

Prevalence and Risk Factors of Hearing Impairment among High-Risk Neonates Born in a Tertiary Care Hospital in North Karnataka

Vijay B¹, Ramesh Pol^{2*} and Ashok badakali³

¹Resident, Department of Pediatrics, S.N. Medical College and HSK Hospital, Bagalkot, India

²Professor, Department of Pediatrics, S.N. Medical College and HSK Hospital, Bagalkot, India

³Professor and Head, Department of Pediatrics, S.N. Medical College and HSK Hospital, Bagalkot, India

*Corresponding Author: Ramesh Pol, Professor, Department of Pediatrics, S.N. Medical College and HSK Hospital, Bagalkot, India.

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Abstract

Introduction: Hearing is necessary for the proper mental, social, speech, and language development of a newborn child. Delay in diagnosis leads to improper development of mental, social, speech and language skills. There are several preventable causes for hearing impairment which is either maternal, intrapartum, or postpartum. The objective of the study is to find out the prevalence of hearing impairment in high-risk neonates admitted to the NICU of tertiary care hospital in north Karnataka.

Objectives: To find out the prevalence of hearing impairment in high-risk neonates who were admitted to a tertiary care hospital in north Karnataka.

Methods: This is a case series study, performed at Hanagal Shri Kumareshwar hospital Bagalkot a tertiary care center in north Karnataka from June 2021 and May 2022. This study was conducted after taking informed consent and ethical committee clearance, those who fulfilled the inclusion and exclusion criteria are taken into the study. All the high-risk new-born were subjected to the first Otoacoustic examination (OAE), and those who did not pass the first OAE were subjected to a second OAE before discharge. Those who did not pass the second were subjected to BERA at 3 months of age. Those who failed in BERA were considered as having a hearing impairment and were considered for further management.

Results: 470 high-risk neonates were subjected to 1st OAE screening, out of which 179 were subjected to 2nd OAE. Among 179 neonates 70 cases were subjected to BERA. Out of which 40 (8.5%) cases showed hearing impairment. Common risk factors for hearing impairment noted were, babies on mechanical ventilation for > 5 days (17.46%), family history of hearing loss (14.29%), maternal comorbidities (11.11%), birth asphyxia (9.72%), child on ototoxic medication (9.66%), Preterm (8.74%), low birth weight (8.03%) and hyperbilirubinemia (5.30%), These risk factor did not show a statistically significant influence on hearing impairment except hyperbilirubinemia (P value < 0.05).

Conclusion: Due to multiple risk factors exposure in newborns who are admitted to NICU are at higher risk for hearing impairment. For detecting hearing impairment in newborns two staged OAE and BERA are useful protocols that can be implemented as a national program. Early detection and management of hearing impairment will reduce the problem associated with that such as mental, social, speech, and language development of the child.

Keywords: Early Hearing Impairment; High-Risk Neonates; Prevalence; Risk Factors

Abbreviations

BERA: Brain Stem Evoked Response Audiometer; OAE: Otoacoustic Emission

Introduction

Hearing impairment in children will cause serious obstacles in education and language development. In newborns, hearing impairment is much more commoner than other disorders, such as congenital hypothyroidism and Phenylketonuria [1,2]. Prevalence of bilateral hearing impairment is approximately 1 to 5 per 1000 live births. Whereas unilateral hearing loss is more commoner than bilateral hearing loss and accounts to be 1 to 8 per 1000 live birth [3-5]. By using screening tests like OAE and BERA, hearing impairment can be identified early and early intervention can be taken, which provides a better prognosis in language development and social integration, and successful participation in society [5].

Studies carried out in India the use of unique paying attention to screening protocols have anticipated the prevalence of hearing impairment in neonates varies between 1 and 8 per 1000 babies screened [6-9]. Brain development especially the auditory pathway will develop during the first year of life. Auditory experience during this period has a good influence on the functional development of the auditory system and inadequate stimulus leads to suboptimal development of the auditory pathway [10]. Therefore, early detection is vitally important in providing appropriate care. The provision of hearing aid and special training for deaf and hearing-impaired babies will help them enjoy opportunities in society alongside all other children. A two-stage screening protocol with Oto-acoustic emission (OAE) as the first screen, followed by brainstem evoked response audiometry (BERA) for those who show hearing impairment in OAE for confirmation.

