AUDIOLOGIC AND ELECTROPHYSIOLOGIC EVALUATION IN THE AUTISTIC SPECTRUM DISORDER

Avaliação audiológica comportamental e eletrofisiológica notranstorno do espectro do autismo

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ABSTRACT

Purpose: to describe the audiological and electrophysiological findings of a group of patients with autistic spectrum disorder. **Methods:** this is a cross-sectional descriptive study. Nine patients with autistic spectrum disorder participated in these study and it was performed the audiological and electrophysiological evaluation. Results were expressed as descriptive statistics. **Results:** all patients presented audiometric threshold within normal standards. Eight patients had type A tympanogram and one had type C. It was observed the presence of distortion product otoacoustic emission responses in all patients. The results of brainstem auditory evoked responses indicated the integrity of auditory pathways. **Conclusion:** the population studied showed results consistent with normality in behavioral and electrophysiological assessment of hearing. Because there is no consensus, in specialty literature, regarding the audiological findings in this population, particularly with regard to electrophysiological assessment of auditory processing, we would like to suggest the performance of new studies.

KEYWORDS: Hearing; Evoked Potentials, Auditory; Electrophysiology; Autistic Disorder

INTRODUCTION

The literature emphasizes that change in communication is a key element in clinical profile of individuals with autism spectrum disorders (ASD) characterized by a triad of severe and chronic impairments in the areas of social interaction, verbal and nonverbal communication and restricted interests [1-5].

In the literature there is controversy about communication skills in patients autism spectrum and how the hearing handicap can be related to the problems.Despite parents and educators observe atypical and adverse responses to sounds, these hearing behaviors have not been quantified. Patients enrolled in ASD often present different sensory domains that can manifest as hyposen-sitivity or hypersensitivity to sounds, however the visual- spatial processing appears to be relatively preserved[6,7].

The differential diagnosis and appropriate intervention of this population are conducted using subjective and objective procedures to assess hearing.The behavioral assessment is a subjective procedure, i.e., depends on the subject's responses it may be impaired due to interaction problems of this population,which may generate unreliable responses[8]. In order to reduce this variability the association of behavioral and electrophysiological measures in assessment of children with ASD

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provide an accurate diagnosis and a more effective intervention[9].

The pure tone audiometry is used in the assessment of peripheral hearing in patients who respond reliably and this associated to the objective assessment can complement and ensure the reliability of the assessment´s results of patients with social interactions problems, perceptual disorders, attention and memory that can be mistaken for hearing loss [8-10].

Among physiological and objective measures of hearing assessment, the acoustic impedance provided information about mobility of the tympanic ossicular system and integrity of auditory pathway at this level[11], while distortion product otoacoustic emissions (DPOAEs) assess cochlear function from basal to apical spiral and exhibit great sensitivity to detect damage to outer hair cells[12].

Evoked Auditory Brainstem Response (ABR) is an electrophysiological measure that assesses the integrity of the auditory pathway from auditory nerve to brainstem[13].This test is useful to investigate infants and children with neurological and psychiatric disorders, especially children with ASD [14-16],which are difficult to be assessed by conventional audiological tests, because they are objective and do not require active participation of the patient [13-17].

Some studies using ABR to assess children with ASD observed changes on conduction time of the stimulus, with elongated neural responses, which indicatesneurodevelopmental abnormalities in the brain of these individual[16,18-20].

Considering this the aim of this study was to describe the findings of behavioral and electrophysiological hearing assessment of patients with ASD.

METHODS

The Ethics and ResearchCommittee of Faculty of Sciences and Philosophy - UNESP - Marilia, approved this study, protocol no. º 486-2012. The responsible for the participants received information about the methodological procedures and signed the consent form.

The design of this study is descriptive, cross-sectional and contemporary cohort.

This study was conducted in a clinic of a public university in the state of São Paulo and the sample consisted of nine male patients, whose ages ranged from four to 27 years (median = 8 years), who attended speech therapy to children´s language in this institution, diagnosed with ASD.

Individuals with ASD had their diagnoses established by specialized professionals, for a better categorization of the sample was used the Autistic Trait Assessment Scale –ATAS[21]. The instrument consists of 23 subscales and each scale divided into different items. Its construction was carried out considering the diagnostic criteria of DSM - III, DSM - III -R and ICD - 10and,on theauthors standardization were alsoused the corrections derived from the criteria publications of the DSM - IV . The ATA is a tool of easy application by an expert professional, not necessarily a doctor; this professional is responsible for the evaluation of responses, depending on every item[21]. It is not a diagnostic interview, but a standardized test that gives the profile of the behavior of children, and also assists the development of a more reliable diagnosis.

