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ELSEVIER SSRN Universal Impact Factor

OBJECTIVE METHODS OF HEARING EXAMINATION IN CHILDREN IN THE FIRST YEARS OF LIFE

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Abstract: 77.11% of the studied children with sensorineural hearing loss and deafness were exposed to various risk factors for the formation and development of hearing impairment. In 9 (20.93%) children of group I and in 11 (27.50%) children of group II, we did not ascertain risk factors deafness and deafness. The method of recording short-latency auditory evoked potentials (100% and 98.3%) and the ASSR test (99.5% and 96.7%) have the maximum sensitivity for determining the pathology of hearing perception in children.

Keywords: sensorineural hearing loss and deafness, children, objective methods of hearing research.

The first years of any child's life are the basis for the formation of speech, cognitive skills, cognitive function and socialization. At the same time, the auditory function significantly determines the formation and development of these and other components of the higher nervous activity of each individual.

Hearing loss and deafness are recorded in 0.1-0.2% of full-term and 2-3% of premature newborns, which allows us to consider prematurity as a significant risk factor for the development of hearing loss [6]. Hearing loss and deafness are among the most common genetic diseases in the UK (1.33 per 1000 newborns) and the USA (1.86 per 1000) [5]. Mutations in the GJB 2 gene encoding connexin 26 (Cx26) are the main cause of congenital and preverbal non-syndromic hearing loss and deafness [2].

It should be noted that by the age of three years, hearing loss is already diagnosed in 2.7 children out of 1000, and by the age of 4-5 - in 3.5 per 1000 children [4].

It is obvious that the perception of sounds of "speech frequencies" (500-4000 Hz) is an integral and main factor in the formation of normal speech and the learning of any language in children, as well as a secondary factor in cognitive development [1]. In 82% of cases of childhood hearing loss and deafness, this pathology develops in the 1st or 2nd year of life, i.e. in the pre-speech period or in the initial period of speech development [3].

Thus, accordingly, the development of hearing loss in a child, often not detected at an early age, has an extremely negative impact on the development of conversational and language skills of full and correct speech, behavioral, emotional and cognitive development of the child as a full-fledged member of modern society [7].

There is no doubt that it is necessary to conduct not only a study of the presence of hearing or its absence, but also to determine the degree of hearing loss in the examined children, since this is vital in terms of the quality of life of a child and an adult in the future, will provide adequate electroacoustic correction of hearing impairment and, if its early implementation will allow the child to develop speech skills in parallel with healthy peers and without the involvement of a teacher of the deaf for his education, which will favorably affect his socialization and cognitive development, and will also be more cost-effective.

Modern methods of diagnosing hearing impairments and increasingly improved technologies for their electroacoustic correction, including cochlear implantation , allow early diagnosis and treatment of hearing loss and even deafness [4].

The purpose of the study: in a comparative aspect, to analyze the applicability of some objective methods for the study of hearing in children of the first years of life.

Material and methods

In the course of this study, we examined the dynamic state of the auditory function of 83 children of various gestational ages from 3 months to 5 years with sensorineural hearing loss (SHL) and deafness. Group I included 43 children with a gestation period of 35-37 weeks, group II - 40 children with a gestation period of 38-40 weeks. The control group (CG) of the study included 30 full-term children without hearing pathology. The study was conducted in the period 2017-2023. The children under study were consulted by deaf teachers and neuropsychiatrists.

In the course of the study, we carried out a rigorous anamnestic and clinical study, a detailed examination of the ENT organs, tympanometry and reflexometry , a study of delayed evoked otoacoustic emission, OAE at the frequency of the distortion product, registration of short-latency auditory evoked potentials (SEPs) and stationary auditory potentials to modulated tones (Auditory Steady -State Response) (ASSR). At the age of 2-3 years, the studied children underwent noise behavioral audiometry and playing audiometry in a free sound field.

We carried out electroacoustic correction of hearing impairment in children with I - III degrees of hearing loss, and in case of IV degree of hearing loss and deafness, children were referred for cochlear implantation, as well as children in whom electroacoustic correction had no effect.

