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Original Research Article

Neonatal Hearing Screening Amongst the High Risk Groups at District Early Intervention Centre in a Peripheral Tertiary Care Hospital

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Abstract

Objectives: To evaluate hearing loss in high-risk neonates and to correlate between the severities of hearing loss among high-risk babies attending DEIC at Burdwan Medical College & Hospital, Burdwan, Purba Bardhaman.

Materials and Methods: This study was conducted over a period of 3 months (March 2023 to May 2023). A total 1022 patients aged upto 3 months, who undergone hearing screening in the DEIC, Burdwan Medical College Hospital, Burdwan were included in this study.

Result: A total no of 1022 (male-50.94% & female-49.06%) targeted babies were screened. Sixty-one (5.9%) cases had hearing impairment. Out of 61 hearing impaired children 32 were male and 29 females were there. 324 (31.7%) babies failed in 1st screening procedure. Out of 324, 72 (22.22%) babies failed in 2nd screening procedure who then underwent BERA. Sixty-one babies had abnormality in BERA study. 3 (0.29.%) babies came for hearing screening only for suspicion of hearing loss by their parents. 6 (0.58%) babies had positive family history. 813 (79.59%) babies had history of stay at NICU for more than 5 days for multiple variable reasons like very low birth weight, jaundice, birth asphyxia, low APGAR score. 51 (4.9%) babies had history of in-utero infections. 36 (3.5%) babies had craniofacial anomalies. 3 (0.29%) babies had white forelock. 28 (2.7%) babies had syndromic features. 39 (3.81%) babies had neurodegenerative disorder. 29 (2.8%) babies had culture positive post-natal infection. 3 (0.29%) babies had history of head trauma. 4 (0.39%) baby was under chemotherapy.

Discussion: 40 % hearing impaired children had positive family history. 3.08% of hearing-impaired children having positive history of NICU stay for more than 5 days. 11.76% hearing impairment children had in utero infection. 27.78 % craniofacial anomalies children had hearing loss. 10.34% hearing impaired children had positive history of culture positive post-natal infection. There were 75% changes of hearing impairment caused by ototoxic drug effect.

Conclusion: In our study the overall prevalence of hearing loss was 5.97% in high-risk babies. It is recommendable that all hospitals with level 3 neonatal cares should have OAE & AABR facilities. If not, a centralized hearing screening with a portable OAE is suggested and all abnormal cases can be referred for OAE & AABR to the nearest centre. All babies with abnormal AABR should undergo detailed ENT evaluation and auditory rehabilitation before 6 months of age.

Keywords: Hearing loss; Children; BERA; OAE; HRR; Newborn Hearing Screening.

Introduction

The structural or functional abnormalities, including genetic or metabolic disorders, which are present from birth, are illustrated as birth defects/ congenital anomalies. The Global Burden of Disease (GBD) study 2013 identified congenital anomalies to be one of the top ten causes of mortality in children less than five years of age. The GBD study 2017 has declared that congenital anomalies accounted for highest deaths worldwide and the burden in years of life lost is higher. India having a large number of infants born annually with birth defects bears a quarter of global neonatal deaths. In 2013, the country reported a neonatal mortality rate of 29 per 1000 live births, responsible for 753,000 neonatal deaths and a national estimate of the birth prevalence of congenital anomalies also reported that an average of 472,177 births are affected by birth defects each year. Under its organizational structure, accredited social health activists (ASHA's) and Mobile health

teams (MHT) will do the community screening, while the DEIC located in the district headquarters will screen, diagnose and treat children referred from the community. DEIC has to establish institutional capacities like Infrastructural, manpower and their training capacities, as per guidelines by Ministry of Health & Family Welfare, Government of India. Accordingly, DEIC has to acquire different type of equipment and specialist manpower for effective operationalization. The services provided by DEIC include occupational and physical, psychological, cognitive, audiological, language, vision, speech, and nutritional therapies apart from laboratory services. Different levels of training Programs conducted by the DEIC for staff, basic level of training and advanced level training was there. Children diagnosed with any of the 30 listed health conditions shall receive follow up treatment including surgeries at tertiary level, free of cost.

