AN OBJECTIVE TEST OF HEARING IMPAIRMENT IN CHILDREN BELONGING TO AGE GROUP OF 1-5 YEARS, USING BRAINSTEM EVOKED RESPONSE AUDIOMETRY.

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ABSTRACT

AIM: To evaluate and to analyze hearing impairment in auditory pathway in children with compromised hearing ability using brainstem evoked response audiometry.

SUBJECT AND METHOD: Total 25 children between 1-5 years with compromised hearing ability were subjected to brainstem evoked response audiometry. Click stimuli were given having intensity of approximately 60db or above and the waveforms were recorded. They were labeled I to VII waves, of which I, III and V waves are the most visible and more significant waves.

RESULT: Totally 25 children were taken for study. Out of them, 20 (80%) had bilateral hearing loss with no wave pattern and remaining five, out of them 3 children had bilateral hearing loss while 2 had unilateral hearing loss. Difficult labour was most commonly associated risk factor for hearing impairment.

CONCLUSION: We believe that a larger sample and the follow up of these infants at risks by means of the study of BERA may offer valuable information on the state of maturation of the acoustic pathway achieved by the children.

KEY WORDS: Brainstem evoked response audiometry, bilateral hearing loss, unilateral hearing loss, follow up, infants.

INTRODUTION:

Hearing is an important sense, humans have. It is very important for speech and language development, communication and learning. The prevalence of congenital hearing loss has been estimated to be 1.2 -5.7 per 1000 live birth.

Incidence of severe hearing loss among survivor of neonatal intensive care ranges from 1% to 28%, while mild to moderate deficit are even more prevalent 2. Deafness in first three years of life may impair the full development and maturation of auditory system and it is well known that deafness in infancy and childhood interferes with normal development of speech and language.

In the absence of normal speech, child's ability to communicate is restricted and this has a negative impact on child's social, emotional, cognitive and academic development.

Conversely, as a child grows into adult hood, his/her vocational and academic potential is significantly attenuated and family/society is left to bear the cost of the care of an otherwise healthy individual for life.

To prevent this and to initiate rehabilitative procedure as early in life as possible, a screening method to detect auditory disabilities in newborn is of great importance. Although many methods like behavioral audiometry disabilities, impedance audiometry, respiratory and cardiac responses and crib movement systems are evaluated. BERA, which yields information on threshold sensitivity of peripheral part of audiometry apparatus and on conduction velocity in brainstem, is the satisfactory procedure which can be performed with ease in children.

A child's normal speech and language development depends on ability to the prevalence of hearing loss is 0.5-6/1000 neonates across the globe.

Hearing loss is the most common sensory deficit in human beings in the world. Hearing impairment can range from slight to profound. Moderate to profound hearing loss is disabling condition which affected more than 360 million people worldwide in 2012 according to World Health Organization.

Prior detection and appropriate management provide the best choice of maximizing the critical period of hearing and thereby availing the resources to improve hearing and oral communication skills. However, diagnosis of these children at an early stage can be difficult task even for the experienced clinician.

Selecting the appropriate method and instruments in clinical diagnosis at an early stage is also practically difficult. To overcome this, brain stem evoked response audiometry is a simple, noninvasive test for early detection of hearing impairment in children and neonates.

Brainstem Evoked Response Audiometry (BERA) is an electrophysiological procedure which studies the electrical potential which is generated at different levels of auditory system starting from cochlea to cortex. BERA was first described by Sohmer and feinmesser in 1967.5 Auditory Brainstem response applications were described by Hecox and Galambos (1974).

In this study, hearing threshold was not estimated using BERA in high risk infants associated with various etiological factors and in children to detect hearing loss and find the degree of impairment.

Hearing is one of the five primary senses which help us to communicate properly with fellow human beings. Unfortunately, we take sense of hearing as often and realize its importance only after it is lost or impaired. Until recently, the problem of hearing loss was not a priority for Indian government. Important causes of hearing impairment are ageing, exposure to excessive noise, head and ear injuries, use of ototoxic drugs and infectious diseases such as meningitis, measles, mumps and chronic ear infections and congenital defects. Half of all these cases of deafness and hearing impairment are avoidable through prevention, early diagnosis and management. Auditory sense is vital for the development of brain in a child. Identifying the hearing loss in early will prevent the problem to go out of hand. This will also decrease the burden of hearing loss and thus many presumptively nonproductive years will not happen. Screening of

the newborns and infants as early as possible is a cost-effective way to reduce the burden of hearing impairment.

