

Indicators of Objective Methods of Research of Hearing in Patients with Menier's Disease During the Period Between Attacks

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Abstract Purpose of the study was to analyze of the results of electrophysiological and electroacoustic methods for studying hearing in patients with Meniere's disease in the period between attacks. 191 patients with bilateral Meniere's disease aged from 31 to 67 years (main group) were examined. The control group consisted of 30 healthy individuals. The following objective research methods were used - impedance measurement, registration of delayed evoked otoacoustic emission (TEOAE), registration of the product of distortion of otoacoustic emission (PIOAE), registration of short- and long-latency auditory evoked potentials. In 89.5% of patients with BM, the absence of OAE registration was cut off, while TEOAE was not recorded in 97.4%, PIOAE - in 91.6%. In all cases, a type A tympanogram was recorded and a relationship was revealed between the registration of acoustic reflexes and the degree of hearing loss, which was manifested by a decrease in the number of frequencies at which acoustic reflexes were recorded at probed frequencies with an increase in the degree of hearing loss. ABR changes were characterized by a tendency to decrease the amplitude of all ABR peaks and lengthen their latency, and a significant change in the inter-peak intervals on the affected side. In the cortical section of the auditory analyzer, functional changes were revealed, which were manifested by an unreliable lengthening of the latency and a decrease in the amplitude of its waves ($P > 0,1$).

Keywords Sensorineural, Clinical manifestation, Psychosomatic state, Otoacoustic, Interictal period

1. Introduction

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) [3,8]. 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. [7,11]. It in most cases occurs in the form of a unilateral lesion, although it cannot be bilateral [6].

An important and most persistent clinical manifestation of BM is changes in the organ of hearing. In assessing the state of the hearing organ in BM, both psychophysiological and objective (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, high information content of the results. In this regard, in the sources of recent years, psychophysiological research methods are in the first positions in the list of the main research methods for patients with BM [1,8,10]. Over the past decades, objective methods of hearing research have been widely used to diagnose, predict the course and result of BM treatment [8]. Their advantage is the speed of implementation, the independence of receiving a response from the psychosomatic state of the patient, the ability to assess all parts of the organ of hearing [4].

In this regard, it is of interest to study the results of objective methods of hearing research, their features of manifestation in patients with BM.

Purpose of the study. Analysis of the results of electrophysiological and electroacoustic methods for studying hearing in patients with Meniere's disease in the period between attacks.

2. 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 Otolaryngology 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 ± 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 Health Problems (ICD-10) was followed. Until 2017, she additionally used the classification of 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 Otolaryngology 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 Equilibrium (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 hearing organ, the following objective research methods were used - impedance measurement, registration of delayed evoked otoacoustic emission (TEOAE), registration of the product of distortion of otoacoustic emission (PIOAE), registration of short-, long-latency auditory evoked potentials.

3. Research Results

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

Both classes of OAE - delayed evoked otoacoustic emission and the product of distortion of otoacoustic emission were recorded in 171 (89.5%) subjects of the control group. When registering both classes of OAE in healthy individuals, a regular correlation was revealed between age and an increase in tonal hearing thresholds by

the amplitude of the otoacoustic response.

The spectral indices of TEOAE in healthy individuals were characterized by:

- the maximum peak of the spectrum was located at frequencies of 1300-1500 Hz;
- its average amplitude, the maximum peak of the spectrum was equal to 16.2 ± 4.4 dB, which tended to decrease with increasing age.
- single peaks of the spectrum were found in 31%, a wide range of responses -24% and their combination with a predominance of single peaks in 45%.
- in persons over 55 years old, the minimum intensity values were recorded.

In patients with BM, TEOAE was recorded only in 5 patients with first-degree hearing loss. In most cases, it was recorded with a low amplitude of the response in the form of single peaks, a decrease in the cases of their combination with each other, a narrowing of the spectrum of the curve. There was a shift in the frequency range towards lower frequencies and a decrease in the amplitude of the maximum peak with an increase in the degree of hearing impairment.

