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ORIGINAL ARTICLE

BRAINSTEM AUDITORY EVOKED POTENTIALS IN BIRTH ASPHYXIA INFANTS

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ABSTRACT: BACKGROUND: 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, in utero 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 and subjected to BERA. Parameters such as absolute latencies of waves I, III and V, Inter peak latencies I-III, I-V and III-V were assessed and analyzed 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.
KEYWORDS: Birth Asphyxia infants, Brainstem Evoked Response Audiometry (BERA), hearing impairment, Hypoxic Ischemic Encephalopathy.

INTRODUCTION: Hearing impairment has a devastating detrimental and invariable adverse impact on the development of children. Late detection causes irreversible stunting of the language development potential of the child. 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 1½ - 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.

Professional leadership in the subspecialty of infant hearing and early detection has been largely provided by the Joint Committee on Infant Hearing (JCIH). Initially the JCIH did not recommend hearing screening for all newborn (JCIH, 1972), instead they endorsed a High Risk Register (HRR) for screening infant who should receive hearing evaluation. They revised and expanded the high risk criteria in 1982, 1990 and 1994.

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Unfortunately only about 50% of infants with sensorineural hearing losses are identified by using the HRR. Since the goal should be 100%, consensus has been reached that universal detection of infant hearing loss requires Universal screening of all infants. The JCIH (2000, 2007) revised the risk indicators for neonates where universal hearing screening is not yet implemented. Any infant with these risk indicators who has passed the birth screen should, nonetheless, receive audio logical monitoring every 6 months until age 3 years.

Several risk factors associated with hearing loss during early infancy have been described by Joint Committee on Infant Hearing which includes hereditary cause, in utero infection, prematurity, asphyxia, hyper bilirubinemia and ototoxic medications.[1] Auditory evoked responses are electrophysiologic 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).[2] Auditory Brainstem Response (ABR) is a far – field recording of the synchronized response of numerous neurons in the auditory pathways within the brainstem. ABR was first described by Sohmer and Feinmesser.[3] Primary application of ABR is as a tool for estimating audiometric thresholds, assessing integrity of auditory pathway till the level of brainstem, newborn hearing screening, monitoring eighth nerve and auditory brainstem function during certain neurotologic operations.[4]

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.[5] 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 sequelae.[6]

ABR is an invaluable clinical tool that can be used a number of ways, including estimating auditory sensitivity, screening newborns for hearing loss, diagnosing auditory nerve or brainstem lesions, and monitoring the auditory nerve and brainstem pathways intra operatively, or during surgery.[7] Also used in estimating hearing thresholds in difficult-to-test patients, monitoring brainstem function in critically ill or comatose patients, including evaluation of brain death.[8]

BERA appears to be exceptionally suited for study of birth asphyxia infants to evaluate the hearing threshold and BERA parameters. This study was done 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.

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37 birth asphyxia 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 skin at the point of placement of electrodes was 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 inter peak 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 + 15.67 dB compared to control 30 + 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).

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

Table 1: Comparison of BERA parameters in cases with birth asphyxia and controls

Unpaired t test
* Significant
** Highly significant

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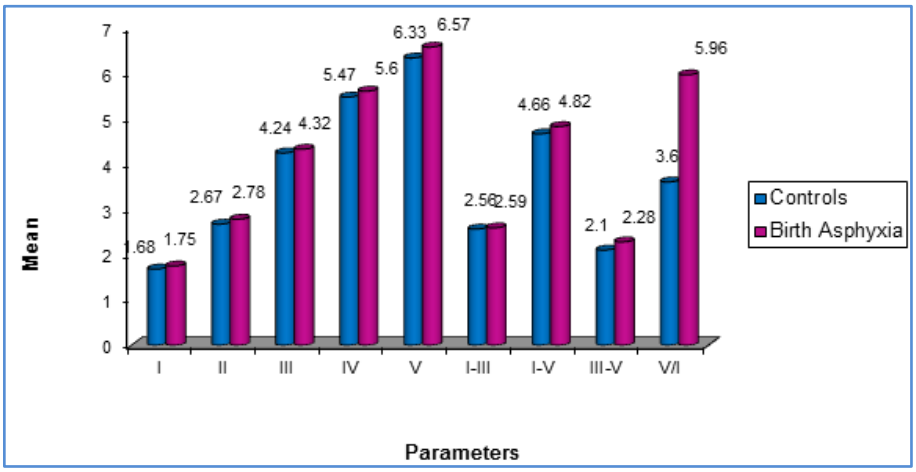

Graph 1: Comparison of BERA parameters between controls and birth asphyxia babies

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.[9] BERA abnormalities were found in 22% of HIE subjects in a study by Anand et al.[10] Prolonged latency of wave V with normal IPL 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.[11] Involvement of cochlea is asphyxia has also been observed clinically[12] and in narcopsy series.[13]

Increased risk for SNHL 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.[8] When an infant has low APGAR scores (0-3) that permit longer than 5 minutes, severe acidosis (PH ≤ 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 brainstem is affected frequently in newborns both in term and in preterm infant. Hearing loss is secondary to hypoxic injury to brain stem dorsal cochlear nuclei or to the cochlea can be present.[11]

Dysfunction in peripheral auditory process indicated by increased wave I latency in preterm infants with birth asphyxia was present in study by Streletz.[14] 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.[15] 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.[9] 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[16] and Cycowixz.[17] These transient abnormalities have been attributed to middle ear effusion, collapse of ear canal, immaturity of peripheral neural structure or temporary insult like asphyxia. The limitation of our study being we could not do a follow up study of these infants.

CONCLUSION: Although we cannot make a definite conclusion concerning the outcome of the present study, birth asphyxia does affect the hearing in the infants which may be transient. Therefore it seems that all high risk 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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