

# The Rate of Consistency between Auditory Brainstem Response and Gilliam Autism Rating Scale among Autistic Children

## Abstract

**Objective:** to use the ABR as a predictive tool for assessment of ASD and to correlate the ABR results with GARS.

**Methods:** the research was done on 44 children with DLD 24 of them diagnosed clinically as ASD. ABR was done to all participants, while those diagnosed as ASD subjected to GARS evaluation.

**Results:** There was a highly statistically significant difference in absolute latency of wave I, inter-peak latencies of wave I-III and I-V between ASD and control groups. In addition to a strong negative correlation between absolute latency of ABR wave I and GARS in ASD group.

**Conclusion:** The ABR used during hearing assessment of the suspected ASD as a predictor tool prior to further assessment of those children.

**Keywords:** ASD; ABR; GARS; Autism scale; Autistic children

## Clinical Paper

Volume 8 Issue 2 - 2017

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**Received:** June 14, 2017 | **Published:** August 07, 2017

**Abbreviations:** ASD: Autism Spectrum Disorder; DSM-V: Diagnostic and Statistical Manual of Mental Disorders V; ABR: Auditory Evoked Brainstem Response; GARS: Gilliam Autism Rating Scale; DLD: Delayed Language Development

## Introduction

Autism Spectrum Disorder (ASD) constitute a single continuum of neurodevelopmental disabilities with multifactorial etiology and significant individual variability according to the recently published Diagnostic and statistical Manual of Mental Disorders V (DSM-V) [1]. ASD is characterized by a rising prevalence, currently amounting to 11/1000 [2] but expected to slightly decrease due to DSM-V changes in the diagnostic criteria. The latter changes mainly include rearrangement of criteria into two, instead of three areas (social communication/ interaction and restricted, repetitive behaviors), merging of all previous sub-diagnosis under the same spectrum, and inclusion of sensory abnormalities among the symptoms related to the second criterion (restricted, repetitive behaviors) [3]. Several sensory modalities that produce auditory, visual, touch, and oral symptoms in more than three-quarters of preschool children with autism [4]. A disruption of sensory modulation with both under and over-reactivity to sound has given rise to a series of auditory perception and processing studies. Abnormal behavioral responses to auditory stimuli are frequently reported in individuals diagnosed with autism [5].

Auditory Evoked Brainstem Response (ABR) is an electrophysiological measure that assesses the integrity of the auditory pathway from auditory nerve to brainstem [6]. This test is useful to investigate infants and children with neurological and

psychiatric disorders [7,8] which are difficult to be assessed by conventional audiological tests, because they are objective and do not require active participation of the patient [9]. Some studies using ABR to assess children with ASD observed changes on conduction time of the stimulus, with elongated neural responses, which indicates neuro-developmental abnormalities in the brain of these individual [10,11].

Gilliam Autism Rating Scale (GARS) is a scale that was designed to assess individuals, ages 3 to 22 years, for autism. Parents, teachers, and other professionals complete it. The GARS consists of 56 items divided into four scales: (a) Stereotyped Behaviors, (b) Communication, (c) Social Interaction, and (d) Developmental Disturbances [12].

## Aim of the work

To analyze ABR results in group of children with autism and age matched controls. To correlate the ABR results with psychological assessment of these children using GARS.

## Materials and Methods

### Subjects

The present study was consisted of two groups:

**Study group:** It included 24 children. They had Delayed Language Development (DLD) with different autistic features reported by their parents, presented to Audiology and Phoniatic unit. They were 21 males and 3 females. Their ages ranged between 36-60 months. Any child with middle ear effusion, mental retardation or hearing loss was excluded from the study.

**Control group:** It was selected to be age and gender matched with the study group. This group included 20 children, 16 males and 4 females, their ages ranged between 36-60 months without any psychiatric, medical disorders or hearing loss.

## Methods

This study was conducted in Phoniatic unit, Audiology unit and Psychiatric department.

Each subject in the two groups was subjected to the following:

- i. Written consent was taken from the parents of all participants. The study was approved by Ethics Committee of Medical University
- ii. Patient interview: pre-peri and postnatal history and developmental history. Family histories of consanguinity, hearing loss or delayed language development (DLD) were taken from the parents.
- iii. Language evaluation (eye contact, response to examiner, eye head co-ordination), assessment of passive and active vocabulary.
- iv. Audiological evaluation for threshold determination through behavioral audiometry using free field test and play audiometry using pure tone audiometry, Madsen Orbiter 922, Immittance; tympanometry and acoustic reflex using Maico, MI44.
- v. Auditory brain stem evoked potential: The ABR was carried out under sedation (chloral hydrate 50 mg/kg body weight). ABR was recorded using Evoked potentials system SMART intelligent hearing system.

