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Research Article

INITIAL STATE OF COCHLEOVESTIBULAR FUNCTION IN PATIENTS WITH HD WITH CVD

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ABSTRACT

Cochleovestibular disorders (CVD) are of great medical and social importance due to their significant prevalence and the presence of a large number of negative manifestations on the part of the hearing and balance organs, as well as other body systems. All authors agree that cochleovestibular disorders affect the most active and able-bodied population, and this determines its social significance. Considering that the statistics of hearing and balance disorders are kept separately, it is not always possible to characterize the real statistical picture, the epidemiology of CVN. Approximately 17% of the total population complains of cochleovestibular disorders, but more than half of the cases do not seek medical help. Long-term temporary incapacity for work, a high rate of disability in patients with CVN, make the problem even more urgent to develop, require the improvement of early diagnosis methods. During mass examinations, cochleovestibular disorders were noted in 9-12% of the population of the Russian Federation. Approximately 10% of patients who visit an ENT doctor present complaints typical of KVN, and this figure for a general practitioner is 5%, and for a neurologist about 10-20%. According to the World Health Organization (WHO), in 2020, over 460 million people in the world suffered from hearing loss and by 2050 this number could exceed 900 million).

Dizziness is one of the three most common complaints presented by patients to a general practitioner, and among emergency consultations it occurs in 2.4-2.6% of patients.

KEYWORDS

Cochleovestibular apparatus, nerves, auditory canal, cochlea, dizziness.

INTRODUCTION

The cochleovestibular apparatus is one of the most ancient analyzers; it is the first of all receptors to form in embryogenesis [1]. In terms of its structure, extensive connections within the CNS, and functional properties, the cochleovestibular apparatus differs sharply from all cranial nerves: when it is irritated, not a narrow local reaction occurs, but an effect on all body functions (somatic and vegetative) is observed.

The central parts of the vestibular and auditory analyzer are very complex, which reflects the diversity and complexity of the function of this peculiar nerve [2-6]. Morphologically and functionally, the vestibular apparatus is clearly divided into two sections: the otolith apparatus and the system of semicircular canals. The first responds to rectilinear accelerations and deviations from the vertical, while the second to angular accelerations in any of the three main planes in which the channels are oriented.

The vestibular nerve enters the brain stem at the level of the cerebellopontine angle, slightly above the external (cochlear) root, between it and the spinal root of the fifth nerve. In the internal parts of the rope body, not reaching the bottom of the IV ventricle, the vestibular nerve divides into ascending and descending branches. Part of the descending fibers terminate in the lower nucleus, part in the medial and lateral nuclei. The ascending fibers of the vestibular nerve terminate in the superior nucleus. Some of these fibers, passing through the nucleus, end in the roofing nucleus of the cerebellum.

A. Brodal, F. Wahlberg, O. Pompeano revealed the specific nature of the commissural, as well as the somatotopic organization of vestibular connections with the cerebellum and spinal cord. The vestibular nuclear complex is located at the level of the upper part of the medulla oblongata and stretches in the retrocaudal direction by 9.5-12 mm. The works of the above authors have shown that the nuclei of the vestibular complex are very complex in structure. The cytoarchitectonics of each of them has features, as well as extensive afferent-efferent connections with various formations of the central nervous system, and from the latter to the vestibular nuclei. A distinctive feature of the nuclear vestibular complex is an unusually large number of pathways emerging from it in a wide variety of directions and connecting the nuclei with various anatomical structures of the brain. These connections provide a diffuse effect of the vestibular apparatus on all functions without exception. The most important clinically are the following connections of the vestibular nuclei: connections with the spinal cord; with eye muscles; vestibulo-vegetative connections; vestibulocerebellar

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connections; connections with the reticular formation of the brain stem; with the cerebral cortex [7-12].

In addition to the vestibular analyzer, the pyramid of the temporal bone contains peripheral sections of the auditory analyzer. The peripheral receptor of the auditory analyzer is a spiral organ located in the cochlea.

