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Research Article

Auditory Evaluation in Low Birth Weight Infants by Brainstem Evoked Response Audiometry

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Abstract: Hearing is the link by which the newborn comes in contact with the world of sound and language. Sense of hearing is a gift to mankind from god, as hearing and speech are the cornerstones of communication. Speech is intimately related to hearing because those with impaired hearing often have speech delay. The aim of the study was to analyze the effectiveness of BERA (Brain stem evoked response audiometry) in auditory evaluation in low birth weight infants. This is a comparative study in 30 low birth weight infants aged below one year and 30 infants with normal birth weight. BERA testing was done with RMS EMG EP MARK-II machine manufactured by the RMS recorders and Medicare system, Chandigarh. Students unpaired t test was used for statistical analysis. Out of 30 cases of low birth weight infants, 19 had hearing impairment. No BERA waves were recordable in 7 of 19 children. Remaining 12 had mean wave V threshold 42.36 ± 21.41 dB, which was highly significant statistically when compared to the threshold of 30± 0.1 dB in those with normal birth weight. Awareness needs to be created in the population regarding good antenatal care. Milestones in children also need to be carefully monitored and early intervention needs to be done if any delay in attainment of milestones. Screening programme should be performed in the nursery and well-baby clinic during immunization in the early neonatal stage to avoid harmful effect on speech and language development.
Keywords: Low birth weight, Brainstem Evoked Response Audiometry (BERA), Hearing impairment.

INTRODUCTION

Low birth weight (LBW) is defined as a birth weight of a live born infant of less than 2.5 kg irrespective of gestational age. LBW is either caused by preterm birth, that is, a low gestational age at birth, younger than 37 weeks of gestation or the infant is small for gestational age, or an occurrence of both. Low birth weight infants are vulnerable to growth impairment, with its attendant risks of increased morbidity and mortality. Low birth weight infants have a higher incidence of hearing loss than normal. This can be attributed to varied reasons like they are more likely to have suffered episodes of hypoxia and acidosis. These babies have immature metabolic functions and are prone for kernicterus which can result from smaller increases in serum bilirubin levels than in mature neonates. Moreover, these children spend a variable amount of time in intensive care units in noisy incubators in the immediate postnatal period. As their overall maturity is low, they are susceptible to serious infections which may require antibiotics which are potentially ototoxic [1]. Brain stem evoked response audiometry [BERA] has gained widespread acceptance as a test of neonatal auditory function because the response which is measured is involuntary and quantifiable. The response, however, requires interpretation, which is based upon knowledge ofthe technical and physiological variables which influence the test results [2].

The incidence of low birth weight babies is 25 million per year amounting to 17% of all live births.95% of them being in developing countries, India accounts for 26% of all live births [3].

These babies with low birth weight have overall higher mortality and morbidity as they are more prone for malnutrition, recurrent infections and neuro - developmental delay [4]. As per the WHO report, there are about 250 million people with hearing impairment in the world and is the second most common cause of disability. The WHO estimates that every year 38,000 children with hearing impairment are born in Southeast Asia. India has 6.3% prevalence rate of moderate to severe hearing impairment [3].

Brainstem evoked response audiometry also known as Auditory brainstem response (ABR) is a neurologic test of auditory brainstem function in response to

auditory (click) stimuli. The auditory evoked potentials of the first 10 milliseconds i.e. Short Latency Response (SLR) is known as Brain Stem Evoked Response Audiometry (BERA) [5]. It's a set of seven positive waves recorded during the first 10 seconds after a click stimuli. They are labeled as I – VII of which waves I, III and V are the most visible and of more significant. A click stimulus is used to generate a response from the hair cells of the cochlea, the signal then propagates along the auditory pathway from the cochlear nuclear complex to the inferior colliculus in mid brain to generate a wave. Sohmer and Feinmesser described auditory evoked potentials for the first time [6].

BERA not only helps to identify hearing loss but also helps to distinguish the type of deafness.[Conductive or sensorineural]. The waves of BERA with their sites of generation can be summarized as: I - distal portion of the auditory nerve relative to the brainstem; II - proximal portion of the auditory nerve relative to the brainstem; III - cochlear nucleus; IV - superior olivary complex; V - lateral lemniscus; VI - inferior colliculus; and VII - medial geniculate body [7].

MATERIALS AND METHODS

This study was conducted in department of Physiology, JJM Medical College, Davangere during the period from March 2011 to May 2012. Ethical clearance was obtained from the institute. 30 low birth weight infants from pediatric and ENT out- patient department were taken for the study.30 age and sex matched normal weight infants from the general population formed the control group.

Inclusion Criteria

All infants at genetic risk, who attended the pediatric OPD of Bapuji Hospital and Chigateri General Hospital attached to J.J.M Medical College were interviewed and infants with birth weight less than 2.5 Kg were included for the study.

Exclusion criteria

Newborns who were admitted in Neonatal intensive care unit for more than 5 days or neonates having any of the following regardless of length of stay like Extracorporeal membrane oxygenation (ECMO), assisted ventilation, exposure to ototoxic drugs or loop diuretics (furosemide) and hyperbilirubinemia that requires exchange transfusion, In -utero infections such as cytomegalovirus, herpes, rubella, syphilis and toxoplasmosis, infants with craniofacial anomalies, those with bacterial meningitis, those with Apgar scores < 4 at 1 minute or < 6 at 5 minute, Severe multiple anomalies, atresia or stenosis of external ear canal anomalies were excluded for the study.

