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Research Article

A PROGNOSIS METHOD OF PEDIATRIC SENSORINEURAL HEARING LOSS

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ABSTRACT

Pediatric hearing loss is a serious disorder, which often leads to disability and goes beyond the field of otology. Prognosis of pediatric hearing loss might contribute to its early detection and prevention. Since auditory analyzer impairment may be caused by various unfavorable factors during the ante-, intra- and postnatal periods, the first stage of prognosis relates to highlighting the most significant predisposing factor of hearing loss in children. The audiological examination was carried out by recording the brainstem auditory evoked potentials at the Republican Center of Audiology, Institute of Mother and Child. The study included 110 children (study group) with a variety of neurological disorders and sensorineural hearing impairment and 30 children (control group) with normal hearing. The advantages of this study are to provide possible prognostic data for sensorineural hearing loss in children, which will improve to some extent the situation regarding this pathology.

INTRODUCTION

Pediatric hearing loss is a serious disorder, which often leads to disability and goes beyond the field of otology, thus requiring significant attention of the specialists who deal with this issue. Although , considerable progress have been recently made to expand the possibilities of diagnosis and rehabilitation of hearing-impaired children viaBAEPs, OAE, auditory prosthesis, cochlear implant, the problem of early diagnosis and prevention of sensorineural hearing loss is still highly significant.(1, 2)

Prognosis of pediatric hearing loss might contribute to its early detection and prevention. Since auditory analyzer impairment may be caused by various unfavorable factors during the ante-, intra- and postnatal periods, thefirst stage of prognosisrelates to highlighting the most significant predisposing factor of hearing loss in children.(3, 4)

Purpose of the study

MATERIALS AND METHODS

The audiological examination was carried out by recording the brainstem auditory evoked potentials at the Republican Center of Audiology, Institute of Mother and Child. The study included 110 children (study group) with a variety of neurological disorders and sensorineural hearing impairment and 30 children (control group) with normal hearing. The groups were divided according to their age and gender, and involved children aged 1 to 36 months.

Distribution of patients by gender and age

Table 1.1

Patients	110 children
Boys	43 (39,09%)
Girls	67 (60,90%)
Age (years)	1-36 months

The present study was based on the data analysis of patient's medical history regarding the presence of ante-intra- and postnatal risk factors. The statistical discriminant analysis has been used to highlight the most important risk factors.

The monofactorial " step-by-step" discriminant analysis according to F-criterion enabled to determine 24 factors during the ante- and intranatal periods, which distinguish the group of hearing-impaired children from the group of healthy children ($P < 0.05$). However, it was not possible to predict the certainty of occurrence of pediatric sensorineural hearing loss, based on each factor apart. The multi-factoranalysis and the intercorrelation between themwere used for the prognosis of deafness in children. Therefore, 84.40% children were found to develop hearing loss, showing a high level of prognosisprobability, whereas the most informative factors were those occurring within the ante- and intranatal periods.

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RESULTS

The "step by step" discriminant analysis highlighted 9 more informative hearing loss- predicting factors in the ante- and intranatal periods. These are as follows: pathological birth (F = 56,714); anemia in pregnancy (F = 20,322);low Apgar score (<7) (F = 12,154); birth asphyxia (F = 5.371); VRI during pregnancy (F = 5.359); child gender (F = 4,455); pyelonephritis in pregnant women (F = 2,824); oligohydramnios (F = 2,622); cord coiling (F = 3,510).

As the fetus grows and develops interdependently of mother's body, complications that might occur during the antenatal period may lead to multiple structural or functional disorders of different organs and systems. Thus, VRI may cause the impairment of the auditory analyzer particularly in the first half of pregnancy. Anemia in pregnant women does not directly affect the child's auditory organ, but it might worsen the stress response during newborn delivery and adaptation to extrauterine life. Exacerbation of chronic pyelonephritis or its onset in pregnant womenmay usually cause chronic fetal hypoxia, which can result in multiple organic and functional impairment, as well as metabolic disorders, being the underlying causes of sensorineural deafness.

