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Comparative study of hearing assessment in normal and high risk infants by newborn hearing screening methods in a tertiary care institute

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***Abstract*---**Background: Hearing plays an important role for children in development of speech and language and socialization. Hearing impairment can have a negative impact on an individual's social, educational, and emotional life. If not detected early, it can affect the speech and language development. Early diagnosis by newborn hearing screening methods and protocols helps in prevention of hearing impairment. Objective: The primary objective of this study was to find the incidence of hearing loss in normal and high risk neonates. Materials and Methods: The study was carried out in a tertiary care teaching hospital over a period of 12 months. A total of 1200 babies including 810 normal and 390 high risk babies were enrolled into the study. All neonates underwent otoacoustic emission (OAE) test within first 3 days of birth. Those who failed in this test underwent repeat OAE after 2 weeks, followed by brain stem evoked response audiometry (BERA), when the neonates fail in second OAE. Results: Of 810 normal babies and 390 high risk babies, 65 and 103 babies showed absent OAE respectively on initial screening. On follow up, 10 and 21 babies still showed absent OAE in normal and high risk

group respectively. BERA showed hearing loss in 5 and 9 babies in normal and high risk group respectively. Conclusion: A proper protocol is required for the early detection of hearing loss. In this study, the incidence of hearing loss is found to be more in high risk babies compared to normal ones.

***Keywords*---**otoacoustic emission, brain stem evoked, response audiometry, neonatal hearing screening.

Introduction

Hearing plays an important role for children in learning speech and language, for socialization and cognitive development. The child learns speaking based on what is heard.[1] The prevalence of congenital hearing loss has been estimated to be 1.2–5.7 per 1000 in neonates and more in high risk neonates.[2] Hearing impairment affects communication, socialization, education, economic independence and quality of life. Newborn hearing screening program helps in early identification and management of hearing loss. In 1994, the Joint Committee of Infant Hearing suggested the 1-3-6 rule of screening before 1 month, diagnosis by 3 months, and intervention by 6 months of age.[3] Early identification and management of hearing loss for infants enable normal speech and language development.[4] Healthcare providers such as ENT surgeons,physicians, pediatricians, and nurses play an important role in the successful implementation of UNHS program.[5,6]

Clinically, it is difficult to detect the hearing loss in newborns. Hence, otoacoustic emission (OAE) and brain stem evoked response audiometry (BERA) are the two tests used effectively. OAE is an objective test to determine the functioning of the outer hair cells, and BERA tests the functional integrity of the auditory pathway from the eighth nerve to auditory cortex. Since OAE is simple, quick, and inexpensive, it is used more often than BERA for screening procedure.[7] The primary objective of this study was to find the incidence of hearing loss in normal and high risk infants.

Materials and Methods

This study was conducted in the department of ear, nose, and throat in a tertiary care teaching hospital, over a period of 1 year from July 2020 to June 2021. A total of 1200 babies born during this period were enrolled in the study. Ethical clearance for the study was obtained from the institutional ethics committee. Detailed history regarding prenatal, natal, and postnatal period was taken from parents. History included demographic details, family history of deafness and consanguinity, prenatal, intra-natal and postnatal events, and complications. Preterm baby, Low birth weight baby, birth asphyxia, congenital anomalies, neonatal jaundice, newborns with a history of convulsions, and infection were categorized into high-risk group. Newborns were clinically evaluated and screening done by OAE within first 3 days of birth. Those who failed in this test underwent second screening with OAE at 2 weeks of age, followed by BERA if the repeat OAE was absent.

Results

In our study, we have included 1200 infants. Of 1200 newborns screened, 675 (56.25%) were male and 525 (43.75%) were female. Among 1200 infants, 810 (67.5%) were normal and 390 (32.5%) were high-risk babies. Among 693 normal babies, 462 were male and 348 were females, and among 390 high-risk neonates, 213 were male and 177 were female.

After first otoacoustic emission

Ater 1st OAE, 1032 (86%) babies passed the test and showed normal hearing. 168 (14%) babies failed the test, in whom 48 babies had failed result in right ear, 54 babies in left ear, 66 babies in both ears. Among 810 normal infants, 745 passed the initial screening with OAE (91.9%). Left, right, and bilateral ear fail was shown by 18 (2.2%), 26 (3.2%), and 21 (2.6%) infants, respectively. Of 390 high risk babies who underwent initial screening by OAE, 287 infants passed the test. 30 (7.7%) showed right, 28 (7.1%) showed left, and 45 (11.5%) infants showed bilateral hearing loss.