The procedure of BERA test was explained to the parents to allay apprehension. Informed consent was obtained from them before. They were subjected to BERA test. The instrument used was RMS EMG. EP MARK –II machine which is a fully computerized machine manufactured by RMS RECORDERS & MEDICARE SYSTEM Chandigarh.The infants were sedated if required with syrup pedichloryl in dosage 20mg/kg body weight.An abrasive strip was used to clean the site of application of electrodes. The entire BERA procedure was carried out in a quiet, semi-darkened room. Surface electrodes were placed at the vertex (CZ), both mastoids (Ai and Ac) and forehead (ground). The resistance was kept below 5K. Electrode electrolyte gel was used and electrodes were fixed. Monaural auditory stimulus consisting of rarefaction clicks of 100 microseconds were delivered through electrically shielded earphones at the rate of 11.1/sec. Pure white noise of 40 dB was used to shield the contra lateral ear. Responses to 2000 click presentations were averaged [8].

RESULTS

Out of 30 babies with low birth weight, 19 had hearing impairment. Out of these 19 infants, 7 showed no BERA response. Remaining 12 had wave V amplitude of 42.36 $\pm$ 21.41 dB compared to control 30 $\pm$ 0.10 dB which was highly significant statistically. Absolute latencies of all waves were higher than control, however statistically significant only in Wave V absolute latency. Inter Peak Latencies of I – III, I-V, III – V and amplitude ratio V/I group did not differ much when compared to the control group. An infant was considered to have normal hearing threshold if wave V was present at 30 dB in both ears, Mild hearing impairment at threshold between 40 dB to 60 dB moderate at 60 dB to 70 dB, severe 70 dB to 90 dB, and profound hearing impairment at thresholds above 90 dB.

Table 1: Characteristics of the study group

Gender	No. of cases	No. of controls
Male	20	17
Female	10	13
Total	30	30

Table 2: Comparison of BERA parameters in low birth weight and normal birth weight infants

BERA parameters	Normal birth weight infants (N= 30)	Low birth weight infants (N= 30)	Normal birth weight v/s low birth weight infants	
	Mean± SD	Mean± SD	t value	p value
V (dB)threshold	30.00± 0.10	42.36±21.41	-5.02	<0.0001**
I	1.58± 0.20	1.60±0.22	-0.50	0.62
III	4.24± 0.26	4.32±0.34	-0.84	0.4
V	6.44±0.35	6.58±0.51	-2.10	<0.05*
I-III	2.67±0.27	2.54±0.36	-1.10	0.42
I-V	4.77±0.35	4.89±0.42	-1.19	0.24
III-V	2.12±0.32	2.72±0.49	-2.82	<0.05*
V/I	3.50±5.01	5.76±6.24	-1.37	0.18

Unpaired t test, * Significant, ** Highly significant

DISCUSSION

Several clinical trials have shown auditory brainstem evoked response (ABR) testing as an effective screening tool in the hearing assessment in newborns, with a sensitivity of 100% and specificity of 96-98% [9]. Dorothy *et al*. [10] found the sensitivity of BAEP as a screening test to be 100%, specificity of the test is 86% . Low birth weight infants have a higher incidence of hearing loss than normal. This can be attributed to varied reasons like they are more likely to have suffered episodes of hypoxia and acidosis. These babies have immature metabolic functions and are prone for kernicterus which can result from smaller increases in serum bilirubin levels than in mature neonates [11].

Brainstem Evoked Response Audiometry (BERA) is an objective and non-invasive method of hearing assessment which detects electrical activity from the inner ear to the inferior colliculus [12]. Low birth weight infants are at risk of life threatening infections which may require powerful antibiotics. Some of them may be ototoxic further aggravating the problem [13]. Auditory evoked responses are electrophysiological recordings of responses from within the auditory system that are activated by sounds. The evoked transient responses can be recorded up to 500 milliseconds from time of onset of the sound stimulus. The evoked potentials of the first 10 milliseconds i.e. Short Latency Response (SLR) is popularity known as Brain Stem Evoked Response Audiometry (BERA).

CONCLUSION

The present study emphasizes the importance of using brain stem evoke response audiometry as a screening test for the early detection of hearing loss which would otherwise go unnoticed till about 2-3 years.This would further help us in early rehabilitation of the child as this would make the child socially acceptable. Most screening tests show limited reliability and validity during the first few months of life. For adults, objective and subjective threshold are comparable. For young children, only the determination of acoustic evoked potentials can provide exact diagnostic data. Brain stem response audiometry, even in newborns, is the method of choice for accurate detection of hearing threshold [14-16].

ABR audiometry because of its accuracy has emerged as a technique of choice in the screening infants. Since it is an objective test it useful in early identification of hearing loss. All infants should ideally be screened for hearing loss. In developing countries like India screening all infants with BERA involves practical difficulties because of the cost involved.

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