BRAIN STEM EVOKED RESPONSE AUDIOMETRIC FINDINGS IN POST NEONATAL MENINGITIS

Paediatrics

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ABSTRACT

Background: Hearing loss is an important complication of meningitis. We usually advise BERA study for detection of hearing loss particularly sensorineural type. BERA is superior to pure tone audiometry in malingering patients. **Objective:** To evaluate the sensorineural hearing following meningitis in children between 1 month to 2 years. **Material and methods:** This was a cross sectional, observational study of children aged 1 month to 2 years who were admitted in Department of Paediatrics, R. G Kar. Medical college, Kolkata during the period of January 2017-June 2018, the study includes 30 babies who were suffering from Meningitis. **Result:** We found that out of 30 patients 23(76.7%) patients had no hearing loss, 3(10.0%) patients had mild hearing loss, (3.3%) patient had moderate hearing loss and 3(10.0%) patients had severe hearing loss in right ear. **Conclusion:** BERA is a helpful tool for assessing the severity of Hearing loss in post-meningitis patient. It is a useful test for screening of SNHL, especially in the young children and infants in whom other conventional methods may not be of much use.

KEYWORDS

Hearing loss, Audiometric findings, Meningitis, Brain Stem Evoked Response Audiometric

INTRODUCTION

Neonatal meningitis is a serious medical condition in infants. Meningitis is an inflammation of the meninges (the protective membranes of the central nervous system (CNS)) and is more common in the neonatal period (infants less than 44 days old) than any other time in life and is an important cause of morbidity and mortality globally.¹ Mortality is roughly half in developing countries and ranges from 8%-12.5% in developed countries.²

Symptoms seen with neonatal meningitis are often unspecific that may point to several conditions, such as sepsis (whole body inflammation). These can include fever, irritability, and dyspnea. The only method to determine if meningitis is the cause of these symptoms is lumbar puncture (LP; an examination of the cerebrospinal fluid).¹

The most common causes of neonatal meningitis is bacterial infection of the blood, known as bacteremia (specifically Group B Streptococci (GBS; Streptococcus agalactiae), Escherichia coli, and Listeria monocytogenes).¹ Although there is a low mortality rate in developed countries, there is a 50% prevalence rate of neuro developmental disabilities in E. coli and GBS meningitis, while having a 79% prevalence for non-E. coli Gram-negative caused meningitis.¹ Delayed treatment of neonatal meningitis may cause include cerebral palsy, blindness, deafness, and learning deficiencies.³ In this study we assessed hearing problems in a child (age 1 month to 2 yrs) with meningitis by BERA. Brainstem evoked response audiometry though more time-consuming, is an accurate test for early detection of neural conduction irregularities in the auditory pathway. It is a short latency response. It detects electrical activity from the inner ear to the inferior colliculus. It can be reliably recorded even in premature infants of 30 weeks gestational age. It gives an estimate of degree and type of hearing impairment. It helps to find the cause of delayed speech. It is used to localize the site of lesion in patients with hearing loss and vertigo. BERA is superior to pure tone audiometry in malingering patients. Threshold estimation by BERA is used to identify hearing impairment in neonates thus facilitating early rehabilitation. The existence of peak V is considered as sound stimulus perceived by the ear. Pure tone threshold can be obtained by subtracting 5-10 dB from the point where wave V is just identifiable. It is an effective tool in assessing the sensorineural hearing loss in patients with meningitis as it is more sensitive & specific. Also when OAE failed twice then we use BERA as per national guideline.

To evaluate the sensorineural hearing following meningitis in children between 1 month to 2 years.

MATERIALS AND METHODS

Source of data:

Children admitted to paediatric ward between 1 months to 2 years of age with Meningitis.

Method of collection of data:

Study design- cross sectional study.

Samples size- Sample size is proposed to include 30 cases of Meningitis. The sample size is proposed on the basis of hospital records of minimum number of cases seen at R G KAR Medical College in previous year.

Inclusion Criteria:

Children of 1 month to 2 years of age with signs and symptoms of Meningitis

Exclusion Criteria:

Children with:

1. History suggestive of Neurodevelopmental delay.
2. Hearing impairment prior to illness.
3. Family history of hearing impairment.

