Type of Article: Original Research Article

UNIVERSAL HEARING SCREENING IN NEONATES IN A TERTIARY CARE HOSPITAL

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Abstract

Background: The hearing threshold of more than 25 decibels (dB) at the frequencies (500,1000, 2000 and 4000 Hertz) which are important for speech recognition can result in significant auditory deficits. Hearing loss can be slight, moderate, severe or profound hearing loss based on the average threshold.

Objective: to determine the incidence, associated risk factors hearing impairment in a population ofneonates seeking care at Rohilkhand Medical College and Hospital, Bareilly.

Methods: The present descriptive exploratory study was conducted among 200 neonate who are born or admitted in Rohilkhand Medical College and Hospital, Bareilly over a period of 12 months.

Results: The first otoacoustic emission (OAE) screening was done on infants at the time of discharge from the NICU. Eighty-three infants (55.33%) had "refer" on the first OAE and the remaining67 (44.67%) were passed results at the time of discharge. **At 21 DAYS of life**, on repeat screening with a second OAE test, 36% "refer" on the first screen had a "refer" result on the second DPOAE. However, 4.4%"pass" on the first screen turned out to be "refer" on the second screen. These 33 infants who had "refer" results on the second screen were subjected to testing. **At 3 MONTHS of life**, BERA was performed on 33 infants. 11 infants out of 33 had sensorineural hearing loss (SNHL) on AABR.

Conclusions: Two-stage OAE done prior to BERA is helpful in the early detection of hearing loss. Our study demonstrates the use of a combination of OAE and BERA testing ensures high sensitivity and acceptable specificity, and predict the incidence of hearing impairment in Neonates Our efforts identified 11 Neonates with auditory neuropathy who hopefully will benefit from early remediation of their hearing deficit.

Keywords: incidence, associated risk factors, hearing impairment, neonates seeking care,

INTRODUCTION

A newborn's ability to hear is a fundamental component of his interaction with his surroundings and is essential for the development of his speech and language[(1)]. The ability to communicate, acquire skills, and perform academically all greatly depend upon a child‟s ability to hear spoken language. Also, it can affect social and emotional development of the child. Approximately 0.5 to 5 in every 1000 newborns and infants suffer from congenital or early childhood onset sensorineural deafness or severe to profound hearing impairment, according to a variety ofresearch and surveys carried out in various countries. Children who are deaf or have hearing loss frequently endure delayed speech, language, and cognitive ability development, which can slow learning and hinder academic advancement. If suitable and effective interventions are not offered during the crucial period during central auditory pathway development, congenital & early childhood onset deafness or severe to profound hearing impairment may have an impact on children's auditory neuropathways at a later developmental stage. Early identification is therefore crucial to giving deaf and hearing-impaired infants with the proper support so they can have the same possibilities as other children in society.[(2)] The duration of uncorrected hearing loss is typically associated with the severity of such hearing impairments. Therefore, the “wait and watch” approach cannot be used when a child has hearing loss in the hopes that they would outgrow it[(3)]. Early intervention beforethe age of 6 months facilitates normal development of language, regardless of the severity of hearing loss[(4)]. Many of the causes are preventable/ treatable if detected early. The first 36 months of life are crucial for language acquisition.[5)] In order to improve a child‟s overall development in the cognitive, physical, and social domainsand consequently lower the morbidity associated with treatable hearing loss, early detection and adequate treatment are therefore essential. The earlier the detection, the better the reduction of the deleterious effects of impaired audition and better development of the child. For the improvement of communication and language abilities, Auditory stimulation during the first 6 months of life is critical.[6] Hearing capacity, mild to profound degree of Hearing Impairment (HI), age of identificationof hearing loss, age of intervention, aided audibility, duration, consistency of hearing aid use, and characteristics of the child's language environment are some of the variables that are expected to influence the normal development of speech and language skills in children, which will eventually also predict cognitive development. Early HI diagnosis and prompt, effective treatments are required to reduce its detrimental impact on the growth of cognitive, psychosocial, and linguistic communication skills.[(7)] Hence this study was conducted to determine the incidence, associated risk factors hearing impairment in a population of neonates seeking care at Rohilkhand Medical College and Hospital, Bareilly