The cochlear part perceives sound vibrations. It originates outside the brain from a special gang node. spiralis located at the base of the spiral plate. One of the processes of the ganglion cells of the cochlear nerve goes to the periphery. The cochlear part branches between the epithelial cells in the spiral organ, while the central process passes into the nerve fibers. The receptor elements of the cochlea are represented by external hair cells (13500) and internal (3400).

According to modern concepts, the mechanism of physiological processes occurring in the cochlea under the influence of sound is carried out as follows: a mechanical wave that occurs in the liquid media of the inner ear under the influence of sound leads to a displacement of the tenctorial membrane relative to the hair cells, which causes the tilt of the hairs. The latter, acting like microlevers, cause certain physical and chemical changes in the microstructures of receptor cells, bringing them into a state of excitation. The transmission of excitation from the hair cells to the fibers of the auditory nerve is carried out chemically through synapses or electrically by irritating the fibers of the auditory nerve with an electric current of the microphone effect. The endocochlear potential of the cochlea provides a high sensitivity of the receptor apparatus. There is a frequency-temporal-spatial representation of the stimulus along the structure of the cochlea.

Unlike vestibular hearing disorders are subjective sensations, they are difficult and sometimes impossible to investigate in severely ill patients, young children. The information content of auditory disorders is much lower than that of vestibular ones. In most cases, despite the use of the full range of modern audiometric tests, it is often difficult to establish the level of damage to the central auditory pathways. It is determined by comparison with more topically reliable vestibular disorders, as well as taste and other otoneurological and neurological symptoms.

MATERIAL AND METHODS

Under our supervision were 110 patients with HD of a stable course treated in the clinical bases of the Research Institute of Cardiology of the Ministry of Health of the Republic of Uzbekistan. HD was diagnosed according to the WHO criteria. The control group consisted of 30 persons not suffering from HD.

All examined were males, whose age was distributed as follows. 25-44 years old - 12 people (10.9%), 45 - 59 years old - 76 patients (69.1%) and over 60 years old - 22 examined (20%).

As can be seen from the above data, among the patients with HD examined by us, persons aged 45-59 years predominate, i.e. mature and older persons.

The duration of HD varied from 1 year to 20 years, including; 1 year suffered from hypertension 1 person, 1 - 5 years - 30 patients, 5-10 years - 36 examined, 10-15 years - 30 people and more than 15 years were 13 people.

Regarding the research methods, it should be noted that all patients underwent a general clinical examination, which included: examination of the somatic (cardiological), neurological and otoneurological status, rheoencephalography (REG),

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echoencephaloscopy (EchoES), electroencephalography (EEG), audiometry (AM) and electronystagmography (ENG) according to generally accepted methods.

In addition, all patients underwent a general analysis of urine, blood, the level of total cholesterol, lipid fractions in the blood, and a coagulogram were determined. Since the obtained results of biochemical studies did not differ from the literature data, we did not describe them.

RESULTS AND DISCUSSION

The functional study of the organ of hearing and the vestibular apparatus was preceded by an examination of the upper respiratory tract and ear, the results of which are shown in Table 1.

Таблица 1

The state of the upper respiratory tract in patients with HD with DBCD.

Changes	Number of patients	% of the total
Deviation of the nasal septum	26	23,6
Vasomotor rhinitis	3	2,7
Nasal bleeding	15	13,6
The development of the vascular pattern		
a) nasal septum	25	22,7
б) oropharynx	14	12,7
атрофия слизистой:		
a) nose	6	5,4
б) pharynx	9	8,1
chronic tonsillitis	13	11,8
chronic pharyngitis	11	10

The table shows that in hypertension with DBCD, the most common deviation of the nasal septum and the development of the vascular pattern on the mucous membrane of the nose and pharynx. These changes were usually localized in symmetrical areas of the nasal septum and soft palate, and were not accompanied by any unpleasant subjective sensations..

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Changes in the function of the auditory analyzer in patients with HD with DBCD.

Subjective symptoms.

