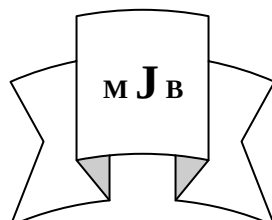


Eelectrophysiological Assessment for Children with Sensory Neural Hearing Impairment

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Abstract

Background : Hearing impairment refers to a lessening of hearing ability in the widest possible sense, ranging from subjectively barely appreciable impairments to total deafness. An identification or assessment method is broadly defined as any test, measure, or procedure that can be used to identify possible hearing impairment or assess the hearing status of infants and young children. Auditory brain stem response are the most widely used physiological measures for neuro-otological evaluation.

The aim : The aims of this study are to assess children with sensory neural hearing impairment and to explore the importance and the benefits of auditory brain stem response (ABR) in diagnosis of children with hearing impairment in Iraq.

Materials and methods : One hundred and ten Iraqi children with sensory neural hearing impairment (53 male and 57 female) , and sixty normal hearing children (29 male and 31 female) are involve in this study. The children between 1- 12 years age old .All children did auditory brain stem response .

Results: Regarding the hearing threshold of left and right ears stimulation and the difference of hearing impairment degree between right & left ear of the children measured by ABR test the percentages of patients with severe degree of their hearing disability as it was measured by ABR test, with highest value in severe degree (54 patients , 49.1%) and lowest value in borderline and profound degree (2 patients , 1.8%).

Conclusions: ABR , is the main use in the assessment of hearing level in children with no age limitation or mentality state of patients, and in the determination of hearing threshold in children.

Keywords: ABR; Auditory brainstem response, HI ;Hearing impairment , HL; Hearing level (dB) decibel

تقييم الكهروفسلجية لخلل السمع العصبي الحسي عند الاطفال

الخلاصة

الخلفية العلمية : الخلل السمعي يشير الى ضعف في قابلية حاسة السمع بأوسع مدى ممكن .حيث يتراوح من فقدان السمع الخفيف جدا الى فقدان السمع التام .

ان طرق اكتشاف وتقييم الخلل السمعي متعددة وواسعة ولكن اشارة جذع الدماغ السمعي (ABR) الاوسع انتشارا لتقييم الحالة العصبية الفسلجية لعصب السمع.

الهدف : ان الهدف من هذه الدراسة هو لتقييم الأطفال المصابين بخلل السمع الحسي العصبي واستكشاف اهمية وفوائد اشارة جذع الدماغ السمعي في تشخيص مرضى الخلل السمعي في العراق .

الطريقة : تضمنت الدراسة مئة وعشر طفل مصاب بخلل السمع العصبي (٥٣ ذكر و٥٧ انثى) وستون طفل غير مصاب بخلل السمع (٢٩ ذكر و٣١ انثى) وكانت اعمارهم تتراوح بين السنة و الثانية عشر من العمر . جميع الاطفال المختارين خضعوا لفحص جذع الدماغ .

النتيجة : اظهرت نتائج جهاز قياس استجابة اشارة جذع الدماغ السمعي نسبة عالية من اطفال منطقة الفرات الاوسط في العراق ٥٤ طفل بنسبة ٤٩,١% مصابين بدرجة خطرة من خلل السمع الحسي العصبي وأقل نسبة هي فقدان السمع التام ٢ طفل يمثلون ١,٨%.

الاستنتاج: يعتبر جهاز فحص اشارة جذع الدماغ السمعي هو الاداة الاساسية والمناسبة للاستعمال في تقييم وفحص مرضى خلل السمع بدون التقييد بالعمر والحالة العقلية والعامة عند الاطفال.

Introduction

Hearing impairment (HI) is a diminished ability to detect, recognize, discriminate, perceive, and /or comprehend auditory information. Because the ability to hear sounds is crucial for the typical development of spoken language, a HI is classified as a communication disorder [1]. According to the world health organization (WHO , 2007), HI is one of the six leading contributors to the global burden of disease [2]. However, medical professionals learn little about HI, about how to advise parents of children who are deaf or impair of hearing, or about the special considerations needed in the care of children with HI [3].

Hearing impairment (HI) is more prevalent than diabetic mellitus, myelomeningocele, all pediatric cancers, and numerous other medical conditions [4].