MATERIALS AND METHODS

The present descriptive exploratory study was conducted among 200 neonate who are born or admitted in Rohilkhand Medical Collegeand Hospital, Bareilly over a period of 12 months. Written informed was obtained from guardians of all the patients enrolled in the study in a language they can understand. Anonymity will be proposed as optional and confidentiality will be guaranteed.

Inclusion Criteria:

1. All babies born or admitted in our hospital irrespective of gender.

Exclusion Criteria:

1. Neonates with severe multiple anomalies incompatible with life
2. Neonates with atresia or stenosis of external ear canals of both ears.
3. Those whose guardians refused to give consent

Methodology:

Parents/guardians of all the neonates shall be invited to participate in study.Only those providing consent to participate in study shall be enrolled in the study. After review of clinical history, physical examination along with all investigations,patients will finally be included or excluded from the study.

Procedure:

From all the patients consenting to participate in study, demographic information, detailed maternal medical and obstetric history shall be obtained. Details of gestation including complications during pregnancy, gestational age at delivery, mode of delivery and birth weight will be noted. A thorough clinical examination will be carried out.

All the neonates shall be subjected to hearing screening test using Oto Acoustic Emmision (OAE). The test will be carried out in quiet surroundings in the presence of mothers, whenever possible. The mother will be 7 instructed to feed thebaby just prior to the testing. Most of the neonates fall asleep after getting their feed. The neonates who would not sleep after the feed will be sedated using syrup Triclofos (25- 30 mg / kg). OAE test will performed by using the Autoport. Autoport is placed on the baby‟s head. The correct position is checked with the Impedance test. After passing the impedance test, the measurement starts. Babies who fail the screening will be tested again between 14-21 day of age with same technique. If thenstill fail the test, they will be advised to undergo BERA at 3 months of aged. **The test results shall be noted as positive (for hearing loss) or negative (for hearingloss).**

Statistical Analysis Method:

Data will be analyzed by using descriptive and inferential statistics. Statistical analysis such as mean, median, standard deviation and percentage distribution will be done to describe the demographic variables. Chi-square test, „t‟-test and ANOVA shall be used to find out association between different factors andoutcomes. **IEC clearance** Study will be conducted after approval from InstitutionalEthical Committee.

RESULTS

Out of 150 participants, 90 were male (60%) and 60 were male (40%), no gender preponderance for hearing impairment wasobserved in this study.

TABLE 1: DATA OF PERIOD OF GESTATION (TERM VS PRETERM) ANDITS IMPACT ON HEARING LOSS-

GESTATION	NUMBER	PERCENTAGE	P-VALUE
PRETERM	94	62.6%	0.08
TERM	56	37.3%	

Out Of 150 Participants, 94 Were Preterm (62.6%) And 56 Were Male (37.3%). P-Value Is 0.08.

Out of 150 participants, 67 were born via NVD, 83 were born via LSCS, no preponderance for hearing impairment was observed in this study on the basis of mode of delivery.

TABLE 2: COREELATION OF BIRTH WEIGHT OF NEONATE ANDHEARING ASSESSMENT

BIRTH WEIGHT	OAE PASS @ DISCHARGE	OAE FAIL @ DISCAHRGE	OAE PASS @ 21 DAYS	OAE FAIL @ 21 DAYS	BERA PASS	BERA FAIL	P value
ELBW	0	2	1	0	0	0	
VLBW	11	22	24	9	8	1	
LBW	29	36	54	11	5	5	
NORMAL WEIGHT	25	26	37	14	9	5	

P-VALUE – 0.001

Extremely low birth weight babies have high incidence ofhearing loss as comapred to normal birth weight babies