The scale score is based on the following criteria: each subscale has a value of 0 to 2; zero if there is no item, 1 if there is only one item and 2 if more than one item, then it is made the sum of the points obtained. The cutoff is twenty-three[21].

The inclusion criteria was patients with ASD treated at the clinic. The exclusion criteria were the presence of other impairments diagnosed by a specialized team (psychiatrist and neurologist, speech therapists and psychologists) and risk factors for hearing handicap.

All guardians answered the audiological history. The first procedure was otoscopic inspection made in order to rule out the presence of any structural anomalies and / or obstruction of the external auditory canal that could prevent the audiological testing.

The audiologic assessment consisted of the following: pure tone audiometry, tympanometry, distortion product otoacoustic emissions and auditory brainstem response (ABR). Individuals were characterized using a data sheet and Autistic Traits Assessment Scale (ATAS) (Table 1).

Table 1 - Children with autistic spectrum disorders characteristics

Subjects protocol	Age (years)	Gender	Medical Diagnosis	ATA
1	9	male	Autism	29
2	7	male	Autism	31
3	12	male	ASD	27
4	27	male	ASD	23
5	8	male	ASD	30
6	4	male	Autism	29
7	5	male	Autism	32
8	8	male	Autism	30
9	5	male	ASD	37

Legend: ASD–Autistic Spectrum Disorder / ATA - Autistic Traits Assessment

The pure tone audiometry performed in a sound booth with the audiometer GSI -61 (GrasonStandler), phones TDH - 50. Hearing thresholds were obtained by air conduction on the frequencies from 500 to 4000 Hz.Audiograms were classified according to the individuals ‘age, less than seven years the classification proposed by Northern and Downs[22] and, or older ones, Lloyd and Kaplan[23] .

Acoustic immitance and reflex performed with the GSI -38 (GrasonStandler) with 226 Hz probe. The tympanogram results classified according to Jerger[24]. The acoustic reflex, ipsilateral mode, were classified as present, absent or abnormal[24,25] .

To assess cochlear function, specifically the outer hair cells, was used distortion product otoacoustic emissions. The equipment was Eclipse EP-25 (Interacoustics) coupled to a computer. Distortion product otoacoustic emissions (DPOAE) are elicited by simultaneously presenting two stimulus tones with different frequencies (F1 and F2) on two intensity levels (L1 and L2).The intensity of the stimulus used was 65 dB for F1 and 55 dB to F2. It was analyzed the responses of frequency bands 750-8000 Hz, the probe stability was 70%. The criterion for the presence of response based on the finding of the amplitude, ie, signal / noise ratio equal to or greater than 6 dB SPL.

Auditory brainstem response was recorded using Eclipse EP-25 (Interacoustics) and there sponses captured with the electrodes positioned as followed: the noninverted electrode located in the midline on the forehead (the Fz site), and with the inverting electrode on the ear lobe of the stimulus side, right (A1) and left (A2) and, ground electrode on the forehead (Fpz). Insert earphones (3A) presented the stimulus and their parameters were: click type, rarefaction polarity, rate of 19, 9 clicks/sec, replications of 1000-2000 clicks with duplication response. The high pass filter was 30 Hz and the low pass filter of 3000 Hz, amplification of 50.000 and analysis time of 15 ms. The normative data used at 80 dB for absolute latency was 1.65ms for wave I, 3.76 ms for wave III and 5.61ms for wave V. The interwave latency value adopted was 2.1 ms for I –III interval, 1.86 ms for III - V interval and 3.94 ms for I-Vinterval. In children above three years of age, Hall (2006) recommended two standard deviations above and below the mean value plus a correction related to chronological age.

The results were analyzed using descriptive statistics.

RESULTS

Nine patients performed pure tone audiometry, from 500 to 4.000 Hz, and the thresholds were within normal limits,in most cases the thresholds were less than 15 dB (Table 2). The adaptation of the procedure was due the children´s age and behavior; sometimes they got tired or refused to continue the test.

Eight patients presented bilateral type Atympanograms indicating normal mobility of the tympanic- ossicular system, and one patient had bilateral type C tympanograms indicating negative middle ear pressure. The ipsilateral acoustic reflex described in Table 3.

