



Research Article

HEARING ASSESSMENT OF NICU GRADUATES AT A TERTIARY CARE HOSPITAL IN SOUTHERN RAJASTHAN: A HOSPITAL BASED STUDY

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ABSTRACT

Hearing impairment is one of the most critical sensory impairments with significant social and psychological consequences.

Objective: To determine the hearing outcome of the Neonatal Intensive Care Unit graduates at a tertiary care hospital at Udaipur, Rajasthan.

Methods: This study was a hospital based prospective observational study. 3485 newborns admitted at Neonatal Intensive Care Unit (NICU) were included in this study. This study was conducted at Department of Pediatrics, RNT Medical College, Udaipur, Rajasthan. Neonates admitted in Neonatal intensive care unit of the hospital were subjected to Otoacoustic emissions (OAE) for their hearing assessment. Referred cases were subjected to a second screening and those referred even at the second screening were subjected to Auditory Brainstem Response (ABR).

Results: In this study of 3485 NICU graduates, the prevalence of hearing defects was found to be 8.3 per thousand. Hearing defects were significantly higher in premature ($p = 0.029$), very low birth weight ($p = 0.017$) and extremely low birth weight infants ($p < 0.00001$). Most common co-morbidities in newborns diagnosed with hearing impairment was neonatal jaundice (37.9%) followed by respiratory distress syndrome (31%) and perinatal asphyxia (20.7%).

Conclusion: There is high incidence of hearing loss in NICU admitted newborns. OAE and ABR both should be performed for complete evaluation of hearing. Important risk factors include prematurity and low birth weight.

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INTRODUCTION

Hearing impairment is one of the most critical sensory impairments with significant social and psychological consequences. Significant hearing loss is the most common disorder, occurring in 1-2 newborns per 1000 in general population, and 24%-46% of newborns admitted to Neonatal Intensive Care Unit (NICU). When undetected, elevated hearing thresholds can delay language, communication, and cognitive development. Even mildly elevated bilateral and any elevation of unilateral hearing thresholds can cause significant developmental delays as a result of limited access to spoken language.^[1] According

to WHO recommendation, all newborns should be screened by 1 month of age, diagnosed by 3 months of age, and intervened by 6 months of age. [1-3-6 Principle].^[2]

This study aims at early diagnosis of hearing impairment in NICU graduates to facilitate timely intervention, thus preventing them from adverse speech and language outcomes.

METHODS

This study was a hospital based observational prospective study conducted at Department of Pediatrics, RNT Medical College, Udaipur between March 2021 to December 2022. During the study period, 3485 NICU graduates were included in the study and were screened for hearing impairments by Otoacoustic emissions (OAE) at the time of their discharge from NICU.

Normal and abnormal results of the hearing assessment were labelled as "Pass" or "Refer" respectively. The babies having

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abnormal result in any of the ears were subjected to repeat screening after one week and those who were found to have abnormal examination even at the repeat screening visit were subjected to ABR (or BERA: Brainstem evoked response audiometry) preferably within 3 months of age.

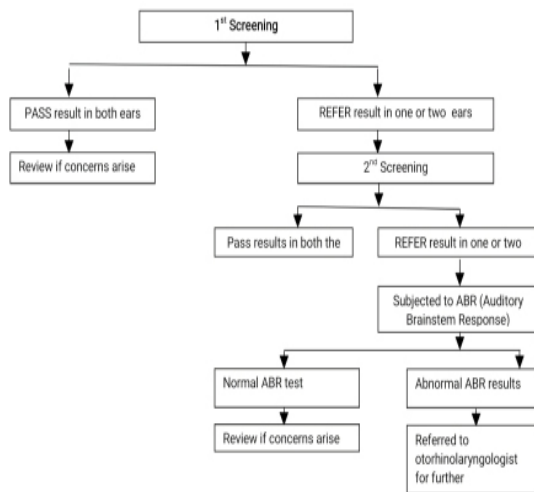


Fig.1 Two stage screening protocol

1st Screening

REFER result in one or two ears

PASS result in both ears

2nd Screening

Review if concerns arise

REFER result in one or two ears

Pass results in both the ears

Subjected to ABR (Auditory Brainstem Response)

Abnormal ABR results

Normal ABR test

Referred to otorhinolaryngologist for further management

Review if concerns arise

Data regarding the neonates’ birth weight, gestational age, morbidity and result of hearing assessment were collected in a predesigned proforma.

Statistical Analysis: All the data were entered in Microsoft Excel Worksheets and were analysed statistically using SPSS version 26.