TABLE 3: DATA OF MATERNAL HISTORY

MATERNAL HISTORY	NUMBER	PERCENTAGE
HIGH RISK MOTHER	56	37.3%
LOW RISK MOTHER	94	62.7%

P-VALUE IS 0.91

Out of 150 participants, 56 were at high risk and 96 were born to low risk mother, no preponderance for hearing impairment was observed in this study on basis of mode of delivery

TABLE4: CORRELATION WITH RESUSTICATION

RESUSTICATION	OAE PASS @ DISCHARGE	OAE FAIL @ DISCAHRGE	OAE PASS @ 21 DAYS	OAE FAIL @ 21 DAYS	BERA PASS	BERA FAIL
DONE	10	30	28	12	13	7
NOT DONE	60	50	86	24	10	4

Out of 150 participants, resustication was given to 43 newborns. P-value is 0.712 which is statistically not significant.

TABLE 5: DATA OF TORCH INFECTION

TORCH INFECTION	NUMBER	PERCENTAGE
POSITIVE	3	2%
NEGATIVE	147	98%

***p* value < 0.00001 (significant at *p* < .05)**

TABLE 6: CORRELATION WITH AMINOGLYCOSIDE (OTOTOXICDRUGS)

OTOTOXIC DRUGS EXPOSURE	OAE PASS @ DISCHARGE	OAE FAIL @ DISCAHRGE	OAE PASS @ 21 DAYS	OAE FAIL @ 21 DAYS	BERA PASS	BERA FAIL
GIVEN	41	49	73	17	15	8
NOT GIVEN	24	36	43	17	7	3

P VALUE (AT OAE ON DISCHRGE) = 0.29P-
VALUE (AT OAE ON 21 DAYS) = 0.912P-
VALUE (OF BERA AT 3MONTH) = 0.09

TABLE 7: CORRELATION WITH PERINATAL ASPHYXIA

PERINATAL ASPHYXIA	OAE PASS @ DISCHARGE	OAE FAIL @ DISCAHRGE	OAE PASS @ 21 DAYS	OAE FAIL @ 21 DAYS	BERA PASS	BERA FAIL
HIE	12	19	21	10	8	2
NO HIE	53	66	95	24	14	9

TABLE 8: CORRELATION WITH NEONATAL HYPERBILIRUBINEMIA

NEONATAL HYPERBILIRUBINEMIA		OAE FAIL @ DISCAHRGE	OAE PASS @ 21 DAYS	OAE FAIL @ 21 DAYS	BERA PASS	BERA FAIL
NO PHOTOTHERAPY	56	63	93	26	20	6
PHOTOTHERAPY	9	17	22	4	1	3
DVET	0	5	1	4	1	3

DISCUSSION

This descriptive exploratory study was performed to assess Hearing Loss in neonates by using OAE at discharge and at 21 days of age, followed by BERA performed at 3 months of age in those failing OAE (refer) at 21 days of age. In our study, 7.33% of neonates had SNHL.

There were 60% males & 40% females. John et al[8]. conducted study in Christian Medical College (C.M.C.) Vellore and evaluated 500 newborns found there was no significant difference in the genderdistribution in hearing loss (p value – 0.015).
There were 94 (62.6 %) preterms and 56 (37.3 %) term neonates in the study. Out of preterms 38 passed and 27 were refer in OAE which was done at discharge and at IN OAE whichwas done at 21 days of life 73 managed to pass and only 21 were referred for BERAat 3 months of life. In BERA at 3 month of age 13 passed and 7 had SNHL out of 20 total. P-value is 0.23, hence prematurity is not a significant risk factor for hearing loss in this study.

