International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Proportion of Hearing Impairment in High - Risk Neonates in a Tertiary Care Centre

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Abstract: ***The prevalence of hearing impairment is higher among high risk neonates. This study aimed to determine the proportion of hearing impairment in neonates admitted to a NICU with identified risk factors. A prospective observational study was conducted on 567 neonates, using Otoacoustic Emission (OAE) as the initial screening tool, followed by Brainstem Evoked Response Audiometry (BERA) for those with abnormal OAE results. The study found a 2.3 incidence of hearing impairment with significant associations observed with craniofacial anomalies, a family history of congenital hearing impairment, and sepsis.***

Keywords: High risk neonates, Permanent childhood hearing impairment (PCHI), OAE, BERA, Neonatal screening

1. Introduction

Hearing is the key area in developing spoken language and cognitive development of children. Hearing impairment is an invisible disability that affects communication abilities, social skills, education, personal achievement, economic independence and quality of life, making it a significant public health concern. Individuals who have at least one risk factor, the risk of congenital or delayed - onset hearing loss increases with each risk factor when compared with normal hearing[1]. As per the American Academy of Pediatrics Task Force on Newborn and infant hearing, significant bilateral hearing loss has been shown to be present in approximately 1 to 3 per 1000 new born babies in the well - baby nursery population and in approximately 2 to 4 per 100 infants in the intensive care unit population[2]. The universal neonatal hearing screening is the most effective means of early detection of hearing loss in neonates. Newborn hearing screening should be done within 1 month of age, diagnosed within 3 months of age and rehabilitation should be started at the age of 6 months. The Joint Committee for Infant Hearing JCIH (2007) recommended this 1 - 3 - 6 guideline for early detection and intervention[3]. Tests used for screening newborns for hearing loss are Distortion Product Otoacoustic emissions (DPOAE) and Automated Auditory Brainstem Response Audiometry (AABR). These tests are non imvasive and require only minimal patient cooperation[4]. The primary objective of this study is to find out the proportion of hearing impairment in high risk neonates admitted into newborn ICU in the tertiary care centre. The secondary objective is to find the proportion of each risk factor among hearing impaired neonates.

2. Materials and Methods

This hospital based prospective observational study was conducted among high risk inborn neonates admitted to NICU in a tertiary care Centre. Neonates (0 - 28 days) admitted to the NICU with any high - risk factors (Table1) whose parents have given consent, were included in the study and neonates with anotia and external canal atresia were excluded from the study.

Table 1: High risk factors

S. No	Factors
1	Craniofacial abnormalities
2	Family history of congenital hearing loss
3	Low birth weight (<1500gm)
4	Hyperbilirubinemia requires exchange blood transfusion
5	Babies born out of consanguineous marriage
6	Low Apgar score at 1 and 5 min
7	Intrauterine infection with HSV, rubella, CMV, syphilis, toxoplasma,
8	Other stigmata/ syndrome associated with hearing loss
9	Ototoxic drug administration
10	Mechanical ventilation for 5 days or more
11	NICU admission for 5 days or more
12	Re admissions in NICU in the first month of life for all infants
13	conditions associated with potential hearing loss (eg; hyperbilirubinemia requiring exchange transfusion
14	Culture positive sepsis

After obtaining informed consent from the parents, every 5th neonate in NICU with risk factors for hearing impairment who met the inclusion criteria were included in the study. Babies were subjected to clinical and ENT examination. Distortion Product Oto Acoustic emission (DPOAE) was done when their general condition improved or when they met discharge criteria. Patient details with risk factors and test results of each ear were entered in the proforma. Results were interpreted as either “pass” (normal/emissions present) or “refer” (absent emissions). Those with “refer” results were asked to report after 1 month for retesting. Those who failed the repeat Oto Acoustic Emission (OAE) were subjected to Auditory Brainstem Response (BERA) after 1 month. Babies with absent wave V at 40 dB in (BERA) were considered as

abnormal (hearing impaired) and were referred for further evaluation and rehabilitation.

