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Original Research Article

Incidence of hearing impairment in at risk babies

Manjushree R[1], Bhagya V[2,*], Brid S V[3]

[1]*Dept. of Physiology, Adichunchanagiri Institute of Medical Sciences, Mandya, Karnataka, India*
[2]*Dept. of Physiology, JJM Medical College, Davangere, Karnataka, India*
[3]*Dept. of Physiology, SN Medical College, Bagalkot, Karnataka, India*

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ABSTRACT

Introduction: Babies treated in neonatal intensive care are prone for hearing problems and with the decrease in infant mortality, babies who survive many perinatal risk factors are increasing. Deafness in 1st three years of life may impair the full development & maturation of auditory system & it is well known that deafness in infancy & childhood interferes with normal development of speech & language. To prevent this & to initiate rehabilitative procedure as early in life as possible a screening method to detect auditory disabilities in newborns is of great importance. Based on this background the present study determine to evaluate to know the incidence of hearing impairment in infants at risk.

Materials and Methods: This is a prospective observational study conducted in JJM Medical College, Davanagere, Karnataka. A total 940 patients attended to JJM Medical College and Hospital and diagnosed with hearing impairment according to American Joint Committee statement on infant hearing screening (JCIH) criteria. All the patients under 2 years with history of high risk factors – pre–term, low birth weight, birth asphyxia, neonatal seizures, and hyperbilirubinemia were selected for the study. Those who failed in this test underwent repeated OAE after 6 weeks, followed by brain stem evoked response audiometry (BERA) if the second OAE was negative.

Results: Out of 940 high risk cases, 350 had profound hearing loss, 83 had severe hearing loss, 125 had moderate hearing impairment, 36 had mild hearing impairment &346 had normal hearing sensitivity. Out of 48 patients with normal hearing sensitivity, 53 patients were preterm, 166 had hyperbilirubinemia, 23 had neonatal convulsions, 68 birth asphyxia, 89 were of low birth weight. Out of 147 cases 31 patients had mild/moderate hearing impairment.

Conclusion: Neonatal jaundice carries the highest risk of hearing impairment followed by birth asphyxia, neonatal convulsions and low birth weight. BERA is the tool which can confirm the normal sensitivity of hearing whenever required & is very useful in early detection of hearing loss and planning rehabilitative procedures.

1. Introduction

There is a1% to 28% incidence of severe hearing loss among survivors of neonatal intensive care, while mild to moderate deficits are even more prevalent.[1] In a considerable number, hearing loss persists and in some of these babies there is a transient loss of hearing.[2] Deafness in 1st three years of life may impair the full development & maturation of auditory system & it is well known that deafness in infancy & childhood interferes with normal development of speech & language. In the absence of normal speech, child's ability to communicate is restricted & this has a negative impact on child's social, emotional, cognitive &

* *Corresponding author.*
E-mail address: drbhagyav1980@gmail.com (Bhagya V).

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academic development.[3] Consequently, as a child grows into adulthood, his/her vocational & academic potential is significantly attenuated & family/society is left to bear the cost of the care of an otherwise healthy individual for life.

To prevent this & to initiate rehabilitative procedure as early in life as possible a screening method to detect auditory disabilities in newborns is of great importance. Although many methods like -behavioral audiometry, impedance audiometry, respiratory & cardiac responses & crib movement systems are evaluated, BERA that gives information on threshold sensitivity of peripheral part of auditory apparatus & on conduction velocity in the brainstem is a satisfactory procedure and can be performed with ease in children.[4] The risk factors according to joint committee on Infant Hearing are family history,in utero infections, craniofacial anomalies, birth weight <1500g, hyperbilirubinemia at serum levels requiring exchange transfusion, ototoxic medications, postnatal asphyxia.[5] The high prevalence of hearing impairment in this population underlines the importance of early audiological testing.[6] A proper protocol and methodology is required for the early detection of hearing loss so that rehabilitation can be started at the earliest. In this study, the incidence of hearing loss is found to be more in high-risk neonates as compared to normal ones. As OAE is simple and quick, it is preferred for screening, but BERA is required for the definitive diagnosis.[7] There are very few south indian studies are there and there is a need on this area, Based on this background the present study was done to know the incidence of hearing loss& to evaluate the relative importance of the various otonoxious risk factors in producing hearing impairment in infants at risk in & around Davangere city.

