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RESEARCH ARTICLE

Comparison of the absolute latency of wave V in the auditory brainstem response between the children with and without Autism

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Abstract

Background and Aim: Autism is a neurodevelopmental disorder characterized by disturbances in social interactions and limited and repeated behaviors. The symptoms of this disease appear before the age three. Autism affects information processing in the brain, and it also affects the relation between the nerve cells and synapses and their order. Therefore, the current study aimed at comparing the absolute latencies of wave V in the auditory brainstem response (ABR) between children with and without Autism.

Methods: A total of 15 children with Autism and 15 healthy children, aged 4 to 6 years were enrolled in the current study. ABR with click stimulus was recorded at intensity of 75 dBnHL and rate of 27.1 for both groups.

Results: The independent t-test was used in this study to determine the differences between the groups. The mean absolute latencies of ABR wave V for the right ear were 5.80 and 5.71, respectively, for the Autism and normal groups, whereas the mean absolute latencies for the left ear were 5.81 and 5.70, respectively, for the Autism and normal groups. The difference in the absolute latency of ABR wave V was significant between the groups both in the left and right ears ($p<0.001$).

Conclusion: Since wave V indicates the performance of the auditory system, based on the obtained results, the absolute latency of wave V can provide specialists with an appropriate prognosis for the therapeutic approaches.

Keywords: Autism; auditory brainstem response; auditory system

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Introduction

Autism is a type of developmental disorder (of social type) characterized by abnormal verbal communication and behaviors. Its primary cause is still unknown [1]. Individuals with Autism display three primary characteristics: a) disruption of social interactions, b) unusual growth and difficulty in using language, and c) repetitive behaviors and a limited range of interests. In addition, neural disorders are the secondary characteristics that are common among all individuals with Autism [2].

There is considerable heterogeneity at the onset of Autism. Some children have growth retardation during their first 18 months of life. However, about 25% to 40% of children with

Autism are initially close to normal till the age 18 to 24 months, after which symptoms of Autism appear. It is likely that at the onset of Autism and while the Autism regression phenotypes are present, there may be important implications for the type and duration of neuropathology, which may be encountered [3].

Autism affects the normal growth of the brain in terms of social interactions and communication skills. Children and adults with Autism have difficulty in their verbal and non-verbal communications, social interactions, and game-related activities. It makes it difficult for them to communicate with others and with the outside world. Repetitive movements (shaking hands and jumping), unusual responses to people, abnormal progression or lack of progression in verbal language, attachment to or affection by objects, and resistance to change are observed in individuals with Autism [1,4,5]. Linguistic damage is a major defect in Autism, although its neurological cause is yet unknown [4]. Different communication behaviors can be observed from the first year of life and may include a delay in the onset of babbling, unusual pointing and modes of expression, the reduced sensitivity and appropriate environmental reaction, and sound schemes without any harmony with the environment [5,6].

One of the nervous system centers that affect auditory and verbal communications is the brain stem. Auditory brainstem response (ABR) is an objective electrophysiological technique used to assess the functional integrity of the brain stem auditory pathway [7]. ABR contains a wave-guide kit that shows the bioelectric activity of the auditory nerve and the auditory cortex of the brain stem [8]. Since this response is closely related to the anatomy of the auditory pathways of the brain stem, it is a good indicator for the neurophysiological function of the brain stem. Wave V is the most stable and prominent wave of the ABR waves and is more useful in the diagnosis and thresholding procedure. This response is similar in sleep and wakefulness; in the other wordssleepdoen't have any negative effect on the ABR,herefore, it is applicable to young hard-of-hearing patients or people with severe physical or mental handicaps [7,8].

For patients with Autism should be performed initial interventions. ABR is one of the most widely used tools to study the auditory function of children with Autism. Several studies reported that children with Autism have longer latencies of ABR waves, compared with the normal ones [4,9], while some other studies did not show such a relationship, the differences between the results may be attributed to the differences in the inclusion and exclusion criteria of the studies. The latencies of ABR waves were also reported in clinical evaluations on normal hearing children within the age range 2 to 4 years [10], which indicates that ABR latency is evident in the prolonged symptoms of Autism. However, it is unclear whether such prolongation is evident even before the symptoms of Autism appear, and therefore, it can be used as a potential risk factor for Autism [15].

