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Auditory Evoked Response in Infants with Birth Asphyxia

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ABSTRACT

The consequences of birth asphyxia in infants range from death to various degree of neuro developmental sensory and motor deficits. The prognosis of infants who survive apparent still birth or birth asphyxia is difficult to judge from few reports. BERA is useful in determining hearing threshold in difficult and uncooperative patients. Hearing is the means by which the newborn comes into contact with the world of sound and with language. The first three years of life are the most important period for speech and language acquisition. Reduced hearing acuity of any severity in infancy or early childhood may prevent the child from receiving adequate auditory, linguistic and social stimulation required for speech and language development. Several risk factors associated with hearing loss during early infancy have been described by Joint Committee on Infant Hearing which includes hereditary cause, inutero infection, prematurity, asphyxia, hyperbilirubinemia and ototoxic medications.

Objectives: *To assess the degree of hearing impairment in infants with birth asphyxia by using BERA.* ***Methods:*** *37 high risk infants having one or more risk factors attending Pediatric OPD of Bapuji hospital and Chigateri General Hospital and 30 age matched controls satisfying the inclusion criteria were randomly selected from immunization centre were subjected to BERA. Parameters such as absolute latencies of waves I, III, and V, Interpeak latencies I-III, I-V and III-V were assessed and analysed by using unpaired t-test.*

Results: *The infants with birth asphyxia had increased wave V threshold when compared to the control group. Absolute latencies of wave V was prolonged in the cases. The incidence of hearing impairment was 60 % in the birth asphyxia infants.*

Key words: *Birth Asphyxia infants, Brainstem Evoked Response Audiometry (BERA), hearing impairment, Hypoxic Ischemic Encephalopathy.*

INTRODUCTION

Hearing loss that goes undetected in infants and young children compromises optimal development and personal achievement. Because language and communication serve as the foundation for development of normal child, delays in the acquisition of these skills affect literacy, academic achievement, social and personal development. Therefore, early detection of hearing loss in children has been a long standing clinical priority. The basic assumption of newborn hearing screening is that early detection followed by early intervention maximizes the benefit the child, the family and society will receive. Hearing loss is not a visible disability, and even normal – hearing children may not begin talking until 1 ½ - 2 years of age. Thus if hearing loss is not detected through newborn hearing screening programmes, it often goes undetected up to 18 months of age, especially in children who have no medical conditions and/or other disabilities.

Auditory evoked responses are electro physiologic recordings of responses from within the auditory system that are activated by sounds. The evoked transient responses can be recorded upto 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 Audio metry (BERA)[1]. As per WHO report, there are about 250 million deaf people in the world and is the second most common cause of disability. WHO estimates that every year 38,000 deaf children are born in South – East Asia. India has 6.3% prevalence rate of moderate to severe hearing impairment[2].Joint Committee on Infant Hearing (JCIH)[3] promulgated a list of specific risk factors to identify infants at risk for hearing impairment for careful follow – up and assessment. Later the consensus recommended screening of all newborns. Hecox and Galambos[4] first reported about successful application of ABR in the audiological evaluation in children. JCIH recommends the use of ABR and Oto Acoustic Emission (OAE) for screening of newborns. These electrophysiological methods are efficient, cost effective and accurate for identifying the degree of hearing loss.

When an infant has low APGAR scores (0-3) that permit longer than 5 minutes, severe acidosis (PH $\leq$ 7.0), neonatal encephalopathy and some degree of systemic organ injury, the infant can be diagnosed as having had perinatal asphyxia significant enough possibly to cause neurologic sequelae. The outcome of perinatal asphyxia ranges from death to various neuro-developmental sensory and motor deficits. Sensorineural hearing loss is one of the most common sequel[5].Increased risk for Sensorineural hearing loss has been described among infants who experienced hypoxia or anoxia during prenatal period, resulting from factors such as placental insufficiency, mechanical compression of the umbilical cord, or neonatal seizures[6]. The present study was undertaken to study the BERA parameters in Birth asphyxia infants.