The study was initiated after getting clearance from the Institutional Ethics Committee. Patient information sheet was provided to all the participants. No cost was incurred by the participants for the purpose of study. Test results were informed to the participants and those who were tested ABR negative were followed up for further evaluation. Confidentiality was maintained throughout the study.

3. Data Analysis

Data were entered in excel sheet and analyzed by SPSS version20. Prevalence of hearing impairment expressed in proportion and qualitative variables expressed in percentage. Chi square test and Fischer test applied for statistical significance. Multiple logistic regression was applied to independent risk factors. "P" value less than 0.05 was considered significant.

4. Results and Observations

This study was conducted among 567 neonates admitted to the inborn NICU and the results were charted. There were 305 (53.8%) Males and 262 (46.2) Female babies (Fig 1).196 (34.6%) were 7 days or less in age at the time of first OAE, 173 (30.5%) between 8 - days, 68 (12%) between 15 - 21 days and 130 (22.9%) more than 21 days.

192 (33.8%) neonates were born by normal vaginal delivery, 13 neonates were born by assisted vaginal delivery (2.29%) and 362 (63.8%) were born by lower segment Caesarean section.117 (20.6%) neonates had birth asphyxia, 53 (9.34%) had extremely low birth weight (<1000g), 208 (36.68%) were more than 1000 to 1500g, 199 (35.09%) were of normal birth weight.

44 (7.8%) neonates had craniofacial anomalies. Out of that 17 had microcephaly, 6 had cleft lip with cleft palate, 4 had isolated cleft palate, 4 had ear tag, 3 had trigonocephaly and 3 had dysmorphic facies. Isolated cleft lip was present in 2 neonates and 2 had low set ears with facial dimorphism.1 neonate had malar hypoplasia with cleft lip and palate and 1 neonate with agenesis of corpus callosum.

7 neonates (1.2%) had stigmata associated with hearing loss, of which 6 had renal anomalies and 1 had limb anomalies. Neonates with hyperbilirubinemia were 225 and among them 6 (1.05%) were managed with exchange blood transfusion and the rest with photo therapy.

187 (32.9%) neonates needed mechanical ventilation, out of which 123 were ventilated for less than 5 days and 64 neonates for 5 days or more.262 neonates (46.2%) received ototoxic drugs and the most common ototoxic drug administered was Amikacin (177) followed by Vancomycin (77). Only one neonate had culture positive meningitis in our study.374 (66%) babies had ICU care for 5 days or more, the rest 193 neonates had less than 5 days ICU care.

Maternal factors were also analyzed.443 (78.1%) babies were born to mothers of age group 20 - 30 years, 104 (18.3%) neonates were born to mothers of 31 - 40 years, 13 (2.3%) neonates were born to mothers of less than 20 years of age and 7 (1.2%) born to mothers more than 40 years of age.307 (54.1%) mothers were primi gravida and the rest 260 (45.9%) were multi gravida. Of these 567 neonates, 10 (1.8%) neonates were born out of consanguineous marriage.27 neonates (4.8%) had maternal TORCH infection and the most common was syphilis in 6, followed by Rubella in 5. Family history of childhood hearing loss was in 4 neonates (0.7%).

Table 2:

Perinatal risk factors	Number	Percentage
Birth weight <1.5kg	261	45.05%
Craniofacial anomalies	44	7.8%
Other stigmata associated with congenital hearing loss	7	1.2%
Hyperbilirubinemia requiring exchange transfusion	6	1.06%
Mechanical ventilation 5 days or more	64	11.29%
Oto toxic drugs	262	46.2%
Sepsis	75	13.2%
Meningitis	1	0.2%
ICU admission 5 days or more	374	65.96%
Other stigmata associated with congenital hearing loss	7	1.2%

Table showing the distribution of perinatal risk factors

Table 3

Antenatal risk factors	Number	Percentage
Consanguinity	10	1.8%
Antenatal torch infection	27	4.8%
Family history of congenital hearing loss	4	0.7%

Table showing the distribution of Antenatal risk factors

The first stage screening was conducted for all 567 neonates with Distortion Product Otoacoustic Emission and 87 neonates (15.3%) failed the test. Unfortunately, one neonate expired and second stage OAE testing was done on 86 neonates who failed the first testing. Among these, 45 neonates (52.32%) had a "pass" response and 41 neonates (47.7%) had a "refer" response. Bilateral "refer" was in 24 neonates (27.9%) and unilateral "refer" in 17 (19.76%) neonates (Figure 2).