Table 2 – Descriptive analysis of thresholds (in dB) obtained by Pure Tone Audiometry (n = 9)

	500	1000	2000	4000
RE				
Minimum Threshold	5	5	0	0
Maximum Threshold	20	15	15	15
Mean	11,11	8,88	8,88	7,22
Standard deviation	± 4,86	± 4,17	± 4,86	± 6,18
LE				
Minimum Threshold	5	5	0	5
Maximum Threshold	20	15	15	20
Mean	11,11	9,44	8,88	10,00
Standard deviation	± 4,86	± 4,64	± 5,46	± 5,00

Legend: RE – right ear / LE – left ear

Table 3 – Descriptive statistics of right and left ear ipsilateral acoustic reflex, minimum thresholds (dB), of patients with ASD (n = 9)

Ear	Frequency (Hz)	Valid Measures	Absent Responses	Mean	Minimum	Maximum
Right	500	5	4	100,00	100,00	100,00
	1000	6	3	98,75	95,00	105,00
	2000	6	3	97,50	85,00	105,00
	4000	6	3	95,00	80,00	100,00
Left	500	4	5	93,12	90,00	105,00
	1000	5	4	101,00	95,00	105,00
	2000	6	3	100,00	95,00	105,00
	4000	5	4	91,25	80,00	100,00

Distortion product otoacoustic emissions (DPOAEs) elicited on eight individuals, one of them did not allow the insertion of the probe. The signal / noise ratio of all individuals was equal to or greater than 6dB, the highest values observed was at high frequencies, the maximum values were 35 dB for the left ear and 39 dB for the right ear (Table 4).

All individuals did ABR and Table 5 shows the results.

Table 4 – Descriptive statistics of distortion product otoacoustic emissions, right and left ear, considering signal / noise ratio (dB SPL)

Ear	Frequency (Hz)	Valid Measures	M ± SD	Minimum	Maximum
Right	750	6	8,33 ± 1,37	7	11
	1000	7	10,28 ± 5,41	6	21
	2000	8	15,37 ± 6,25	9	25
	3000	8	17,12 ± 5,67	8	26
	4000	7	15,85 ± 5,49	10	25
	6000	8	21,75 ± 6,78	14	32
	8000	8	20,37 ± 8,72	12	39
Left	750	6	7,40±1,94	6	10
	1000	7	8,42±2,07	6	12
	2000	8	15,12±6,15	6	25
	3000	8	16,25±6,25	7	23
	4000	7	17,50±6,30	10	27
	6000	8	22,37±5,23	17	33
	8000	8	22,50±7,36	13	35

Legend: M– Mean / SD – Standard Deviation

Table 5 – Descriptive statistics of Auditory brainstem responses considering wave latency

Ear		Absolute and Interwave Latency (ms)		
		M ± SD	Minimum (ms)	Maximum (ms)
Right	Wave I	1,34 ± 0,18	1,20	1,77
	Wave III	3,56 ± 0,13	3,43	3,83
	Wave V	5,54 ± 0,21	5,30	5,90
	Interwave I-III	2,21±0,08	2,07	2,33
	Interwave III-V	1,97±0,22	1,77	2,47
	Interwave I-V	4,19±0,21	3,97	4,67
Left	Wave I	1,36 ± 0,15	1,20	1,63
	Wave III	3,56 ± 0,16	3,27	3,77
	Wave V	5,54 ± 0,18	5,27	5,87
	Interwave I-III	2,20±0,09	2,00	2,33
	Interwave III-V	1,97±0,21	1,70	2,27
	Interwave I-V	4,18±0,22	3,90	4,60

Legend: ms – milliseconds / M – Mean / SD- Standard Deviation

DISCUSSION

There is no consensus among the results of studies on peripheral hearing on ASD children; most of these individuals presents irritability or inattention to sound.Comparative studies of hearing among children with ASD and typical development, using behavioral procedures, found normal auditory function with no significant difference between the two groups studied in all tests[26,27], which corroborates the results of this study.

In this study, no significant abnormality was observedat pure tone audiometry, in all individuals were only assessed frequencies between 500 and 4000Hz due to behavior and reduced attention span of the individuals[28,29], which generally prevents the search across the frequency range.