METHODOLOGY

In this study 37 term infants with 5 minute APGAR score <6 and clinical signs of Hypoxic

Ischemic Encephalopathy were selected from Bapuji Hospital and Chigateri General Hospital, attached to J.J.M. Medical College, Davangere and 30 age matched controls were selected randomly from the immunization centre and pediatric OPD. Exclusion Criteria includes: Family history of permanent childhood hearing loss, Neonatal intensive care of more than 5 days or any of the following regardless of length of stay, exposure to ototoxic drugs or loop diuretics (furosemide) and hyperbilirubinemia that requires exchange transfusion, In utero infection such as cytomegalovirus, herpes, rubella, syphilis and toxoplasmosis, Craniofacial anomalies, Birth weight < 1500g, Bacterial meningitis, Gestational age < 37 weeks, Severe multiple anomalies, Incompatible with life, Atresia or stenosis of external ear canal, Untreated otitis externa, Babies more than one year of age. 37 birth aspyxia infants and 30 age matched controls satisfying the inclusion criteria were included in the study. Written informed consent was taken from the parents after explaining them the procedure and its significance in their vernacular language. Detailed history and thorough ENT examination was done before the procedure. The infants were subjected to BERA testing on RMS EMG EP MARK-II machine manufactured by the RMS RECORDERS and MEDICARE SYSTEM, CHANDIGARH. Infants were sedated with syrup Trichlofos (pedichoryl) 20mg/kg body weight. The skins at the point of placement of electrodes were cleaned with 'abrasive strip. Recording of BERA was carried out in a quiet and semi-darkened room. Surface electrodes were placed at the vertex (C_Z), both mastoids (Ai and Ac) and forehead (ground). The resistance was kept below 5K. Monoaural auditory stimulus consisting of rarefaction clicks of 100 microseconds were delivered through electrically shielded earphones at the rate of 11.1/sec. Contralateral ear was masked with pure white noise of 40dB. A band pass of 150-3000Hz was used to filter out undesirable frequencies in the surroundings. Responses to 2000 click presentations were averaged. BERA threshold for each ear with absolute latencies of wave I, III, and V waves interpeak latencies (IPL) of I-III, I-V and III-V were considered from the recording for comparison among high risk infants and controls.

STATISTICAL ANALYSIS

The results are expressed as mean and standard deviation. Unpaired t-test was used for intergroup comparisons, p-value of 0.05 or less has considered as statistical significance.

RESULTS

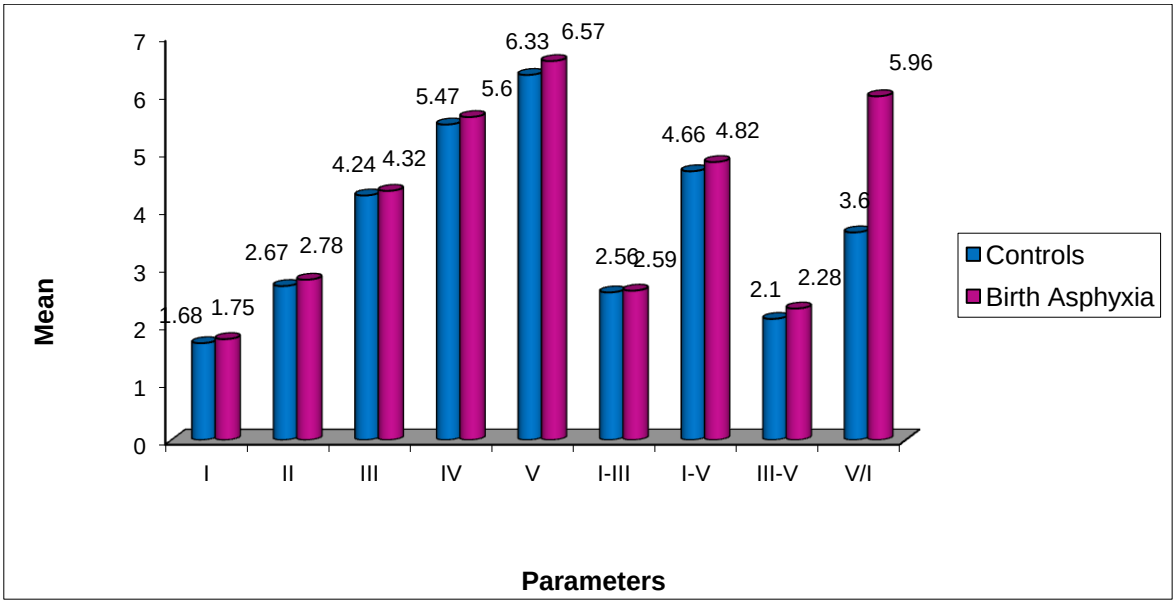
Of the 37 babies with Birth asphyxia, no BERA response was seen in 7 babies. 30 babies with birth asphyxia had wave V amplitude of 44.50 $\pm$ 15.67 dB compared to control 30 $\pm$ 0 dB which was highly significant statistically. Absolute latencies of all waves were higher than control, however statistically 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 (Table No.1, Graph No.1).

