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Study of brain stem evoked audiometry in children under 10 years of age: a case series study

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ABSTRACT

Background: Brainstem evoked response audiometry (BERA) is a diagnostic tool which can be used to assess the early hearing loss and planning rehabilitative procedures. It is noninvasive and can be performed in uncooperative children.
Methods: To evaluate the hearing threshold and find the incidence of hearing loss in infants and children under 10 years of age.
Results: Totally, 55 patients under 10 years of age were included in the study. 15 children had normal hearing (27.27%) and 40 (72.72 %) were found to have sensorineural hearing loss. Amongst 40, 19 (47.5%) children were found in the age group of 1-5years. 14 (35%) were found to have profound hearing loss, 15 (37.5%) had severe, 8(20%) had moderate, 3 (7.5%) had mild hearing loss.
Conclusions: Newborn screening is mandatory to identify hearing loss in the prelinguistic period to reduce the burden of handicap in the community. BERA should be carried out as a routine procedure to detect hearing impairment in high risk children and rehabilitative measures should be started as early as possible.

Keywords: BERA, Sensorineural hearing loss, Newborn hearing screening

INTRODUCTION

Hearing problems are common among the children which could be conductive or sensorineural in nature. The prevalence of hearing loss is 0.5–6/1000 neonates across the globe.[1]

Early diagnosis of hearing impairment is important as the rehabilitative procedure can be started early which will help speech and language development.[2] It provides the best choice, maximizing the critical period of hearing and thereby availing the resources to improve hearing and oral communication skills.[3]

Various audiological procedures are used to assess hearing sensitivity in children such as behaviour observation, free field audiometry, visual reinforcement audiometry, play audiometry, etc.[4] but only objective hearing tests provide an accurate assessment of hearing loss.

However, diagnosis of these children at an early stage can be a difficult task even for the experienced clinician. Choosing the appropriate method and instrument in establishing the clinical diagnosis at an early stage is also practically difficult.[5]

Brainstem evoked response audiometry (BERA) is a simple, noninvasive, objective test for early identification of hearing impairment in children and neonates. It can be used as a screening test and is useful in newborns, infants and other difficult to test subjects. BERA testing measures the stimulus evoked electrophysiological response of the eighth cranial nerve and brain stem to

clicks or tone bursts presented to external ear. The response is recorded from the electrodes on the skin. Wave V detection thresholds correlate best with hearing sensitivity.

In this study, threshold estimation was done using BERA in infants and children under 10 years of age to detect hearing loss and also find the degree of impairment.

Aims and objectives of the study are: To evaluate the hearing threshold using BERA, to find the incidence of hearing loss in infants and children under 10 years of age.

METHODS

This observational study was conducted in the outpatient Department of ENT, S. Nijalingappa Medical College and HSK Hospital, Bagalkot on a sample of 55 children under 10years of age, undergoing audiological evaluation during the period of one year i.e., June 2017 to May 2018.

Inclusion criteria

In this study, children less than 10 years underwent BERA, who reported to us or were referred for the following reasons: (A) Delay in speech and language development. (B) Inconsistent responses to sound. (C) History of high risk factors in family, consanguineous marriage, difficulty/obstructed labour, preterm /premature labour, administration of antibiotic drugs during pregnancy.

Exclusion criteria

Patients who refused to undergo bera and children above 10years of age.

Detailed history taking, and general and ENT examination were done to rule out external ear and middle ear pathology. BERA was done in dust free, sound proof, air-conditioned room. Syrup pedicloryl 20mg/kg was given to sedate the baby half an hour before the procedure. RMS BERA instrument was used. Vertex, forehead and both mastoid regions were cleaned, and surface electrodes were applied to Ten 20 electrode gel. Headphones were held in the ear canal. Children were subjected to brainstem evoked response audiometry. Clicks were given at the rate of 11.1 clicks/s. Totally, 2000 responses were averaged. The intensity at which wave V just disappears was established as hearing threshold. Incidence of hearing loss & Degree of impairment were analysed.