Considering the increased prevalence of Autism and the need for timely diagnosis and action to decrease the complication of this disorder, the current study aimed at evaluating the ABR in children with Autism in order to find out the relationship between ABR and the risk of Autism. As this test does not need patients' cooperation and is applicable at all ages (while Autism diagnostic tests such as DSM-4 or DSM-5 [11] are often administered through questionnaires that require the aging of a child and observation of specific behaviors by him/her for diagnosis), This test can be used along with other tests to increase the risk of autism at an early age [15].

Methods

This cross sectional, comparative study was performed on 15 children with Autism and 15 normal children (aged 4 to 6 years). Each group contained 8 males and 7 females. The subjects were selected from Perans Kindergarten, special for children with Autism, and also an audiology clinic by a pediatric neurologist. The control group was selected from the community using the convenience sampling method and the children selected for the control group were similar in terms of age and gender to the patient group.

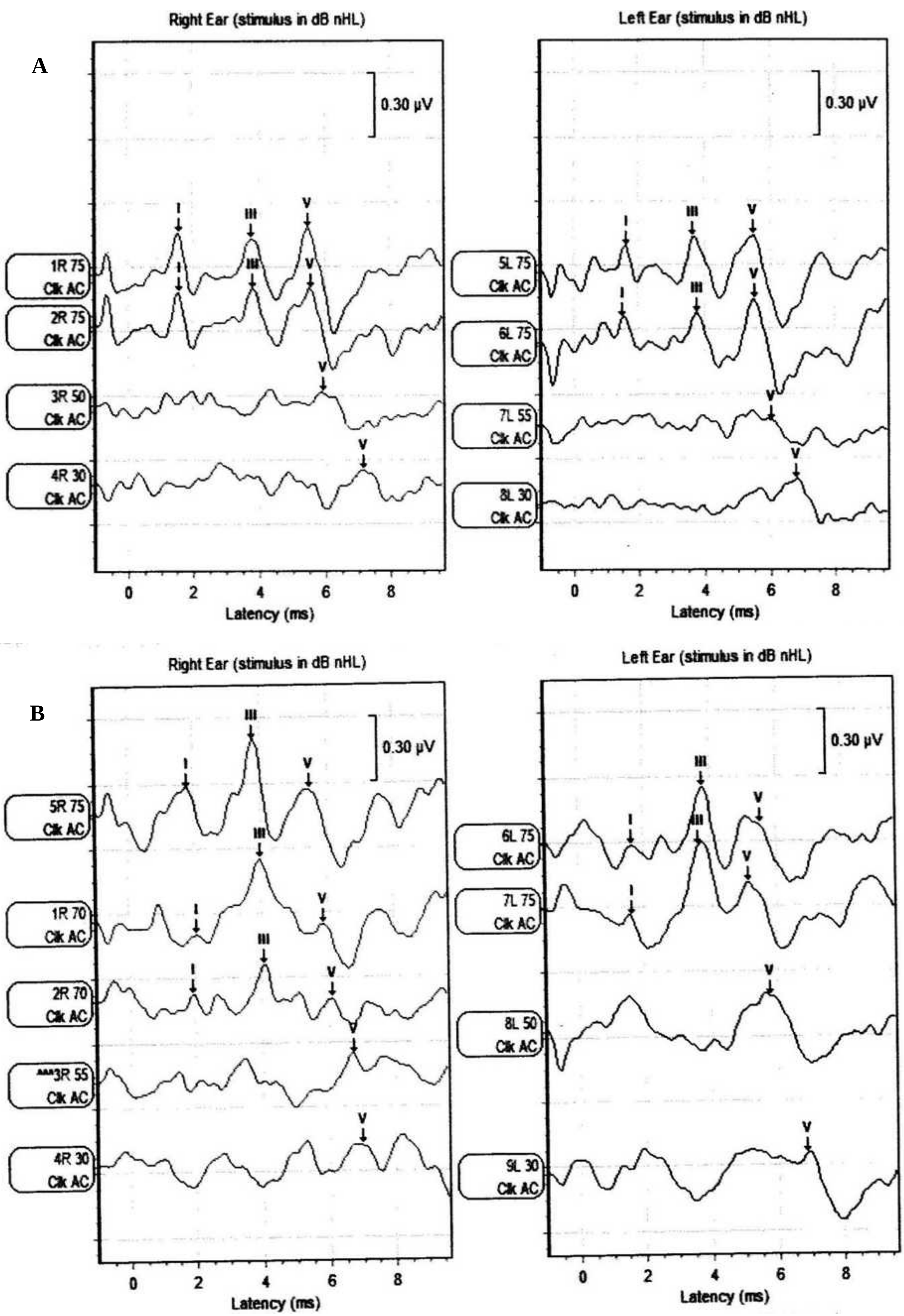

Fig. 1. A sample of ABR waves in right and left ear in two groups, A) right and left in control group, B) right and left in Autism group.

Table 1. The mean hearing threshold in the Autism and the control group in the right and left ears

Frequency		250	500	1000	2000	4000	8000
Mean hearing threshold in control group	Right ear	15	10	10	15	10	10
	Left ear	10	15	10	10	15	15
Mean hearing threshold in autistic group	Right ear	15	15	10	15	15	15
	Left ear	15	10	15	15	10	15

All children had normal hearing in both the patient and control groups. Hearing in children was evaluated at a frequency of 250 to 8000 Hz using an audiometricgame. Based on the age and weight of the child, the pediatrician prescribed chloral hydrate, as a sedative, for children. A standard electrode placement method was used (forehead: positive electrode, experimental ear mastoid, negative electrode, and non-experimental ear mastoid: ground electrode). The ABR waves were recorded using an insert phone and the intensity level was 75 dB nHL and 2 traces were recordedin both groups (Fig. 1). Click stimulus, with rate of 27.1 (due to the low tolerance of the autistic patients and the likelihood of their waking up) and alternate polarity was used, the ABR performed by Vivo Sonic Device (Canada).

Table 2. The mean absolute latency of the waves I, III, V in the two groups in the right and left ears

	Normal	Autism
ABR wave latency	**Mean (SD)**	**Mean (SD)**
Right ear I	1.65 (0.11)	1.69 (0.15)
Right ear III	3.82 (0.07)	3.93 (0.11)
Right ear V	5.71 (0.05)	5.80 (0.081)
Left ear I	1.68 (0.09)	1.71 (0.09)
Left ear III	3.80 (0.07)	3.95 (0.11)
Left ear V	5.70 (0.05)	5.81 (0.082)

The absolute latency of wave V was calculated in both ears, and the results were analyzed using SPSS16. The Kolmogorov-Smirnov test was used to examine the normal distribution of data. As the data were normally distributed, the independent t-test was used to analyze the data.

Results

The behavioral audiometry test was conducted at frequencies 250 to 8000 Hz in both ears for all of the participants. Table 1 shows the average hearing threshold of the frequencies evaluated in the 2 groups.

The absolute latencies of wave I–V were recorded in the right and left ears of 15 children with Autism and 15 children with normal hearing thresholds. Table 2 shows the mean absolute latencies of waves I, III, and V in the 2 groups in their right and left ears. Children in the control group showed significantly lower values of absolute latency for all waves in both ears than that of children in the Autism group ($p<0.001$).

Fig. 2 shows the mean absolute latency of wave V in the right and left ears in the 2 groups. As can be seen, children in the normal group showed significantly lower values of absolute latency of wave V than that of children in the Autism group ($p<0.001$).

