

Psychoacoustic Indicators of Hearing State in Patients with Menier's Disease during the Period between Attacks

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ABSTRACT

Purpose of the study was the analysing of the results of psychophysiological methods for studying hearing in patients with Meniere's disease in the period between attacks.

KEYWORDS

Patients, Fluctuations, Tinnitus, Organ of Hearing, Idiopathic Disease, Duration of the Disease.

Introduction

The main group consisted of 191 patients with bilateral Meniere's disease (BM) aged 31 to 67 years (mean age $48,8 \pm 0,7$ years). There were 127 females (66,5%), males - 64 (33,5%), their ratio was 1,5:1. The duration of the disease varied widely - from 10 days to 15 years. The control group consisted of 30 healthy individuals. The state of the organ of hearing was assessed in the period between the attacks of BM. Psychophysiological research methods were used - acoumetry, tone threshold audiometry in the usual frequency range, determination of sensitivity to small (short) intensity increments (SISI test). In all patients, along with hearing impairment, constant tinnitus occurred. Tinnitus in 64,4% of patients had a multi-tone character, 36% was leading, 51% was one of the main complaints of BM patients. Hearing impairment was manifested by impairment of the type of sound perception with a predominant lesion of its peripheral section. In 80,1% of patients, hearing loss of the second and third degree was established. FUNG was found in 81,7% of cases.

Meniere's disease (BM) is an idiopathic disease of the inner ear characterized by recurrent attacks of dizziness, the development of sensorineural hearing loss and noise in the ear (s) [3,7]. The incidence averages 13,1 new cases per 100 thousand population per year [2]. The estimated prevalence of BM varies from 17 to 513 patients per 100,000 [8].

BM can occur between the ages of 17 and 80, but in most cases it occurs between the ages of 30 and 70 than in younger people. [4,6,10]. In most cases it occurs in the form of a unilateral lesion, although it cannot be bilateral [5].

An important and most persistent clinical manifestation of BM is changes in the organ of hearing. In assessing the state of the organ of hearing in BM, both psychophysiological and electrophysiological and electroacoustic research methods are used. However, due to a number of circumstances, psychophysiological research methods are most widely used among them. In particular, this is due to their availability for doctors of various levels of health care, the presence of direct constant communication between the researcher and the subject, and the high information content of the results obtained. In this regard, in the sources of recent years, psychophysiological research methods are included in the list of basic research methods for patients with BM [1,9].

In this regard, it is of interest to continue the application of psychophysiological methods of hearing research in the diagnosis of BM.

Purpose of the Study

Analysis of the results of psychophysiological methods for studying hearing in patients with Meniere's disease in the period between attacks.

Material and Research Methods

A total of 191 patients with a reliable or confirmed diagnosis of BM were under observation, which constituted the main group. Of these, 159 patients had a reliable diagnosis in accordance with the classification of the American Academy of Otorhinolaryngology and Head and Neck Surgery and 32 - a confirmed diagnosis, according to the

classification developed jointly by the European Academy of Otolology and Otoneurology, AAO - HNS, Barani Society, Japan Society for the Study of Balance, Korean society for the study of balance. These patients made up the main group. Of this number of patients, 179 (94,4%) cases were diagnosed with unilateral and 12 (5,6%) with bilateral BM. There were 127 females (66,5%), males - 64 (33,5%), their ratio was 1,5:1. The age of the examined patients ranged from 31 to 67 years (mean age $48,8 \pm 0,7$ years). The duration of the disease varied widely - from 10 days to 15 years. 30 healthy individuals constituted the control group.

When diagnosing BM, the tenth revision of the International Statistical Classification of Diseases and Problems (ICD-10) was followed. Until 2017, she additionally used the classification criteria for the accuracy of diagnosis of Meniere's disease of the American Academy of Otorhinolaryngology and Head and Neck Surgery (AAO - HNS, 1995). Since 2018, the classification of criteria for the accuracy of diagnosis of Meniere's disease has been used by the European Academy of Otolology and Otoneurology, the American Academy of Otorhinolaryngology and Head and Neck Surgery, the Barani Society, the Japan Society for Equilibrium Research, and the Korean Society for the Study of Balance (2016). To assess the degree of hearing loss, the international classification of hearing impairments was used (WHO, 1997).

All patients underwent examination of ENT organs and examination of the state of the organ of hearing and balance. The study of patients included the study of complaints, history of the development of the disease and life, assessment of the state of organs and body systems, endoscopic examination of the ENT organs. To assess the state of the organ of hearing, the following psychophysiological research methods were used - acumetry, tonal threshold audiometry in the usual frequency range, determination of sensitivity to small (short) intensity increments (SISI test).

Research Results

Comprehensive examination of patients was carried out in the period between the attacks of BM.