Statistical method

Data entry was done in Microsoft excel. The data was tabulated and analysed by using percentages and proportions.

RESULTS

A sample of 55 children under 10 years of age, undergoing audiological evaluation in the Department of ENT, SNMC and HSK hospital, Bagalkot was studied during the period of one year i.e., June 2017 to May 2018.

The age of presentation was minimum being 2 months, maximum being 10 years (Table 1).

Table 1: Age group wise distribution of cases.

Age group (years)	Number of patients with decreased hearing (%)	Number of patients with normal hearing (%)	Total (%)
<1	3 (7.5)	5 (33)	8 (14.5)
1-5	19 (47.5)	7 (47)	26 (47.27)
6-10	18 (45)	3 (20)	21 (38.18)
Total	40 (100)	15 (100)	55 (100)

Table 2: Distribution of cases according to degree of hearing loss.

Degree of hearing loss	<1 years of age	1-5 years of age	6-10 years of age	Total (%)
Profound	2	7	5	14 (35)
Severe	1	6	8	15 (37.5)
Moderate	0	3	5	8 (20)
Mild	0	3	0	3 (7.5)
Total	3	19	18	40 (100)

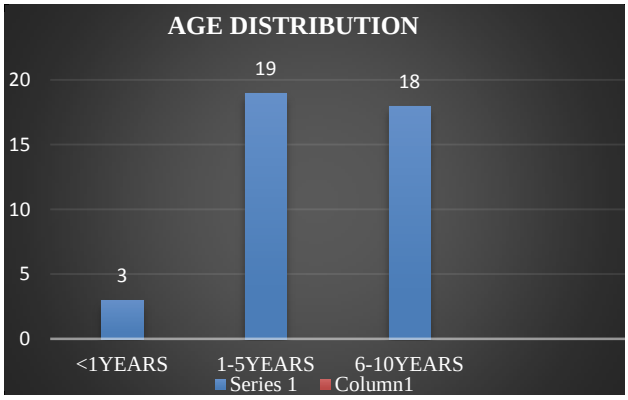

Figure 1: Age distribution.

Out of 55 children who were screened, 15 children had normal hearing and 40 had hearing loss indicating that risk factors hinder the maturity of auditory pathway. A total 40 children with hearing loss belonged to the age group 2 months–10 years. Amongst these 3 (7.5%) children were less than 1 years of age, 19 (47.5%) were

between 1-5 years and rest 18 (45%) were 6-10 years of age (Figure 1).

Out of total 55 children, 31 were male and 24 were female (Figure 2).

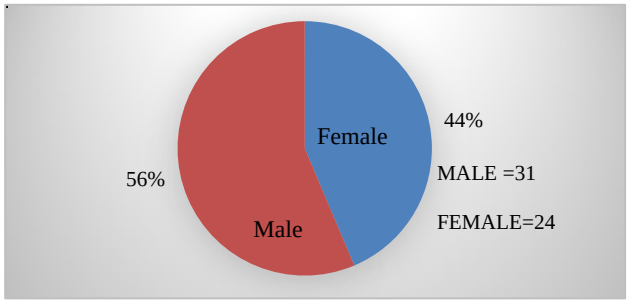

Figure 2: Sex distribution.

40 children had hearing loss, among them 22 were male and 18 were female patients with a male to female ratio of 1.2:1. And, in normal hearing group, male to female ratio was 1.5:1.

A total of 40 children were found to have sensorineural hearing loss. In which 14 children had profound (35%), 15 had severe (37.5%), 8 had moderate (20%), and rest 3 (7.5%) had mild hearing loss (Table 2).