Among all disabilities hearing impairment is hidden difficulty. The impact of permanent deafness on a child's development is profound. It affects not only language acquisition but also social development and quality of life. Early detection of congenital deafness with targeted intervention significantly reduces negative impacts in these areas. In 1994, the Joint Committee on Infant Hearing (JCIH) [table 1] published a position statement that endorsed the goal of universal detection of infants with deafness and encouraged continuing research and development to improve techniques for detection of and intervention for deafness as early as possible.

Today, the crucial role of newborn hearing screening (NBHS) is emphasized by the fact that almost all states and territories of the India have introduced newborn hearing screening under DEIC, with the remainder of states having implemented newborn hearing screening without legislation. Currently, the JCIH recommends universal newborn hearing screening by 1 month of age, diagnosis by 1 month of age, and early intervention by 3 months of age to allow optimal intervention for children with deafness, if warranted and if desired by the family.

Objectives:

1. To evaluate hearing loss in high-risk neonates
2. To correlate between the severities of hearing loss among high-risk babies.

Materials and Methods

The study was conducted on 1022 high risk infants, aged birth to 3 months, referred to the department of District Early Intervention Centre (DEIC) at Burdwan Medical College & Hospital (BMC&H) between 1st March, 2023 to 31st May 2023 after institutional research and ethical committee clearance was obtained. High risks infants referred from paediatrics department of BMC&H, Sadar Hospitals of Purba Bardhaman district or adjoin districts of Purba Bardhaman were evaluated for hearing loss by external ear canal examination, behavioural observation audiometry, otoacoustic emission, Auditory Brainstem Response (ABR), Auditory Stady State Response (ASSR). Evaluations were done to detect the hearing loss in high-risk infants. The evaluation was done in two ways:

Institute based: All high-risk newborn babies referred from paediatrics department were screened by audiologist using distortion product otoacoustic emission (DPOAE) after 7 days at first follow up visit at follow up clinic attached with DEIC. Newborns admitted in the neonatal intensive care unit (NICU) were screened prior to discharge from the NICU (once their general condition was stable). Guardian of all babies were counselled regarding the benefits of hearing screening, procedure of the screening test, need for follow-up and further tests if the neonate failed the screening test and the interventions available if hearing loss was confirmed.

Community based: The guardian of well babies was counselled regarding developmental milestone of auditory and language development. They are asked to report if any discrepancy of developmental milestone. The Block Public Health Nurses, ANM were trained on developmental milestones and hearing screening using behavioural observation method. As they can screen child during immunization at block, primary health care levels, they are trained to maintain the database of hearing screening result. The Medical officers of Block & Primary health care level were also trained to hearing screening using noise makers and voice tests. The child must be referred to DEIC at BMC&H if any quarries in auditory developmental milestones. Special care was given to parents who failed to attend in follow up clinic.

Screening: The first screening test was done at audiology clinic in a sound treated room while the babies were asleep or clam stage. Parents of babies who failed ('refer') the screening test were counselled and asked to return after 2 weeks for second screening. These babies underwent for second testing in the same room. Those who passed on the second screening were discharged from the study but kept under observation at home by Accredited Social Health Activists (ASHA).

While those who failed a second time were referred for further evaluation in DEIC, where a detailed history for risk factors was obtained, parents were counselled and diagnostic testing using Brainstem Evoked Response Audiometry and Auditory Steady State Response (ASSR) were done. ASSR was used

as the diagnostic procedure to confirm hearing loss, as well as to obtain frequency specific thresholds to enable more effective and appropriate hearing aid fitting. Those confirmed cases with hearing loss were followed up in the Audiology & communication disorders section at DEIC for further evaluation and appropriate rehabilitation. The parents who failed to return for follow-up were communicated through repeated phone calls, by social worker of DEIC though proper channels to reduced dropout rate. The 'refer' children were tracked through functionaries at grass root level such as Anganwadi workers, Accredited Social Health Activist (ASHA) and Trained Birth Attendants.

