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Original Research Article

A study of hearing loss in infants using brain stem evoked response audiometry

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ABSTRACT

Background: Hearing is necessary to learn languages and speech and to develop cognitive skills. Unfortunately, many children with severe hearing loss from birth are not diagnosed until 21/2-3 years. of age. Implementing high-risk neonatal screening, detecting hearing loss before 3 months, and intervention before 6 months will result in a better speech performance of neonates.
Methods: Detailed history taking and general and ear, nose and throat (ENT) examination were done to rule out external ear and middle ear pathology. Brainstem evoked response audiometry (BERA) was done in a dust-free, sound-proof, airconditioned room. Feed was given 10–15 min before the procedure. Syrup pedichloryl 20 mg/kg was given to sedate the baby half an hour before the procedure. Intelligent hearing system BERA instrument was used. The study included a total of 60 infants. 30 were in the high-risk group and 30 were in the normal group. There were 14 males and 16 females in each group.
Results: 21 infants had hearing loss out of the 30 infants in the high-risk group on initial screening. On doing a repeat BERA after 3 mins on the affected infants, 3 were detected to have normal hearing, i.e., 18 out of 30 infants were affected. All the infants in the normal or no risk factor group had normal hearing.
Conclusions: The present study emphasizes the importance of using ABR as a screening tool for the detection of hearing impairment at an early stage which would have otherwise go unnoticed for about 2-3 years. Since it is an objective test, it is useful in the early identification of hearing loss.

Keywords: Brain stem evoked response audiometry, Hyperbilirubinemia

INTRODUCTION

Hearing is a crucial link in the development of normal speech and language. The human ear has evolved in such a way as to be tuned with sensitivity to the range of human speech. Speech is the primary mode of human communication, but its acquisition relies upon auditory experiences during a critical period between birth and three years. With sensory experiences deprivation, a child's speech and language development will never fully attain its potential. Additionally, delays in speech and language development can cause delays in other aspects of child development, such as literacy, overall academic achievement, social and emotional development.

Speech and language development may begin as early as in the womb. However, environmental stimulation is of paramount importance to strengthen synaptic connections. If there is no stimulation, as in the case of deafness, the synapses die out. Hence, for synaptic maturation, the speech must be audible. Audition is vital in the process of normal speech and language development.

A deaf infant who ages without the ability to hear speech has fewer and fewer synapses available to develop

auditory perceptions and language skills (Chugani, 1997).[1] These effects on development can be reduced with intervention. However, due to the brief and early critical period for language hearing, this intervention must occur as soon as possible in the hearing-impaired child's life.

The joint committee on infant hearing 2007 position statement endorses early detection and intervention for infants with hearing loss. Early detection and intervention are to maximize linguistic competence and literacy development for children who are deaf.

All newborns should be screened at no later than one month of age for hearing. Those who do not pass screening should have a comprehensive audiological evaluation at no later than three months of age. Infants with hearing loss should receive intervention at no later than six months of age from healthcare and educational professionals with expertise in managing hearing loss and deafness in infants and young children.[2]

In this context, the present study aims to evaluate the performance of brainstem evoked response audiometry (BERA) in detecting hearing loss in high-risk and normal neonates.

Aims and objectives

The objectives of the research were: to study the incidence of hearing loss in normal and high-risk infants by using BERA, to confirm the hearing impairment and its magnitude in the abnormal study subjects using a follow-up BERA, and to analyze common risk factors associated with sensorineural hearing loss.

METHODS

Source of data

Infants are brought to ENT OPD, and infants are referred from the obstetrics department for screening.

Methods of collection of data

Study design

The design of the study was hospital-based prospective study.

Study period

The duration of the study was from June 2018 to July 2019.

Place of study

The study was conducted at the department of otolaryngology, Santhiram General Hospital, attached to Santhiram Medical College.

Sample size

The sample size was 60 (30 normal and 30 high risk) infants.