One of every 1000 babies born in the United States is completely deaf [5]. The incidence of congenital HI in United States is estimated to be approximately 1–3/1000 live births [6], while in Oman the incidence were 1.2/1000 live births [7] and in Saudi Arabia the incidence were 1.7/1000 live births [8]. The incidence of bilateral sensory neural hearing impairment (SNHL) described in children 50% is thought to be as genetic factor, 25% acquired, and 25% of unknown etiology [9]. The prevalence of significant bilateral HI is 1-3/1000 newborn well-infant, and 2-4 /100 newborn infants in the intensive care

unit (ICU) [10]. However, HI can be present at any age. The importance of early identification of HI has been recognized years ago [11]. An undiagnosed or delayed diagnosed HI may have serious effects on a child's language, social ,emotional, cognitive , academic, and vocational development, significantly affecting the child's quality of life [12].

Hearing impairment (HI) can result from disorders of the auricle, external auditory canal, middle ear, inner ear, or central auditory pathways. In general, lesions in the auricle, external auditory canal, or middle ear cause conductive hearing impairment (CHI). while SNHI tends to result from lesions in the inner ear or eighth nerve (central auditory pathways) [5].

Auditory brain stem response (ABR) is a neurologic test of auditory brainstem function in response to auditory (click) stimuli. First described by *Jewett and Williston* in 1971, ABR audiometry is the most common application of auditory evoked responses. Test administration and interpretation is typically performed by an audiologist [13]. ABRs provide an objective and noninvasive means for examining[14] This form of testing is not painful, although you may need to be sedated in certain situations.

Materials and Methods

One hundred and ten Iraqi children with sensory neural hearing impairment (patients group) , referred to hearing and speech units in middle

Euphrates provinces hospitals, and sixty normal hearing child (control group), fulfilled the selection criteria. were included in this study which lasted from November 2011 to July 2012. The patients were divided into male and female subgroup 53 male and 57 female ; whereas the control group included 29 male and 31 female. All children between 1- 12 years age old with a mean age 4.7 years .They were assessed by a well-structured questionnaire designed for this study. full detailed and relevant history and physical examination were performed for both patient and control groups , and both groups were sent for audiological assessment according to age of child ,all of patient and control groups did auditory brainstem response.

Auditory brain stem response (ABR) is an auditory evoked potential extracted from ongoing electrical activity in the brain and recorded via electrodes placed on the scalp. ABR audiometry typically uses a click stimulus transmitted from an acoustic transducer in the form of an insert earphone or headphone. The elicited waveform response is measured by surface electrodes typically placed at the vertex of the scalp and ear lobes. The amplitude (microvoltage) of the signal is averaged and charted against the time Millisecond (Ms), much like an Electro Encephalo Graphy (EEG) , that generates a response from the basilar region of the cochlea. The signal travels along the auditory pathway from the cochlear nuclear complex proximally to the inferior colliculus. ABR waves I and II correspond to true action potentials. Later waves may reflect postsynaptic activity in major brainstem auditory centers that concomitantly contribute to waveform peaks and troughs. The positive peaks of the waveforms reflect

combined afferent (and likely efferent) activity from axonal pathways in the auditory brain stem[13]. The resulting recording is a series of vertex positive waves of which I through V are evaluated. These waves, labeled with roman numerals in Jewett and Williston convention, occur in the first 10 Ms after onset of an auditory stimulus. The ABR is considered an exogenous response because it is dependent upon external factors[15;16] .The auditory structures that generate the ABR are believed to be as follows : [15;17].

Wave I – generated by the peripheral portion of cranial nerve VII

Wave II – generated by the central portion of cranial nerve VIII

Wave III – generated by the cochlear nucleus

Wave IV – generated by the superior olivary complex/lateral lemniscus

Wave V – generated by the lateral lemniscus/inferior colliculus

Procedures use: After a child sedated with chloral hydrate (50 mg/kg, administered orally) and made a sleep put him in comfortable place and position and were monitored for oxygen saturation, respiratory rate, and heart rate throughout the procedure by a nurse from the otolaryngology clinic. Testing took place in the audiology clinic., then connect him with electrode and headphones to instrument and start to give stimulation usually started at 70 decibel (db) if there is a response and wave V appear we decrease stimulation 10db until the wave disappears (and this point conceder degree of HI) or reaches 10 db (and this point conceder normal degree of hearing). But if there is no response at 70 db we increase stimulation 10 db until the wave V appears (and this point conceder degree

of HI) or reach 100 db (and this point conceder profound degree for HI).