PIOAE in patients with BM was recorded only in 16 patients, of whom 12 with first-degree hearing loss and 4 of the second degree were recorded. In most patients with I and II degrees of hearing loss, PIOAE. In all patients with grade III, IV hearing loss and deafness, PIOAE was not recorded. Upon registration, PIOAE also had a tendency to decrease in intensity with an increase in the degree of hearing impairment and an increase in age.

Impedance measurements were carried out for all examined persons. All patients of the main group, as well as those of the control group, had a tympanogram type A.

Ipsilateral acoustic reflexes were recorded at 4 probed frequencies - 500, 1000, 2000, 4000 Hz.

Table 1 shows the parameters of acoustic reflexes in patients with BM.

In 45.5% of patients, acoustic reflexes were not recorded, in 33.5% they were recorded at some and 19% were recorded at all probed frequencies (500-4000 Hz). Most of the recorded reflexes revealed changes in the threshold and amplitude, as well as their time periods - latency, growth, active action and relaxation. More often, the absence of registration of acoustic reflexes was noted at high frequencies (2000 and 4000 Hz), in comparison with low frequencies.

A relationship was established between the registration of acoustic reflexes and the degree of hearing loss, which was manifested by a decrease in the number of frequencies at which acoustic reflexes were recorded at probed frequencies with an increase in the degree of hearing loss.

In a comparative aspect in relation to the results of the interictal period, the following differences were revealed:

- decrease in the amplitude of the formed acoustic reflex (the main group - 6.6 ± 0.18 ml and the control group - 8.9 ± 0.76 ml);
- lengthening of the latent period of the acoustic reflex

(the main group - 147 ± 4.45 ms and the control group - 107 ± 2.7 ms);

- an increase in the ratio of the forms of the acoustic reflex, unchanged and altered, towards the latter forms (the main group - 32/68% and the control group - 94/6%).

60 patients with BM underwent registration of ABRs and DSVPs. Of the examined patients, 48 were unilateral and 12 were bilateral BM. Analyzed the indicators of latency, amplitude, peak-to-peak intervals of ABR and DSP.

On the affected side, there was a tendency to decrease the amplitude of all ABR peaks and lengthen their latency. The lengthening of the latency was combined with a significant increase in the inter-peak intervals I-III, I-V, III-V, and they increased with an increase in the degree of hearing

impairment. Unilateral BM was characterized by the asymmetry of the studied parameters and the absence of a difference in the results of the healthy side from those of the control group (Table 2).

Analysis of the results of ABR registration revealed the presence of changes in the process of impulse transmission between I-V neurons of the auditory analyzer. Along with the predominant lesion of the peripheral part of the auditory analyzer, there were changes in the pathways. In order to assess the state of the cortical part of the auditory analyzer, DSVP was registered in 60 patients.

When registering DSVP revealed a tendency to lengthen the latency and decrease the amplitude of the peaks of DSVP (Table 3).

Table 1. Impedance measurements in patients with Meniere's disease (period between attacks)

Index	Control group (n = 30)	Patients (n = 191)
The amplitude of the peak of the tympanogram, mmho	1,78±0,03	1,63±0,02
Tympanogram peak gradient, daPa	100±5,05	95±5,65
Tympanogram peak pressure, daPa	-20±6,25	-25,0±4,30
Tympanogram type A, %	100%	100%
Acoustic reflex threshold, dB	87,4±4,25	96.1±4,75
Amplitude of the formed acoustic reflex, ml	8,9±0,76	6,6±0,18*
Latent period of acoustic reflex, ms	107±2,7	147±4,45*
The rise time of the acoustic reflex, ms	310±13,2	347±12,6
Relaxation period of the acoustic reflex, ms	330±10,6	378±11,1
General view of acoustic reflexes not changed,%	94%	32%
modified,%	6%	68%

Note: * - differences relative to the control group are significant (* - $P < 0.05$).