1st OAE	Normal babies	High risk babies	Total	Chisquare test 73.90 P = 0.0001
Pass	745	287	1032	
Refer	65	103	168	
Total	810	390	1200	

91.97% of normal babies passed the first OAE whereas only 73.58% of the high risk babies passed the first OAE. This difference was highly significant**.**

1st OAE Refer	Normal babies	High risk babies	Total
Right ear	18	30	48
Left ear	26	28	54
Both ears	21	45	66
Total	65	103	168

After the second otoacoustic emission

Among 168 infants who failed the initial screening by OAE, 136 infants passed the test after the second OAE. A total of 1168 babies were shown to have normal hearing sensitivity after 2nd OAE. In the remaining 32 infants, 6 babies were lost to follow-up, 8 babies showed failed result on the right side, 6 on the left side, 12 babies failed in both ears. In normal category, after the second OAE, 54 passed making the number of normally hearing babies as 799. With 2nd OAE test, 82 infants passed the test in high risk group making a total of 369.

2nd OAE	Normal babies	High risk babies	Total	Chisquare test 0.31 P= 0.577
Pass	54	82	136	
Refer	11	21	32	
Total	65	103	168	

87.09% of normal babies passed the 2nd OAE whereas 79.61% Of high risk babies passed the 2nd OAE among 168 babies who failed 1st OAE. Among 32 babies who failed 2nd OAE, 6 were lost to follow up. BERA was done in 26 babies who failed 2nd OAE, 12 had Normal hearing, whereas 14 babies had Hearing loss.

After brain stem-evoked response audiometry

Of 1200 newborns screened, 26 babies were subjected to BERA to confirm hearing loss. Of this, 12 babies showed normal hearing. Hearing loss was present in 14 babies, out of whom, 2 had hearing loss in right ear, 2 in left ear and 10 babies had bilateral hearing loss. Among these, 8 were male and 6 were female. Among 26 babies who underwent BERA, 10 were normal babies and 16 were high-risk babies. In the normal category,5 babies showed hearing loss of whom 3 were male and 2 were female.1 infant had hearing loss in right ear and 4 had bilateral hearing loss. Among the high-risk category, 9 babies showed hearing loss, out of which 5 were male and 4 were female. 1 infant had hearing loss in right ear, 2 in left ear and 6 had bilateral hearing loss.

Hearing loss in BERA	Male	Female	Total
Right ear	1	1	2
Left ear	1	1	2
Both ears	8	6	14

Hearing loss in BERA	Male	Female	Total
Normal babies	3	2	5
High risk babies	5	4	9
Total	8	6	14

Hearing loss in BERA	Normal babies	High risk babies	Total
Right ear	1	1	2
Left ear	0	2	2
Both ears	4	6	10
Total	5	9	14

Discussion

Congenital hearing impairment is said to affect 2–3 in 1000 newborns.[8] Nearly 50% of the cases of deafness in children follow genetic etiology and involve single-gene mutation.[9] American Academy of Paediatrics Task Force on newborn and infant hearing advises universal hearing screening within 3 months of life and intervention by the age of 6 months.[10] According to reports by World Health Organization, 278 million people worldwide have moderate to profound hearing loss in both ears. Most of the people who have hearing disabilities live in developing countries.[11]. Four to six out of every 1000 children born in India are found to have severe to profound hearing loss.[12] In our study, screening was

done by OAE within first 3 days of birth. The test was repeated at 2 weeks of age in those who failed the test during first screening by OAE.BERA was done in those who failed in repeat OAE. Among 1200 neonates enrolled in our study, 810 were normal babies without any risk factors. Of these 810 newborns, hearing loss was detected in 5 babies by doing BERA. 390 babies were high-risk neonates out of whom, 9 babies had hearing loss. This accounts for an incidence of hearing loss of 6.17/1000 live births in normal and 23/1000 live births in high risk infants. The incidence of hearing loss in high-risk group is more compared to normal group. In a study by Rai and Thakur, the incidence of hearing loss was found to be 2.29 in 1000 normal and 49.18 in 1000 risk babies.[13] According to the study by Parab *et al*, the incidence of hearing loss was 1.68 in 1000 normal babies and 10.6 in 1000 high-risk babies.[14] A study by Nagapoornima *et al*. reported the incidence of hearing loss as 10.75 and 4.7 per 1000 live births in high risk and normal infants respectively.[15] According to the study by Nishad *et al*, incidence of hearing loss was 7.21/1000 live births in normal and 16.2/1000 live births in high-risk neonates.[16] A study by Ramkumar, reported the incidence of hearing loss as 7 to 10 per 1000 in high risk babies while 1 to 5 per 1000 in normal babies.[17] According to study by Satish *et al*, the incidence of hearing loss among the high risk group was 0.188 whereas incidence among normal group was 0.528 per 1000 infants.[18] The reasons for loss of follow up include long distance, lack of knowledge among parents, hearing given a lesser priority over other medical problems.

