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Original Research Article

To Study targeted newborn hearing screening in newborns admitted in NICU to determine the prevalence and associated risk factors

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Abstract

Background & Methods: The aim of the study is to targeted newborn hearing screening in newborns admitted in nicu to determine the prevalence and associated risk factors. All the newborns admitted in NICU of MTH hospital Indore during first 28 days of life with risk factors associated with hearing loss was be included. The parents of all eligible patients were explained about the study in detail in the language which they can understand very well, including the type of study, risks/benefits, procedure, compliance, etc.

Results: The common risk factors for hearing loss seen in our study were – intrauterine infection (TORCH) seen in 9 (4.5%) patients; craniofacial anomalies seen in 6 (3%) patients; birth weight <1.5 kg seen in 53 (26.5%) patients; hyperbilirubinemia requiring exchange transfusion seen in 15 (7.5%) patients; Neonatal sepsis seen in 19 (9.5%) patients; Apgar score 0-4 at 1 minute or 0-6 at 5 minutes seen in 40 (20%) patients; mechanical ventilation for 5 days or longer seen in 98 (49.5%) patients; and ototoxic medications used >5 days in 65 (32.5%) patients. In our study the prevalence of hearing loss on follow up screening (BERA) is 2.5%. In our study several significant associations between hearing impairment and key risk factors such as low birth weight, hyperbilirubinemia, culture-positive infections, and low Apgar scores.

Conclusion: Neonatal hearing loss presents a significant health challenge with far-reaching implications for childhood development and lifelong well-being. Our study involving 200 neonates underscores the critical role of early detection through otoacoustic emissions (OAE) and auditory brainstem response (BERA) tests. We found that 91.5% of neonates passed the OAE and 97.5% passed the BERA, with 8.5% and 2.5% respectively showing refer results. These findings underscore the importance of systematic screening for identifying hearing impairments early in infancy.

Keywords: newborn, hearing, prevalence & risk.

Study Design: Cross-sectional study.

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Introduction

Hearing impairment stands out as the predominant sensory deficiency and among the foremost congenital anomalies.[1] It impacts 432 million adults and 34 million children worldwide. Studies suggest that the occurrence of moderate to severe bilateral hearing loss ranges from 1-3 per 1000 in normal newborns to 2-4 per 1000 in newborns at high risk.[2]

Hearing plays a crucial role in language acquisition and learning. Thus, early identification and timely intervention are critical in preventing the adverse outcomes associated with hearing loss. Neonatal hearing impairment can be either congenital (syndromic or non-syndromic) or acquired, such as through ototoxicity. Moreover, hearing loss can manifest as conductive, sensorineural, or mixed types.[3]

The majority of neonatal hearing loss is sensorineural, with a genetic etiology identified in 50% of affected children. Among these cases, approximately 70% involve non-syndromic deafness, commonly linked to cochlear hair cell dysfunction due to errors in connexin 26, a gap junction protein. Other causes of neonatal sensorineural hearing loss include congenital infections, hyperbilirubinemia, and exposure to ototoxic medications.[4]

The occurrence of moderate to severe bilateral hearing loss (HL) (> 40 dB) varies significantly among different populations. Rates are typically reported at 2–3 per 1000 live births in well baby nursery populations, but higher, at 10-20 per 1000 infants, in intensive care settings globally. In India, newborn hearing loss affects 6.3% of the population.

Childhood hearing loss not only impacts language, speech, and cognitive development but also profoundly influences education, self-esteem, and social skills. Therefore, early detection of congenital hearing loss and timely intervention are crucial to mitigate its far-reaching effects on children.

Despite its significant prevalence, congenital hearing loss frequently remains undetected due to the lack of newborn hearing screening programs, increasing the risk of adverse impacts on speech, language, and cognitive development.