Mode of collection of data:

All children between 1 month to 2 years with clinical signs and symptoms suggestive of meningitis were subjected to CSF analysis. Those children satisfying the inclusion criteria were included as cases. The data regarding the detailed history and examination were collected in a predesigned proforma. CSF analysis, Gram's stain, CSF culture, CBNAAT, blood culture, viral culture, serum electrolytes & neuroimaging were done to identify the etiology.

All the patients had received the treatment as per the standard protocol for treatment of meningitis.

Once the patient is diagnosed to be clinically cured of meningitis, an Audiological assessment was done at the time of discharge using BERA (Brainstem Evoked Response Audiogram).

The association of demographic findings, clinical feature & laboratory investigations with BERA study was analysed using appropriate statistical methods.

Statistical Analysis:

For statistical analysis data were entered into a Microsoft excel spreadsheet and then analyzed by SPSS 24.0. and GraphPad Prism version 5. Data had been summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables. Two-sample t-tests for a difference in mean involved independent samples or unpaired samples. Paired t-tests were a form of blocking and had greater power than unpaired tests. A chi-squared test (χ^2 test) was any statistical hypothesis test wherein the sampling

distribution of the test statistic is a chi-squared distribution when the null hypothesis is true. Without other qualification, 'chi-squared test' often is used as short for Pearson's chi-squared test. Unpaired proportions were compared by Chi-square test or Fischer's exact test, as appropriate.

p-value ≤ 0.05 was considered for statistically significant.

RESULT AND DISCUSSION

This is a cross sectional, observational study of children aged 1 month to 2 years who is admitted in Department of Paediatrics, R. G Kar. Medical college, Kolkata during the period of January 2017-June 2018, the study includes 30 babies who were suffering from Meningitis.

We found that the mean age (mean $\pm$ s.d.) of patients was 8.3333 $\pm$ 6.0931 months with range 2.0000- 22.0000 months and the median was 6.0000 months.

Chandrashekar C et al.⁴ found that twenty-two (73.26%) were males and 8 (26.74%) were females. Present study found that 13(43.3%) patients were female and 17(56.7%) patients were male.

Chandrashekar C et al.⁴ found that 30 children enrolled in the study, 6 (20%) developed SNHL following ABM, of which, 4 (13.33%) had mild SNHL, 2 (6.66%) had moderate SNHL and none had severe or profound hearing loss.

Jiang ZD⁵ found that abnormal BAER results were seen in 9 of the 70 children (12.9%), We found that out of 30 patients 23 (76.7%) patients had no hearing loss, 3 (10.0%) patients had mild hearing loss, 1 (3.3%) patient had moderate hearing loss and 3 (10.0%) patients had severe hearing loss in right ear.

We also showed that 24 (80.0%) patients had no hearing loss, 1 (3.3%) patients had mild hearing loss, 2 (6.7%) patients had moderate hearing loss and 3 (10.0%) patients had severe hearing loss in left ear.

We also found that 7 (23.3%) patients had abnormal BAER results in right ear and 6 (20.0%) abnormal BAER results in left.

Chandrashekar C et al.⁴ found that Etiology could be identified in only 3 (10%) cases; S. pneumoniae, H. influenzae and N. meningitidis were responsible for 1 case each.

Husain, et al.⁶ conducted a retrospective review of 104 children with confirmed bacterial meningitis identified at 8 tertiary Canadian hospitals. Their review revealed S. pneumonia (56%), Group B streptococcus (13%), N. meningitidis (11%), H. influenzae type B (8%), and E. coli (5%) to be the most common organisms causing bacterial meningitis. Group B streptococcus was the main organism associated with bacterial meningitis during the neonatal period (58% of cases) whereas S. pneumoniae was more common beyond the neonatal period. Hearing loss was identified in 12/104 (11.5%) of cases.

Bacterial meningitis is associated most commonly with Haemophilus influenzae type b, Streptococcus pneumoniae, and Neisseria meningitidis.⁷ With the introduction of vaccines for H. influenzae type b in the 1990's, the number of cases of meningitis and resultant hearing loss due to H. influenzae has been greatly reduced leaving S. pneumonia and N. meningitidis to become the leading causes of bacterial meningitis in the US.⁸ The most common pathogens causing meningitis related hearing loss are also those most likely to cause cochlear ossification (Streptococcus pneumoniae > Neisseria meningitidis > Haemophilus influenzae).⁹

We found that 1 (7.1%) patients had escherichia coli, 1 (7.1%) patients had group b streptococcus, 2 (14.3%) patients had Haemophilus influenzae, 2 (14.3%) patients had klebsiella pneumoniae, 3 (21.4%) patients had neisseria meningitidis, 1 (7.1%) patients had staph aureus and 4 (28.6%) patients had streptococcus pneumoniae as a causative organism among blood culture positive babies.