Among the 41 infants with a "refer" 2nd OAE result, 2 infants were lost for follow up. The rest 39 infants who failed in the second screening test were subjected to Brain Stem Evoked Response Audiometry test.

Out of these 39 neonates, BERA was normal for 26 neonates and abnormal for the rest 13; bilateral abnormal for 11 infants and unilateral abnormal for 2, thereby identifying 2.3% incidence of hearing loss (Fig 3)

Number of risk factors	Hearing impairment				*p value*
	No		Yes		
	Number	Percentage	Number	Percentage	
1 - 3 Risk factors	473	98.3 %	8	1.7%	0.034
>3 Risk factors	81	94.2%	5	5.8%	

Table 5: Comparison of independent risk factors based on hearing impairment

Risk factors	B	S. E.	*P*	Odds (95% CI)
Family history of congenital hearing loss	3.58	1.33	0.007	35.74 (2.63 - 486)
Sepsis	3.26	1.14	0.004	25.93 (2.76 - 243.67)
Craniofacial anomalies	3.11	0.70	0.000	22.4 (5.7 - 87.99)

5. Discussion

Hearing is one of the vital parts of a newborn's contact with his environment. The ability to communicate, acquire skills and perform academically all depend on hearing ability. Early identification and intervention of hearing impairment helps to reduce the future problems associated with speech and language development. Prior to the introduction of newborn hearing screening, the average age of diagnosis of hearing impairment that compromised speech and language development was 26 months with hearing aid fitting at 32.2 months.5 In many of these children, delayed diagnosis leads to poorly acquired speech and oral language as the critical period for speech and language acquisition has passed. The implementation of newborn hearing screening programs has indeed lowered the mean age of hearing loss identification and many deaf children are now diagnosed at an earlier age[6]. The Joint Committee on Infant Hearing (JCIH) endorses early detection of and intervention for infants with hearing loss (early hearing detection and intervention, EHDI) through integrated, interdisciplinary state and national systems of universal newborn hearing screening, evaluation, and family - centered intervention.

Otoacoustic Emissions (OAE) is the currently acceptable methodology for physiological screening, as it is non - invasive, quick and easy to perform. Distortion Product Otoacoustic Emission (DPOAE) contains information about cochlear place (frequency), is sensitive to low frequency hearing losses and therefore is the apt test for screening and examination of specific regions of the organ of Corti.

567 neonates were enrolled in the present study where 1 baby expired before the first follow up, and 2 babies lost follow up before BERA. A two - staged screening was done with Distortion Product OAE (DPOAE) with confirmation done with the help of BERA (ABR). S. Korres T. P. Nikolopoulos et al[7] in their study preferred doing neonatal screening once the neonate is 36 weeks old. In the present study, screening OAE was done for the NICU inmates once they were out of the NICU care irrespective of the age. Though OAE is a test with high sensitivity it has limitations like less specificity, false positive results and inability to diagnose auditory neuropathy which can be overcome with the help of Auditory Brainstem Response Audiometry. In our study we used a two stage OAE protocol, wherein neonates were subjected to 2 stages of screening using otoacoustic emission followed by confirmation using Brainstem Evoked Response Audiometry. Of the 567 neonates included in the study, 87 neonates had "refer" response in the initial OAE and were advised for re - evaluation after 1 month.1 neonate expired before first follow up and 86 neonates underwent repeat OAE testing. Among the 86 infants who underwent repeat OAE, 41 had "refer" response so were advised to return after 1 month for BERA.2 infants were lost follow up and 39 underwent BERA. Among the 39 who underwent BERA, 13 were diagnosed to have absent wave V at 40 dB in either one or both the ears. Hence, the proportion of hearing impairment in this study is 2.3%.