Inclusion criteria

All infant (both normal and high risk) patients of both the sexes referred to the outpatient department of ENT for screening of sensorineural hearing loss will be included in the study. Only those cases registered, who will give consent for the protocol were included.

High-risk criteria include

High-risk criteria include: family history of congenital or delayed onset childhood sensorineural hearing loss; maternal infections-toxoplasmosis, syphilis, rubella, cytomegalovirus, herpes; birth weight <1500 gm; hyperbilirubinemia at a level exceeding for exchange transfusion; ototoxic drugs (aminoglycosides) (infant and mother); bacterial meningitis; severe respiratory depression at birth; stigmata or other findings associated with a syndrome known to include sensorineural hearing loss (e.g., Waardenburg's or Ushers syndrome); and consanguineous marriage of parents.

Exclusion criteria

Parents not willing to give consent were excluded.

Methodology

Detailed history taking and general and ENT examination were done to rule out external ear and middle ear pathology. BERA was done in a dust-free, sound-proof, airconditioned room. Feed was given 10–15 min before the procedure. Syrup pedichloryl 20 mg/kg was given to sedate the baby half an hour before the procedure. Intelligent hearing system BERA instrument was used.

Data will be analyzed statistically using descriptive statistics.

RESULTS

The study included a total of 60 infants. 30 were in the high-risk group and 30 were in the normal group. There were 14 males and 16 females in each group.

21 infants had hearing loss out of the 30 infants in the high-risk group on initial screening. On doing a repeat BERA after 3 m on the affected infants, 3 were detected to have normal hearing, i.e., 18 out of 30 infants were affected.

All the infants in the normal or no risk factor group had normal hearing.

There were 8 infants with birth asphyxia, 10 infants with hyperbilirubinemia, 1 with cytomegalovirus infection, 5

infants with low birth weight, 2 infants with craniofacial anomalies, and 4 infants with a family history of hearing loss.

21 infants had hearing loss out of the 30 infants in the high-risk group on initial screening. All the infants in the normal or no risk factor group had normal hearing.

Table 1: Incidence of hearing loss among high-risk babies and normal infants.

Variables	Affected (%)	Not affected (%)	Total (%)
High risk infants	21 (70)	9 (30)	30 (100)
Normal infants	0	30 (100)	30 (100)
Total	21	39	60

On doing a repeat BERA after 3 m on the affected infants, 3 were detected to have normal hearing, i.e., 18 out of 30 infants were affected.

There were 8 infants with birth asphyxia, 10 infants with hyperbilirubinemia, 1 with cytomegalovirus infection, 5 infants with low birth weight, 2 infants with craniofacial anomalies, and 4 infants with a family history of hearing loss.

Table 2: The difference in the incidence of hearing loss in high-risk infants before and after 3 m using BERA.

Variables	Hearing loss (%)		
	Present	Absent	Total
Before 3 months	21 (70)	9 (30)	30 (100)
After 3 months	18 (60)	12 (40)	30 (100)

Table 3: Hearing level among various risk factors in the left ear in males.

Risk factor	Mild (%)	Moderate (%)	Severe (%)	Maturational delay (%)	Normal (%)	Total
Birth asphyxia	-	-	1 (25)	1 (25)	2 (50)	4
Hyper bilirubinaemia	1 (25)	-	2 (50)	-	1 (25)	4
Low birth weight	-	-	-	-	2 (100)	2
CMV	-	-	-	-	-	-
Family history of hearing loss	-	1 (33.33)	-	-	2 (66.6)	3
Craniofacial anomalies	-	1 (100)	-	-	-	1

Table 4: Hearing level among various risk factors in the right ear in males.