RESULTS

In this study 3485 NICU Graduates were assessed for hearing loss. Of these, 2078 (59.6%) were males and 1407 (40.3%) females (Male: Female ratio = 1.48:1). [Table 1]

Table 1 General Characteristics of the study patients

Characteristics		Number of Patients	Percentage
Gender	Male	2078	59.6
	Female	1407	40.4
Maturity	Preterm	1250	35.9
	Term	2235	64.1
Birth weight	>2500 gram	2249	64.5

	1500-2499 gram	853	24.5
	1000-1499 gram	369	10.6
	<1000 gram	14	0.4
Morbidity	Hyperbilirubinemia	1270	36.4
	Respiratory Distress Syndrome	833	23.9
	Birth Asphyxia	467	13.4
	Hypoxic ischemic encephalopathy	139	3.9
	Meconium Aspiration Syndrome	185	5.3
	Dehydration/ AKI	155	4.4
	Sepsis	160	4.6
	Infant of Diabetic Mother	52	1.5
	Congenital Malformations	47	1.3
	Intrauterine infections	13	0.4
	Down’s Syndrome	11	0.3
	Hemorrhagic disease of newborn	5	0.1

Out of 3485 newborns screened for hearing impairments using OAE, 2187 (62.7%) had “Pass” result in both the ears whereas 1298 were referred who were subjected to a second screening after 1 week of the first screening. In the subsequent screening, 1232 patients had “Pass” result in both the ears and 66 had abnormal hearing. Of these, 32 were lost to follow up and one baby expired. The remaining 33 patients were subjected to ABR and 29 of them were found to have abnormal ABR results.

1st Screening

REFER result in one or two ears (n=1298)

PASS result in both ears (n=2187)

2nd Screen

Review if concerns arise

REFER result in one or both ears (n=66)

Pass results in both ears

(1232)

Subjected to ABR (Auditory Brainstem Response) (33)

Did not turn up till date (32)

Died (1)

Abnormal ABR results (29)

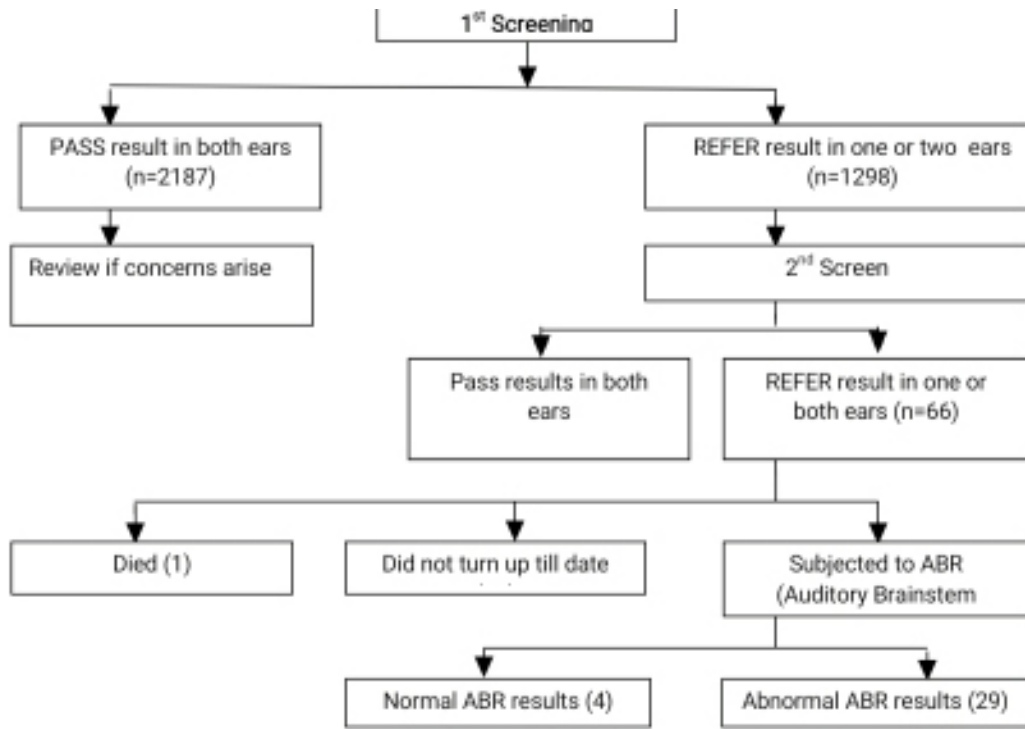


Fig. 2 Results of NICU graduates hearing assessment

Normal ABR results (4)

Out of patients diagnosed with hearing defects, 72.4% were male and 27.6% females. Fifty five percent of the patients with hearing impairment were premature (Gestational age <37 weeks). Hearing loss was significantly higher in premature (**p 0.029**), very low birth weight (**p 0.017**) and extremely low birth weight (**p <0.00001**) babies. [Table 2]

Table 2 Distribution of hearing loss according to demographic profile

Characteristics		Number of Patients screened	Patients diagnosed with hearing loss (29)	P value
Gender	Male	2078	21 (72.4)	0.16
	Female	1407	08 (27.6)	
Maturity	Preterm	1250	16 (55.2)	0.029
	Term	2235	13 (44.8)	
Birth weight	≥2500 gram	2249	14 (48.3)	0.066
	1500-2499 gram	853	06 (20.7)	0.63
	1000-1499 gram	369	07 (24.1)	0.017
	<1000 gram	14	02 (6.9)	<0.00001

Number in parenthesis indicates percentage.

