



Clinical significance of BERA(Brainstem Evoked Response Audiometry) in children with Sensorineural hearing loss affected by Pyogenic Meningitis and application of BERA in prognosis of hearing loss.

Zafar Iqbal

Deptt. of ENT, JNMCH, AMU, Aligarh, UP

S C Sharma

Professor , Deptt. of ENT, JNMCH, AMU, Aligarh, UP.

S F Hashmi

Professor , Deptt. of ENT, JNMCH, AMU, Aligarh, UP.

ABSTRACT

OBJECTIVE: Sensorineural hearing loss (SNHL) is an important sequelae of acute pyogenic meningitis in children. This study was undertaken to determine the incidence of SNHL following meningitis in non-neonates and its correlation

with various factors. **METHODS:** Children below age 6 years with ABM admitted in a teaching hospital over a period of 27 months were enrolled. Detailed history was taken, clinical examination performed and cerebrospinal fluid analyzed at commencement of therapy, 48 hours later and at the end of treatment. On discharge brainstem evoked response audiometry (BERA) was recorded. Data were analyzed using appropriate statistical tests. **RESULTS:** Out of 75 children enrolled, 45 (60%) developed SNHL, all bilateral, while the rest had unilateral SNHL. Among hearing impaired subjects, 22.2% had mild while 38.85% each had moderate and profound hearing loss. There was significantly higher protein content and neutrophils in the second CSF sample of those with SNHL. Age, presence of vomiting, altered sensorium seizures and aminoglycoside usage were not significantly different in those with and without SNHL, but the total duration of fever was ($p < 0.05$). There was significantly higher protein content and neutrophils in the second CSF sample of those with SNHL. **CONCLUSION:** There is a greater than 50% probability of the child developing SNHL if neutrophil percentage in the second CSF is 80% or more. Since the overall risk of SNHL is significant in children with meningitis, it is recommended that BERA be recorded in all, so that early intervention may be possible.

KEYWORDS : Brainstem evoked response audiometry, pyogenic meningitis, sensoryneural hearing loss

Introduction

Hearing is one of 5 senses of human being. Impairment of which affects the total development of a child and affects the personality of an adult. Fisch (1983) in his review about the development and maturation of hearing in normal children postulated for the first time that for optimum development of speech and language in children, the auditory pathway must be stimulated from a very early stage to allow higher centers to mature optimally. While children are profoundly affected and adults with deafness also have adverse affects that are multifaceted like their social life, personal life, jobs etc. while hearing occurs at much later stage sensorineural hearing loss occurs much earlier. These sensorineural changes can be detected easily by BERA.

BERA is thus not a test of hearing but a neurological test and can detect neurological hearing impairment earlier than PTA (5). Extensive research has shown that BERA wave components arise from VIII cranial nerve and auditory region in caudal and rostral brainstem. Wave I represents synchronously stimulated compound action potential from peripheral portion of VIII cranial nerve, wave II from VIII cranial nerve near brainstem.

These waves are generated by structures ipsilateral to the ear stimulated. All later waves have multiple generators in auditory brainstem. wave III is a prominent wave that is generated by caudal pons with likely contributions from cochlear nuclei, trapezoid body & superior olivary complex. The most prominent rostral component of wave V is thought to arise in the region of inferior colliculus and probably contralateral to the ear stimulated.

The various waves are thus representing the region of origin in auditory pathway. Also the latency and interpeak latency vary in health and disease. A well formed clear wave I at a delayed latency value for the maximum stimulus value is characterized by conductive or mixed deafness. When it is small and ill formed but interwave latencies are inside normal limits, high frequency sensory loss is suspected. Delayed interpeak latency values are signature of retrocochlear auditory dysfunction. Abnormal delays between early wave component (I-III) are consistent with posterior fossa lesion that involve VIII cranial nerve and lower brainstem. Whereas prolonged latency in waves III-V suggest intra-axial auditory brainstem dysfunction.

False negative BERA outcomes can occur in small percentage individuals with normal hearing & among patients with risk of retrocochlear

auditory dysfunction. With emergence of universal newborn hearing screening children at risk for hearing loss can be identified at birth. Also the children suffering from disease such as Pyogenic Meningitis and TB may be affected and by doing BERA it can be detected early and timely intervention can be done.

While hearing loss is the ultimate outcome of the auditory pathways affected by disease and other adverse factors, it is prudent to detect the impairment in neurological function as early as possible so as to avert this outcome. By doing BERA therefore one can find out the anatomical area affected in the auditory pathway and there remains a hypothetical possibility of taking measures to prevent damage. Further if done at various stages of the disease, serial BERA can throw light on progress/regress of the disease as to in what sequence it affects the neurons.

