Auditory brainstem evoked response in autistic children in central Saudi Arabia

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Autism is a behaviorally diagnosed disorder with onset prior to 36 months. It is a syndrome characterized by impairment in social related communication, failure to develop verbal communicative skills, repetitive behavior, abnormal movements and sensory dysfunction.[1] Several reports have proposed brainstem or midbrain dysfunction as the underlying pathology in autistics.[1] The presence of vestibular nystagmus, visual vestibular interaction, and eye movement during the rapid eye movement stage of sleep, are suggestive of the existence of brainstem dysfunction.[2] Language communication is markedly impaired in autism. Moreover, abnormal behavior responses to auditory stimuli have often been reported in autism, suggesting abnormal auditory processing.[2] Several attempts to clarify these abnormalities using auditory evoked potentials (AEPs) were carried out. Although brain stem abnormalities are higher in autistic compared to normal children, they are not a necessary condition for autistics, since most autistic children display normal brainstem AEPs.[3] Furthermore, difficulty in filtering relevant auditory information in background noise is one feature of autism. Others demonstrated an intact sensory sound processing, including pitch discrimination. In addition, their attention orienting to sound changes was impaired. Accordingly, they can perceive but do not attend.[4] Due to the contradictory results of brainstem auditory potentials (ABR) on autistics in the literature, the aim of the current study was to investigate brainstem auditory function through the measurement of ABR on autistic children in Saudi Arabia.

The study was conducted at the Department of Physiology, King Saud University, Riyadh, Kingdom of Saudi Arabia between September 2005 and April 2006. Twenty-two children, age up to 10 years old, with confirmed professional diagnoses of autism participated in the study. The diagnosis was carried out either by a qualified psychologist, psychiatrist, or neurologist, according to diagnostic criteria DSM-IV. An informed consent was obtained from each subject's guardian, after approval of the experimental protocol by a local human ethics committee, in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration. Healthy age and gender matched control volunteers were recruited from King Khaled University Hospital. Children with metabolic or chromosomal disease, history of substantial neurological disorders or seizures, abnormal EEG with either slow waves or epileptiform discharges were excluded. All children were free of psychotropic medication for at least one month before the electrophysiological study.

The ABR was carried out under sedation (chlorohydrate 50 mg/kg body weight), using manoaural click stimuli with vertex, earlobe electrode placement. An evoked response audiometry was carried with click stimulus at 20, 40, 60, 80 dbs. The potentials were averaged using clinical average (Nicolet). Hearing threshold was determined by using Nicolet desktop and portable evoked potentials system. This test was used to evaluate the peripheral component of the auditory pathway. In short, latency ascending fine waves were recorded, absolute latency and interpeak latencies were measured, prolongation of interpeak latencies I-III or III=V are a determinant of brainstem involvement.

Results were analyzed using SPSS for windows. Results were expressed as mean ± SD. Statistical analyses for differences among the groups were first assessed by ANOVA test, followed by Student's t-test. *P* values equal to or less than 0.05 were considered significant.

Twenty-two autistic subjects participated in the ABR study. The hearing threshold for normal children and autistic was 20 dB. In all autistic subjects, waves I–V were within normal range, and the interpeak latencies were within normal, as compared to normal subjects (**Table 1**). No interpeak latency abnormalities were recorded, and the latencies of peak I, III, and V were within the average range in both cases.

The present study aimed to determine whether autistic children have difficulty in processing auditory sensory signals. No differences were recorded in the ABR study of autistic children compared to normal children. The ABR is often the only test that gives us some indication of the hearing status of these children, due to their lack of cooperation, attention deficit, and cognitive dysfunction. This is the case for all autistic children presented in this study, from which it was not possible to obtain information by behavioral hearing tests. The ABR studies were carried out under sedation,

Table 1 - Auditory evoked potentials study in autistics as compared to controls (values are mean ± standard deviation).

Latencies (milliseconds)	Autistic	Control
Wave I	1.52 ± 0.07	1.52 ± 0.06
Wave II	2.68 ± 0.1	2.56 ± 0.09
Wave III	3.42 ± 0.1	3.92 ± 0.1
Wave IV	4.24 ± 0.3	5.00 ± 0.1
Wave V	5.46 ± 0.5	5.7 ± 0.2
Interpeak latencies I-III	1.85 ± 0.42	2.2 ± 0.60
Interpeak latencies I-IV	3.88 ± 0.41	4.3 ± 0.70

so as to avoid the interference of excessive muscle activity during the test, and we could thereby hope to achieve more exact measurements in regard to the stability of the response. No interpeak latency abnormalities were recorded, and the latencies of peak I, III, and V were within the average range in both cases. In ABR, peak I reflects activity of the distal portion of the cochlear nerve. Of the 5-7 waves constituting the ABR, waves I, III, and V can be obtained consistently, whereas waves II and IV appear inconsistently between and within subjects.[5] With the child's development, there are changes in the response morphology wave amplitudes, and wave latencies of the ABR. Very early in life, only waves I, III, and V are evident, with wave I having a much greater amplitude than that of V. Over time the relationship changes, with wave V becoming much more prominent than the other waves in the first year of life.[5]

Results from the current study are different from all ABR studies performed on autistics in the literature. In children with autistic disorders, the prevalence of sensory neural hearing loss is not well established, with values ranging from 3-44%.[6] In the ABR studies available in the literature the results are also contradictory, involving prolongation, shortening and no abnormalities (similar to results we reached in our study).[6] In central transmission latencies, prolonged I-III and I-V intervals,[6] and other unspecific abnormalities may suggest a brainstem involvement in autism. This suspected brainstem dysfunction, affecting the processing of the sensorial potential through the auditory pathways, may be part of a generalized process of neurological dysfunction that accounts for the unusual social, cognitive, and language development, which are part of autistic behavior. Despite the fact that results from the current study demonstrated no differences in the ABR among autistic compared to controls, these findings do not rule out the presence of any differences among autistics, as demonstrated by other scientists. The reason for this might be due to sample collection of autistics included in this study.

Auditory brainstem evoked response is currently the best available method of audiological assessment in children for whom information on behavioral tests is either unobtainable or unreliable, such as children who have a delay in development, or who are hyperactive or autistic.[7] One reason for using the ABR study on autistics, is the fact that communication development abnormalities that are present in sensorineural hearing loss may be confused with autistic behavior and vice versa. Thus, we must stress the importance of ABR testing in these children, related with the other audiological tests and integrated into a complete and exhaustive clinical examination.[7]

Despite the fact that no abnormalities were found in the autistic children examined, this does not rule out the presence of brainstem dysfunction. Proper referral and specialized early intervention may improve the prognosis of autism, as well as offer better support to the child's family. Disturbances in the processing of auditory afferencies in autistics, have been repeatedly reported by several authors in the past 20 years. Otoacoustic emissions on evaluating active cochlear mechanisms, may play an important role in the workup of these children, namely in regard to their auditory sensitivity. One of the major limitations for the current study is the small number of autistic children enrolled. Another study with larger numbers is strongly recommended to gain better knowledge and understanding of autistic children's hearing and behavior patterns.

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