Traditionally, clinical screening for hearing loss in infants and young children relied on observing their behavioural responses to sounds, such as a bell rung out of their direct sight. However, this method lacks comprehensive validation through studies. Typically, diagnosis in populations using this approach occurs only when a child shows noticeable and irreversible language delays.[5]

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Material and Methods

The present study was conducted in the Neonatal Intensive Care Unit, MTH, Department of Paediatrics, M.Y. Hospital, Indore (M.P.) All newborns admitted in NICU, with age less than 28 days of life with risk factors for hearing loss.

INCLUSION CRITERIA

1) Newborns admitted in NICU, age less than 28 days of life with risk factors for hearing loss.

EXCLUSION CRITERIA

1) Newborns who's Guardians not giving consent for the screening test.

METHOD

All the newborns admitted in NICU of MTH hospital Indore during first 28 days of life with risk factors associated with hearing loss was be included. The parents of all eligible patients were explained about the study in detail in the language which they can understand very well, including the type of study, risks/benefits, procedure, compliance, etc. A voluntary written consent was taken from the parents and/or legally acceptable representative for allowing the participation of their baby in the present study.

Demographic details, clinical parameters including relevant history, clinical examination and investigations was be recorded in predesigned proforma.

The patient's hearing screening was be done in NICU before discharge using OAE. Follow-up was be done in ENT OPD by BERA testing by an audiologist & results of the screening were recorded in a proforma. Patients who was enrolled in the study, details of BERA recorded during follow-up appointments. If parents did not attend the follow-up appointments in our OPD, details about BERA were obtained through telephonic conversations. If the answer was negative, reasons for noncompliance were recorded. If BERA was performed on any other centre then result was recorded through social media.

Hearing screening using OAE: Neonates with risk factors underwent OAE screening in the NICU administered by an ENT specialist just before discharge. Results were documented as either pass or fail.

BERA tests were conducted during follow-up appointments after hospital discharge in accordance with NRHM guidelines, in the ENT department and before the age of 3 months. Results were recorded accordingly.

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Result

Table No. 1: Distribution of newborns according to gestational age at time of birth

Gestational Age at birth		Number (No.)	Percentage (%)
< 37 weeks	≥28 – <32 weeks	44	22.0
	≥32 – <34 weeks	20	10.0
	≥34 - <β7 weeks	67	33.5
≥ 37 weeks		69	34.5
Total		200	100.0

The above table shows the distribution according to gestational age at the time of birth. 44 (22%) newborns with gestational age between 28 to 32 weeks; 20 (10%) newborns with gestational age between 32 to 34 weeks; 67 (33.5%) newborns with gestational age between 34 to 37 weeks; and 69 (34.5%) newborns with gestational age beyond 37 weeks. Most of the women delivered beyond 37 weeks of gestation.

Table No. 2: Distribution according to maternal risk factors for neonatal hearing loss

Maternal Risk Factors	Number (No.)	Percentage (%)
Preterm delivery	52	26.0
Meconium stained liquor	38	19.0
Preeclampsia	25	12.5
Twin / Triplet pregnancy	21	10.5
Prolonged labour/ Obstructed Labour	29	14.5
Polyhydramnios/ Oligohydrominos	17	8.5
Rh incompatibility	10	5.0
Leaking P/V for 24 hours	6	3.0
Elderly gravida	6	3.0
TORCH infection	5	2.5
Gestational Diabetes	4	2.0
PROM	2	1.0
None	18	9.0

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The above table shows the distribution according to maternal risk factors for hearing loss.