Of the 110 patients with DBCD examined by us, 76 people (69.1%) complained of noise (Table 2): 15 patients (13.6%) of them localized noise in the ears, 12 people (10.9%) in the head , in the head and ears of 49 patients (44.6%).

Table 2

Noise frequency and localization by DVR forms

TsVR form	in the ears	in head	in the head and ears	Total	% to total Quantity
NPNMK	2	2	8	12	10,9
GE-I Art.	4	4	16	24	21,8
GE-II Art.	5	3	14	22	20
HPP PNMK	4	3	11	18	16,4
Total	15	12	49	76	69,1

Of the above 76 patients with HD with DBCD, 25 people noted constant noises, 51 - periodic. Most patients noted a relationship between the occurrence and intensity of noise with a deterioration in general well-being, increased blood pressure and increased headaches. These noises were usually subjective in nature and were expressed in a very diverse way: patients noted whistling, ringing, buzzing, murmuring water, slight wind noise, etc. The nature of the subjective noise was different: low and high pitch, constant, periodic, one-sided and two-sided.

According to the data in Table. 2, out of 28 people suffering from NPLMC, 12 (42.8%) complained of noise in the head, ears; hypertensive encephalopathy (HE)-I stage out of 37 people 24 (64.8%) complained of noise in the head, ears: hypertensive encephalopathy stage II - 22 (84.6%) of 26 patients and out of 19 patients with HE and PNMK - 18 (94.7%). Therefore, the frequency of noise complaints increases as the disease worsens. We also conducted an analysis of the ratio of complaints about noise and hearing loss. (Table 3)

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Table 3.
The ratio of complaints of patients with HD with DBCD for noise and hearing loss

Complaints	Illness complicated by:				
	NPNMK	GE – I	GE – II	GE with PNMK	Total
Noises	12	24	22	18	76
Hearing loss	4	13	17	16	50

Thus, as can be seen from Table 3.3, in 50 examined tinnitus and head noise coincided with complaints of hearing loss.

In order to clarify the nature of tinnitus and head noise, we compared these data with those of the control group. In the control group, noise was detected in 2 people out of 30 examined, which is 6.6%. Thus, in patients with hypertension, noise was more common by 62.5% than in the control group, and, therefore, is a sign of damage to the organ of hearing in HCVR on the basis of HD.

Of the 110 examined, 50 (45.5%) complained of hearing loss, and of these, only 6 people complained of unilateral hearing loss, the rest - bilateral. Most of those who complained of hearing loss noted that they hear the words, but they do not always understand their meaning.

Audiometric study of hearing.

1. Results of tone threshold audiometry.

For the purpose of a more detailed study of auditory reliefs over a wider frequency range, we conducted, along with tuning fork studies, a study of hearing with an audiometer.

Of the 110 examined, in 82 (74.5%) on the audiogram, damage to sound perception of varying degrees was detected, in 28 (25.5%) patients, tonal hearing was within the normal range. If we consider the state of tonal hearing according to the stages of HE, then normal hearing was detected in 11 out of 28 patients with NLUMC, with HE - Ist. in 13 out of 37, with GE - II st. in 3 out of 26 patients and in HE with PNMK - in 1 out of 7 patients.

According to the degree of hearing loss in air and bone conduction, all audiograms were divided into 4 groups. Information on the number of patients in each group is presented in Table 4.

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Table 4

Degree of hearing loss by air conduction

Used -	A loss	Forms		DTSVR		Total	
Frequencies	hearing in %	NPNMK	I	II	With PNMK	Qty	% to total Quantity
125-2000 Hz	5 -10	13	15	9	5	42	38,2
	11 - 20	3	5	7	8	23	20,9
	21 - 30	1	3	5	3	12	10,9
	>30	-	1	2	2	5	4,5
3000 - 8000 Hz	5 -10	7	7	3	2	19	17,3
	11 - 20	8	10	5	2	25	22,7
	21 - 30	2	3	4	1	10	9,1
	>30	-	4	11	13	28	25,5

As can be seen from the table, for damage to the organ of hearing in DBCD, a predominant decrease in the perception of high tones is characteristic. So, if during the perception of tones of the speech zone, hearing loss of more than 30% was detected in 5 (4.5%) patients, then with the perception of tones of 3000-8000 Hz in 28, which is more than 5 times more often.

