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Original Research Article

Incidence of hearing loss in high-risk neonates admitted in neonatal intensive care unit in a tertiary care centre using otoacoustic emissions

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ABSTRACT

Background: Neonates admitted in neonatal intensive care units (NICU) are at higher risk of hearing impairment due to multiple perinatal and postnatal risk factors. Early detection of hearing loss is essential for timely intervention and prevention of speech and language delay. This study was conducted to estimate the incidence of hearing loss in high-risk neonates admitted in NICU in a tertiary care hospital and to identify the associated risk factors.
Methods: A hospital-based observational study was conducted among neonates admitted in the NICU of SAT Hospital, Thiruvananthapuram. A total of 384 neonates with risk factors as defined by the Joint Committee on Infant Hearing were included. Hearing screening was performed using otoacoustic emission (OAE). Neonates who failed OAE screening underwent confirmatory testing using brainstem evoked response audiometry (BERA). Data regarding antenatal history, perinatal events, clinical risk factors and NICU course were collected and analysed.
Results: A total of 384 neonates were screened. Thirty-two neonates failed OAE screening, of which 11 had unilateral failure and 21 had bilateral failure. Among these neonates, BERA was normal in 15 and abnormal in 17 cases. The incidence of hearing loss among high-risk neonates was 4.4%. Significant associations with hearing loss were observed with low APGAR score, presence of external anomalies, exposure to ototoxic drugs, culture positive sepsis, hypoxic ischemic encephalopathy, meningitis, intraventricular haemorrhage, respiratory distress syndrome, mechanical ventilation, recurrent apnoea and longer duration of NICU stay.
Conclusions: The incidence of hearing loss among high-risk neonates admitted in NICU is considerably higher compared to the general newborn population. Early screening using OAE followed by confirmatory BERA can facilitate early diagnosis and timely intervention.

Keywords: Hearing loss, NICU, Otoacoustic emission, BERA, Neonatal screening

INTRODUCTION

Hearing impairment is one of the most common congenital sensory disorders affecting children worldwide. Early auditory stimulation is essential for normal speech, language and cognitive development. Undetected hearing loss during infancy can lead to delayed speech development, poor academic performance and social difficulties.[1] The prevalence of permanent hearing impairment in the general newborn population ranges from 1 to 3 per 1000 live births. However, this prevalence is significantly higher among neonates admitted in neonatal intensive care units because of multiple risk factors such as prematurity, low birth weight, birth asphyxia, neonatal infections, hyperbilirubinemia and exposure to ototoxic medications.[2]

Advances in neonatal care have improved survival among high-risk infants but have also increased the number of neonates at risk for hearing impairment. Early detection and intervention programmes have therefore become essential components of neonatal care. Neonatal hearing screening programmes allow identification of hearing impairment before the onset of speech delay and enable

timely rehabilitation. These screening programmes are increasingly being implemented in hospitals across India.

Otoacoustic emission testing is widely used as an initial screening tool because it is simple, rapid and non-invasive. However, neonates who fail OAE screening require further evaluation with brainstem evoked response audiometry to confirm the diagnosis of hearing impairment.[3] They have the advantage of being economical as well rapid and having relatively good sensitivity.

Several studies have demonstrated the usefulness of targeted screening among high-risk neonates admitted to NICU. Early identification of hearing impairment in this group allows prompt intervention including hearing aids, cochlear implantation and speech therapy, which significantly improve developmental outcomes.[4] The present study was conducted to determine the incidence of hearing loss among high-risk neonates admitted to NICU and to evaluate the risk factors associated with hearing impairment in these high-risk groups.

METHODS

Study design and setting

This hospital-based observational study was conducted in the Neonatal intensive care unit of SAT Hospital, Government Medical College, Thiruvananthapuram.

Study population

All neonates admitted to NICU with risk factors for hearing impairment recommended by the Joint Committee on Infant Hearing (AAP) were included in the study.[9]

Study period

The study was conducted from August 2021 to January 2021.

Sample size

A total of 384 neonates were included in the study.

Inclusion criteria

All neonates admitted to the NICU of the hospital with at least one of the risk factors for hearing loss as identified by the Joint Committee on Infant Hearing Screening were included.[9]

Exclusion criteria

Neonates in whom informed consent could not be obtained, and neonates with severe craniofacial anomalies in whom OAE test could not be administered were excluded.

Data collection

Detailed antenatal, perinatal and neonatal histories were obtained from medical records. Information regarding maternal risk factors, delivery details and neonatal clinical course was recorded.

Hearing screening protocol

All neonates underwent hearing screening using otoacoustic emission (OAE) testing before discharge. Neonates who failed the initial OAE screening underwent confirmatory testing using brainstem evoked response audiometry (BERA).