Out of 150 participants, 67 were born via NVD, 83 were born via lscs, no preponderance for hearing impairment wasobserved in this study on the basis of mode of delivery. P-value was 0.76

which was statistically insignificant

P-VALUE – 0.001 which is significant

Extremely low birth weight (elbw) babies have high incidence of hearing loss as comapred to normal birth weight babies

Low birth weight is categorized into- Very low
birth weight (VLBW, <1500 g)
Extremely low birth weight (ELBW, <1000 g)

Out of 150 participants, 56 were born to high risk and 96 were born to low risk mother, no preponderance for hearing impairment was observed in this study on basis of maternal risk history. P-value was 0.666 which was statistically insignificant

There were 43 neonates which required resustication in the study. Out of preterms 10 passed and 33 wererefer in OAE which was done at discharge and at IN OAE which was done at 21 days of life 37 managed to pass and only 6 were referred for BERA at 3 months of life. In Bera at 3 month of age all passed. P-value is 0.212, hence giving resustication is not a significant risk factor forhearing loss in this study.

Out of 150 participants, 3 were born to torch positivemother**.** All 3 failed in 3 month bera and were reffred for hearin aid. P-value – 0.001

There were 90 neonates which required resustication in the study. Out of preterms 10 passed and 33 were refer in OAE which was done at discharge and at IN OAE which was done at 21 days of life 37 managed to pass and only 6 were referred for BERA at 3 months of life. In Bera at 3 month of age 4 of them failed, p-value is 0.002. hence giving aminoglycoside administration is a significantrisk factor for hearing loss in this study.

There were 150 neonates which were assessed in this study. Out of total only 12 passed and 19 were refer in OAE which was done at discharge and at IN OAE which was done at 21 days of life 37 managed to pass and only 6 were referred for BERA at 3 months of life. In Bera at 3 month ofage 3 of them failed, ***p-value is 0.002.*** hence perinatal asphyxia is a significant risk factor for hearing loss in this study.

There were 87 neonates which were having neonatal hyperbilirubinemia in the study. Out of them 83 werecured with phototherapy and 4 required DVET. 63 were refer in OAE which was done at discharge and at IN OAE which was done at 21 days of life 37 managed to pass and only 6 were referred for BERA at 3 months of life. In Bera at 3 month of age 4 of them failed, p-value is 0.8. hence it is a significant risk factor for hearing loss in this study.

This study was performed to assess HL in sick infants by using OAE at discharge and at 21 DAYS of age, followed by BERA performed at 3 MONTHS ofage in those OAE failing (refer) at six weeks of age. ***In our study, 7.33% of infantshad SNHL***. In contrast to our study, other previously published studies had 2%- 6.5% SNHL, but these studies were performed either in high-risk neonates or healthyand high-risk neonates

Gouri et al.[9] studied hearing assessment on healthy and sick newborns with "AABR after transient-evoked otoacoustic emissions (TEOAE)," where 137 out of 415 newborns required NICU admission. In their study, 8.03% of total NICU admissions had SNHL, which is almost comparable to our study; otherwise, the overall prevalence of SNHL was 4.3%. Pourarian et al. [10] did a similar study in NICU-admitted sick neonate and their study prevalence was found to be 13.7% by applying the two-stage method AABR after TEOAE. Stadio et al[11]. found a prevalence of SNHL to be 7.8% using two-stage hearing screening, i.e., "AABR after TEOAE," which was almost similar to our study.

Hardani et al[12]. conducted a study with a screening protocol of the first TEOAE in all sick neonates, then a second TEOAE in those sick neonates who failed the firstTEOAE, not all sick neonates, followed by AABR and hearing auditory stable-state response (ASSR) tests. In their study, the prevalence of total HL was 5.09% and the SNHL prevalence was only 2.64%; in contrast, we performed DPOAE two times inall sick neonates.