Material and methods

This study was carried out in 75 patients of less than or equal to 6 years age group attending the Indoor Patient Department and Outdoor Patient Department of Jawaharlal Nehru Medical College and Hospital in Paediatrics, and are diagnosed with Pyogenic Meningitis. These cases were done between July 2007 and October 2009.

Meningitis –

Diagnostic criteria :

- Suggestive CSF – cytology & biochemistry and/or
- Organisms in culture & smear and/or
- CT evidence of Meningitis
- Response to antimicrobial therapy in suspected cases presenting with signs of meningitis. Therapy lasting not more than 7 days

Inclusion criteria : consecutive children of pyogenic meningitis below 6 years who were discharged.

Exclusion criteria :

- All those patients given Aminoglycosides / Vancomycin longer than 7 days were excluded from the study.
- Also patients who were discharged from hospital and those who died were also excluded.

The ABR data were collected because the patients were unable to provide reliable estimates of hearing sensitivity, based on behavioral test techniques, due to developmental level. Data were included only if subsequently obtained behavioral audiometric data were available to which the ABR data could be compared.

They were subjected to BERA at the time of stay at the hospital and then at 3 months after discharge.

Control group –

75 subjects inclusive of all 0-6 years age groups were evaluated. These subjects were taken from Indoor and Outdoor Patient Departments of Jawaharlal Nehru Medical College and Hospital in Paediatrics, AMU. These subjects gave no history of any hearing impairment, ear discharge, drug toxicity, excessive noise exposure or any nervous system ailment. The control subjects were age and sex matched with that of patient group.

Place –

All recordings were done in a separate BERA room in the Department of ENT , Jawaharlal Nehru Medical College, AMU.

There was no interference from any electrical gadget or any external electrical stimuli. The standard test condition were followed.

Equipment –

Brainstem evoked response is produced by electrical events occurring along auditory pathway in the brainstem , evoked by repeated presentation of stimulus . Following amplification and removal of the background Electroencephalogram activity, these responses were averaged. For this equipment used was IHS ABR unit. The calibration of the instrument was checked before recording the response from bi-mastoid and 2 vertex electrodes.

Stimulus –

Mono aural clicks of 150 millisecond was presented to each ear at the rate of 21.7/second at an alternating polarity with 1024 to 2048 click samples.

Intensity –

The threshold , that is minimum intensity to elicit wave-V response was initially obtained and then recording were done at 30dBnHL, 50dBnHL, 70 dBnHL and 90 dBnHL.

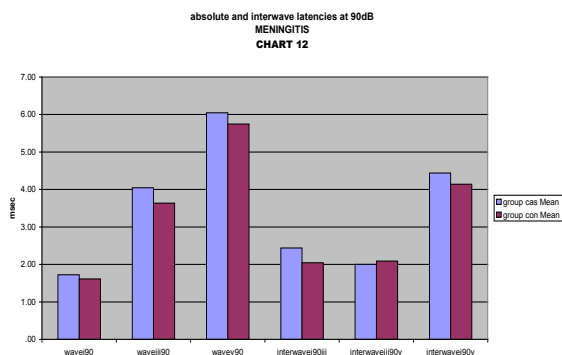
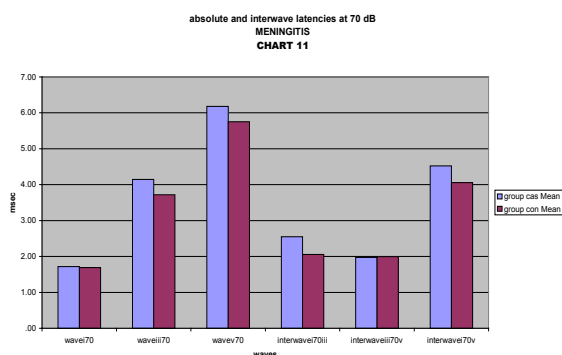
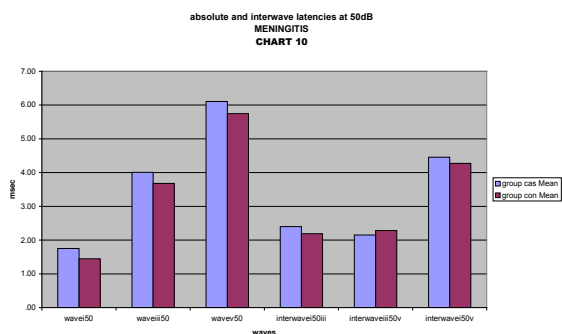
Procedure -

All paediatric patients were sedated , the mastoid and forehead areas were cleaned using spirit and cleansing gel. Silver cup electrodes were used , filled with standard electrolyte jelly. Two mastoid electrodes were fixed over them using adhesive tape. One active electrode and another ground electrode were fixed over forehead. Desired sound stimulus were was given mono-aurally using IHS ABR unit.the position of head was checked to ensure that the auditory canal was not compressed. No masking was employed in the other ear.