Conclusion

This study demonstrates importance of Universal Neonatal Hearing Screening Program so that hearing loss can be detected as early as possible. In our study, on initial screening with OAE, 168 infants out of 1200 live births showed hearing loss. The incidence of hearing loss reduced to 32 babies after repeat OAE. The overall incidence of hearing loss was 14 out of 1200 live births after BERA test. The incidence of hearing loss was 6.17/1000 live births in normal and 23/1000 live births in high risk infants. The incidence of hearing loss was more in high risk group compared to normal group. We followed a protocol of initial screening within 3 days of birth by OAE. Repeat OAE was done in those with suspected hearing loss. BERA was considered for confirmation of hearing loss. Many false positive reports were noted that during the initial period of life. OAE is a simple test and faster, preferred for the initial screening. Screening with only OAE may yield high false positives. BERA is essential for confirmation of hearing loss.

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References

1. Rundjan L, Amir I, Suwento R, Mangunatmadja I (2005) Neonatal hearing screening high risk.Sari Pediatr. 6(4):149–154

2. Parving A (1993) Congenital hearing disability: epidemiology and identification—a comparison between two health authority districts. Int J Pediatr Otorhinolaryngol 27:29–46
3. Joint Committe on Infant Hearing (1995) Joint committee oninfant hearing 1994 position statement.American academy of pediatrics joint committee on infant hearing. Pediatrics 95:152–156
4. Kennedy CR, Kimm L, Cafarelli Dees D, Campbell MJ, Thornton ARD, Bamber J et al (1998) Controlled trial of universal neonatal screening for early identification of permanent childhood hearing impairment. Lancet 352:1957–1964
5. Goedert MH, Moeller MP, White KR (2011) Midwives' knowledge, attitudes, and practices related to newborn hearing screening. J Midwifery Women's Heal 56(2):147–153
6. Moeller MP, White KR, Shisler L (2006) Primary care physicians' knowledge, attitudes, and practices related to newborn hearing screening. Pediatrics 118(4):1357–1370
7. Shang Y, Hao W, Gao Z, Xu C, Ru Y, Ni D. An effective compromise between cost and referral rate: A sequential hearing screening protocol using TEOAEs and AABRs for healthy newborns. Int J Pediatr Otorhinolaryngol 2016; 91: 141-5.
8. Balázs A, Neagoș A. Risk factors for congenital hearing loss: Which are the most relevant? J Interdisciplinary Med 2017; 2:58‑61.
9. Marazita ML, Ploughman LM, Rawlings B, Remington E, Arnos KS, Nance WE. Genetic epidemiological studies of early-onset deafness in the US school-age population. Am J Med Genet 1993; 46:486‑91.
10. Gans DP. Improving behavior observation audiometry testing and scoring procedures. Ear Hear 1987; 8:92‑100.
11. Tucci DL, Merson MH, Wilson BS (2010) A summary of the literature on global hearing impairment: current status and priorities for action. Otol Neurotol 31(1):31–41
12. Harvey C (2003) Newborn hearing screening. Aust Prescr 26:82–87
13. Rai N, Thakur N. Universal screening of newborns to detect hearing impairment –Is it necessary? Int J Pediatr Otorhinolaryngol 2013;77:1036‑41.
14. Parab SR, Khan MM, Kulkarni S, Ghaisas V, Kulkarni P. Neonatal screening for prevalence of hearing impairment in rural areas. Indian J Otolaryngol Head Neck Surg 2018;70:380‑6.
15. Nagapoornima P, Ramesh A, Srilakshmi., Rao S, Patricia PL, Gore M, *et al*. Universal hearing screening. Indian J Pediatr 2007;74:545‑9.
16. Nishad A. A Study of Incidence of Hearing Loss in Newborn, Designing a Protocol and Methodology to Detect the Same in a Tertiary Health-care Center. Indian Journal of Otology. 2020;26(2):85-88.
17. Ramkumar V. A review of neonatal hearing screening practices in India. J Hear Sci [Internet]. 2017;7(2):9–15.
18. Satish H, Anil Kumar R, Viswanatha B. Screening of Newborn Hearing at a Tertiary Care Hospital in South India. Indian Journal of Otolaryngology and Head & Neck Surgery. 2018;71(S2):1383-1390.