2. Materials and Methods

This is a prospective observational study was conducted in department of Physiology at JJM Medical College, and Davangere after obtaining ethical clearance from the institute. A total 940 patients attended to JJM Medical College and Hospital and diagnosed with hearing impairment according to American Joint Committee statement on infant hearing screening (JCIH) criteria.[8] All the patients under 2 years with history of high risk factors – pre–term, low birth weight, birth asphyxia, neonatal seizures, and hyperbilirubinemia were selected for the study. Those who failed in this test underwent repeated OAE after 6 weeks, followed by brain stem evoked response audiometry (BERA) if the second OAE was negative. All the patients were included after obtaining the consent form from the parents as well as after applying the exclusion criteria. The risk factors which were assessed included those are Low birth weight (less than 2 lb) and/or prematurity, Assisted ventilation (to aid with breathing for more than 10 days after parturition), Low Apgar scores with severe birth asphyxia (defined as Apgar score of three or less at 1 min of age), Severe jaundice after birth requiring exchange transfusion or serum bilirubin level >20 mg/deciliter, Hydrocephalus Maternal illness during pregnancy, An illness or condition requiring admission of 24 h or more to a NICU, Stigmata or other findings associated with a known syndrome to include a sensorineural and conductive hearing loss, Family history of permanent childhood sensorineural hearing loss, Craniofacial anomalies including those with morphological abnormalities of the pinna & ear canal, In utero infection by TORCH group of organisms, Respiratory distress;(presence of at least two of the following criteria-respiratory rate more than 60 per minute/subcostal or intercostal recession/expiratory grunt or groaning, Meningitis and sepsis with positive CSF and blood cultures respectively, Parental concern.

2.1. Procedure

All patients were administered the test procedures with prior appointment. An ENT check up was done to rule out the possibility of wax, ear infection, middle ear problems etc. The parents were instructed to wash the scalp of the child thoroughly as a requirement of the test. Prior to the test, each child was examined by the paediatrician and the dosage for sedation was prescribed. Drug used for sedation was syrup Triclofos 20mg/kg body wt. or diazepam 0.1mg/kg body wt. The instrument used was RMS EMG. EP MARK –II machine which is a fully computerized machine manufactured by RMS Recorders & Medicare System Chandigarh. Test was carried out in pre–cooled, quiet, dimly lit room with subject relaxed in supine position with eyes closed. The skin was cleaned with spirit and OMEN abrasive skin preparatory paste. The silver electrode were placed as follows: Cz–vertex, both mastoid, (Ai & Ac) forehead (ground). Resistance was not more than 1ohms. Electrode electrolyte gel was used and electrodes were fixed. Acoustically shielded THD 32 ear phones were placed on the ear and head bands were adjusted. Monaural auditory stimulus consisting of rare faction clicks of 100 microseconds with intencies starting from 30 dB to 110 dB were delivered through electrically shielded earphones at a rate of 11.1/sec. Contra lateral ear was masked. The filter settings used were 150Hz–3000Hz. The polarity used was alternate and the analysis time was 10m/sec. About 2,000responses were averaged. The existence of peakV was considered as sound stimulus heard and perceived by the auditory mechanism. The threshold for each ear was confirmed. The guidelines used for the confirmation of peak V were as follows:

1. Peak V occurs around latency of 5.7 m/sec with S.D. of 0.25 (as per our norms).
2. With decrease, an intensity level latency of peak V increases and its amplitude decreases.

3. Peculiar in shape.

2.2. Statistical analysis

The data analysis was done by using Microsoft Excel Spread Sheet and data expressed in Percentage.