Discussion

The current study was conducted on 15 children with Autism and 15 children with normal hearing thresholds. The absolute latency of wave V was studied in 2 groups. Children in the

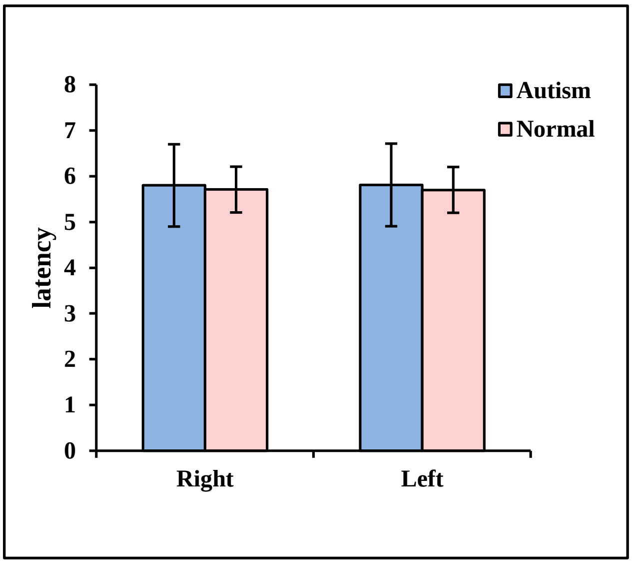

Fig. 2. The mean absolute latency of wave V in the autism and the control group in the right and left ear.

control group showed significantly lower values of absolute latency of wave V in both ears, compared with the ones in the Autism group. Several studies were conducted on children with Autism using ABR [9-15].

According to the current study results, children with Autism have higher hearing thresholds, especially in mid- frequencies (2000 Hz), which is significantly associated with performance in all speech and language functions [12]. Children with Autism showed different results compared to normal children not only in the ABR test, but also in the P100M test, and indicates the reduced pre-attentive processing in the right hemisphere and/or its changes to the left hemisphere may help the abnormal sensory behavior in Autism spectrum disorders [5].

In ABR-tested studies, children with autism group showed longer absolute latencies of waves I, III, and V in both ears [4,13]. Another study showed different results in the brainstem auditory evoked potential (BAEP) and P 300 component in children with autism [14]. The preliminary results of these studies show a reduced synaptic efficiency in the auditory pathway in children with Autism, which may provide a neurological basis for sensory reaction and linguistic disorder and show a disturbance in the brainstem of the auditory pathway and cortical/subcortical regions in these children [4,14].

Mirono et al., conducted a retrospective study in order to compare the absolute latency of ABR wave V in autistic and normal neonates without considering the hearing thresholds before the onset of Autism symptoms [15]. According to their results, in neonates who developed Autism in the future, the absolute latency of waves III and V had increased in comparison to the control group. They found that it is possible to diagnose autistic neonates using ABR test before the onset of its symptoms. Similar results were obtained in present study. Based on the age group in the current study, it can be concluded that this increase in absolute latency is also observed until the age of 6 years.

ABR test is typically used as a clinical tool to assess the integrity of functioning of the auditory system and for measuring hearing thresholds in neonates with a risk of neurological abnormality, which is not limited to hearing. In this study, the performance of the auditory system in children with Autism was significantly different from that of the ones in the control group.

The comparison of the ABR record of children with Autism with clinical norms and previous studies [10] suggests that the ABR wave latency during the initial growth of Autism has a basic unknown neuropathology that results in prolonged ABR. One potential explanation is that the latency of wave V is due to the poor myelination of the auditory system in the affected children, and some studies indicated that latency is due to weakness in the white matter [13].

Although the diagnosis of Autism is primarily based on social and communicative capabilities, it is well documented that complications include various types of disorders in the sensory process and initial movement. In concordance with this concept, the results of the current study indicated an objective evidence for the abnormal hearing process in the primary stages of the auditory system in the children with Autism characterized by physiological disorders in the auditory neural pathway.

Conclusion

According to the results of the study, it is possible to use ABR in the clinical evaluations of hearing status in neonates and also in the prognosis of the risk of neurophysiological disorders including Autism. As many medical centers regularly perform ABR test for every neonate at the risk of hearing impairment, it is important to conduct further researches on this test to determine the risk of Autism.

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Conflict of interest

The authors declared no conflicts of interest.

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