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Optimizing The Treatment of Patients with Acute Sensorineural Pain

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ABSTRACT

Objective: *This study aims to evaluate the outcomes of treating patients with acute neurosensory hearing loss across different age groups. The research emphasizes the restoration of hearing as a complex, multi-level process, focusing on the highest level responsible for ensuring proper sensory-motor correction of functional activities.* ***Methods:*** *Hearing restoration was examined using advanced methods, including posturography, which provided insights into sensory-motor adjustments. The study involved patients from varied age demographics, ensuring a comprehensive analysis of age-related differences in treatment responses.* ***Results:*** *The findings demonstrate significant improvements in hearing restoration across all age groups. Posturography proved instrumental in facilitating sensory-motor corrections, highlighting its efficacy as part of a structured rehabilitation process. Age-specific variations in recovery patterns were also observed, providing valuable data for tailoring treatment protocols.* ***Novelty:*** *This research introduces a novel approach by integrating posturography into the treatment framework for acute neurosensory hearing loss. The study underscores the importance of addressing sensory-motor functions as a critical element of hearing restoration, particularly in a multi-level rehabilitation context.*

INTRODUCTION

Currently, posturography is one of the fundamental methods in clinical and research fields, widely applied in posturology. As a method for studying balance functions, proprioceptive systems, visual analyzers, vestibular apparatus, and other systems involved in maintaining balance, posturography and its variations are used in many areas of medicine, including orthopedics, neurology, otorhinolaryngology, ophthalmology, and rehabilitation [1]. Posturography is a sensitive but non-specific tool that enables early detection of balance disorders before the manifestation of vestibular dysfunction. The primary receptors of the vestibular system and the related statokinetic analyzer, located in the semicircular canals oriented in three mutually perpendicular planes, play a key role in this process [2], [3]. The sensory corrections of balance are based on a synthesized complex of signals processed at multiple levels rather than isolated receptor signals [4], [5]. This multi-level integration ensures that the corrections are adequate to the afferent input and allow appropriate sensory-motor adjustments to maintain balance [6].

The purpose of this study was to assess patients with acute sensorineural hearing loss using posturography.

RESEARCH METHOD

The study included 130 patients diagnosed with acute sensorineural hearing loss (SNHL) who were observed and divided into two groups. The main group consisted of 80 patients diagnosed with acute sensorineural hearing loss, while the control group included 50 healthy individuals without vestibular or auditory dysfunctions. The study employed a posturography-based diagnostic method to assess balance and vestibular function. A comprehensive diagnostic protocol was applied, including audiometric evaluations, vestibular function tests, and computerized posturography.

The posturography platform used in this study, developed by "MBN" (Russia), consisted of an advanced biomechanical system capable of detecting subtle postural adjustments and balance abnormalities. The platform measured oscillations of the body's center of gravity in the sagittal and frontal planes under various testing conditions, including visual input and deprivation (Romberg test). Patients underwent posturography in both static and dynamic conditions, with a functional test duration of 30 seconds for each trial and a 3-minute interval between trials.

Diagnostic assessments also included tonal threshold audiometry (TTA) and advanced vestibular tests, such as evaluation of vestibulo-ocular reflexes, spontaneous and positional nystagmus, and caloric testing. All procedures were conducted under standardized conditions, and the data collected were analyzed for correlations between hearing loss severity, vestibular dysfunction, and postural stability parameters.

Ethical approval was obtained for the study, and informed consent was secured from all participants. Statistical analyses were performed using appropriate parametric and non-parametric tests to evaluate the significance of observed changes in auditory and vestibular functions.

Table 1. The dynamics of statistical parameters and the relationship between costs and expenses, determined by the method (acceptable increase at r<0.05).

Parametric posturography	Meaning of parameters		
	M ± δto training	M ± δafter training	Degree of friendship results (r)
Standard removal forward backward	12.68±21.02	5.57±6.96	0.059
Standard mediolateral deflection	16.89±36.45	3.69±3.19	0.054
Average speed back and forth	21.22±34.39	10.04±7.07	0.090
Medium speed mediolaterally	21.29±51.49	6.67±6.69	0.140
Area of an ellipse	13867.33±38725.15	728.63±2421.40	0.078
Average on the X axis	21.88±46.43	1.92±18.97	0.071
Average on the Y axis	-19.5±55.81	-7.04±24.17	0.322

The standard deviation is forward-backwards	5.10±6.41	3.5±5.45	0.338
Standard deviation is mediolateral	27.81±7.39	28.96±5.29	0.327
Srednyaya variation sily	4.17±8.45	1.45±1.11	0.123

RESULTS AND DISCUSSION

The distribution of patients in this sample shows that the majority of elderly patients with moderate hearing loss had their condition primarily determined by vascular factors. The second most common group consisted of patients whose SNHL was caused by infectious factors. A critical factor influencing the effectiveness of treatment is the time of initiation of therapy from the onset of the disease. It is well-known that there is a close anatomical and physiological connection between the auditory and non-auditory labyrinths.