TABLE I
MEAN ABSOLUTE AND RELATIVE LATENCIES OF BERA WAVES IN 75 POST-MENINGITIC PATIENTS AS COMPARED TO 75 CONTROLS; 115dB SPL (MEAN ± SD)

Waves	Ear	Normal	Meningitic	t	p
ABSOLUTE LATENCY					
I	Rt.	1.37 ± 0.07	1.48 ± 0.16	2.67	
0.05	Lt.	1.38 ± 0.05	1.52 ± 0.13	4.05	
0.01					
III	Rt.	3.38 ± 0.06	3.66 ± 0.26	2.45	
0.05	Lt.	3.53 ± 0.10	3.65 ± 0.25	2.80	
0.05					
V	Rt.	5.27 ± 0.19	5.63 ± 0.37	2.79	
0.05	Lt.	5.32 ± 0.14	5.51 ± 0.28	2.95	
0.05					
RELATIVE LATENCY					
I-III	Rt.	2.12 ± 0.11	2.20 ± 0.21	2.13	NS
	Lt.	2.14 ± 0.10	2.18 ± 0.19	1.17	NS
III-V	Rt.	1.82 ± 0.13	1.98 ± 0.28	2.93	
0.05	Lt.	1.88 ± 0.15	1.90 ± 0.30	0.39	NS
I-V	Rt.	3.92 ± 0.18	4.16 ± 0.36	2.18	
	Lt.	3.94 ± 0.16	4.02 ± 0.32	1.46	NS

CHARTS 10,11 & 12 REPRESENTING MEAN ABSOLUTE & RELATIVE LATENCIES OF BERA WAVES IN POST-MENINGITIC PATIENTS AND CONTROLS (refer table I)



discussion

Sensorineural hearing loss (SNHL) is an important sequelae of acute bacterial meningitis (ABM) in children. This study was undertaken to determine the incidence of SNHL following meningitis in non-neonates and its correlation with various factors following detailed history, clinical examination was performed and cerebrospinal fluid analyzed at commencement of therapy, 48 hours later and at the end of treatment. On discharge brainstem evoked response audiometry (BERA) was recorded. Data were analyzed using appropriate statistical tests. Out of 75 children enrolled, 45 (60%) developed SNHL, all bilateral. Among hearing impaired subjects, 22.2% had mild while 38.85% each had moderate and profound hearing loss. There was significantly higher protein content and neutrophils in the second CSF sample of those with SNHL. Though the mean values of study group on comparison with the control group was slightly higher , it was statically insignificant at all the three intensities, which is against the study by Mathur and Kakar et. al. (1990) who considered only the mean values of various wave latencies. But closely concurs with those of Zimmermann's and Donald's.

The values of interpeak latencies of our study are more or less comparable to that of Mathur and Kakar et. al. (1990). The comparison of our study group with our control group at 50, 70 & 90 dBnHL was statistically insignificant though the mean values for interpeak latencies III-V and I-V was high but it was within the normal range of Mathur and Kakar et.al. (1990).

conclusion

Human being communicates with others and his environment through sight and hearing. Deafness will hamper this communication if it is present since birth or during childhood.

- BERA can detect neurological abnormalities health and disease.
- While different abnormalities was found were found in different patients its difficult to say from this study as to what changes occur at what stage of disease.

➤ Assessment of ABR continues to be a readily available, relatively inexpensive, and reasonably sensitive procedure for initial diagnostic evaluation of eighth-nerve and auditory brainstem status in the care of patients with retrocochlear deafness signs and symptoms that puretone audiometry provides limited purview in this regard. There is a greater than 50% probability of the child developing SNHL if neutrophil percentage in the second CSF is 80% or more(1,2,3,4). Since the overall risk of SNHL is significant in children with meningitis, it is recommended that BERA be recorded in all, so that early intervention may be possible (6).

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