Important risk factors for hearing impairment infants are family history, in-utero infections, craniofacial anomalies, birth weight <1500g, hyperbilirubinemia at serum levels requiring exchange transfusion, ototoxic medications, postnatal asphyxia. So, the present study is done to know the incidence of hearing loss and to evaluate the relative importance of the various ototoxic risks factors in producing hearing impairment in infants at risk.

BERA is a simple, non-invasive, objective test for early identification of hearing impairment in children and neonates. It can be used as a screening test and is useful in neonates, infants and others difficult test subject.

In this study we localize hearing impairment in auditory pathway in children presenting with compromised hearing ability and to establish the relation between hearing defect and the various etiologic factors.

The brainstem audiometry evoked potential (BAEP) is an objective electrophysiological method for assessing the auditory pathways from the auditory nerve to the brainstem. It is considered a short latency potential, since it occurs within the first 10 milliseconds after a sound stimulus is presented.

The BAEP comprises seven waves of which waves I, III and V are the most visible and of more significant clinical value. The currently used classification for the generating site of these waves is: 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 9,10

Recording of this potential may be clinically analyzed according to a number of parameters: morphology; absolute latency of wave I, III and V amplitude; I-III, I-V and III-V interpeak interval latency and amplitude relation; and I –V interval interaural difference or wave V absolute latency difference.

MATERIAL AND METHODS:

This prospective study was carried out on twenty-five patients of 1-5 years of age at the outpatient ENT department of SMS medical college, Jaipur from 20th April to 28th September, 2017.

The present study was conducted in department of ENT SMS Medical college Jaipur to conduct BERA test on 25 deaf mute children under approval of institutional ethical committee.
After informed consent was taken a detailed information about the patient was obtained from the parents and before BERA, all of information about the patient is recorded from the hospital, gestational age, sex, birth, weight, final diagnosis, period of hospitalization and possible factors for hearing impairment.

In this study an attempt is made to study the findings of BERA in infants. These children reported to us or were referred to us for the following reasons:

- Inconsistent responses to sound or inability to sound or inability to respond to sound
- History of high-risk factors – Preterm, low birth weight, birth asphyxia, neonatal seizures, hyperbilirubinemia.

- To rule out the extent of malformation anomalies especially in atresia.

Inclusion Criteria:

All subjects with pure sensorineural deafness giving reliable response to pure tone audiometry and who had given consent were included.

Exclusion Criteria:

- All subjects with conductive or mixed type of deafness were excluded.
- Unreliable response to pure tone Audiometry.
- Not willing for procedure.

PROCEDURE:

All patients were administered the test procedure with prior appointment. An ENT check-up was done to rule out the possibility of wax, ear infection, middle ear problem etc.
Detailed history taking and general ENT examination were done to rule out external ear and middle ear pathology. BERA was done in dust free, sound proof and air condition room.
Feed was given 10-30 minutes before the procedure. Syrup Pedicloryl was given in dosage 20mg/kg body weight to apprehensive children an hour before BERA test and findings are recorded to proforma. The skin cleaned with cotton sponge by nuprep gel (skin prep gel) to remove dirt and oil for placement of electrode to get proper tracing.
The electrodes were placed on left and right mastoid regions, forehead and vertex area. Black electrodes were placed on left and right mastoid over forehead and ground electrode on the vertex of head. Both ears were tested independently. The BERA was done at 0.2microvolt switch amplitude, frequencies of sound waves were used and 25 samples included in the study.
The auditory evoked potential was elicited by approximately 60db above the average pure tone hearing level of the patient and was recorded with the active electrode placed over the vertex.
The child hearing sensitivity was assessed based on the following hearing threshold:

- Normal hearing sensitivity: Threshold up to 30db level and below.
- Mild hearing impairment: Threshold between 40db to 60db.
- Moderate hearing impairment: Threshold between 60db to 70db.
- Severe hearing impairment: Threshold between 70db to 90db
- Profound hearing impairment: Threshold above 90db.

OBSERVATIONS AND RESULTS:

The present study was under taken in 25 suspected deaf children brought to the department of ENT, SMS Medical college, Jaipur. BERA was done and inference were made according to causative factors. BERA findings were considered under latent period wave morphology and inter wave interval.