Statistical analysis

Data were entered into Microsoft Excel and analysed using statistical package for the social sciences (SPSS) software version 27. Continuous variables were expressed as mean ±standard deviation and categorical variables as frequencies and percentages. Unpaired t test, Chi-square test and Fisher's exact test were used where appropriate. A $p<0.05$ was considered statistically significant.

Ethical approval

The study protocol was approved by the Institutional Ethics Committee of Government Medical College, Thiruvananthapuram. IEC no: 08/25/2021/MCT.

RESULTS

A total of 384 high-risk neonates admitted in NICU were screened for hearing impairment. Among the neonates screened, 32 failed OAE screening, with 11 showing unilateral failure and 21 showing bilateral failure. Subsequent BERA testing revealed that 15 neonates had normal results, whereas 17 neonates had abnormal BERA, confirming hearing impairment (Table 1).

Table 1: OAE and BERA screening outcomes among high-risk neonates.

Screening outcome	Number of neonates
Total neonates screened	384
Failed OAE screening	32
Unilateral OAE failure	11
Bilateral OAE failure	21
BERA normal	15
BERA abnormal	17

Out of a total of 384 high-risk neonates screened, thirty-two neonates (8.3%) failed OAE screening. Among these, BERA confirmed hearing impairment in 17 neonates. The incidence of confirmed hearing loss among high-risk neonates was 4.4%. The duration of NICU stay was significantly higher among neonates with hearing impairment compared to those without hearing

impairment. Several factors were significantly associated with OAE failure including increased NICU stay duration, gestational diabetes mellitus, low APGAR score, external anomalies, exposure to ototoxic drugs, sepsis, mechanical ventilation, recurrent apnoea, respiratory distress syndrome, intraventricular haemorrhage and meningitis (Table 2).

Table 2: Risk factors significantly associated with OAE failure.

Variable	OAE fail (n=32)	OAE pass (n=352)	P value
Age (days)	4.72±2.89	2.91±1.53	<0.0001
NICU stay duration (days)	9.94±6.78	5.18±3.68	<0.0001
Maternal age (years)	26.97±3.82	24.94±3.35	0.0013
Gestational diabetes mellitus	15	55	0.0001
Low APGAR score	4	11	0.0283
External anomalies/syndrome	11	16	0.0001
Exposure to other ototoxic drugs	3	5	0.0221
Sepsis	3	6	0.0313
Perinatal depression	4	10	0.0220
Mechanical ventilation	8	17	0.0004
Recurrent apnoea	7	23	0.0073
Respiratory distress syndrome	7	31	0.0278
Intraventricular haemorrhage	9	18	0.0001
Meningitis	2	2	0.0364

DISCUSSION

Early identification of hearing impairment in neonates is crucial for optimal speech and language development. Neonates admitted in NICU represent a high-risk group for hearing loss due to exposure to multiple antenatal, perinatal and postnatal risk factors.

In the present study, the incidence of confirmed hearing loss among high-risk neonates was 4.4%, which is considerably higher than the prevalence reported in the general newborn population. Similar findings have been reported in previous studies evaluating hearing impairment among NICU infants.[5]

Perinatal asphyxia reflected by low APGAR score is a known risk factor for sensorineural hearing loss. Hypoxic injury to the cochlea and auditory pathways may lead to permanent hearing impairment. Previous studies have also reported a strong association between perinatal complications and hearing loss.[6] Neonatal infections such as meningitis and sepsis can cause inflammatory damage to the cochlea and auditory nerve leading to permanent hearing impairment.[7]

Exposure to ototoxic medications and the requirement for mechanical ventilation are additional risk factors frequently encountered in NICU settings. These factors may contribute to cochlear damage and increase the likelihood of hearing impairment.[8]

Similarly, longer duration of NICU stay is also significantly associated with increased incidence of hearing impairment. This is also a frequently encountered risk factor.[7]

The findings of this study highlight the importance of targeted hearing screening among high-risk neonates admitted in NICU. Early screening using OAE followed by confirmatory BERA allows timely diagnosis and initiation of appropriate intervention. The Joint Committee on hearing has recommended that all infants should be screened no later than 1 month, all infants who fail the screening should have appropriate medical and audiological evaluation to confirm no later than 3 months and all infants with confirmed hearing loss should receive interventions as soon as possible and no later than 6 months.[9]

Limitations

This study was conducted in a single centre which limits generalization. Also, long term follow-up of hearing loss was also not done. Further multicentric studies with larger sample size and longer follow-ups are recommended.

CONCLUSION

The incidence of hearing impairment among high-risk neonates admitted in NICU was found to be significantly high. Early screening using otoacoustic emission followed by confirmatory BERA testing plays a crucial role in the early detection of hearing impairment. Routine hearing screening of high-risk neonates should be encouraged in NICUs to facilitate early diagnosis and timely intervention.

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