In patients with NPLMC, a decrease in hearing acuity by more than 30% was not detected in any of them, in patients with HE-I stage. in 4 out of 37, with GE-II st. in 11 out of 26, and in those suffering from HE with PNMK - in 13 out of 19 examined. Consequently, with the aggravation of the disease, the volume of hearing for high tones decreases.

For a more complete reflection of the nature of the damage to the organ of hearing, we analyzed the degree of hearing loss for bone conduction sounds. Information about this is presented in Table 5.

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Table 5

The degree of hearing loss for bone conduction sounds.

Used	A loss hearing in %	Forms of DTSVR				Total	
Frequencies		NPNMK	I	II	With PNMK	Qty	% to total Quantity
125-2000 Hz	5 -10	11	11	7	2	31	28,2
	11 - 20	4	7	7	4	22	20
	21 - 30	2	4	5	6	17	15,5
	>30	-	2	4	6	12	10,9
3000 - 8000 Hz	5 -10	3	1	-	-	4	3,6
	11 - 20	4	4	4	-	12	10,9
	21 - 30	6	8	4	3	21	19,1
	>30	4	11	15	15	45	40,9

As can be seen from the table, the drop in hearing acuity for bone-conducted sounds is also more pronounced for high tones. Thus, a decrease in auditory volume by more than 30% was detected in 12 (10.9%) patients with tones of the speech zone, and in 45 (40.9%) patients with tones of 3000-8000 Hz.

We have analyzed and systematized tone audiograms and obtained the following types: 1. Curves with almost normal hearing up to 2000 Hz followed by a sharp decline ("dip") at 2000 Hz, 4000 Hz or 6000 Hz. This type of audiogram was obtained in 20 (18.1%), and 3 of them had it in only one ear. 2. Curves of a descending type - with a gentle or steep drop in hearing to high tones or concave were present in 56 (50.9%) of the examined, 3 of them had only one ear. 3. The horizontal type of the curve was found in 6 (5.4%) examined patients with a loss of hearing acuity in air and bone conduction by an average of 20 dB.

Most of the surveyed met mainly the first and second types of audiometric curves. Thus, 28 examined patients had normal hearing, 20 had an isolated fall on tones of 2000 Hz, 4000 Hz or 6000 Hz, and 62 had impaired sound perception.

In the first type of curves, there was a slight decrease in hearing acuity or there was none at all up to 2000 Hz, and then a drop by 4000 Hz in 11 patients, by 6000 Hz in 8, and in one examined person - 2000 Hz.

Here are typical audiograms of this type (Figure 1).

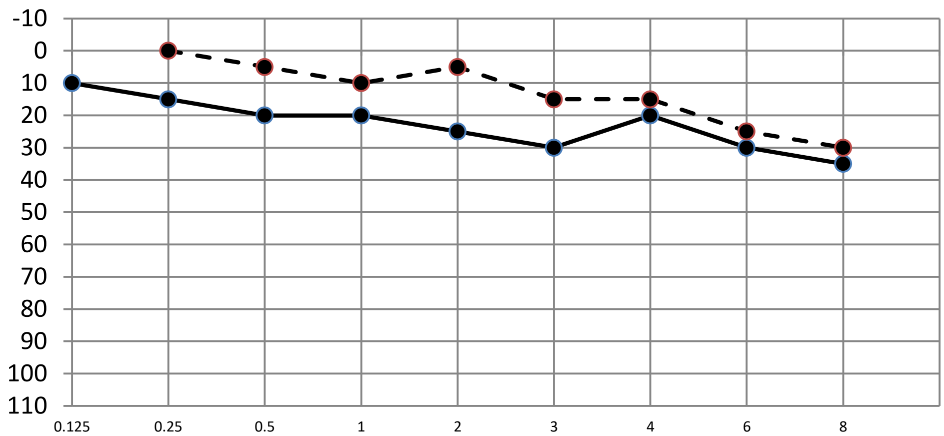

Figure 3.1. Audiogram: The first type of audiometric curves.