Instrument: TEOAE & DPOAE: Maico, BERA: Neurosoft dual channel ABR system, ASSR: Neurosoft dual channel ABR system.

Inclusion Criteria: Infants with at least any high-risk factors were included into the study.

Exclusion Criteria: a) Consent not obtained, b) Active ear infections, c) Severe multiple anomalies and incompatible with life.

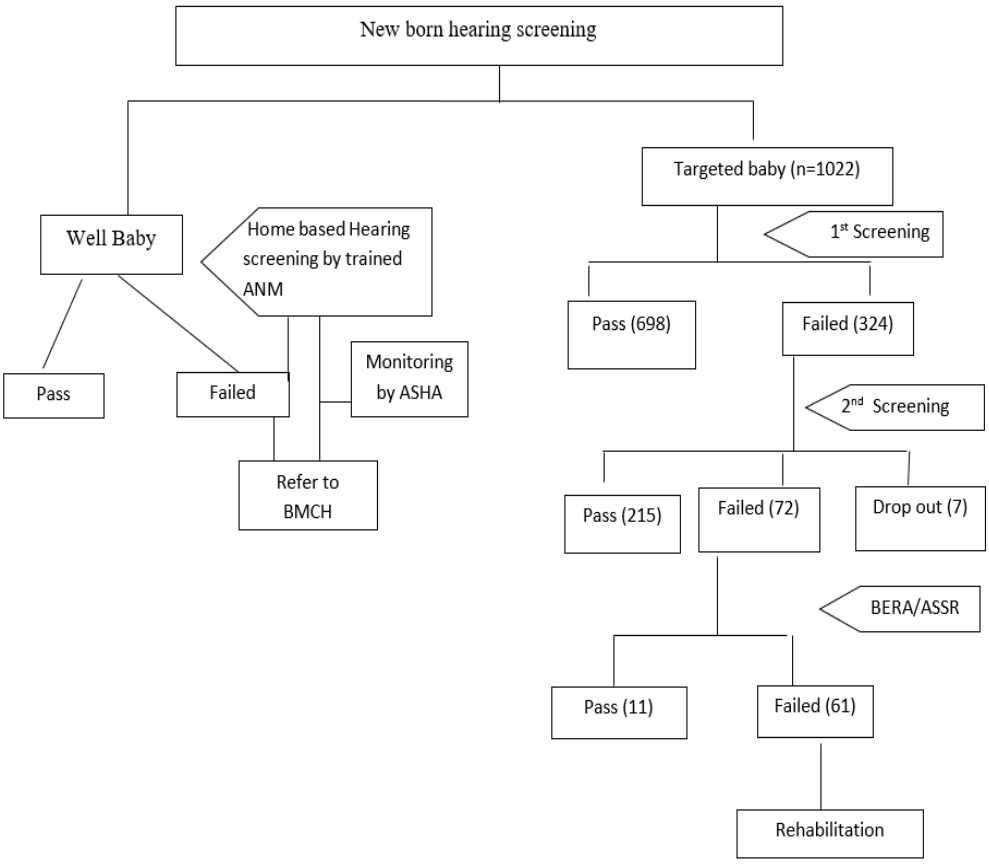
Data obtained was analysed using SPSS software.

Result

A total no of 1022 (male-50.94% & female-49.06%) targeted babies were screened [Table 2]. Sixty-one (5.9%) hearing impaired cases were found. Out of 61 hearing impaired children, 32 male and 29 female were there. 324 (31.70%) babies were failed in 1st screening procedure. Out of 324, 72 (22.22%) babies fail in 2nd screening procedure that then underwent BERA. Sixty-one (5.9%) babies were abnormal in BERA study.

Hearing loss of these 61 babies was confirmed by BERA and ASSR. The severity of hearing loss of these babies was Moderate to Profound degree of sensori-neural hearing loss.