Results and discussion.

We scrupulously studied the anamnestic data of the studied children with SHL and deafness in order to identify the most significant risk factors for the formation of this pathology. The occurrence of risk factors in the studied patients is presented in Table 1.

It should be emphasized that only in 9 (20.93%) children of group I and in 11 (27.50%) children of group II we did not state risk factors for hearing loss and deafness. In 20 (46.51%) in group I and in 18 (45%) representatives of group II , we recorded the presence of one risk factor for the formation of SNT, 2-3 factors - in 11 (25.58%) and 9 (22.50%)) respectively, 3 or more risk factors for SNT - in 3 (6.98%) and 2 (5%), respectively, in groups I and II .

Screening tests, such as registration of THROAE and PIOAE, are objective methods for the study of hearing, are widely used for infant screening in many countries of the world. The duration of the study was 10-15 minutes.

In the CG (n = 30), out of 60 ears, 56 had a TEOAE test, in 4 cases a false positive result was stated - in 3 cases due to dysfunction of the Eustachian tube and in 1 case due to an anomaly in the structure of the external auditory canal (EAM). Therefore, the result of TTOAE depends on the structure and condition of the ESP (sulfuric and epidermal plugs), on the state of the tympanic cavity (otitis media and exudative otitis media), which is a relative disadvantage of this method.

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Table 1
Occurrence of risk factors for the formation of SHL and deafness

Risk factors	Group I (n=43)		II group (n=40)		CG (n= 30)	
	abs	%	abs	%	abs	%
Gestational age less than 37 weeks	7	16.28	-	-	-	-
Birth weight less than 1500g	2	4.65	-	-	-	-
Birth trauma or birth asphyxia	4	9.30	3	7.50	2	6.67
Hyperbilirubinemia ≥ 200 μmol /l in neonates	2	4.65	1	2.50	-	-
The use of ototoxic drugs	3	6.98	2	5.00	-	-
Infectious pathology of the mother in the first trimester (measles, rubella, scarlet fever, herpes)	4	9.30	3	7.50	1	3.33
Acute meningitis in history of children	2	4.65	1	2.50	-	-
history of traumatic brain injury	1	2.33	-	-	-	-
Burdened heredity (hearing loss and deafness in parents)	6	13.95	5	12.50	-	-

In the studied groups of children with SNT and deafness (166 ears), in 158 cases, TTOAE was not registered. 8 ears passed the TEOAE test, although the remaining tests confirmed the presence of SHL or deafness - in 3 children (2 - binaural and 1 - monoaural) ABR and ASSR test diagnosed retrocochlear disorders, 2 ears had auditory neuropathy, and 1 had central hearing loss due to organic cerebral pathology, encephalopathy and many cysts of the temporal lobes of the brain.

Examination of CG using the PIOAE method registered a positive result in 57 ears, and false positive (erroneous) results in 3 ears.

In the studied groups of children with SNT and deafness (166 ears), PIOAE was not registered in 162 cases, and false-positive results were stated in 4 cases.

It is well known that UAE examines only the hair cells of the organ of Corti , does not diagnose retrocochlear (central) disorders, so screening studies by different classes of UAE lead to a certain proportion of erroneous results.

In the present study, the sensitivity of TEOAE was 99.5% and specificity 93.3%, while for PIOAE the sensitivity was 99.6% and specificity 95%.

In our study, tympanometry was used to diagnose diseases of the middle ear system, although this technique does not examine hearing.

We also carried out acoustic reflexometry as a method of objectifying the force m . stapedius with sound stimulation, which allows subjectively assessing the thresholds of hearing perception, taking into account the significant difference in the reaction between I and IV degrees of SNT.

We studied brainstem ABR as a deep audiological diagnostic method in all the studied patients. Registration of ABRs diagnoses the activity of the conductive path of auditory stimuli and weakly depends on the sound conduction system.

In the study of CG ABR with all components, normal hearing was noted in 59 ears out of 60 in children older than 2 years with a clear V-peak. 1 false-positive test in the form of the absence of a V-peak with normal hearing was due to the narrowness of the

ESP and a large angle of cartilage-to-bone transition, which led to excessive bending of the sound guide during the test.