3. Results

Table 1 shows the WHO's Grades of hearing impairment and corresponding audiometric ISO value(a,b). In that 0: no impairment, 1: slight impairment, 2: moderate impairment, 3: severe impairment, 4: profound impairment including deafness, with ISO Values respectively 25 dB or better, 26–40 dB, 41–60 dB, 61–80 dB and 81 dB or greater.

Table 2 shows the BERA findings out of 940 high risk cases, 350 had profound hearing loss, 83 had severe hearing loss, 125 had moderate hearing impairment, 36 had mild hearing impairment &346 had normal hearing sensitivity. Out of 48 patients with normal hearing sensitivity, 53 patients were preterm, 166 had hyperbilirubinemia, 23 had neonatal convulsions, 68 birth asphyxia, 89 were of low birth weight. Out of 147 cases 31 patients had mild/moderate hearing impairment.

Table 3 shows the risk factors & severity of hearing impairment out of 280 patients with profound hearing loss, 10 patients were preterm, 18 had hyperbilirubinemia, 6 had neonatal convulsions, 12 birth asphyxia, 4 low birth weight. Out of 156 patients with severe hearing impairment 10patients were preterm, 39 had hyperbilirubinemia, 58 had neonatal convulsions, 37 had birth asphyxia and 12 had low birth weight. Out of 159 preterm cases, 44% had severe hearing loss. Out of 325 cases of neonatal jaundice 16 had mild- moderate hearing impairment & 36% had severe hearing loss. Out of 169 neonatal convulsions cases 10 had mild- moderate hearing impairment & 67% had severe hearing loss. Out of 198 birth asphyxia cases 24 had mild-moderate hearing impairment & 44.95% had severe hearing loss, hearing impairment, Out of 89low birth weight cases 10 had mild- moderate hearing impairment and 51.68% had severe hearing loss. Out of all 940 risk cases 433 (46.06%) had significant (Severe/Profound) hearing loss. All the above cases were sent for further rehabilitative procedures as per their requirement.

Table 1: Shows the WHO's grades of hearing impairment

Grade of impairment	Corresponding audiometric ISO value(a,b)
0: no impairment	25 dB or better
1: slight impairment	26–40 dB
2: moderate impairment	41–60 dB
3: severe impairment	61–80 dB
4: profound impairment including deafness	81 dB or greater

a In the better ear; b Average of 500, 1000, 2000 and 4000 Hz.

Table 2: Shows the BERA findings of study subjects

Type of Impairment	No. of. Subjects according to BERA
Normal hearing/ no impairment	346
Mild hearing impairment	36
Moderate hearing impairment	125
Severe hearing loss	83
Profound hearing loss	350
Total	940

4. Discussion

American Academy of Paediatrics' Joint Committee on Infant Hearing 1994 position statement suggests that all high risk neonates should undergo screening for hearing impairment.[6] Schulman – Galambos & Galambosstudied 325 children with BAEP 1year or more after discharge from their intensive care nursery.[9] They found 8 children (2.14%) with severe hearing loss. Galambos et alin a more recent large follow up study continues to maintain a higher incidence of significant hearing loss of 4-9%.[10] Roberts et al in another recent large follow up study could confirm hearing loss in only 2.3% therefore this issue remains controversial.[11] Study by Ira Bergman shows that the frequency of hearing loss among surviving & followed Out of 50 patients with profound hearing loss, 10 patients were preterm, 18 had hyperbilirubinemia, 6 had neonatal convulsions,12 birth asphyxia, 4 low birth weight infants was 9.7%, among survivors of neonatal seizures it was 16.7% and confirms the high frequency of hearing loss among surviving VLBW premature infants & highlights the fact that 61% of these children are otherwise neurologically & intellectually intact.[12–14]