Table 1:

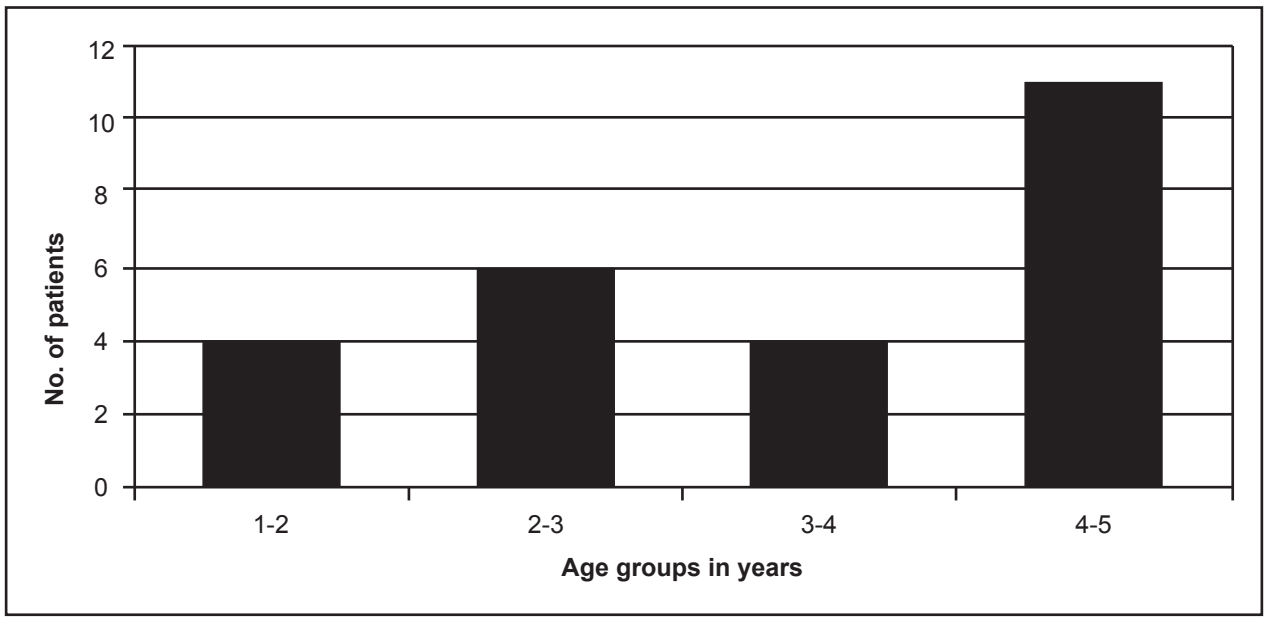
S.NO	Clinical diagnosis	No. of Cases	Percentage %
	Bilateral profound hearing loss	20	80
	Sensitivity to hearing	5	20

Table 2:

S.NO	Type of patients	No. of Cases	Percentage%
	Difficulty in Labour	14	56
	Premature Delivery	3	12
3	Trauma during Delivery	3	12
	Meningitis	2	8
	Viral Infection	1	4
	Hyperbilirubinemia	1	4
	Asphyxia and Cyanosis	1	4

Table 1 shows that out of 25 children (80%), 20 children had bilateral profound hearing loss having no wave pattern and out of remaining five children, 3 with bilateral hearing loss and 2 with unilateral hearing loss. The history revealed the type of patients having difficult labour (most common) in 14 cases, premature delivery in 3 cases, trauma during labour in 3 cases, meningitis in 2 cases, viral infection in 1 case, asphyxia and cyanosis in 1 case, hyperbilirubinemia in 1 case (shown in table 2).

Table 3:



Bar graph showing age distribution of study subjects

Table 3 shows that out of 25 selected cases, 11 cases were among age group 4-5 years. 6 cases were of age group 2-3 years and rest 8 cases were of age group 1-2 years or 3-4 years (4 in each age group.

DISCUSSION:

Deafness is an unseen disability of human beings which cannot be recognized up to 3 years of age. Hearing plays a great role in development of speech, education, social behavior and personality at large. So, early detection and rehabilitation has an important role. Brainstem evoked response audiometry (BERA) is an important tool is objective, noninvasive and without any influence of state of consciousness and environment. The present study was under taken on 25 children with a history of hearing impairment visiting the department of ENT SMS Medical College, Jaipur.

After initial detailed history, and the routine investigation these children were subjected to BERA.