DISCUSSION

The incidence of hearing impairment in high-risk infants according to different statistics varies from 1to 40%.[6]

Hearing loss early in development can be highly detrimental to the linguistic and cognitive development of an affected child. Early intervention in hearing challenged child will reduce such developmental losses. So it is important to screen every child's hearing beginning at birth so that early detection can be made and intervention started early.[7]

Brainstem evoked response audiometry, and otoacoustic emission (OAE) are two commonly used objective tests for childhood deafness.[8] OAEs are widely used in neonatal screening programs as they are quicker to perform. They provide information about outer hair cell function which is commonly affected in congenital hearing loss. It has a high incidence of false positive results as it is affected by external and middle ear function, which in neonates, is temporarily affected due to amniotic fluid residues.[9]

Brainstem evoked response audiometry though more time-consuming, is an accurate test for early detection of neural conduction irregularities in the auditory pathway.

It is a short latency response. It detects electrical activity from the inner ear to the inferior colliculus. It gives an estimate of degree and type of hearing impairment. It helps to find the cause of delayed speech. The existence of peak V is considered as sound stimulus perceived by the ear. The morphology of the graph was noted until wave V is no longer identifiable. The minimum intensity at which wave V is identifiable is taken as the hearing threshold for that individual. Since threshold estimation was the only aim of the study, latencies and inter peak intervals were not considered. The child's hearing sensitivity was assessed based on the following.[10]

- Normal hearing sensitivity: ≤25 dB.
- Mild hearing impairment: 30–45 dB.
- Moderate hearing impairment: 50–65 dB.
- Severe hearing impairment: 70–85 dB.
- Profound hearing impairment: 90 dB and above.

In this study, 72% of the total patients showed decreased hearing, which is comparable to the study by Ramnathan and Ganesh[10] who also had higher incidence hearing loss among 125 patients screened. In the present study, incidence is on higher side as compared to the prevalence of hearing loss in population as in the present study we have included children with high‑risk factor.

We have found male to female ratio to be 1.2:1 among patients having hearing loss. This was comparable to the study conducted by Dippen on 60 infants and children where male to female ratio was 1.3:1.[11]

In this study, 47.2% of patients belong to 1–5 years of age group. And, most of the patients (47.5%) who had decreased hearing fall under the age group of 1–5 years. Much of the speech and language development occurs during this period. Hence, hearing loss is identified when the child presents with delayed speech. This indicates that neonatal screening can identify such children at an earlier stage which helps in early rehabilitation In the study of Thirunavukarasu et al 68% of patients belonged to 1–5 years of age group.[10]

Patients who had severe to profound hearing loss fall under the age group of 1–5 years and patients who had mild to moderate hearing loss fall under the age group of 6–10 years. Hence, in patients with mild to moderate hearing loss, complaint gone unnoticed and patients had presented late to ENT surgeon. And in less than 1 year of age, we have included patients with risk factors who show severe to profound hearing loss and bilateral presentation.

In 55 cases where free field assessment had shown a suspected hearing loss and BERA was requested in order to confirm and assess accurately the hearing impairment, BERA confirmed the hearing loss in 40 children, where a significant increase of wave I-V IPL was seen. The IPL is a reflection of neural conduction time between the auditory nerve and the brainstem nuclei and reflects upon the efficiency of the auditory pathway. Prolonged I–V IPL is a feature of neurological impairment and is

indicative of delay in neurological conduction within the brainstem. Evidence that both the peripheral and central components may be abnormal during the early stages and the impairment may be temporary in some infants is provided by Kileny et al.[12] This result is consistent with study conducted by Aiyer et al.[13] where interwave I–V intervals were significantly prolonged in high-risk infants.

CONCLUSION

Newborn screening is mandatory to identify hearing loss in the prelinguistic period to reduce the burden of handicap in the community. As hearing loss commonly goes undetected until the child presents with delayed speech. Screening programs should include newborn screening, and also screening in later periods based on the risk factors.

BERA is more definitive for detection of sensory as well as neural deafness than OAE. OAE gives idea about cochlear portion (sensory part), while BERA gives idea of the entire auditory pathway.

BERA should be carried out as a routine procedure to detect hearing impairment in high risk children. Regular follow-up should be done, and rehabilitative measures should be started as early as possible**.**

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Ethical approval: The study was approved by the Institutional Ethics Committee

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