Forty one percent of the patients diagnosed with hearing impairment had suffered from Neonatal Jaundice. Other common co-morbidities were Respiratory distress syndrome,

Perinatal asphyxia. Down’s syndrome has been found to be significantly associated with hearing loss (**p0.002**). (Table 3)

Table 3 Distribution of hearing loss according to morbidity profile

Morbidity profile	No. of patients screened (N=3485)	Patients with hearing loss (n=66)	P value
Neonatal Jaundice	1270	11 (37.9)	0.867
Respiratory Distress Syndrome	833	9 (31)	0.366
Perinatal Asphyxia	606	6 (20.7)	0.638
Meconium Aspiration Syndrome	185	0 (0)	
Dehydration	155	0 (0)	
Sepsis	160	2 (6.9)	0.551
Transient tachypnea of newborn	105	0 (0)	
Infant of Diabetic Mother	52	0 (0)	
Congenital Malformations	47	0 (0)	
Intrauterine infections	13	0 (0)	
Downs syndrome	11	1 (3.4)	0.002
Hemorrhagic disease of newborn	5	0 (0)	

Number in parenthesis indicates percentage.

Of the patients with hearing impairment, 3 patients had unilateral hearing loss whereas 26 had bilateral hearing loss. [Table 4]

Table 4 Abnormal ABR results in the study

Hearing impairment	No. of patients
Unilateral mild to moderate	0 (0)
Unilateral moderate to severe	0 (0)
Unilateral severe to profound	3 (10.3)
Bilateral mild to moderate	1 (3.4)
Bilateral moderate to severe	1 (3.4)
Bilateral severe to profound	24 (82.8)

Number in parenthesis indicates percentage.

DISCUSSION

In this study 3485 babies (NICU Graduates) were subjected to hearing assessment via OAE and it was found that 1298 babies were found to have abnormal results as "Refer". These patients were subjected to a repeat OAE examination and 66 babies were still found to have "Refer" in one or both ears. 33 out of these 66 patients could be followed till now and were subjected to ABR and 29 (8.3 per 1000 neonates) of them were found to have abnormal hearing.

Hazare P, et al.^[3] have reported a prevalence of 14.9 per 1000 NICU graduates at Belagavi. Paul AK.^[4] have reported a prevalence of 10.3 per 1000 high risk newborns in their study conducted at Cochin. Mehar V. et al.^[5] performed hearing screening of 103 high risk newborns using OAE followed by ABR of which 78 per 1000 were found to have hearing loss. Prevalence in the current study is relatively less than the previous similar studies which may be due to attrition as only half of the babies with two abnormal OAE screening turned up for ABR.

In our study, 55.2% of the babies with hearing loss were premature and 51.7% were low birth weight (Birth weight less than 2500gm). Mandal S. et al.^[6] have reported in their study that out of 25 babies with abnormal ABR results, 24% were premature and 42.85% were low birth weight. Mehar V. et al.^[5] have reported in their study that 87.5% of the babies with abnormal hearing assessment were premature and all the babies were low birth weight.

In our study, Neonatal jaundice (37.9%), respiratory distress syndrome (31%) and perinatal asphyxia (20.7%) are co-morbidities associated with hearing loss in neonates. Mandal S. et al.^[6] have reported in their study of high risk newborns that hyperbilirubinemia (36%) and perinatal asphyxia (32%) were found to be the most common co-morbidities. Mehar V. et al.^[5] have reported that Neonatal hyperbilirubinemia

(37.5%), respiratory distress syndrome (37.5%) and perinatal asphyxia (25%) were most commonly associated with hearing abnormalities. These findings were similar to our study.

LIMITATION

Though ABR is the ideal investigation for hearing assessment of high risk neonates, but due to scarcity of resources ABR could not be performed in all the neonates. Also, only 50% of the neonates found to have two abnormal OAE examination turned up for ABR examination despite frequent reminders.

CONCLUSION

There is high incidence of hearing loss in NICU admitted newborns. Prematurity and Low birth weight are associated with increased risk of hearing impairment. Neonatal hyperbilirubinemia, respiratory distress syndrome and perinatal asphyxia are co-morbidities in neonates with hearing loss. Routine hearing evaluation of all NICU graduates is of utmost importance.

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