The test was done, observation of BERA recording considering the latent periods, wave morphology and inter wave interval of all the waves I to V wave noted and entered in excel sheet. The observations were also analyzed according to the etiologic factors, found during history taking. The tables thus show the prevalence of the presence of hearing impairment according to etiologic factors and also show the presence of severity of the hearing loss in these 25 patients. The observations were also analyzed on the basis of etiological factors found during history taking. The tables thus show the prevalence of the presence of the hearing impairment according to the etiologic factors and also show the presence of the severity of the hearing loss in the 25 patients.

The prevalence of BERA abnormality in difficult labour cases stands out to be 56% which goes parallel to 89% reported by Yashuhara (1986) but higher than 43.3% reported by Mishra.
In the present study it appears that premature delivery resulting in low birth weight may lead to hypoxia, acidosis, immature metabolic function, such children prone to get injury in auditory pathway. These infants are also at risk at higher infectious rate, which may lead to the use of ototoxic drugs.

No wave pattern in BERA was observed in these children showing sensorineural hearing loss. Branfort (1982) found that out of 107 children, 20 were having no potential in BERA recording that implies hearing impairment.

In our study, 2 cases were of meningitis and viral infection, viral and bacterial meningitis give rise to bilateral deafness. Gupta found 26.8% of bilateral sensorineural hearing loss in cases of meningitis. Mc cabe found that arachnoiditis and adhesion in cochlear and vestibular nerve and atrophy in the cochlea give rise to deafness. Pneumococcal and meningococcal infections are also associated with degree of deafness. Out of 25 cases, 8% had history of hyperbilirubinemia.

Hyperbilirubinemia is toxic to auditory pathway as reported in studies done by gosh and hymen cb, holmes ge, the Johnson wh. It affects the superior olivary complex, lateral leminiscus and inferior colliculus (dubin wb). It gives risk to lose one or more peaks of wave I to V or III to V.
Out of 25 children 20 (80%) children had bilateral profound hearing loss having no wave pattern, out of remaining five children, 3 had bilateral impaired hearing while 2 had unilateral hearing loss.
In BERA observation out of 25 cases, 20 had no latent period and having no tracing frequencies

of sound and intensity level in both ears, showing no potential either at cochlear or at the midbrain nuclei of auditory pathway. Out of remaining 5 cases, 2 had unilateral hearing having normal latent period and wave form and inter wave interval in one ear at 100db and 30db respectively, showing profound loss. Remaining three cases having 40db, 90db 30db had normal latency and inter wave intervals.

Two cases had bilateral hearing and two cases had normal latency and inter wave interval while Kinley observed delayed latency period and inter wave interval which goes parallel to reports of Anand and Bardan that had normal latency period and inter wave interval. Immaturity of peripheral neural structure or temporary insults like hypoxia may be responsible for it.

However, the cause of transient abnormality of BERA is not clearly explained. In our study, 3 (12%) cases had normal auditory threshold while 2 (8%) cases had high auditory threshold which is comparable to the findings shown in the study done by Anand.

The study done by BERA test we can observe that infants exposed on risk factors like preterm babies, neonatal jaundice, neonatal convulsions, birth asphyxia and LBW are prone for some hearing abnormalities. So, this hearing impairment has to be detected in the early stages and proper rehabilitation measures were taken at the earliest so that further development milestones are not delayed.

BERA as a screening procedure will give idea of degree of hearing impairment.

CONCLUSION:

BERA is an important tool to confirm the normal sensitivity of hearing whenever required, to detect hearing loss early and to plan rehabilitation procedures. In case of high risks babies who are exposed to multiple risk factors like preterm babies, neonatal jaundice and LBW and even multiple risk factors which have chances of impaired hearing ability, BERA should be carried out as a routine procedure to detect the hearing loss.

The study has revealed that there is a definitive cause related hearing loss, in children exposed to various perinatal and natal causes like difficult labour, premature delivery, birth trauma, viral and bacterial meningeal infections, asphyxia and cyanosis and hyper bilirubinemia.

Most patients showed definitive BERA findings indicating damage to central neural structures. However, a definitive cause related specific changes in BERA were to be obtained. Hence, it is not possible to predict the type of changes in BERA recording with different causative factors.

Screening for hearing impairment at an early age is important method for determining the normal or abnormal auditory function in order to identify infants having marked hearing loss. Early diagnosis followed by appropriate intervention and management is necessary for children to recovery as their full communication and educational potential.

BERA is reliable and it helps in early identification of hearing impairment so that rehabilitative measures can be taken.

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