There were three (0.29%) babies came for hearing screening only for suspicion on hearing loss by their parents. 10 (0.97%) babies had positive family history. 813 (75.94%) babies had history of staying at NICU for more than 5 days for various causes like very low birth weight, jaundice, birth asphyxia, low APGAR score etc. 51 (4.99%) babies had a positive in-utero infection history. 36 (3.52%) babies had craniofacial anomalies. 3 (0.29%) babies had white forelock. One baby was suffering from Treacher Collins syndrome. 28 (2.74%) babies were syndromic cases. 39 (3.82%) babies had neuro-degenerative disorder. 29 (2.84%) babies had culture positive post-natal infection. 3 (0.29%) babies had history of head trauma. 4 (0.39%) baby was under chemotherapy [Table 3].



Flowchart 1:

Table 1: Joint Committee on Infant Hearing (JCIH) –High Risk Indicators

S N	**Joint Committee on Infant Hearing (JCIH) –High Risk Indicators**
1	Caregiver concern regarding hearing, speech, language, or Developmental delay.
2	Family history of permanent childhood Hearing loss.
3	Neonatal intensive care of more than 5 days or any of the following regardless of length of stay
4	In utero infections, such as CMV, herpes, rubella, syphilis, and toxoplamosis
5	Craniofacial anomalies, including those that involve the pinna, ear canal, ear tags, ear pits, and temporal bone anomalies.
6	Physical findings, such as white forelock, that are associated with a syndrome known to include a sensorineural or permanent conductive hearing loss
7	Syndromes associated with hearing loss or progressive or late---onset hearing loss, such as neurofibromatosis, osteopetrosis, and Usher syndrome; other frequently identified syndromes include Waardenburg, Alport, Pendred, and Jervell and Lange---Nielson
8	Neurodegenerative disorders, such as Hunter syndrome, or sensory motor neuropathies, suchas Friedreich ataxia and Charcot---Marie---Tooth syndrome.
9	Culture---positive postnatal infections associated with sensorineural hearing loss, including confirmed bacterial and viral (especially herpes viruses and varicella) meningitis.
10	Head trauma, especially basal skull/temporal bone fractures that requires hospitalization
11	Chemotherapy-“Chemotherapy” refers to a number ofdrugs which can be “ototoxic.”

Table 2: Distribution of various risk factors

Distribution of Various risk factors based on JICH 2007				
SN	**HRR**	**M**	**F**	**Total**
1	Caregiver concern	4	2	6
2	Family History	4	6	10
3	NICU stay>5 days	405	408	813
4	In utero infections	30	21	51
5	Craniofacial anomalies	24	12	36
6	Physical findings	2	1	3
7	Syndrome	17	11	28
8	Neurodegenerative disorder	22	17	39
9	Culture positive post-natal infection	19	10	29
10	Head trauma	1	2	3
11	Chemotherapy	2	2	4
	Total-	530	492	1022
based on JICH-2007				

Table 3:

Hearing test findings of HRR babies		
SN	Normal	Abnormal
1	6	0
2	6	4
3	788	25
4	45	6
5	26	10
6	1	2
7	23	5
8	37	2
9	26	3
10	2	1
11	1	3
	961	61

Discussion

Most of the studies considered the prevalence of severe to profound hearing loss [1], and the exact prevalence of hearing loss in all levels is not known due to the few number of services implemented in the country. Even with the variables, the Joint Committee on Infant Hearing [2], and other world organizations recognize the importance of neonatal hearing screening, studying and discussing, as from the year 2000, the feasibility of each TEOAE and

AABR tests used to detect hearing alterations, considering the main advantages and disadvantages; and the cost of each or both procedures for the institution implementing the neonatal hearing screening [3-8].

The present investigation followed the protocol implemented by DEIC for neonatal screening using the option of re-testing in case of "failure" in the first assessment, before referring the baby for further diagnosis. We agree that there are cases of false-positive results, and we also included AABR testing in the group of babies from the regular nursery [9-10]

The study used the recording by statistical analysis, and we observed a quick response capture by both TEOAE and AABR. As for the latter test, we noticed only the wave V for non-linear click-type stimuli at the fixed intensity of 35 dB HL.