In the interictal period, the complaints of patients associated with the organ of hearing were manifested by hearing loss, noise, impaired speech intelligibility, intolerance to loud sounds in the affected ear. The hearing loss was permanent in all cases. In 31 (16,2%) patients, fluctuations in hearing acuity (the so-called "subjective" fluctuation of hearing) in the diseased ear were noted. Hearing loss was in 179 (93,7%) patients with unilateral and 12 (6,3%) with bilateral. 94,2% of patients indicated a progressive hearing loss with an increase in the duration of the disease, especially after each subsequent attack. 17 (8,9%) noted a stable character, i.e., without a tendency to progression of hearing loss throughout the duration of the disease.

Noise in the affected ear was present in all examined patients, of which 167 were constant and 24 were intermittent. It is unilateral in 179 (93,7%) patients and bilateral in 12 (6,3%) patients. Immediately before the attack and during it, the intensity of the noise increased in all patients. In 41 (21,5%) cases, the noise corresponded exclusively to the low- and medium-frequency spectrum, in 27 (14,1%) patients its spectrum corresponded to the high-frequency range. In the majority of patients, i.e., 123 (64,4%) cases, the noise was multicomponent. 7 patients with bilateral BM could not localize the noise in each ear separately, and described it as "noise in the head".

According to the classification of the manifestation of tinnitus according to A.P. The patients were assigned to Wielicki in the following sequence:

- tinnitus of the 1st degree: does not bother the patient much, is detected only with an active survey - 13%;
- tinnitus II degree: worries the patient greatly, is one of the main complaints - 51%;
- tinnitus III degree: is the main leading complaint of the patient - 36%.

The feeling of congestion, heaviness or pressure in the affected ear or both ears was noted by 178 (93,2%) patients and it was periodic, i.e., before the attack during the period or at the moment of the attack, while outside the attack it was absent.

Violation of speech intelligibility of varying severity on the diseased side occurred in 178 (93,2%) patients. Distortion of perceived sounds usually increased before the attack or at the time of the attack. In 34 (19,1%) cases,

this condition was noted on both sides.

151 (79,1%) patients indicated varying degrees of severity of intolerance to loud sounds, and 144 (95,4) of them increased immediately before the attack and remained at this level during and the next few hours after it.

The average index of speech perception on the diseased ear was:

- whispering speech – $1,1 \pm 0,11$ m (control group – $5,8 \pm 0,02$ m).
- colloquial speech – $3,8 \pm 0,12$ m (control group – $6,0 \pm 0,01$ m).

The average speech perception in a healthy ear was:

- whispering speech – $5,7 \pm 0,01$ m (control group – $5,8 \pm 0,02$ m).
- colloquial speech – $6,0 \pm 0,02$ m (control group – $6,0 \pm 0,01$ m).

The studied parameters had a significant difference from the analogous values of the control group and the healthy ear ($P < 0,05$).

The results of tuning fork research methods (study of the absolute time of tuning forks by air and bone conduction, tuning fork experiments by Weber, Rin, Lewis-Federici) in all patients corresponded to hearing impairment by the type of sound perception in the classical form.

The average indicator of the absolute time of the C128 tuning fork sounding by air and bone conduction on the diseased ear was:

air conductivity – $21,2 \pm 0,12$ sec. (control group – $44,3 \pm 0,14$ sec.);
bone conduction – $13,8 \pm 0,09$ sec. (control group – $22,2 \pm 0,11$ sec.).

The average value of the absolute time of the C128 tuning fork sounding by air and bone conduction in a healthy ear was:

air conductivity – $43,8 \pm 0,09$ sec. (control group – $44,3 \pm 0,14$ sec.);
bone conduction – $21,8 \pm 0,07$ sec. (control group – $22,2 \pm 0,11$ sec.).

The studied indicators of speech and tuning fork studies had a significant difference from the analogous values of the control group and the healthy ear ($P < 0,05$).

The patency of the auditory tubes in all patients on the sick and healthy sides were within physiological boundaries, i.e., within 0 degree ("empty" swallow) in 87, I degree (Toinbee's experiment) in 91, II degree (Valsalva's experiment) in 13 cases.

Tonal threshold audiometry in the usual frequency range was performed for all examined patients, the results of which are presented in Table 1. There was no significant difference between the indicators of the tonal threshold audiometry and the speech study as a whole, only 47 (24,6%) patients had tonal-speech dissociation due to pronounced impaired speech intelligibility.

The distribution of patients by the degree of hearing impairment according to the WHO classification is presented in Table 2.

As can be seen from the table, the most common hearing loss of the II and III degrees in almost the same ratio, then the hearing loss of the I degree, then the hearing loss of the IV and last of all - deafness.