The acoustic immitance assessment showed results consistent of normal pattern that suggests absence of peripheral auditory disorders in individuals of the autism spectrum, which corroborates the findings of Gomes, Pedroso and Wagner[7], Coutinhoet al.[28] and Alcântara et al.[30]. One of the individuals presented abnormal tympanograms, this situation was corroborated by studies of Magliaro[29] and Rosenhall et al.[15] that identified approximately 20 % of conductive problems.

The DPOAEs results were within normal limits with average response level from 8.33 dB to 21.75 dB for the right ear and,from 7.40 dB to 22.40 dB for the left ear, the responses were significantly larger at high frequencies due to lower noise interference [26,27].

The findings of this study showed results that are consistent to normal hearing on both, behavioral andelectrophysiological assessment.

Although one of Magliaro[29] study pointed that despite cognitive impairment is not significant in ASD patients, the difficulty of attention, understanding, social interaction and communication, affect the quality of sound response that requires from the evaluator great perspicacity and experience in conducting assessment, and more time available to perform the evaluation.

Electrophysiological assessment of hearing in children with TEA has oneadvantage; the child does not need to give an answerand it is important to determine the peripheral auditory characteristics of children with autistic spectrum[26].

Several studies[31-34] have investigated the changes in language skills of these children, they emphasizes that abnormal language decoding is an important fact in this population[31].

These changes observed in children with ASD can be investigated by objective electrophysiological methods that sometimes are altered due to behavioral abnormalities related to the localization, lateralization, auditory discrimination and auditory pattern recognition, and Central Auditory Processing Disorder (CAPD) [35].

The CAPD may be related to neuropsychiatric disorders such as ASD whereas the auditory function has clinical and neurophysiological similarities with that disorder[36]. Thus, auditory skills and hearing status of these childrenand the search for objective evidence of abnormal auditory processing in ASD, has been investigated by Evoked Auditory Brainstem Response (ABR)[18].

Wong and Wong[16] used the ABR and observed that children with TEA had a significantly longer transmission time on brainstem when compared to children with typical development.

However, the literature reports contradictory results on the ABR of ASD children, involving prolongations, shortenings and absence of abnormalities in neurotransmission of auditory information[10,27].

In this study, normal results were observed for latency and interweaves intervals considering age groups, that indicates integrity of the auditory pathways, these findings corroborate the results reported by Russo et al.[3], Coutinho et al.[28] and Courchesne et al.[37] who also performed the ABR in two autistic children, and obtained normal absolute latencies of waves I, III and V and normal interwave intervals.

Tharpe et al.[27] studied the auditory characteristics of autistic children, and observed no difference between them and the control group in behavioral audiometry, acoustic reflexes, otoacoustic emissions and auditory brainstem, that are in accordance with the findings of this study and emphasizes the importance of hearing assessment and accurate diagnosis in this population.

CONCLUSION

The findings of this study shows consistent results of normal hearing for both procedures, behavioral and electrophysiological, and describes key aspects to enable the understanding of clinical manifestations of this population, especially those related to hearing loss complaints that result in inadequate / erroneous hearing aids indication.

It suggests the need for further studies in order to establish audiological profile of individuals with ASD by providing elements to help investigation, development of preventive behaviors and speech therapy intervention.

RESUMO

Objetivo: descrever os achados das avaliações audiológicas comportamentais e eletrofisiológicas de pacientes com diagnóstico de transtorno do espectro do autismo. **Métodos**: estudo descritivo, de coorte contemporânea com corte transversal, composto por nove pacientes com diagnóstico de transtorno do espectro do autismo, submetidos a avaliação comportamental e eletrofisiológica da audição. Os resultados foram analisados por meio de estatística descritiva. **Resultados**: todos os pacientes avaliados apresentaram limiares audiométricos dentro dos padrões de normalidade. Oito pacientes apresentaram curva timpanométrica do tipo A, e um do tipo C. Observou-se emissões otoacústicas por produto de distorção presentes em todos os pacientes avaliados. Os resultados do potencial evocado auditivo de tronco encefálico demonstraram integridade das vias auditiva. **Conclusão**: a população estudada apresentou resultados compatíveis com a normalidade tanto na avaliação comportamental como na avaliação eletrofisiológica da audição. Pelo fato de não haver consenso, na literatura especializada, quanto aos achados audiológicos nesta população, principalmente no que se refere à avaliação eletrofisiológica do processamento auditivo, sugere-se a realização de novos estudos.

DESCRITORES: Audição; Potenciais Evocados Auditivos; Eletrofisiologia; Transtorno Autístico

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