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Original Article

Comparative study of Automated Auditory Brainstem Response (AABR) and Brainstem Evoked Response Audiometry (BERA) for Hearing Loss Detection in High Risk Infants delivered in Dhulikhel Hospital

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ABSTRACT

Background & Objective: Brainstem evoked response audiometry (BERA) is most specific and sensitive test for brain stem dysfunction. It is most important objective method for evaluating peripheral auditory system in neonates, infants, sedated and comatose patients and other person who doesn't understand the language. Objective of the study was to evaluate correlation BERA with other audiological tests in different types of hearing loss.

Material and Methods: This was a hospital based retrospective observational analytic study that used a cross-sectional approach. The sampling used was consecutive sampling until the minimum size fulfilled from 1st September 2021 to 30th September 2022. All high-risk infants aged 0–3 months who suffer from asphyxia, sepsis, LBW, premature, and hyperbilirubinemia, the baby was stable and transportable, the patient's parents were willing to participate were taken.

Results: Out of 46 high risk infants of 0 - 3 months, male:female ratio of 1.7:1 with mean age of 31 days, the most common high risk factor was low birth weight and hyperbilirubinemia i.e 23(50%). 64% of infants were pass in AABR 2nd test in comparison to 71% pass in BERA test.

Conclusion: There was no difference between AABR and BERA results for HL detection in high-risk infants at NICU.

Keywords: Auditory, deafness, hearing screening

INTRODUCTION

Hearing loss is a well-documented congenital abnormality. It has an impact on the quality of life of the patient, the family members and society. The goal of early hearing detection and intervention (EHDI) is to maximize linguistic competence and literacy development for

children who are deaf or hard of hearing [1]. Without appropriate opportunities to learn language, these children will fall behind their hearing peers in communication, cognition, reading, and social-emotional development. Such delays may result in lower educational and employment levels in adulthood. To maximize the outcome for infants who are deaf or hard of hearing, the hearing of all infants should be screened no later than 1 month of age [2].

Testing hearing in children is performed to identify and quantify any hearing impairment, to localize site of any pathological process and to assess any resulting hearing disability [3]. Newborn hearing screening program became possible after the development of hearing screening technologies like ABR [4]. The Auditory Brainstem Response (ABR) is a neurophysiological test used to assess the functionality of the central auditory pathway, which includes structures from the auditory nerve to the rostral brainstem [5]. Newborn hearing screening plays a major role in early detection of hearing loss, especially in those at risk. Hence this study aims to compare the result of various technology for detection of hearing loss in infants delivered in Dhulikhel Hospital.

MATERIAL AND METHODS

This was a hospital based retrospective observational analytic study that used a cross-sectional approach. The sampling used was consecutive sampling until the minimum size fulfilled from 1st September 2021 to 30th September 2022. Inclusion criteria were high-risk infants aged 0–3 months who suffer from asphyxia, sepsis, LBW, premature, and hyperbilirubinemia, the baby was stable and transportable, the patient's parents were willing to participate and signed the informed consent. The study protocol was approved by Instituitional Review Board (IRB).

Several tools used for ear examination were headlamps, cotton wool, cotton, and otoscope. AABR: MB11 or BERA Phone was made by Maico, Germany in 2011. BERA tool: Interacoustics Assens DK-5610 was made in Denmark, 2010. BERA was performed by an audiologist. The results of AABR and BERA were read by a specialist doctor of otorhinolaryngology head and neck surgery and recorded in the data collection sheet; then the data were processed statistically. The data were processed descriptively using a diagnostic test such as the calculation of sensitivity, specificity, positive predictive value, and negative predictive value.

RESULTS

During the study period, 46 high risk infants were included. Each subject underwent 2 examinations of AABR and BERA on the right and left ear. The basic data of the subjects were age distribution, gender distribution, high-risk factors, AABR results, BERA results, and HL threshold from the BERA results. Table 1 showed that the most age group of high-risk infants was 0–1 month's as many as infants (45%). The youngest was <1 month (21 days) and the oldest was <3 months (85 days) with mean age of 31.23. Table 2 showed 29 male infants (63%) and 17 female infants (37%). The ratio of male to female was 1.7:1.

Table 1: Age Distribution

Age	Amount	Percentage
0-1 month	21	45
1-2 month	13	28
2-3 month	12	27
Total	46	100

Table 2: Sex Distribution

Sex	Amount	Percentage
Male	29	63
Female	17	37
Total	46	100

We found that the most risk factor was LBW and hyperbilirubinemia of 23 infants (50%), asphyxia of 21 infants (45%) as shown in Table 3.