BAER was abnormal in22/30 neonates (73.3%) with risk factors.[12] Out of 593 children (0-5 year) from High Risk category subjected to B.E.R.A. over last 5 years, 126 (21.4%) showed hearing loss. 202 children (34.06%) from Birth Asphyxia category formed the largest group.[15] Thirteen (19.2%) of 68 at risk neonates in an intensive care nursery with one or more adverse prenatal clinical factors were diagnosed to have hearing impairment by BERA testing. Among risk factors only 2 factors have been significantly correlated to hearing impairment in the affected neonates (viz; hyperbilirubinemia at level exceeding indication for exchange transfusion & birth weight (<1500gm).[16] Since most of the survivors in neonatal intensive care units have one or more identified high risk factors their BERA testing at the time of discharge is justified as a screening procedure for early detection of hearing impairment.[17]

Hearing evaluation for high – risk infants throughout the first few years of life is imperative and found the sensitivity of BAEP as a screening test to be 100%, specificity of the test is 86%. With further experience

Table 3: Shows the risk factors & severity of hearing impairment

Risk factors	No. of cases	Normal Hearing	Mild H.I.	Mod. H. I.	Severe H. L.	Profound H.L.	Total no.of cases with Severe /Profound H.L.	Percentage of cases with Severe H.L. (%)
Preterm	159	53	00	36	10	60	70	12%
Neonatal jaundice	325	166	16	26	39	78	117	47%
Neonatal convulsions	169	23	10	22	58	56	114	16%
Birth asphyxia	198	68	24	17	37	52	89	19%
LBW (<1500gm)	89	10	10	23	12	34	46	06%

& technologic advances, BAEP may prove justified for wide-spread clinical utilization in the hearing screening of high –risk newborns. By this study we can observe that infants exposed to risk factors like preterm babies, neonatal jaundice, neonatal convulsions, birth asphyxia & LBW are prone for some hearing abnormality which correlates with earlier school of thoughts as quoted below. Among these risk factors in our study we observed neonatal convulsions, birth asphyxia & neonatal jaundice carry a very high risk of hearing abnormality. Previous studies have found either that many individual neonatal variables such as high serum bilirubin concentration, low Pao2 or cyanotic attacks were associated with hearing loss.[18] Bilirubin can deleteriously affect the auditory pathway anywhere along its course in the brain stem although the cochlear nucleus is usually most involved.[19–21] Precipitation of bilirubin in nervous tissues like basal ganglia, various nuclei in the brainstem, cerebellum and hippocampus leading to kernicterus. Damage to these structures can cause cerebral palsy, mental retardation and sensorineural or central hearing loss. Animal studies suggest that acoustic trauma &aminoglycosside antibiotics may act synergistically to produce hearing loss in premature animals.[22–24] Hypoxemia has been identified as a possible ototoxinalong with that another studies concluded that brainstem auditory nuclei are particularly susceptible to acute hypoxic insults in the neonate.[25,26] Mandrita Chatterjee et al concludes that there are significant BAEP changes in children with receptive Language Disorder with varying degree of hearing loss. So hearing impairment has to be detected in the early stages & proper rehabilitative measures are taken at the earliest so that further language disorders are manifested.[27] BERA as a screening procedure will give an idea of degree of hearing impairment and proper rehabilitation measures either the surgical or hearing aids can be advised.

5. Conclusion

Neonatal jaundice carries the highest risk of hearing impairment followed by birth asphyxia neonatal convulsions and low birth weight. In case of multiple handicaps, BERA is the only test which can give accurate and objective picture of hearing sensitivity. In case of high risk babies who are exposed to multiple risk factors like preterm babies, neonatal jaundice, neonatal convulsions, birth asphyxia & LBW& even other multiple risk factors which have chances of impairing hearing ability, BERA should be carried out as a routine procedure to detect the hearing loss in such babies and its easy repeatability makes it convenient for follow up of those hearing impairment children.

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Conflicts of interest

None.

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Author biography

Manjushree R, Assistant Professor

Bhagya V, Professor

Brid S V, Professor

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