Materials and Methods

This case series study was performed in a tertiary care hospital at Hanagal Shri Kumareshwar hospital Bagalkot in North Karnataka between June 2021 and May 2022 after obtaining informed consent and institutional ethical committee clearance, individuals who met the inclusion and exclusion necessities have been taken into consideration for the study. Those who have not given consent or died or were referred are excluded from the study. Data was collected using predesigned questionnaires. The socio-demographic details of parents, obstetrics history, and any exposure to drugs, infection, and radiation in the intrauterine period were obtained. And a complete clinical examination of the child will be done before the study. The high-risk Newborns admitted to NICU were evaluated carefully to find hearing impairment in them. OAE was done to all high-risk newborns before discharge by a Trained person in OAE with portable handy equipment inner acoustic “The Neuro soft audiometer” [NEURO AUDIO SCREEN]:

- If abnormal result in the 1st OAE, the test was repeated before the discharge (2nd OAE).
- If the 2ndOAE test shows hearing impairment, the child was sent to an audiologist to perform BERA for confirmation at the age of 3 months.

Results

		All high-risk newborns (n = 470)	Chi-Square Test P Value
First OAE (n = 470)	Pass	291	P < 0.001
	Refer	179	
Second OAE (n = 179)	Pass	109	P < 0.001
	Refer	70	
Bera (n = 70)	Pass	30	P < 0.02
	Fail	40	

Table 1: Distribution of study population according to screening OAE result. Significant P value < 0.05.

470 high-risk neonates were subjected to 1st OAE during the hospital stay, out of which 179 (38%) cases were subjected to 2nd OAE, out of which 70 (14.8%) cases were subjected to BERA, out of which 40 (8.5%) case showed hearing impairment.

Risk Factor	Frequency (N=470)	Percentage %
Hyper Bilirubinemia	264	56.2
WEIGHT < 2.5 Kg	249	53
Child On Ototoxic Medication	238	50.6
Preterm	209	44.5
Birth Asphyxia	72	15.3
Mechanical Ventilation for More Than 5 Days	63	13.4
Others - Maternal Comorbidities	54	11.14
Congenital Infection	46	9.8
Culture Positive Sepsis	28	6
Family History of Hearing Loss	7	1.5

Table 2: Distribution of the study population according to the presence of risk factors for hearing.

A total of 470 newborns were included in the study. out of which 49.6% were female and 50.4% were male children. The common risk factors were hyperbilirubinemia (56.2%), birth weight less than 2.5kg (53%), history of ototoxic medication (50.6%), Preterm neonates (44.5%), birth asphyxia (15.3%), newborns on mechanical ventilation for more than 5 days (13.4%), maternal comorbidities (hypothyroidism, diabetes) (11.14%), congenital infection (9.8%), sepsis (6%), family history of hearing loss (1.5%).

Risk factor	No	Hearing loss present		Hearing loss absent		Fischer exact value	
		Number	Percentage	Number	Percentage	P value	Significance
Mechanical ventilation	63	11	17.46	20	31.75	0.266	NS
For more than 5 days							
Family history of hearing loss	7	1	14.29	2	28.57	0.608	NS
Others-maternal comorbidities	54	6	11.11	9	16.67	0.227	NS
Birth asphyxia	72	7	9.72	17	23.61	0.095	NS
Child on ototoxic medication	238	23	9.66	36	15.13	0.118	NS
PRETERM	206	18	8.74	15	7.28	0,071	NS
WEIGHT < 2.5 kg	249	20	8.03	19	7.63	0.071	NS
Hyperbilirubinemia	264	14	5.3	14	5.30	<0.05	Sig
Congenital infection	46	0	0.00	2	4.35	0.323	NS
Culture positive sepsis	28	0	0.00	1	3.57	0.571	NS

Table 3: Association between hearing impairment and risk factor.