Table No -1 Comparison of BERA parameters in cases with birth asphyxia and controls.

Measurement	Controls		Birth asphyxia(BA)		BA + v/s Controls	
	Mean	SD	Mean	SD	t value	P value
V (dB) Threshold	30	0	44.5	15.67	-5.06	< 0.001 **
I	1.68	0.2	1.75	0.28	-1.11	0.26
III	4.24	0.26	4.32	0.54	-0.73	0.46
V	6.33	0.35	6.57	0.49	-2.18	<0.05*
I-III	2.56	0.27	2.59	0.46	-0.31	0.75
I-V	4.66	0.35	4.82	0.49	-1.46	0.14
III-V	2.1	0.33	2.28	0.53	-1.63	0.11

Unpaired t test
* Significant
** Highly significant

Graph No-1 Comparison of BERA parameters between controls and birth asphyxia babies.



DISCUSSION

16 (43.24%) babies with birth asphyxia had Hypoxic Ischemic Encephalopathy (HIE). Incidence of hearing loss was 60% in birth asphyxia babies which is higher compared to Misra et al[7]. 22% of HIE subjects had BERA abnormalities in the study by Anand et al. [8]. Prolonged absolute latencies of wave V with normal interpeak latency would suggest involvement of cochlear nerve or the cochlea which may be due to depression of endocochlear potential as a result of hypoxia and acidosis[9]. Involvement of cochlea is asphyxia has also been observed clinically [10] and in narcopsy series [11]. Histopathological studies show that human neonates' brainstem is highly vulnerable to anoxia

with predominatly damaging effect on brainstem nuclei and inferior colliculi which participate in the formation of auditory brainstem response[12]The brainstem is affected frequently in newborns both in term and in preterm infant due to perinatal hypoxia. Hearing loss is secondary to hypoxic injury to brain stem dorsal cochlear nuclei or to the cochlea can be present[9].

Dysfunction in peripheral auditory process indicated by increased wave I latency in preterm infants with birth asphyxia was present in study by Streletz[13]. Fakhrace et al studied 388 patients, of which 28% had mild to profound hearing impairment most common (11.3%) being mild hearing loss. All of the patients with asphyxia had hearing impairment, 25.6% of patient with aminoglycoside treatment had hearing impairment [14].

In the study by Misra et al., 43.3% of neonates with birth asphyxia had higher mean latencies of various waves in BAEP whereas IPL did not show significant change compared to controls. Abnormally reduced V/I amplitude ratio has been regarded as a bad predictor of anoxic brain damage[7]. The follow up study by Misra showed all BERA parameters reverted to normal, which suggests that the BERA abnormalities are transient. Similar findings are reported in Barden [15] and Cycowixz[16].These transient abnormalities have been attributed to middle ear effusion, collapse of ear canal, immaturity of peripheral neural structure or temporary insult like asphyxia. In contrast to our study some of the studies have normal absolute latencies and normal interpeak latencies in neonates with birth asphyxia[8,15]. The limitation of our study being we could not do a follow up study of these infants.

CONCLUSION

Perinatal birth asphyxia does affect the parameters of brainstem auditory potential suggesting that the infants are prone for sensorineural hearing loss, although these changes may be transient. Therefore it seems these infants will benefit from hearing assessment by using BERA at an early age. Also no child is too young for hearing evaluation.

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