According to the degree of hearing loss during air and bone conduction of sounds, the curves were divided into 4 groups. Information on the number of patients in each group is presented in Table 6.

Table 6

The degree of reduction in the perception of sounds during air conduction in patients with the first type of audiometric curve.

downgrade hearing in %	Researched frequencies			
	125 -2000 Hz		3000 – 8000 Hz	
	Abs	%	Abs	%
5 -10	19	17,2	3	2,7
11 - 20	1	0,9	15	13,6

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21 - 30	-	-	2	1,8
>30	-	-	-	-

Thus, both with air and bone conduction of sounds with the second type of curve, hearing acuity decreases most often by 11-30% in the speech zone, and by more than 30% in high tones. With bone conduction of sounds, perception is disturbed more than with air conduction. For high tones, the sensitivity of the organ of hearing falls more, both with air and bone conduction of sounds.

In addition, in those examined with the second type of audiometric curve, a "break" in bone perception to high tones was revealed: at 3000-8000 Hz. - in one patient, at 4000-8000 Hz. - in 3 patients; at 6000-8000 Hz - in 4 patients; at 8000 Hz. - in 6 patients. Thus, 12.7% of the examined patients had a bone break for high tones (Figure 2). Of all the persons who had a bone "breakage", 1 suffered from the first stage, 6 - from the second stage of HE, 7 - from HE with PNMK.

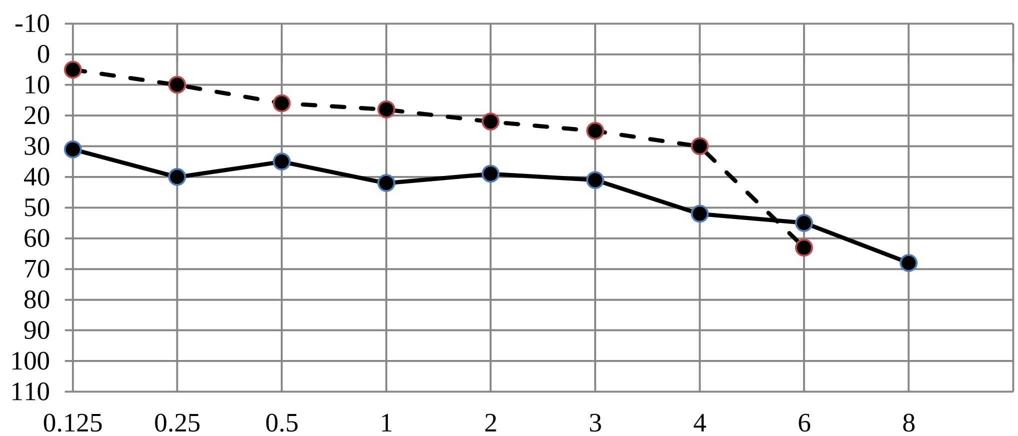

Figure 2. Audiogram: The second type of audiometric curves.

The third type of curve was found in 6 patients. As an illustration, we present an audiogram of the third type of curve. In 5 patients of this group, during air conduction of sounds to the speech zone, the acuity of tonal hearing was reduced by 20%, in one examined - by 30%. With bone conduction of sounds, the acuity of tonal hearing is reduced by tones of 125 - 3000 Hz. in 4 patients by 30%, in 2 by more than 30%, by high frequencies in 2 by 20%, in 4 examined patients by more than 30%. Consequently, in those examined with a horizontal type of curve, the decrease in tonal hearing both with bone and air conduction of sounds is almost the same (Figure 3).