Table 2. ABR values in patients with Meniere's disease

Index	Control Group (n = 10)	Hearing impairment side			
		One-sided (n = 48)		Double sided (n = 12)	
		Sore ear	Healthy ear	Right ear	Left ear
Wave latency, ms					
I	1,76±0,01	1,92±0,11	1,76±0,03	1,92±0,13	1,92±0,17
III	3,78±0,02	4,02±0,14	3,77±0,02	4,04±0,10	4,03±0,10
V	5,71±0,02	6,09±0,12	5,69±0,02	6,06±0,12	6,05±0,10
Wave amplitude, μ V					
I	0,42±0,06	0,28±0,09	0,42±0,08	0,27±0,07	0,28±0,07
III	0,52±0,08	0,37±0,02	0,50±0,06	0,36±0,05	0,36±0,05
V	0,72±0,06	0,58±0,07	0,73±0,06	0,58±0,07*	0,56±0,05*
Peak intervals, ms					
I-III	2,06±0,02	2,13±0,02*	2,04±0,02	2,14±0,02*	2,13±0,02*
III-V	1,91±0,03	2,08±0,02*	1,90±0,03	2,06±0,01*	2,07±0,03*
I-V	3,94±0,04	4,21±0,03*	3,96±0,02	4,19±0,04*	4,18±0,05*

Note: * - differences relative to the data of the control group are significant (* - $P < 0.05$)

Table 3. Indicators of ADP in patients with Meniere's disease

Index	Control Group (n = 10)	Hearing impairment side			
		One-sided (n = 48)		Double sided (n = 12)	
		Sore ear	Healthy ear	Right ear	Left ear
Wave latency, ms					
P1	50,22±0,04	59,05±3,11	50,20±0,06	60,11±3,33	59,54±3,76
N1	111,92±0,02	117,22±2,5	111,91±0,03	118,81±3,21	116,45±2,33
P2	170,24±0,04	179,23±3,72	170,23±0,02	176,34±4,31	174,66±3,76
N2	251,11±0,05	271,12±9,11	251,12±0,04	270,72±11,41	221,17±11,87
Wave amplitude, µV					
N1-P2	10,03±0,05	5,89±0,91	10,04±0,05	5,91±0,52	6,24±1,15
P2-N2	9,58±0,05	5,77±0,87	9,59±0,02	5,72±0,51	6,10±0,787

The results of registration of DSVP revealed the presence of functional changes in the cortical part of the auditory analyzer, which were manifested by an unreliable lengthening of latency and a decrease in the amplitude of its waves ($P > 0.1$).

Thus, the results of this study confirmed the literature data on the high informativeness of objective hearing 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. It is known that psychophysiological research methods are in the first positions in the list of basic research methods for patients with BM. It should be noted that with the help of electrophysiological and electroacoustic methods of hearing research, the possibility of a detailed and objective assessment of the state of each part of the hearing organ, regardless of the psychosomatic status of the subject, is greatly expanded. All this dictates more and more widespread introduction into practice, improvement of electrophysiological and electroacoustic techniques in hearing research and a more in-depth study of their pathophysiological and clinical aspects.

4. Conclusions

1. In 89.5% of patients with BM, the absence of OAE registration was cut off, while TEOAE was not recorded in 97.4%, PIOAE - in 91.6%.
2. Tympanogram type A was recorded in all patients and a relationship was found between the registration of acoustic reflexes and the degree of hearing loss, which was manifested by a decrease in the number of frequencies at which acoustic reflexes were recorded at probed frequencies with an increase in the degree of hearing loss.
3. ABR changes were characterized by a tendency of decreasing the amplitude of all ABR peaks and lengthening their latency and a significant change in the inter-peak intervals on the affected side.
4. In the cortical section of the auditory analyzer, functional changes were revealed, which were manifested by an unreliable lengthening of the latency

and a decrease in the amplitude of its waves ($P > 0.1$).

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