In this study, an attempt was made to compare the degree of hearing loss on one side with the severity of vestibulometric symptoms on the other. Figure 1 illustrates this relationship, showing that the redistribution of the degree of hearing loss among patients corresponds to changes in the vestibulometric coefficient, specifically labyrinthine asymmetry.

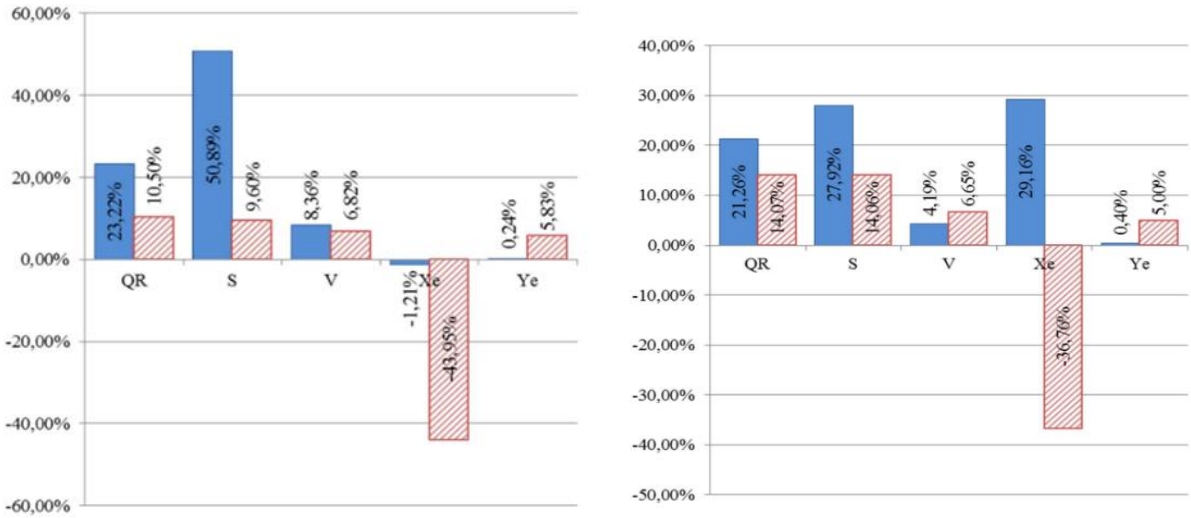

Figure 1. Average dynamics of posturographic indicators in patients after treatment.

The study of vestibulometric symptoms accompanying acute sensorineural hearing loss (SNHL) is of significant interest for predicting the effectiveness of its treatment. A comparison between the degree of hearing loss and the severity of vestibulometric symptoms demonstrated a clear correlation between them. This correlation can be assessed based on the data shown in Figure 2.

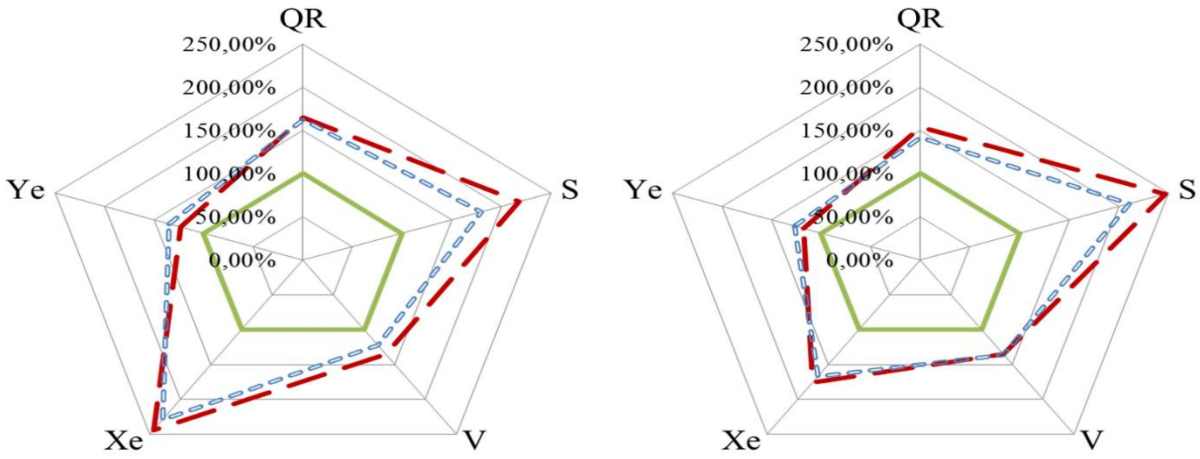

Figure 2. Deviation from normal values (accepted as 100%) of initial indicators in patients with acute sensorineural hearing loss (snhl) (in %).