Vaghasiya D, Deb S et al conducted study on 280 high risk neonates where the incidence was 17.8 per 1000 screened (95% C. I is 0.24% - 3.32%) [8]. Bhat, et al did Target hearing screening in 195 neonates found hearing impairment in 12 (6.15%) neonates[9]. Dora Jerina Jose et al did a study and 200 high risk babies were assessed, yielded 0.5% of hearing loss in the high risk babies[8]. Ishika Vashistha, Yogesh Aseri, B. K. Singh et al conducted study in 100 high risk newborns and 15 neonates were having either unilateral or bilateral hearing loss making a prevalence of 15%[2]. From the above literature, the incidence of hearing impairment varies greatly from 0.5% to 15%. The high prevalence of hearing impairment in this population points to the need for early audiological testing.

In our study of 567 neonates, males were a slight majority.305 neonates were males and (53.8%) and 262 (46.2%) were females. Of the 11 babies with bilateral hearing impairment, 6 (54.54%) were males and 5 (45.45%) were females, showing only a slightly higher prevalence in males. Unilateral hearing loss was found to be of equal prevalence. In a study conducted by Iype, Sasikumaran, Indira et al sex ratio in babies with hearing impairment was found to be 1.06: 1[10].

Out of all the 13 neonates with hearing impairment, there were multiple risk factors.7 had very low birth weight (<1500g), 7 had craniofacial anomalies, 6 had ICU admission for 5 days or more, 6 had ototoxic drug administered in postnatal period, 5 had sepsis, 2 had birth asphyxia, 2 had Mechanical ventilation for 5 days or more, 1 had family history of congenital hearing loss. None of the babies had positive maternal TORCH infection, other stigmata associated with hearing loss. The risk factors found to have strong association with hearing impairment were craniofacial anomaly, sepsis, family history of permanent childhood hearing impairment. We did not get any significant association with birth asphyxia, very low birth weight, consanguinity, hyperbilirubinemia requiring exchange transfusion, meningitis, ICU admission for 5 days or more, mechanical ventilation for 5 days or more and other stigmata associated with hearing loss. In our study, risk of hearing impairment showed an increase with the increase in number of risk factors (Table4). Among the hearing - impaired neonates, 5 had more than 3 risk factors and is a significant association (p=0.03) with hearing impairment. On analyzing independent risk factors, family history of childhood hearing loss had a 35 times risk, culture positive sepsis had 25 times the risk, and craniofacial anomalies had 22 times the risk of developing hearing impairment. (Table5).

6. Conclusion

The proportion of hearing impairment in our study among 567 neonates was found to be 2.3%. Males had only a slightly higher incidence than females of hearing impairment. The

most common risk factor identified was ICU admission for 5 days or more. The two - staged screening protocol with Distortion Product Otoacoustic Emission and confirmation by Brainstem Evoked Response Audiometry was found to be a useful tool in detecting hearing loss in newborns. Even if the babies were not detected to have hearing impairment in the neonatal screening, repeat monitoring at regular intervals is necessary as many risk factors lead to delayed onset of hearing impairment