Table 3: High Risk factors

Risk factors	Amount	Percentage
Asphyxia	21	45
Sepsis	3	7
Low birth weight	23	50
Prematurity	15	33
Hyperbilirubinemia	23	50
Prolonged ventilation	16	35
Ototoxic medications	7	15

Table 4 showed that the AABR results of pass (negative) were 59 infant ears (64%) and refer (positive) were 33 infant ears (36%). Distribution of subjects based on the BERA results could be seen in Table 5. BERA obtained normal (negative) results of 65 infants (71%) and abnormal (positive) results of 27 infants (29%).

Table 4: AABR 2nd test

AABR	Amount	Percentage
Pass(negative)	59	64
Refer(positive)	33	36
Total	92	100

Table 5: BERA test

BERA	Amount	Percentage
Normal(negative)	65	71
Abnormal(positive)	27	29
Total	92	100

Table 6: Threshold degree of auditory based on BERA

Threshold degree	Amount	Percentage	Description
0-25	65	71	Normal
26-40	27	29	Mild
41-60	0	0	Moderate
61-90	0	0	Severe
>90	0	0	Profound
Total	92	100	

The distribution of the subjects based on the threshold degree of the BERA results was shown in Table 6.

DISCUSSION

Auditory development in humans was closely related to the brain development [6]. Neurons in the cortex undergo a maturation process in the first 3 years of life and a rapid brain development occurs in the first 12 months of life. The critical period for the development of hearing and speech systems begins in the first 6 months of life and it continues to grow until the age of 2 years [7]. Difficulties associated with a reliable hearing test for the young infantsincluded appreciation of their generalize compromised condition, which always put the babies ina non-ideal state for hearing screening, and the reduction of electrical interference and excessive noise from the environment [8].

With the ABR as the criteria validity measure, Jacobson reported that the sensitivity and specificity of the Algo-l were 89 and 96%, respectively, and the overall efficiency was 95% [9]. The prevalence of hearing loss in at-risk infants was reported to be between 2 and 20%; among such babies, a conductive hearing deficit accounted for60-80% and the sensorineural hearing impairment was 1.4-6% [10]. As for the retesting of infants who

passed the initial ABR, Baradaran far reported either no hearing loss or no significant hearing loss on follow-up test sat 3 to 12 months of age [11]. However, Jiang reported 11high-risk infants who passed the initial ABR but were found to have significant sensorineural hearing loss on follow-up [12].
HL due to the immaturity of the anatomy and physiology of the auditory organs [13]. LBW in a study conducted by Yang against 286 newborns showed that the highest risk factors were LBW of 146 infants (51.1%), premature of 39 infants (13.6%), asphyxia as many as 38 infants (13.3%), and hyperbilirubinemia of 25 infants (8.7%) [13].

This study was in accordance with a research conducted by Mason *et al*., in Taiwan that obtained 36 normal ears (47.36%) and V wave was detected at 35 dB. Then, mild HL of 22 ears (28.94%) was obtained and V wave was detected at 45 dB. The moderate HL was obtained in 18 years (23.68%) and V wave was detected at 60 dB of 76 infant ears aged 3–4 months [14].

The sensitivity of the hearing screen, and associated false-negative rate, had less improvement over time and demonstrated less consistency across any given year [15]. There is no single year where we observe a sustainable positive shift in the false-negative rate so this issue remains a prominent challenge, at least as of 2007. Infants with a longer length of stay and those with neonatal infections had an increased likelihood of a false-negative result, which indicates that targeted follow-up among these infants is important to ensure the earliest diagnosis possible [16]. This assessment of false-negative rates may be biased due to the way in which coded for hearing loss. Premature birth is a well-known risk factor for sensorineural hearing loss in general and auditory neuropathy in particular. However, relatively little is known about the underlying causes, in part because there are so few relevant histopathological studies [17].

Different literature reviews also postulate that hyperbilirubinemia alone doesn‘t in actual cause hearing loss but has a synergistic action along with other risk factors [18]. All children with unilateral or bilateral hearing loss selected for early intervention need evaluation and consideration of enrollment [19]. It has to be ensured that families are provided with access to information and counselling regarding their child‘s hearing loss and the potential impact of hearing loss on the child‘s daily life and communication development [20].

Newborn hearing screening has improved the lives of families and children who are deaf and hard of hearing [21]. It has been the greatest achievement in public health over the past ten years. This research has shown we still have a long way to go to develop truly comprehensive systems of care that are community based and culturally competent for all the families we serve [22].

CONCLUSION

BERA is a valuable and reliable tool in the diagnosis and management of the patients with sensorineural hearing loss. Its main application is as an objective test for estimation of auditory sensitivity in all cases in which the cooperation of the patient is unobtainable or doubtful and who are unfit for behavioural tests.

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Conflict of interest

The authors declare that they have no conflict of interest.

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