The obtained data from the step-by-step discriminant analysis reveals that pathological birth is determined by the highest F-statistic value. It is well known that pathological birth (inadequate uterine contractions, abnormal fetal position, etc.) is caused bytrauma during pregnancy, underlying the cases of bleeding in both CNS and different parts of the auditory analyzer, which might lead to a hearing loss. The intranatalcauses, which contribute to the installation of hearing loss, include the cord coiling andasphyxia that might result in brain damage and poor function of the auditory analyzer, which is very sensitive to oxygen deficiency. Ultimately, low Apgar score determines the occurrence of these events. Oligohydramniosresults in inability to protect the fetus against traumas while passing through the birth canal during labortime, which may cause bleeding into the auditory organ.

Thus, the disorders that might occur during the gestation period and delivery are unfavorable for the development of both hearing loss and disorders of different organs and systems of the fetus. Our research determined the association of sensorineural hearing loss with various pathologies of the central nervous system. According to specialized literature, deafness is more common among boys, being determined by the lowest F-statistic value within our conducted study.

The discriminant analysis used the above mentioned 9 variables from ante- and intranatal periods to allow prognosis of hearing loss in 84.40% children, showing rather high prognostic values(Table N2). Therefore, we highlighted the most informative factors within the ante- and intranatal periods that might help in determining the group of children at high risk of developing hearing loss. The children require hearing assessment even from the earliest days of life , as well asfurther follow-upat the neurologist, otorhinolaryngologist or family doctor. Moreover, the child's parents should be warned about the possibledevelopment of hearing impairment throughout the lifetime, getting familiar with those postnatal factors that can lead to deafness.

The step-by-step discriminant analysis of the postnatal period highlighted 7 major variables in prognosis of child deafness, namely: ototoxic drugs (F = 26,512); craniocerebral trauma (F = 12,388); influenza (F = 9,492); meningitis (F = 5.645); RVI and high fever (F = 4,196); allergic disease (F = 3,184); neuroinfection (F = 2.923).

It is well known how many pharmacological agents have been shown to have toxic effects onauditory analyzer. The ototoxic effects of gentamicin were determined in our research. The study outcomes revealed that this index shows a higher F-statistic value than the other variables. Thus, we can conclude that children from the risk group are more prone to develop cochlear lesions after administration of ototoxic agents. Therefore it is highly important to focus specifically on this strategies of preventionof deafness in children.

Craniocerebral trauma, which was common in children in the study group, may be a cause of a sensorineural deafness in children due to the haemorrhage in different parts of the auditory analyzer. We believe that prevention of craniocerebral trauma in children at risk will reduce cases of acquired hearing loss.

The sensorineural hearing loss resulting from an infectious disease in children may occur both during the disease and for a certain period afterwards. (5, 6, 7)The present study registered higher F-statistic valuesin cases of influenza and meningitis, followed by RVI with high temperature and neuroinfections. Measures to prevent these diseases are well reflected in scientific literature (normalization of body response, strengthening,immunization, etc.). Allergic diseasesor various allergic reactions may lead to sensorineural hearing lossdue to edema of the labyrinth, which leads to metabolic disorders and hypoxia. Prophylaxis of allergic conditions and their proper treatment could help prevent acquired hearing impairment in children, as well.

Discriminant analysis allows prognosis of hearing loss in 73.64% of children by using 7 postnatal variables (Table 1).