The correlation becomes more evident when analyzing the relationship between the degree of hearing loss and the size of labyrinthine asymmetry (LA). The calculation of the correlation coefficient between LA and hearing thresholds before and after treatment demonstrated a positive correlation between the degree of hearing loss (in dB) and the size of LA (in %) — before treatment, r = 0.71, and after treatment, r = 0.89.

Positive audiometric outcomes after treatment were associated with the normalization of vestibular function, as well as improvements in the relationship between auditory and vestibular functions. Although the linearity of the afferent flow on the affected side was restored, the thermal and cold responses to stimulation of the intact labyrinth became equal in intensity, and labyrinthine asymmetry disappeared.

The correlation between the dynamics of vestibulometric and audiometric data is clearly observed when comparing changes in hearing thresholds with shifts in nystagmometric characteristics.

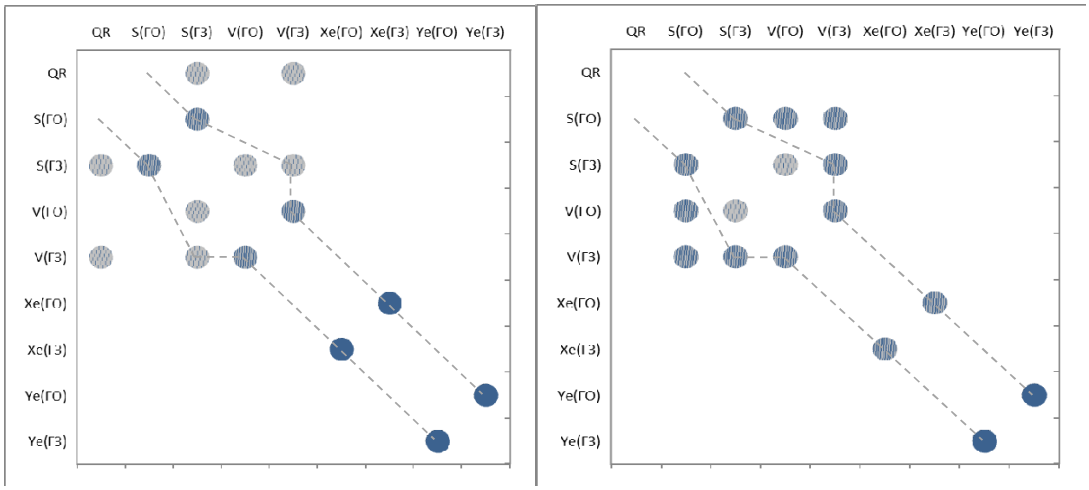

Figure 3. Graphic of Intragroup Correlation of Posturographic Indicators in Patients After TT (Tonal Therapy).

In one of the samples, patients with initially different values and a noticeable shift in posturographic characteristics toward normalization under the influence of treatment were included. The data demonstrate a correlation between the therapeutic effect on hearing and the normalization of vestibular characteristics: the samples are statistically significantly different.

Analysis of vestibulometric data and their changes under the influence of treatment, as well as their comparison with the dynamic improvement in hearing, revealed a similar pattern of changes in auditory and vestibular functions. Several prognostically important signs were identified. Firstly, initial hyperreflexia on the affected side can be considered a prognostically favorable sign. Signs of this hyperreflexia include labyrinthine asymmetry, with the sign of asymmetry corresponding to the side of the damage (e.g., LA < 0 in left-sided stiffness). Another favorable diagnostic indicator is the large size of certain characteristics, which suggests a later onset of disease culmination and is often associated with a large SMK (static and kinetic measure) size. The number of prognostically favorable values did not differ significantly between the intact and affected sides in the curve characteristics (in the model). Prognostically unfavorable signs include:

a. Significant LA size caused by hyporeflexia of the affected ear.
b. Small size of the nystagmometric characteristic.
c. Large differences in the steepness of characteristics between the intact and damaged sides.

Significant disruption of the linearity of afferent flow graphs.

CONCLUSION

Fundamental Finding : The study highlights that adopting a complex systems approach, integrated with posturography, is effective in addressing functional balance issues in acute SNHL patients, enabling the identification of diagnostically and prognostically significant parameters. **Implication :** The findings underscore the clinical utility of combining innovative diagnostic tools with therapeutic strategies to improve balance-related outcomes, offering a pathway for more precise and personalized patient management in acute SNHL cases. **Limitation :** Despite the promising results, the study's scope was limited by the specific parameters analyzed and the sample size, which may restrict the generalizability of the findings across diverse patient populations. **Future Research :** Further studies should explore broader patient cohorts and additional variables to validate and expand on these findings, aiming to refine diagnostic accuracy and therapeutic interventions for SNHL-related balance dysfunction.

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