

Comparison of Indicators of Short and Long Latency Auditory Evoked Potentials in Newborns

Madrimova Aziza Gaipnazarovna*
Sapayeva Sharofat Aminovna

ABSTRACT

Abstract: Auditory evoked potentials (EVP) are an effective and non-invasive way to assess the functional state of the auditory nerve and auditory sensory pathways of the brainstem. An increase in the latent periods of peaks III, IV, V, as well as a lengthening of the time of central sound conduction of III-V and I-V waves in all newborns with hyperbilirubinemia, indicates a pathology of hearing of central origin with impaired conduction along the auditory pathways at the level of the lower and middle third of the brain pons.

Keywords: Short-latency auditory evoked potentials, Registration, Latencies and Amplitudes

Department of Otorhinolaryngology and dentistry, Tashkent Medical Academy, Tashkent, Uzbekistan

*Send correspondence to:

Madrimova Aziza Gaipnazarovna

Department of Otorhinolaryngology and Dentistry, E-mail: madrimova2019@mail.ru, Phone: +998919920005

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INTRODUCTION

The study of the state of the auditory system nuclei of different levels and the state of the auditory nerve was carried out by recording short-latency auditory evoked potentials (ABRP)^{1,2}. The SVP method is based on the study of electrical manifestations of the activity of the auditory system under the action of various sound signals and consists in recording and assessing the activity of large sets of nerve elements. The assessment of the results obtained was studied by recording the ABR waves. ABRs were recorded using the Neuro-Audio evoked potentials registration system (Russia).

In our study, short broadband acoustic clicks with duration of 100 μ s were used as stimuli. The study began with a stimulation intensity of 60 dB above the threshold of normal hearing. In the absence of a response, the intensity was increased; in the presence of a response, it was gradually decreased by 5–10 dB to the threshold level of stimulation³.

The following parameters were subject to assessment: Amplitudes (A) of waves I,III,V (basic); II-IV - Auxiliary; latencies of waves I,III,V (LP); peak-to-peak intervals (MPI) I-III, III-V, IV; Amplitude ratio of V/I peak on both sides; interaural difference in latencies of V peaks on both sides.

Basic criteria for the norm and pathology of ABR:

Norm criterion: The presence of waves IV (in some cases, VI).

Standard values of inter-peak intervals I-III, III-V;

The time of the central IV conduction is not more than 4.4 ms.

The latent period of the V peak is not more than 6.3 ms.

The interural difference in the latent periods of the V peaks is not more than 0.4 ms (in the absence of peripheral disorders).

The ratio of the V wave amplitude to the I wave amplitude is not more than 0.5.

MATERIALS USED

We recorded ABRs according to the standard 4-channel registration scheme with monaural click stimulation at stimulus intensity of 80-90 dB. In the course of the study, such parameters of the emitted components as

latencies and the maximum amplitude of the waves were assessed^{4,5}.

The absolute delays of waves I, III and V, as well as the inter-wave delays of I-III, III-V and IV waves were measured at 90 dB. In order to determine the hearing threshold for the V wave, the stimulus intensity was lowered by 20 dB spacing. The criterion for normal hearing was the presence of the V wave at a stimulus intensity of 20 dB (Table 1). Comparison of waves I, III, and V absolute and delayed interaction in our study sample did not reveal statistically significant gender differences in all tested intensities.

A latent periods 1- peaks neonatal group was left 1.97 ± 0.21 ms, to the right 1.96 ± 0.27 ms; in newborns of the 2nd group, on the left, 2.34 ± 0.12 ms, on the right — 1.87 ± 0.18 ms, which is a statistically significant result; In newborns of the control group, the periods of the first peaks were 1.9 ± 0.21 on the right, 1.89 ± 0.15 ms on the left (Table 2).

The average value in the magnitude of the latent periods of the III peaks in the newborns of the 1st group was 4.62 ± 0.41 ms; in newborns of group 2 it was 4.56 ± 0.4 ms, which is a statistically significant indicator.

The average value in the magnitude of the latent periods of the V peaks in newborns of the 1st group was 6.74 ± 0.44 ms; in the newborns of the 2nd group, the latency lengthening was noted on the left of 7.2 ± 0.41 ms, which is a statistically significant indicator (Table 3).

The value of the peak-to-peak intervals IV for the 1st group was 4.79 ± 0.39 ms., and the values of the intervals for the 2nd group were on the left -5.15 ± 0.52 ms, respectively.

The results of registration of ABRs showed statistically significant differences when comparing the absolute delays for waves I, III and V at 80 dB between 1-2 groups of newborns; lower values were found in infants with high levels of bilirubin compared with infants with moderate levels of bilirubin in the blood. Longer V delays were found at 40 dB/h in newborns from group 2, which are statistically significant. Peak intervals I-III, III-V and IV were more lengthened in newborns with severe hyperbilirubinemia, which is statistically significant.

According to the results, the magnification of the latent periods of III, IV, V peaks, as well as the lengthening of the time of central sound conduction of III-V and IV in all newborns with hyperbilirubinemia, indicates pathology of hearing of central origin.