Table 1 Prognosis of sensorineural hearing loss based on the postnatal child growth

Predisposing factors	Study group n=110,(%)	***Control Group*** n=30,(%)	P
Use of ototoxic drugs	47,27	0,00	<0,001
Craniocerebral trauma	22,73	0,00	<0,05
Flu	20,00	0,00	<0,05
Meningitis	7,27	0,00	>0,05
RVI and high temperature	73,64	53,33	<0,05
Allergic diseases or various allergic reactions	51,82	43,33	>0,05
Neuroinfection	8,18	0,00	>0,05
Prognosis	73,64	100,00	

It is well known that children with mild or moderate hearing impairment have more chances of managing this disorder than severe or profound hearing loss. In consideration of these, we aimed to analyze the factors that have a greater impact on the severity of sensorineural hearing loss in children. We studied the developmental patterns of the ante, intra and postnatal periods in groups with moderate, severe and profound hearing impairment.

The "step by step" discriminant analysis revealed 9 significant factors responsible for the severity of hearing loss during these

periods, viz. addictive behavior in pregnant women (F = 9,340); maternal hepatitis (F = 6.050); presence of intrauterine infection (F = 5,988); meningitis in children (F = 5,597); Cesarean section births (F = 5.420); pyelonephritis in women (F = 3.739); complications during pregnancy (F = 2,616); premature births (F = 2,605); respiratory failure (F = 3,119). Based on these 9 variables determined within ante-, intra- and postnatal period, the discriminant analysis allows the prognosis of moderate hearing lossin 75.00% , whereas severe or profound hearing loss make up 83.95% of cases (Table 2).

Table 2 Prognosis of the severity of sensorineural hearing loss based on anamnestic data

Parameters	Moderate hearing impairment n=29	Severe and profound hearing impairment n=81	P
Addictive behavior in pregnant women	35,71	11,11	<0,05
Maternal pyelonephritis	14,29	30,86	>0,05
Maternal hepatitis	0,00	18,52	<0,05
Complications during pregnancy:			
Absence	-	-	
Toxicosis	64,29	64,20	
Imminent abortion	14,29	9,88	>0,05
Cesarean section births	0,00	9,88	>0,05
Premature births	6,90	19,75	>0,05
Respiratory failure syndrome	20,69	12,35	>0,05
Intrauterine infection	58,62	27,16	<0,05
Meningitisin children	0,00	9,88	>0,05
Prognosis	75,00%	83,95%	

Probable prognosis of hearing impairment and its severity is quite high, based on the analysis of the ante-, intra- and postnatal periods.

The prognosis hearing loss in children will help somewhat improve this pathology if knowing and considering the predisposing factors that will enable to prevent and early diagnosethe impairment , as well as reduce the risks of hearing loss-related disability.

The preventive means of pediatric hearing loss is somehow limited. According to our research data, these are related to improvement of both maternal health and proper behavior during pregnancy (to exclude alcohol, drugs and job-related poisoning, etc.). (8, 9, 10)Professional assistance during childbirthis also crucial in preventing obstetrical trauma leading to hearing impairment. Administration of ototoxic drugs to children, particularly in those with perinatal CNS disorders need to be restricted. Immunization programs will help reduce the number of cases of sensorineural hearing loss. (11, 12) Another tendency of prophylaxis of sensorineuralhearing impairment in children is education of both population and medical staff regarding this issue.

CONCLUSIONS

The advantages of this study are to provide possible prognosticdata for sensorineural hearing loss in children, which will improve to some extent the situation regarding this pathology. The predisposing factors in the development of deafness should be considered while taking the appropriate preventive measures, whereas the early diagnosis might help reduce this disability in children. Particular attention is paid to qualified medical assistance provided during childbirth in order to prevent the obstetrical traumas. The administration of ototoxic drugs to children, particularly in those with perinatal CNS disorders need to be restricted. Another tendency of prophylaxis of sensorineural hearing impairment in children is education of both population and medical staff regarding this issue.

The advantages of this study, which allowed staging and detecting of the most important factors responsible for sensorineural hearing loss in children, included possible screening of these children by restricting the usage of ototoxic drugs and compliance with the rules for maintaining the integrity and functionality of the auditory analyzer.

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