p < 0.05$) higher in the patients of the main group than in the patients of the control group, which indicates an increased level of stress and anxiety, and a deterioration in the quality of life in elderly people suffering from unilateral deafness.

The average score on the HHIE questionnaire in patients of the main group was 27.3 ± 8.8 (the social subscale was 12.6 ± 7.6 points, the emotional subscale was 15.7 ± 9.3 points); the average score on the THI

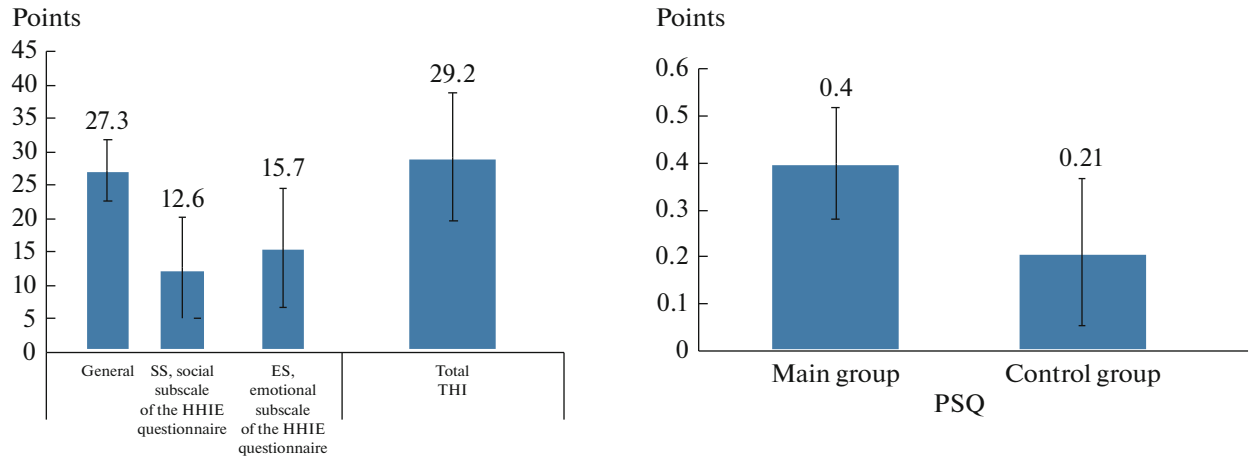

Fig. 1. Indicators in patients of both groups according to HHIE, THI, and PSQ questionnaires.

questionnaire in patients of the main group was 29.2 ± 7.9, in the patients of the control group the results of the HHIE and THI questionnaires were equal to 0 due to the fact that there were no complaints of hearing loss and tinnitus; the average score on the PSQ questionnaire in patients of the main group was 0.40 ± 0.13, in patients of the control group it was 0.21 ± 0.15 (Fig. 1).

The collected complaints and a scrutiny of the survey results revealed that elderly patients with single-sided deafness experience a number of difficulties in communication, attending various public events, suffer from intense tinnitus in the affected ear, which in most cases is not masked by background noise. Unmasked tinnitus leads to psychoemotional disorders and a deterioration in the quality of life in comparison with age norm hearing patients.

In addition to the impaired speech intelligibility and intense tinnitus, patients complained of anxiety, irritation, nervousness, poor sleep, and the constant need to adapt to the different acoustic environment, which required a significant attention concentration, led to increased fatigue and slowdown in mental activity.

Consequently, unilateral deafness has a pronounced negative effect on the psychoemotional state and quality of life of elderly patients and can also be a risk factor for the development of cognitive impairments, which requires additional research using the cognitive functions asessment questionnaires as by MoCA (Montreal Cognitive Assessment) and MMSE (Mini-Mental State Examination) [1].

CONCLUSIONS

Patients suffering from single-sided deafness represent a special group of patients, which, unfortunately, does not receive due attention from many specialists due to their fully functioning intact ear.

However, it has been repeatedly proven that one ear is not enough, patients experience certain difficulties in communicating, especially in noisy environments, they lose the ability to localize sounds, which can pose a threat to life, and also suffer from tinnitus in the deaf ear.

The study data confirm the fact that in elderly patients, as in patients with single-sided deafness in general, there is a disruption\impairement of psychoemotional homeostasis in the form of an increased level of stress and a deterioration in the quality of life.

When interviewed, many patients also complained of unsatisfactory speech intellagibility, intense tinnitus in the affected ear, the inability to localize the sound, and the constant need to adapt, which required increased concentration of attention and led to exhaustion, increased irritation, and nervousness.

Therefore, taking all of the above into account, the primary task is to make\create an effective algorithm for rehabilitation patients with unilateral deafness, which will help restore binaural hearing and cope with a number of psychological, social and cognitive problems and improve the quality of life.

COMPLIANCE WITH ETHICAL STANDARDS

Conflict of interests. The authors declare that they have no conflicts of interest.

Statement on the welfare of humans. All applicable international, national, and/or institutional guidelines were followed.

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