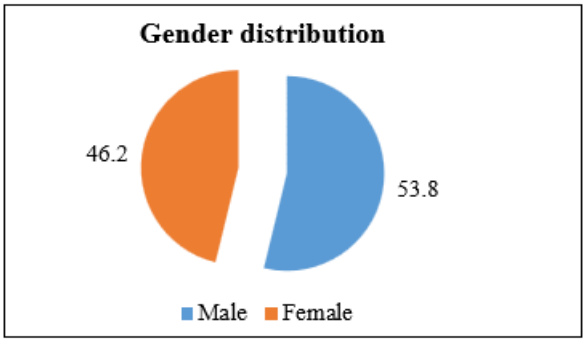

Figure 1: Gender distribution

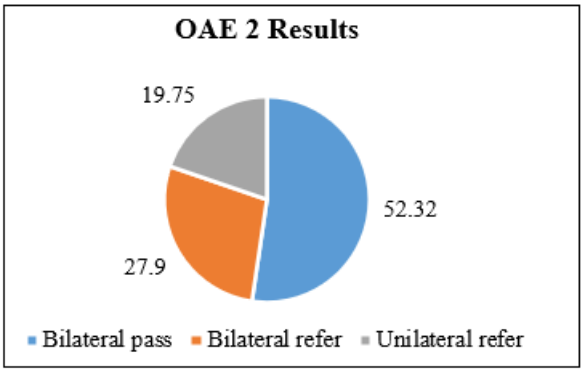

Figure 2: OAE 2 results

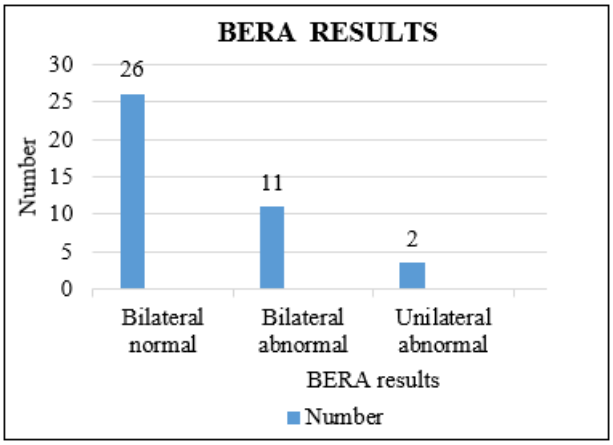

Figure 3: BERA results

References

[1] Kavita Sachdeva, Tulsi Sao. Outcomes of Newborn Hearing Screening Program: A Hospital Based Study. Indian J Otolaryngology Head Neck Surg (Apr–June 2017) 69 (2): 194–198

[2] American Academy of Pediatrics Task Force on newborn and infant hearing. Pediatrics.1999; 103 (2): 527 - 529

[3] American academy of Pediatrics, Joint Committee on Infant Hearing JCon I (2007) position statement: Principlesand guidelinesfor early hearing detection and intervention programmes

[4] Aneena K Siddique, Renuka S Melkundi. Prevalence of hearing impairment in high risk neonates at Kalaburagi region of North Karnataka: A hospital based Cross sectional study Indian J Otolaryngol Head Neck Surg (2023) 75: S16 - S22

[5] Yoshinaga - Itano C. Early intervention after universal neonatal hearing screening: impact on outcomes. Mental retardation and developmental disabilities research reviews.2003; 9: 252–66.

[6] Nikolopoulos TP. Neonatal hearing screening: what we have achieved and what needs to be improved. International journal of pediatric otorhinolaryngology.2015; 79: 635–7.

[7] Korres. S, Nikolopoulos. T P, Komkotou. V, Balatsouras. D, Kandiloros. D, Constantinou. D, Ferekidis. E. Newborn hearing screening: effectiveness, importance of high - risk factors, and characteristics of infants in the neonatal intensive care unit and well - baby nursery. Otology & Neurotology.2005; 26: 1186–90.

[8] Vaghasiya DD, Deb DS, Gogoi DPR, Nongrum DHB, Lurshay DRM. Hearing loss in high risk neonates. Pediatric Review: International Journal of Pediatric Research.2016; 3: 792–7.

[9] Bhat JA, Kurmi R, Kumar S, Ara R, Mittal AK. Targeted screening for hearing impairment in neonates: A prospective observational study. Indian Journal of Otology.2018; 24: 42.

[10] Jose DJ, Renjit RE, Manonmony S. Prevalence of hearing impairment among high risk neonates - A hospital - based screening study. Inte J Biomed Adv Res.2016; 7: 131–4.

[11] Vashistha I, Aseri Y, Singh BK, Verma PC. Prevalence of hearing impairment in high risk infants. Indian Journal of Otolaryngology and Head & Neck Surgery.2016; 68: 214–7.

[12] Iype EM, Sasikumaran S, Devi SI. A clinical study on congenital and neonatal deafness. Indian Journal of Otolaryngology and Head & Neck Surgery.2000; 52: 242.