Table 1: Comparative characteristics of the results of registration of ABRs in newborns of group I by gender.

Index	I group				F group			P
	N	M	Standard deviation	N	F	Standard deviation		
Wave I	34	1.61	0.34	38	1.54	0.23	0.7696	
Wave III	34	4.05	0.30	38	3.98	0.29	0.2904	
Wave V	34	6.27	0.42	38	6.14	0.42	0.1817	
Peak interval I - III	34	8.29	0.24	38	8.17	0.35	0.0888	
Peak interval III-V	34	2.22	0.42	38	2.16	0.28	0.1496	
Peak interval IV	34	4.65	0.42	38	4.6	0.40	0.6652	

Note: * - significant difference according to Student's test at the level of $p \leq 0.05$ in relation to the control group

Table 2: Comparative characteristics of the results of registration of ABRs in newborns of group II by gender.

Index	II group				P		
	N	M meaning	Standard deviation	N		F meaning	Standard deviation
Wave I	24	1.73	0.37	36	1.69	0.33	0, 7235 *
Wave III	24	4.2	0.29	36	4.10	0.29	0.2199
Wave V	24	6.53	0.28	36	6.35	0.41	0.0786 *
Peak interval I - III	24	8.38	0.32	36	8.32	0.28	0.1013
Peak interval III-V	12	2.25	0,4	18	2.39	0.35	0.3155
Peak interval IV	12	2.69	0.35	18	2.43	0.38	0.0744

Note: * - significant difference according to Student's test at the level of $p \leq 0.05$ in relation to the control group

Table 3: Comparative characteristics of the results of registration of ABRs in newborns of the study groups.

ABR parameters	Group I Average meaning	Mr. Rupp II Average value	Control group	P-value
I Right ear	1.97 ± 0.21	1.99 ± 0.28	1.8 ± 0.21	0.46
I Left ear	1.95 ± 0.23	2.11 ± 0.32	1.8 ± 0.15	0.01*
III Right ear	4.62 ± 0.41	4.56 ± 0.4	4.4 ± 0.23	0.49
III Left ear	4.65 ± 0.35	4.61 ± 0.44	4.4 ± 0.31	0.63
V Right ear	6.74 ± 0.44	7.14 ± 0.5	6.6 ± 0.32	0.0001*
V Left ear	6.87 ± 0.39	7.2 ± 0.41	6.6 ± 0.13	0.0002*
Peak interval IV Right ear	4.79 ± 0.39	5.15 ± 0.52	2.11 ± 0.15	0.0003*
Peak interval IV Left ear	4.91 ± 0.39	5.09 ± 0.39	2.11 ± 0.15	0.03*

In order to determine the level of damage to the auditory analyzer, the registration of the APS was carried out. The analysis of latency, amplitudes and peak amplitudes of long ABR was carried out. The latency of the Long ABR waves characterizes the degree of activity of neurons during stimulation, and the amplitude - the number of excited neurons.

According to the results of registration of ABR, an increase in the latency of ABR indicators in newborns with hyperbilirubinemia was revealed, which is a significant difference from the indicators of the group of newborns with asphyxia and the control group. The ABR values in newborns with asphyxia in relation to the amplitude of the peaks had a tendency to decrease their value, but the difference from the control values was not statistically significant.

Thus, in spite of the predominant lesion of the peripheral part of the auditory analyzer, according to the data of registration of long ABR, the presence of abnormalities in the cortical part of the auditory analyzer was also revealed in the group of newborns with a high level of bilirubin in the blood.

RESULTS AND DISCUSSION

According to Table 1, the latency between the waves V, IV between groups of neonatal asphyxia, hyperbilirubinemia and control groups significantly increased, whereas according to Table 2, latent wave I, V, IV between waves were significantly increased in right ear. This suggests neurotoxic damage to the central auditory pathway and damage to both central and peripheral auditory pathways in neonates.

Table 3 shows that in both ears the latency between waves V and IV was statistically significantly increased, and in

the right ear latency I was also statistically significantly increased among children of the 2nd group compared with the group of the 1st group. This indicates significant neurotoxic damage to the central auditory tract of both the ear and significant peripheral neurotoxic damage to the right ear in the group with high bilirubin levels.

Severe neonatal hyperbilirubinemia is particularly toxic to the auditory tract. The aim of the study was to identify changes in ABR among the group of newborns with high levels of newborn bilirubin. This present study clearly demonstrated that there were significant changes in ABR in children with neonatal hyperbilirubinemia. Statistically significant indicators were present in the group with high bilirubin levels.

CONCLUSION

According to the results of registration of ABR, an increase in the latency of ABR indicators in newborns with hyperbilirubinemia was revealed, which is a significant difference from the indicators of the group of newborns with asphyxia and the control group. The values of long ABR in newborns with asphyxia in relation to the amplitude of the peaks had a tendency to decrease their value, but the difference from the control values was not statistically significant.

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