According to the results described on flow chart [Table 4], 698 newborns had "pass" result on ABR; and there was no statistically significant difference among the results of the two tests for the group of newborns from the regular nursery. This value is within the 80 to 100% of the reference for TEOAE and above 84% for the ABR test, found in studies searched in the literature [11]. In the present investigation 21 newborns who did not respond to the ABR were part of the group of the 38 who "failed" the TEOAE. All newborns were submitted to both tests, TEOAE and ABR. The two tests were carried out, coinciding with our findings in this study [11] which used the same protocol in 99% of the newborns.

The group of newborns from the NICU was assessed between 48 hours and 25 days of life and they were found in a good state of health, right before their hospital discharge following all the recommendations from the literature of corrected age above 33 weeks to obtain more reliable responses. The newborns from the regular nursery and from the NICU who passed the test were free from follow-up, as long as the response received for the hearing thresholds was equal to or below 30 dB HL(9).

In the present investigation, we found a higher occurrence of individuals who passed TEOAE and AABR tests among the babies from the regular nursery than those from the NICU, in agreement with the findings by Thompson et al. [12] who reported a higher number of individuals "passing" the tests from the regular nursery in both tests. All newborns from the regular nursery and from the NICU who "failed" their first test returned for a second assessment, within an average of 15 days, after the first screening, in agreement with the papers published which emphasize the importance of newborn follow-up and parent education [7].

Among the newborns from the regular nursery (Table 5), 87.5% of the group tested "passed" the TEOAE and the AABR tests, and 12.5% of newborns did not show responses in both the TEOAE and the AABR tests.

In the group of newborns from the NICU, among ten that "passed" the TEOAE and nine who passed the AABR, only one neonate did not respond to both procedures and there was another one who passed the TEOAE but failed the ABR (Flowchart 1). There was no statistically significant difference in both tests; however, as mentioned in other studies, each one is able to rule out changes in different regions of the auditory system, and TEOAEs are used to test the peripherical system, while AABR tests the central portion of the brainstem. The newborns who "failed" only one of the tests or both were referred to further diagnostic procedures.

Although the present investigation shows results similar to those found in the literature, stating that a "failure" in the first test can be transitory, for the size of the sample size of both groups, it is necessary to continue to apply these tests in studies with larger populations. Many authors reported that vernix and amniotic fluid, which have not been eliminated by newborns in their first hours of life, can interfere in auditory screening; probe size can interfere in response capture, and even body temperature can impact the AABR. These factors may justify the results obtained in this study as far as "failures" in the first assessment are concerned.

6.56% hearing impaired children had positive family history. 40.98% of hearing impaired children had positive history of NICU stay for more than 5days. 9.84% hearing impairment children had inutero infection. 16.39% children with hearing loss had craniofacial anomalies. 4.92% hearing impaired children had positive history of culture positive post-natal infection history. In 4.92% neonates hearing impairment was caused by ototoxic drugs. In this study NICU stay > 5 days (P=0.500), culture positive post-natal infection (P=0.500) were significant independent clinical risk factors for predicting hearing impairment in high risk neonates.

Conclusion

This study was performed over a period of three months in a tertiary care hospital with minimal allocation of resources and according to protocol. In our study the overall prevalence of hearing loss was 5.9% in high-risk babies. Despite its various challenges this study generated data that can potentially be compared to nation wise statistics. It is recommendable that all hospitals with level 3 neonatal cares have OAE & Automated ABR facilities. If not, a centralized hearing screening

with a portable OAE is suggested and all abnormal cases can be referred for OAE & AABR to the nearest centre. All babies with abnormal AABR should undergo detailed ENT evaluation and auditory rehabilitation before 3 months of age. The aim of DEIC is management of 4D's along with preventing avoidable hearing loss, early identification and rehabilitation. Hospital based universal hearing screening of high-risk babies before discharge is feasible at a rural based tertiary care centre. Non specialist staffs are also invaluable in achieving a two-stage hearing screening protocol. However, more efficacious tracking and follow-up system is needed to improve the follow up rate.

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