Significant p value < 0.05.

The 40 cases showed hearing impairment. Common risk factors were, babies on mechanical ventilation > 5 days (17.46%), family history of hearing loss (14.29%), maternal comorbidities (11.11%, birth asphyxia (9.72%), child on ototoxic medication (9.66%), preterm (8.74%), low birth weight (8.03%), hyper bilirubinaemia (5.30%), these risk factor did not show a statistically significant influence on hearing impairment except hyperbilirubinemia. Hyperbilirubinaemia (P value < 0.05) showed a significant association with hearing impairment.

Discussion

Hearing plays a key role in mental, social, speech, and language development. Without speech and hearing it is difficult for interpersonal relationships to develop and thrive. Universal newborn hearing Screening is either recommended or already practiced and legally regulated in a number of developed countries in the west [2]. But it is yet to be a national reality in India. Children who are diagnosed and rehabilitated earlier show better language and behavioral skills at the age of five than children diagnosed later [5].

In our study, 40 newborns out of 470 high-risk newborns failed BERA thus the prevalence of hearing impairment was 8.5% these results are higher compared to a study from Kerala done by Jose DJ., *et al.* found the prevalence rate among high-risk neonates to be 0.9% which is much lower compared to present study, maybe because of the presence of multiple risk factor in a single baby in our present study [12].

The present study found hyperbilirubinemia (P < 0.05) to be significantly associated with hearing impairment compared to other studies which showed prematurity, mechanical ventilation > 5 days were significantly associated with hearing impairment, Pourarian S., *et al.* were prematurity (< 36 WOG) was significantly (P = 0.013) associated with hearing impairment [7]. Some studies showed that birth asphyxia was significantly associated with hearing impairment (P < 0.01), However, a study by Amini E found No statistical association between hearing impairment and birth asphyxia. Our study does not show any association between hearing impairment and birth asphyxia.

One of the most common risk factors is babies on mechanical ventilation > 5 days (17.46%), similar results were found in Kumar P., *et al.* studies the application of mechanical ventilation is related to children's respiratory disorders. provoking hypoxia in the central nervous system (CNS) and the possibility of hearing impairment [6].

A study by Ohl., *et al.* compared infants with one risk factor and infants with two or more risk factors and showed infants with two or more risk factors were more often diagnosed with hearing impairment than infants with single risk factors respectively 6.1% and 1.6% [11].

Some studies showed that various risk factors contribute to transient hearing loss among neonates but could not conclude if these factors contribute to actual hearing impairment. some newborns who failed the initial screening passed the second OAE test. This could be attributed to premature outer hair cells in the newborn or other physiologic changes in the newborn ear. The high number of false positive cases for hearing impairment in the present study (29.6%) may be due to incomplete clearance of normal fetal middle ear fluid and is another good reason why the abnormal results of initial hearing screening should always be verified by 2nd OAE test after several weeks or more specific method such as BERA.

Conclusion

Due to multiple risk factors exposure in newborns who are admitted to NICU is at higher risk for hearing impairment. For detecting hearing impairment in newborns two staged OAE and BERA are useful protocols that can be implemented as a national program [9].

Due to the incomplete clearance of normal fetal middle ear fluid false positive result is much higher if screening is performed early before the discharge [3]. At the time of the follow-up visit or at least during the visit for the infant's vaccinations (after 4 - 6 weeks of life)

Hearing screening can be performed. The population of screened infants would be smaller in such a situation. Early detection of hearing impairment will reduce the problem associated with that such as the mental, social, speech, and language development of the child.

Systematic and sustained involvement by Pediatrics and Otorhinolaryngological Associations and widespread public health education, combined with strong health care guidelines may help in change at the national level and its implementation as a national universal newborn hearing screening program [2].

Conflict of Interest

None.

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