Their responses captured with the electrodes positioned as followed: the active electrode located in the midline on the forehead (Fz), the inverting electrode on the mastoid of the stimulus side, right (A1) and left (A2) and, ground electrode on the forehead (Fpz). Insert earphones presented the stimulus and their parameters were: click type, rarefaction polarity, rate of 21.1 clicks/sec., replications of 1000-2000 clicks with duplication response. The high pass filter was 30 Hz and the low pass filter was 3000 Hz, amplification of 50.000 and analysis time of 15 ms. the normative data used 90 dB nHL for absolute latency was 1.6: 1.8 ms for wave I, 3.6: 3.8 ms for wave III and 5.6: 5.8ms for wave V. The inter-peak latency value was 2 ms for I -III, III - V interval and 4ms for I-V interval.

**Psychological evaluation:** was done using Gilliam Autism Rating Scale (GARS). The GARS was designed to assess individuals, ages 3 to 22 years, for autism. Parents, teachers, and other professionals complete it. The GARS consists of 56 items divided into four scales: (a) Stereotyped Behaviors, (b) Communication, (c) Social Interaction, and (d) Developmental Disturbances. Each scale is comprised of 14 items that are said to be indicative of autistic disorder. Respondents rate the frequency of each behavior on a 4-point scale: (a) never observed, (b) seldom observed, (c) sometimes observed, and (d) frequently observed. Each scale raw score is converted into a standard score (M = 10, SD = 3). The scale standard scores are summed and converted into an Autism

Quotient (M = 100, SD = 15). The Autism Quotient is intended to determine the likelihood that a subject has an autistic disorder. It is also used to estimate the severity of the disorder [12].

## Results

The present study was conducted on 24 children with ASD and 20 normal children.

### ABR results

A statistically significant difference between absolute latency of wave I and inter-peak latency of wave I-III, I-V in study and control groups.

The score of GARS test in the current study was 50 % of autistic children had high degree, 33.33 % above moderate and 16.67 % with moderate degree.

### GARS results

GARS results in ASD showing that the mean was 123.33 and SD was 7.61. There is a strong negative correlation between ABR waves I latency and GARS test.

## Discussion

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 [8]. 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.

Although ABR results abnormalities have been repeatedly reported in patients with ASD, no single ABR pattern has yet to be identified. Many researchers reported abnormalities include significant prolongation/shortening of some or all absolute [11] and or interpeak latencies [8]; whereas, rarely, investigators have reported no significant alteration at all [13].

In our study all ABR waves were obtained in all cases and controls with clear morphology. ABR hearing threshold for the cases and controls was 30 dB nHL which are within the normal range for hearing thresholds. In comparison, Rosenhall et al. [14] noted that 18% of subjects with ASD presented normal auditory thresholds and auditory hypersensitivity with intolerance to clicks above 70 dB nHL, when submitted to brainstem audiometry. Gomes et al. [15] stated that adverse reactions to sound in individuals with ASD may not reflect a physiological difference in the auditory system, but rather a psycho-emotional-behavioral difference: a fear of sound stimuli, accompanied by hyper-reactive avoidance behaviors.

Abnormal behavioral responses to sound in the ASD have been assumed to reflect a deficit in the auditory processing abilities. This were due to an overall hyper-responsiveness in ASD children that resulted in hypersensitivity to sound, sensory defensiveness to tactile stimulation, sensory modulation dysfunction, aversion, and/or lack of habituation to sensory stimuli [16].

An interesting finding in our study, in all our patients, there was a significant earlier autistic children ABR wave I than the controls. This agree with study done by Dabbous et al. [17] which done on autistic children to show the ABR latencies in those children. This finding indicates quicker synaptic processes in the organ of Corti.

The latency of waves III and V were within the average range. This agree with Ververi et al. [18] in their study on ABR in ASD cases, they found that the absolute latencies of peaks I, III and V were within the average range in both cases and no inter-peak latency abnormalities. They stated that these findings in the ABR could not be related to the unusual responses to auditory stimuli, which are often typical of children with autistic disorder [17]. However, other studies found an increase in absolute latencies of wave V and inter-peak I-V and III - V in those with autism compared to controls. They explained this results as children with ASD have a dysfunction or immaturity of the central auditory nervous system [6,13,19,20].

Roth et al. [11] found that all absolute latencies and IPLs were significantly prolonged in the group with suspected ASD compared with the group with language delay, excluding IPL III-V, and compared with clinical norms. Significant prolongation of absolute and IPLs was also evident in the group with language delay compared with clinical norms, excluding IPL III-V and they reported that this provided first-time evidence for a neuro-developmental brainstem abnormality that is already apparent in young children with suspected ASD and language delay. They added that the overlap in ABR findings supports the assertion that an auditory processing deficit may be at the core of these two disorders [11].

It is known that individuals with autism have difficulty in processing the auditory information at the cortical level but this is not consistently seen subcortically [21].

The result of GARS test in the current study was 50 % of autistic children had high degree, 33.33 % above moderate and 16.67 % with moderate degree. Aiming to find out the relationship between ABR results and degree of GARS test, correlation test was done and we found there was a strong negative correlation between ABR latency of wave I and GARS test which means that shorter latency of wave I ABR is associated with the higher degree of GARS.

## Conclusion

The ABR can be used during hearing assessment of the suspected ASD as a predictor tool prior to further assessment of those children.

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