Table No. 3: Distribution according to neonatal risk factors for hearing loss

Hearing Loss Risk Factors		Number (No.)	Percentage (%)
Family history of hereditary childhood sensorineural hearing impairment		0	0.0
Intrauterine infection (TORCH)		9	4.5
Craniofacial anomalies		6	3.0
Birth weight < 1.5 kg		53	26.5
Hyperbilirubinemia requiring exchange transfusion		15	7.5
Ototoxic medications for > 5 days		65	32.5
Neonatal sepsis	Total	19	9.5
	With meningitis	9	4.5
	Without Meningitis	10	5.0
Apgar score 0-4 at 1 minute or 0-6 at 5 minutes		40	20.0
Mechanical ventilation for 5 days or longer		98	49.5
Stigmata of other findings associated with a syndrome known to include sensorineural and/or conductive hearing loss		3	1.5

The risk factors for hearing loss seen in our study were – intrauterine infection (TORCH) seen in 9 (4.5%) patients; craniofacial anomalies seen in 6 (3%) patients; birth weight <1.5 kg seen in 53 (26.5%) patients; hyperbilirubinemia requiring exchange transfusion seen in 15 (7.5%) patients; Neonatal sepsis seen in 19 (9.5%) patients; Apgar score 0-4 at 1 minute or 0-6 at 5 minutes seen in 40 (20%) patients; mechanical ventilation for 5 days or longer seen in 98 (49.5%) patients; and ototoxic medications used >5 days in 65 (32.5%) patients.

In our study, we found that mechanical ventilation for 5 days or longer; and birth weight <1.5kg were the most common risk factors as per IAP Consensus 2017 for hearing loss.

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Table No. 4: Hearing outcome according to OAE

Hearing Outcome	Number (No.)	Percentage (%)
Pass	183	91.5
Refer	17	8.5
Total	200	100.0

The hearing outcome of the patients according to OAE. The hearing outcomes of 200 patients assessed via Otoacoustic Emissions (OAE) testing indicate that a substantial majority demonstrated normal auditory function, with 183 patients (91.5%) showing a "bilateral pass" result, suggesting both ears passed the screening. Conversely, 17 patients (8.5%) received a "bilateral refer" outcome, indicating that both ears failed the test and necessitating further audiological evaluation to diagnose potential hearing impairments.

Table No. 5: Hearing outcome according to BERA

Hearing Outcome	Number (No.)	Percentage (%)
Pass	195	97.5
Refer	5	2.5
Total	200	100.0

The hearing outcomes of 200 patients assessed using BERA testing indicate that a substantial majority demonstrated normal auditory function, with 195 patients (97.5%) showing a "bilateral pass" result, suggesting both ears passed the screening. Conversely, 5 patients (2.5%) received a "bilateral refer" outcome, indicating that both ears failed the test and necessitating further audiological evaluation to diagnose potential hearing impairments.

Discussion

Hearing loss among newborns represents a significant global health challenge, impacting millions worldwide and posing critical hurdles to early language development, education, and social integration. Whether congenital or acquired, this condition profoundly affects childhood development. Early detection through effective screening methods is crucial to mitigating these challenges, yet variations persist in screening practices across healthcare settings. Technological advancements like otoacoustic emissions (OAE) and Brainstem response (BERA) offer promising avenues for early identification though debates persist regarding the

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implementation and efficacy of universal versus targeted screening approaches. It is crucial to understand the prevalence of neonatal hearing loss, its diverse causes, the importance of prompt intervention, and the current state of screening technologies, highlighting their implications for healthcare policy and practice. Addressing these complexities underscores the need to optimize screening protocols to ensure equitable access to timely intervention and enhance better outcomes for infants at risk of hearing impairment.

In our study the prevalence of hearing loss on follow up screening (BERA) is 2.5%. In the study by Bhat et al.[6] the prevalence of hearing loss is 6.15%. There were 56% females and 44% males in our study. The male: female ratio was 1:1.3, showing a female preponderance. 48.7% males and 51.3% females were present in study by Bhat et al.[6] In the study by Pourarian et al.[7] there were 58.8% males and 41.1% females.

In the study, majority were Preterm (65.5%) while 34.5% were Term babies. Among them 26.5% had a birth weight of less than 1500 grams. In the study Labaeka et al.[8] low birth weight babies were 21.9%.