In contrast, in our study, we found 1%-1.5% more SNHL that could have been missed by two-step hearing screening. In our study, we found VLBW infants, amikacin, HIE, and neonatal hyperbilirubinemia (NNH) required for exchange transfusion caused more hearing impairment (p-value <0.5) than other diseases during DPOAE screening. However, on testing with AABR, no such association wasseen. In our study, we found that those infants who had MV for a mean of 7.67±6.24days had SNHL compared to those who had MV for a lesser duration and had no HL. Pourarian et al[10]. found that oxygen therapy and the use of antibiotics were statistically significant compared to other risk factors including the risk factor "duration of MV of more than five days". On the contrary, in our study, the mean duration of MV (7.67±6.24 days) was associated with statistically significant SNHL compared to a shorter duration. Khairy et al[13]. studied HL among neonates admitted to the NICU, and their findings were that MV for more than five days and the use of ototoxic drugs were statistically significant risk factors for HL compared to other risk factors

CONCLUSION

Two-stage OAE done prior to BERA is helpful in the early detection of hearing loss. Our study demonstrates the use of a combination of OAE and BERA testing ensures high sensitivity and acceptable specificity, and predict the incidenceof hearing impairment in Neonates Our efforts identified 11 Neonates with auditory neuropathy who hopefully will benefit from early

remediation of their hearing deficit. Early identification and intervention is a must to overcome the burden of congenital hearing impairment and this has still to gain foothold in our country. Hospital based universal hearing screening programme for neonates is feasible before discharge at a tertiary care centre. Incidence of HI in our study correlates with many other national and international studies and strongly points towards the need of implementing UNHS all over the country.

REFERENCES

1. Epstein S, Reilly JS. Sensorineural Hearing Loss.Pedaitr Clin North Am. 1989;36:1501-19.
2. World Health Organization (WHO). Newborn and infant hearing screening: Current Issues and Guiding Principles for Action. WHO, Geneva, 2009;30:119-125.
3. Merchant RH, Char GS. Infant Hearing Screening. Indian Pediatrics. 1998;35:711.
4. Yoshinaga-itano C, Sedey AL, Coulter DK, Mehl AL (1998) Language of early-and-later-indentified children with hearing loss. Pediatrics 2015;102:1161–1171
5. Galhotra A, Sahu P. Challenges and solutions in implementing hearing screening program in India. Indian J CommunityMed 2019;44:299-302.
6. Kumar RK, Kini P, Sardangouda P, et al. Routine newborn hearing screening-an Indian experience. Int J Pregn & Chi Birth. 2016;1(1):15-7.
7. Roth AD, Hildesheimer M, Maayan-Metzger A, Muchmik C, Hamburger A, Mazkeret R, et al. Low prevalence of hearing impairment among very low birth weight infants as detected by universal neonatal hearing screening. Arch Dis Child Fetal Neonatal. 2006; 91(4):257–62.
8. John M, Balraj A, Kurien M. Neonatal screening for hearing loss: pilot study from a tertiary care centre. Indian J Otolaryngol Head Neck Surg. 2009;61(1):23-6
9. Hearing impairment and its risk factors by newborn screening in north- western India. Gouri ZU, Sharma D, Berwal PK, Pandita A, Pawar S. *Matern Health Neonatol Perinatol.* 2015;1:17.
10. Prevalence of hearing loss in newborns admitted to neonatal intensive care unit. Pourarian S, Khademi B, Pishva N, Jamali *Iran Otorhino-laryngol.* 2012;24:129–134.
11. Sensorineural hearing loss in newborns hospitalized in neonatal intensive care unit: an observational study. Stadio AD, Molini E, Gambacorta V, et al. *Int Tinnitus J.* 2019;23:31–36
12. Prevalence and risk factors for hearing loss in neonates admitted to the neonatal intensive care unit: a hospital study. Hardani AK, Goodarzi E, Delphi M, Badfar

G. *Cureus.* 2020;12:0.

13. Hearing loss among high-risk newborns admitted to a tertiary neonatal intensive care unit. Khairy MA, Abuelhamed WA, Ahmed RS, El Fouly HE,Elhawary IM. *J Matern Fetal Neonatal Med.* 2018;31:1756–1761.