The level of severity of hearing impairment , as used in New York State Department Of Health (2007) guideline, is defined as follows:

- minus 10 to plus 15 dB hearing level (HL) Normal hearing.
- 16-25 dB HL Borderline hearing impairment .
- 26-40 dB HL Mild hearing impairment .
- 41-55 dB HL Moderate hearing impairment .
- 56-70 dB HL Moderate-Severe hearing impairment.
- 71-90 dB HL Severe hearing impairment.

- >90 dB HL Profound hearing impairment .

Results

Regarding the degree of their hearing disability , table (1) show the percentages of patients with severe degree of their hearing disability as it was measured by ABR test, with highest value in severe degree 54 (49.1%) and lowest value in borderline and profound degree 2 (1.8%) , while table (2) shows the hearing threshold of left and right ears stimulation (db) and the difference of hearing impairment degree between right & left ear of the children measured by ABR test.

Table 1 Distribution of hearing impairment according to Severity

Severity	Frequency	Percentage (%)
Borderline	2	1.8
Mild	12	10.9
Moderate	9	8.2
Mod-severe	31	28.2
Severe	54	49.1
Profound	2	1.8
Total	110	100

Table 2 Distribution of hearing impairment and control by left and Right ears stimulation (dB)

Stimulation (dB)	Frequency of Left Ear	Percentage (%)	Frequency of Right Ear	Percentage (%)	Severity degree
10	60	35.3	60	35.3	Normal
20	1	0.9	1	0.9	Borderline
30	4	3.6	6	5.5	Mild
40	6	5.5	6	5.5	Mild
50	7	6.4	8	7.3	Moderate
60	7	6.4	5	4.5	Mod-sever
70	21	19.1	14	12.7	Mod-sever
80	22	20.0	33	30.0	Sever
90	34	30.9	28	25.5	Sever
100	2	1.8	1	0.9	Prefund
110	6	5.5	8	7.3	Prefund
Total	170	100%	170	100%	

Number of decibel(dB)=10 log Intensity of sound / intensity of standard sound*

Discussion

Hearing plays a key part in learning to talk. Without speech and hearing it is difficult for interpersonal relationships to develop and thrive . The American Joint Committee on Infant Hearing recommends that audiological rehabilitation should begin within the first 6 months of life. The only way of detecting congenital deafness at this age is by neonatal screening Measurement of the (ABR) is considered the most sensitive method of assessing the auditory activity of neonates.

Auditory brain stem response (ABR's) clinical applications can be divided into neurologic and audiology, with the main goal of identifying abnormalities in the auditory nerve and the brain stem, and estimate the electrophysiological auditory threshold, based on the presence of responses to different levels of stimulus intensity [18].

Classification of severity is usually based on the average hearing impairment in the frequency range of normal speech .Thus the hearing impairment is described solely in terms of the absolute threshold of hearing. However, the principal function of hearing is to detect rapid changes of frequency and intensity in acoustic signals above the threshold, and thus to understand speech [19] .

The study of this aspect depends on New York State Department of Health (2007) classification of hearing impairment severity degree and the study conclude a highest value of severe degree as in table (1) and table (2) .

While other studies which use Universal New born Hearing Screening programmes [20;21] have found that the highest percentage of severity in mild

degree. Also, *Christine et al., 2009* and *Marcus et al., 2010* have found highest percentage of HI among moderate degree.

In fact these differences in our result than others research results are due to differences in protocol of sample taking and there is no New born Hearing Screening programme and screening programme for patients with hearing impairment in our country.

The majority of the impairment were bilateral and symmetrical of the children with sensory neural hearing impairment table (2) and this agrees with the other investigators[24,25].

Conclusions

Auditory brain stem response (ABR) is useful in the determination of hearing threshold in children ,it is used in the assessment of hearing level in children with no age limitation or mentally retarded , who are not assessed by any other means.

However, ABR should be performed in all hearing speech units using the most recent guidelines recommended by the Joint Committee on Infant Hearing (JCIH) .

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