Chandrashekar C et al.⁴ found that increased CSF protein level (p < 0.014), CSF cell count (p < 0.001), CSF neutrophils (p < 0.0068).

We had observed that CSF protein level was increased and CSF sugar level was decreased (<2/3 of CBG) in all cases (100.0%) with clinical features of meningitis.

The mean cell count (mean $\pm$ s.d.) of patients was 24.6333 $\pm$ 6.7797 with ranges 14.0000-41.0000 and the median was 24.0000.

The mean neutrophil count (mean $\pm$ s.d.) of patients was 40.6333 $\pm$ 17.5371 % with range 10.0000 - 74.0000% and the median was 35.0000%.

The mean Lymphocyte count (mean $\pm$ s.d.) of patients was 59.3667 $\pm$ 17.5371% with range 26.0000 - 90.0000% and the median was 65.0000%.

Jiang ZD⁵ found that the main complications during hospitalization included seizures (22 cases), hydrocephalus (8 cases), enlarged ventricles (6 cases), subdural effusion (6 cases), coma (9 cases), nerve palsies (4 cases), and anemia (5 cases).

We found that 2 (6.7%) patients had enhancing basal exudates, 17 (56.7%) patients had normal impression and 11 (56.7%) patients had ventriculomegaly on neuroimaging with clinical features of meningitis.

Incidence of SNHL in ABM has been reported to range from 10% to 47% by other authors.⁸ Carroll and Carroll¹⁰ observed SNHL in 32.2% of patients with bacterial meningitis. A much higher incidence of SNHL (47%) was found in another study in which hearing was tested immediately following meningitis by BERA.¹¹ On the other hand, the incidence of SNHL was 10.3% in another prospective study.¹⁰

According to SNHL in right ear, in positive blood culture babies, 9 (64.3%) patients had no hearing loss, 3 (21.4%) patients had mild hearing loss and 2 (14.3%) patients had severe hearing loss. Association of SNHL right vs. blood culture was not statistically significant (p=0.1504).

According to SNHL in left ear in positive blood culture babies, 9 (64.3%) patients had no hearing loss, 1 (7.1%) patients had mild hearing loss, 2 (14.3%) patients had moderate hearing loss and 2 (14.3%) patients had severe hearing loss. Association of SNHL left vs. blood culture was not statistically significant (p=0.1934).

CONCLUSION

BERA is a helpful tool for assessing the severity of Hearing loss in post-meningitis patient. It may delineate the anatomical location of the intra-cranial lesions based on the abnormalities detected in various wave forms. It is a useful test for screening of SNHL, especially in the young children and infants in whom other conventional methods may not be of much use. There is significantly increased risk of developing SNHL if the CSF has increased cells, particularly polymorphs and proteins.

Table: Distribution of Mean Age, CELL COUNT, CELL TYPE NEUTROPHIL, LYMPHOCYTE, CSF SUGAR and CSF PROTEIN

	Mean	SD	Minimum	Maximum	Median
Age	8.3333	6.0931	2.0000	22.0000	6.0000
CELL COUNT	24.6333	6.7797	14.0000	41.0000	24.0000
CELL TYPE NEUTROPHIL (%)	40.6333	17.5371	10.0000	74.0000	35.0000
LYMPHOCYTE (%)	59.3667	17.5371	26.0000	90.0000	65.0000
CSF SUGAR (mg/dl)	32.1333	3.2135	26.0000	37.0000	32.0000
CSF PROTEIN (mg/dl)	92.8667	15.2942	64.0000	120.0000	96.0000

Table: Distribution of Organism

Organism	Frequency	Percent
Escherichia Coli	1	7.1%
Group B Streptococcus	1	7.1%
Haemophilus Influenzae	2	14.3%
Klebsiella pneumoniae	2	14.3%
Neisseria meningitidis	3	21.4%
Staph Aureus	1	7.1%
Streptococcus Pneumoniae	4	28.6%
Total	14	100.0%

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