In present study, most common risk factor was Mechanical ventilation for ≥ 5 days (49.5%) followed by Ototoxic medications use >5 days (32.5%), Birth weight < 1.5 kg (26.5%), Low Apgar score (20%), Neonatal sepsis (9.5%), Intrauterine infection (4.5%), Craniofacial anomalies (3%) and Syndromic association (1.5%). In study by Bhat et al.[6] Ototoxic medication (65.1%) was most common risk factor followed by Birth weight < 1.5 kg (48.2%), Low apgar score (22.6%), Meningitis (14.4%), Hyperbilirubinemia (13.3%), Mechanical ventilation > 5 days (8.2%), Torch infection (3.6%), Familial hearing loss (2.1%), Craniofacial Anomalies (2.1%), Syndromic association (2.1%). In study by Risk factors reported by Gupta et al.[9] were Aminoglycoside use (44.4%), Low birth weight (17.8%), Mechanical ventilation >5 days (16.4%), Low apgar score (13.9%).

In our study the prevalence of low birth weight is 26.5%. Among them 15.1% OAE and 7.5% BERA refer in patients compared to the neonates who had birth weight more than 1500 gm. There was a statistically significant association between result of OAE and BERA and birth weight <1500 gm. In the study by Hardani et al.[10], prevalence of low birth weight was seen in 14.7% patients, and hearing loss (refer OAE and BERA) seen in 23% patients it was also found to be a significant risk factors for neonatal hearing loss. In the study by Sabbagh et al.[11] the low birth weight was found to be a significant risk factor for neonatal hearing loss. In the study by Gupta et al.[9] the prevalence of low birth weight <1500 gm is 39.6% out of which 17.8% (OAE and BERA refer)patients having significant risk factors for neonatal hearing loss. The low birth weight (<1500 gm) was found in 8.87% patient with hearing loss(Refer OAE and BERA) present in 16.25% patient which was a significant risk factor for neonatal hearing loss. In the study by Omar et al.[12] the prevalence of low birth weight was 10.5% and they found it to be a significant risk factor for hearing loss.

In our study prevalence of hyperbilirubinemia is 7.5%. Among them 29.4% OAE and 20% BERA refer in patients compared to the neonates who had no hyperbilirubinemia. There was a statistically significant association between result of OAE and BERA and presence of hyperbilirubinemia. Hyperbilirubinemia was seen in 72.6% patients, hearing loss (OAE and BERA refer) present in 4.6% patients and it was found to be a significant risk factor for neonatal

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hearing loss. In the study by Bhat et al.[6] the prevalence of hyperbilirubinemia was seen in 13% with prevalence of hearing loss (both OAE and BERA refer) is 19.2% patients and it was a significant risk factor for neonatal hearing loss. The prevalence of hearing loss is 2.1% with hyperbilirubinemia was found to be a significant risk factor for neonatal hearing loss. In the study Labaeka et al.[8] the prevalence of hyperbilirubinemia was 2.5% with the prevalence of hearing loss by BERA refer was 2% which is statistically significant. In the study by Pourarian et al.[7] the hyperbilirubinemia requiring exchange transfusion with prevalence of 14.8% was not found to be a significant risk factor for neonatal hearing loss may be because exchange transfusion before the fatal complications of high bilirubin.

Conclusion

Neonatal hearing loss presents a significant health challenge with far-reaching implications for childhood development and lifelong well-being. Our study involving 200 neonates underscores the critical role of early detection through otoacoustic emissions (OAE) and auditory brainstem response (BERA) tests. We found that 91.5% of neonates passed the OAE and 97.5% passed the BERA, with 8.5% and 2.5% respectively showing refer results. These findings underscore the importance of systematic screening for identifying hearing impairments early in infancy.

Our research identified several significant associations between hearing impairment and key risk factors such as low birth weight, hyperbilirubinemia, culture-positive infections, and low Apgar scores. These associations reinforce the complex nature of neonatal hearing loss as highlighted in existing literature.

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