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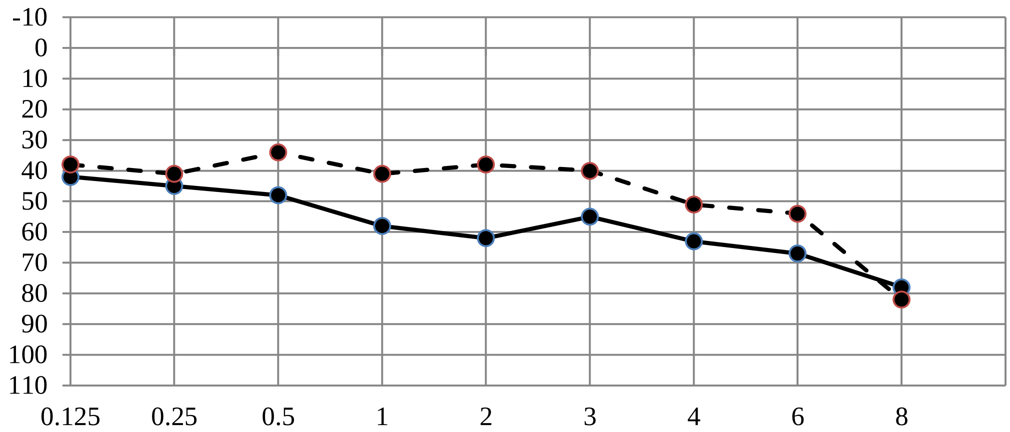

Figure 3. Audiogram: The third type of audiometric curves.

In order to find out whether the found changes in hearing acuity depend on the suffering of DBCD, we compared the average curves of patients and persons in the control group (Figure 4).

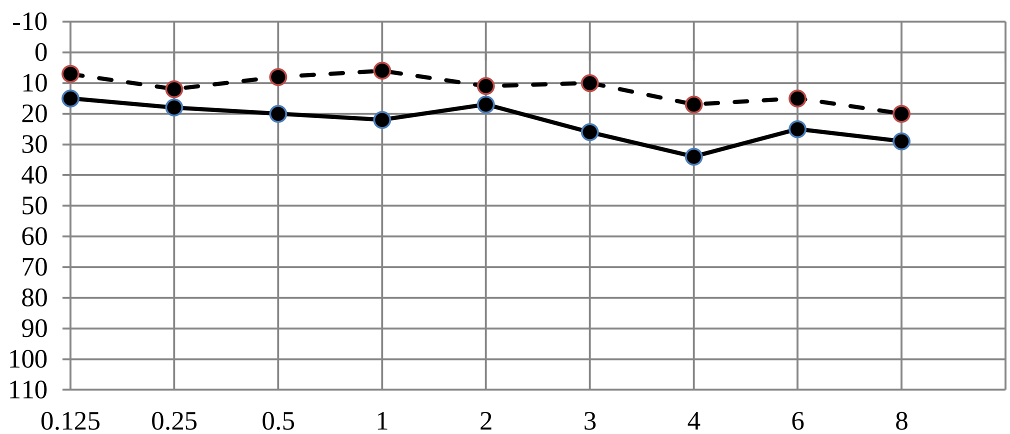

Figure 4. Audiogram of persons in the control group.

As can be seen on the audiograms, the average curves in patients with NPNMK are located below the curves of the faces of the control group by 3-10 dB. - by 5 - 20 dB., GE with PNMK - by 6 - 23 dB. Moreover, this difference is more pronounced for high tones in all stages of the DBCD. As can be seen on these audiograms, the loss of tonal hearing increases with the severity of the disease.

Comparison of complaints about hearing loss and the results of tone audiometry revealed that hearing loss is observed 1.5 times more often than the subjects themselves noticed.

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Therefore, to accurately determine the acuity of hearing in patients with DBCD, it is necessary to conduct pure-tone audiometry. With the latter, the majority of those examined revealed a bilateral decrease in perception both during air and bone conduction of sounds. The curves are located almost at the same level, but the volume of hearing acuity in the vast majority of sounds examined during bone conduction decreases to a much greater extent, especially for high tones. Normal tonal hearing is quite rare. In the majority of the examined patients, there is a lesion of sound perception of varying degrees.