Patients have the following types of audiograms: gently ascending, horizontal, gently descending, steeply ascending, steeply descending, steep (table 3). At the first degree of hearing loss, gently ascending and steeply ascending curves were more common, in the second and third degrees - gently ascending and horizontal, fourth - horizontal and gently descending. With deafness, only abrupt and gently descending curves of audiograms were encountered.

In 156 (81,7%) patients, the SISI index was within 70-100%, which indicates the presence of FUNG, in 10 (5,2%) cases it was less than 30%. In 25 (13,1%) cases the indicator was in the range of 30-70%, which is regarded as an "inadequate" reaction of the structures of the organ of Corti to a sound stimulus.

In general, the results of the SISI test are consistent with the data of literary sources and indicate a predominant lesion of the peripheral part of the auditory analyzer with BM [Kryukov A.I., Fedorova OK, Antonyan V.G., Sheremet A.S. Clinical aspects of Meniere's disease. Monograph. M. Medicine. 2006.240 s.].

Thus, the results of this study confirmed the literature data on the high informativeness of psychoacoustic methods and their irreplaceable role when comparing electrophysiological and electroacoustic research methods in the diagnosis of BM even in the period between attacks, i.e. when the most violent manifestations of the disease are absent. All this dictates the continuation of research to improve the methods of psychoacoustic research of hearing and a more in-depth study of their pathophysiological and clinical aspects.

Findings

1. Tinnitus in 64,4% of patients had a multi-tone character, 36% was leading, 51% was one of the main complaints of BM patients.
2. Among all the degrees of hearing impairment, the most common are hearing loss of the second and third degree and the presence of a lot of tonal noise in the affected ear.
3. FUNG was found in 81,7% of BM patients.

Table 1. Indicators of tonal threshold audiometry in patients with Meniere's disease (period between attacks), in dB

Frequency	Control Group (n = 30)	Hearing impairment side			
		One-sided (n = 179)		Double sided (n = 12)	
		Sore ear	Healthy ear	Right ear	Left ear
125 Hz	8,48±0,49	60,58±2,21*	10,11±0,13	59,19±3,20*	61,19±2,63*
	-	-	-	-	-
250 Hz	8,35±0,71	57,96±2,81*	9,98±0,43	56,94±3,01*	57,35±2,81*
	8,1±0,24	53,01±2,32*	8,7±0,31	52,78±2,24*	53,18±2,23*
500 Hz	9,63±0,32	57,21±3,22*	9,81±0,37	56,89±1,12*	54,89±1,54*
	8,19±0,67	52,21±2,64*	8,47±0,01	51,78±1,34*	50,77±1,76*
1000 Hz	10,88±0,71	54,22±3,21*	11,34±0,65	55,17±1,42*	55,01±1,09*
	9,76±0,64	51,91±2,65*	9,82±0,33	50,92±2,15*	51,02±1,11*
2000 Hz	12,63±0,67	52,32±3,12*	13,94±0,52	52,12±2,31*	53,02±1,92*
	10,41±0,33	50,87±2,64*	11,43±0,26	50,64±1,57*	50,44±1,66*
4000 Hz	14,6±0,81	50,14±3,22*	15,97±0,22	51,15±2,31*	51,86±2,65*
	12,33±0,54	47,77±2,57*	14,33±0,63	46,86±2,02*	47,78±1,98*
6000 Hz	18,33±0,46	47,41±2,67*	19,54±0,35	46,87±2,14*	47,88±2,33*
	17,98±0,12	46,91±1,52*	17,91±0,11	45,93±1,43*	44,93±1,03*
8000 Hz	21,91±0,61	44,96±1,33*	23,91±0,76	45,16±1,02*	46,17±1,13*
	20,32±0,19	44,01±1,65*	21,63±0,32	43,91±1,21*	45,01±1,02*

Note:

At each frequency in the numerator, air and denominator of bone conduction;

* - differences relative to the data of the control group are significant

(* - P < 0.05);

Table 2. Distribution of patients according to the degree of hearing impairment (period between attacks), in absolute values

Degree of hearing impairment	Total (n = 203 ears)	Hearing impairment side	
		One-sided (n = 179)	One-sided (n = 179)

		Sore ear	Sore ear	Sore ear	Sore ear
I	30	27	–	1	2
II	75	66	–	4	5
III	78	69	–	5	4
IV	17	14	–	2	1
Deafness	3	3	–	–	–

Table 3. The incidence of various types of audiogram curves, in absolute values (period between attacks)

Sound conduction type	Curve type (203 ears in total)					
	Gently ascending	Horizontal	Gently descending	Steep ascending	Steep-descending	Abrupt
Air	85	62	34	14	7	1
Bone	84	60	32	17	9	1

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