In groups I and II of children with SHL and deafness, all 166 (100%) studies of ABR revealed the presence of hearing pathologies. ABR has a sensitivity of 100% and a specificity of 98.3%, indirectly determines the perception thresholds within 2-4 kHz.

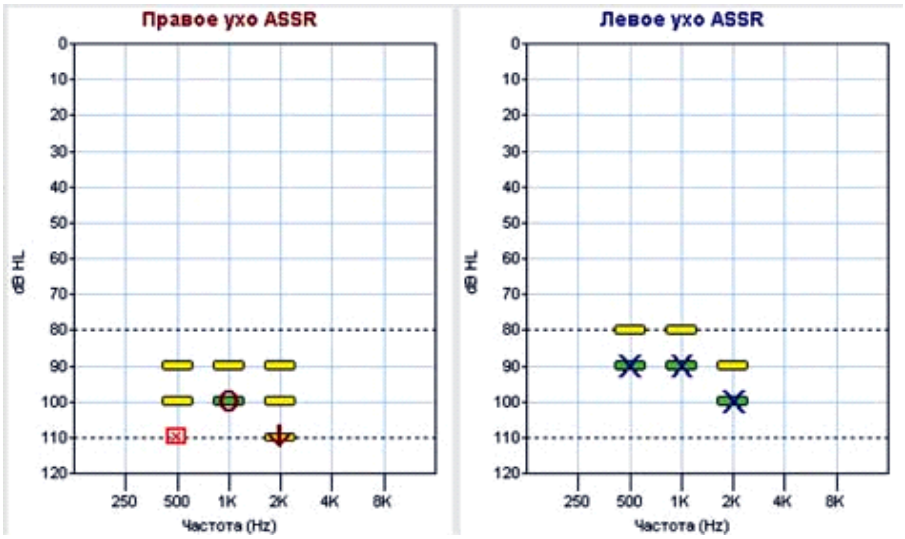
The shortcomings of ABR include the significant duration of the study and the obligatory immobility of the subject, which in children is often achievable only by resorting to medical sedation (narcosis).

We also used the ASSR test, which allows us to register an "objective audiogram" due to the breakdown of stimuli by frequency. In children, this study allows for a more accurate and individualized electroacoustic correction of hearing impairment.

ASSR -test of representatives of the CG in 58 cases out of 60 ears stated normal hearing and 2 false-positive cases in the presence of normal hearing.

In both groups of children with SHL and deafness, the ASSR test diagnosed positive results in 163 cases; in 3 cases, we found a discrepancy between the diagnosed hearing thresholds and hearing on noise behavioral and play audiometry in a free sound field.

In our study, the sensitivity of the ASSR test was 99.5%, and the specificity was 96.7%.



Rice. 1. The result of the ASSR test of a 6-month-old child with SHL IV degree: the hearing threshold by frequency is highlighted in green.

We recorded fluctuations in hearing perception thresholds in 6 (13.95%) children of group I and in 5 (12.50%) children in group II , i.e. in 11 children - 13.25% of all children studied. This required further study of hearing by other methods.

The main advantage of using the ASSR test was the potential for delivering the most intense stimuli at different frequencies with an assessment of hearing perception thresholds of up to 120 dB.

It should be taken into account that the influence of factors that distort the results of the hearing test is possible, such as the anxiety of the subject, the presence of pathologies of the ESP and/or the middle ear system, the inadequacy of stimulation parameters, the lack of repeat tests to consolidate the results, the inability to compare hearing thresholds obtained by different methods.

The most reliable results can be achieved by using psychoacoustic , along with electrophysiological methods, as well as deaf pedagogical tests aimed at verifying the degree of SNT.

Conclusions

1.77.11% of the studied children with SHL and deafness were exposed to various risk factors for the formation and development of hearing impairment.

2.The maximum sensitivity for determining the pathology of hearing perception in children is the method of recording ABR (100% and 98.3%) and the ASSR test (99.5% and 96.7%) .

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