The decrease in the acuity of tonal hearing increases depending on the stage of the disease, and not on age.

At DTSVR three types of audiometric curves are characteristic; isolated drop on tones 4000 or 6000 Hz., descending and horizontal type of curve. For NPNMK and the first stage of HE, the first type is characteristic with an isolated drop into individual tones, with GE-II stage and GE with PNMK, a gently descending type of audiogram is most often observed. In patients with DBCD, regardless of the type of curves, a decrease in perception is especially pronounced, mainly during bone conduction of high-pitched sounds. The greatest hearing loss is found in those examined with the second type of curves.

The vast majority of hearing loss exceeds that of the control group. Consequently, with DTsVR there is a decrease in tonal hearing, and in the presence of age-related changes, the sensitivity of the sound analyzer decreases even more.

In order to find out whether the detected speech hearing impairments depend on dyscirculatory disorders or on age-related changes in the hearing organ, we compared the average indicators of those suffering from CVD with the data of the control group. In the latter, the first type of speech intelligibility curve was found in 2 examined patients (6.67%), the second type of curve in 27 patients (90%), and the third type of curve in 1 (3.33%). Speech hearing disorder was found in 3 patients (10%).

Thus, in persons of the control group, speech hearing is changed to a much lesser extent than in patients with DBCD. They are less likely to have the first type of speech intelligibility curve than hypertensive patients.

We also performed speech audiometry with bass and treble words. In persons suffering from NPNMK and GE-Ist., the speech intelligibility curve for the bass group of words is shifted to the right along the abscissa axis (i.e., loss of speech acuity) by 5 dB, and for the treble group of words - by 10 dB; in II Art. GE the speech intelligibility curve for the bass group is shifted by 10 dB, and for the treble by 15-20 dB. Approximately the same hearing loss is present for HE with MIH.

Therefore, when using the treble group of words, there is a slightly greater loss of speech hearing than when using the bass group of words, which is typical for the defeat of sound perception.

Summarizing the above, we note that in patients with DBCD, changes in speech hearing were detected in the vast majority. Violation of speech hearing, as well as tonal hearing, increases with the severity of the disease. Age-related changes only burden it somewhat. The change in speech hearing is bilateral. According to the type of speech intelligibility curves, the examined can be divided into 3 groups, which differ from each other in the range: increased, normal, shortened. Most patients with DBCD are characterized by speech intelligibility curves of the first type (increased range).

Among those with a second type of speech intelligibility curve (with a normal range), the majority of speech hearing is altered. Moreover, a significant number of their speech intelligibility curves are shifted along the abscissa to the right more than the average loss of tonal hearing in the speech frequency zone, which indicates the presence of tone-speech dissociation.

In the majority of patients with NPNMK and GE-I st. the second type of speech intelligibility curve is observed. For the majority of those surveyed with GE-II Art. and GE with PNMK-1 type of speech intelligibility curve is typical. In persons with NPLMC, the quantitative loss of speech hearing is small, in persons with HE-I st. - it is increased by 2 - 3 times, with HE-II st. - 3-4 times, and in HE with LIMC - by 6-7 times, compared with loss of speech hearing in those suffering from CNMC. Consequently, the acuity of speech hearing worsens with the severity of the disease. Tono-speech dissociation also increases with the progression of the disease. Its presence is characteristic of the defeat of the sound-perceiving department of the cochlea and the cortical department of the sound analyzer.

When perceiving the words of the treble group, speech hearing is impaired more than the words of the bass group, which confirms our observations about the predominant lesion of the sound-perceiving section of the sound analyzer in those suffering from DBCD.

Speech hearing impairment is associated with the severity of the disease and, in addition, it increases with age.

The study of speech hearing allows to reveal subtle disorders in the functional state of the central parts of the sound analyzer, which cannot be detected with tone audiometry.

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