Risk factor	Mild (%)	Moderate (%)	Severe (%)	Maturational delay (%)	Normal (%)	Total
Birth asphyxia	1 (25)	-	1 (25)	1 (25)	1 (25)	4
Hyper bilirubinaemia	1 (33.3)	-	2 (66.6)	-	-	3
Low birth weight	-	-	-	-	2 (50)	2
CMV	-	-	-	-	-	-
Family history of hearing loss	-	-	1 (33.3)	-	2 (66.6)	3
Craniofacial anomalies	-	1 (100)	-	-	-	1

Table 5: Hearing level among various risk factors in the left ear in females.

Risk factor	Mild (%)	Moderate (%)	Severe (%)	Maturational delay (%)	Normal (%)	Total
Birth asphyxia	-	3 (75)	-	-	1 (25)	4
Hyper bilirubinaemia	1 (16.6)	-	2 (33.3)	-	3 (50)	6
Low birth weight	-		-	-	3 (100)	3
CMV	1 (100)	-	-	-	-	1
Family history of hearing loss	--	-	-	-	1 (100)	1
Craniofacial anomalies	-	-	-	-	1 (100)	1

Table 6: Hearing level among various risk factors in the right ear in females.

Risk factor	Mild (%)	Moderate (%)	Severe (%)	Maturational delay (%)	Normal (%)	Total
Birth asphyxia	-	3 (75)	1 (25)	-	-	4
Hyper bilirubinaemia	1 (16.66)	-	2 (33.3)	-	3 (50)	6
Low birth weight	-		-	-	3 (100)	3

Continued.

Risk factor	Mild (%)	Moderate (%)	Severe (%)	Maturational delay (%)	Normal (%)	Total
CMV	1 (100)	-	-	-	-	1
Family history of hearing loss	-	-	-	-	1 (100)	1
Craniofacial anomalies	-	-	1 (100)	-	-	1

DISCUSSION

Among the infants with birth asphyxia, one infant had normal hearing, one had unilateral severe hearing loss and the rest had bilateral hearing loss.

Of the infants with bilateral hearing loss, 2 had severe hearing loss, 2 had moderate hearing loss, 1 had mild hearing loss, and 1 had a maturational delay.

Among the infants with hyperbilirubinemia, 2 had normal hearing and 8 had bilateral hearing loss in the initial screening. On repeat screening, 1 infant with maturational delay and 1 with mild hearing loss had normal hearing. Finally, we had 4 infants with severe hearing loss and 2 infants with mild hearing loss had 1 infant with mild hearing loss in the maternal infections group.

Of the 5 infants in the low-birth-weight group, 4 had normal hearing and 1 had a maturational delay on initial screening, on doing a repeat test the infant with maturational delay had normal hearing.

There were 4 infants with a family history of hearing loss, of which 2 had normal hearing, 1 had unilateral severe, and 1 had unilateral moderate hearing loss.

Hyperbilirubinemia is the most common risk factor associated with sensorineural deafness in neonates.[3]

CONCLUSION

The present study emphasizes the importance of using ABR as a screening tool for the detection of hearing impairment at an early stage which would have otherwise go unnoticed till about 2-3 years. This would further help us in the early rehabilitation of the child as this would make the child socially acceptable.

ABR audiometry because of its accuracy has emerged as a technique of choice in screening infants.[4] Since it is an objective test it is useful in the early identification of hearing loss.[5]

Severe deafness in children is usually due to sensorineural hearing loss rather than conductive loss or auditory processing disorders.[6]

Sensorineural deafness can be due to causes such as: hereditary (genetic), prenatal (rubella), perinatal (kernicterus and birth asphyxia), and childhood acquired deafness (following meningitis, trauma).

Delayed cry, birth asphyxia, cerebral palsy, and neonatal seizures can cause brain hypoxia affecting central auditory pathways and leading to hearing loss.[7] In babies with neonatal jaundice, bilirubin toxicity or transient brainstem encephalopathy can cause sensorineural deafness.[8] This is usually transient and improves with phototherapy. Persistent hearing loss in some cases is due to axonal degeneration and loss of myelin.

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