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RISK FACTORS AND PREVALENCE OF HEARING LOSS IN NEONATES IN THE NEONATAL INTENSIVE CARE UNIT: A HOSPITAL-BASED CLINICAL STUDY

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ABSTRACT

Background: One of the most common disabilities seen in the neonates is the hearing loss. Early detection and screening in neonates and children can safeguard them from various ill-effects of hearing loss in vulnerable age groups of neonates and child subjects.

Aim: The present study was aimed to identify the vital risk factors and to assess the prevalence of the hearing loss in the NICU (neonatal intensive care unit) in Indian Hospital.

Methods: In 265 neonates admitted to the NICU unit of the institute, the risk factors for hearing loss were assessed following the JCIH (Joint Committee of Infant Hearing). The screening tests done for hearing were AABR (automated auditory brain stem response) and TEOAEs (transient evoked otoacoustic emissions). In subjects where AABR and TEOAE results were abnormal, ASSR (Auditory Steady-State Responses) and ABR (Auditory Brainstem response) were assessed.

Results: Neuropathy was seen in 1.13% (n=3) study subjects. The most common type of the hearing loss was sensorineural hearing loss (SNHL) which was seen in 2.64% (n=7) study subjects followed by CHL (conductive hearing loss) in 2.64% (n=4) study subjects, and one subject (0.37%) was missing from the hearing test. A significant association of Apgar score, Ototoxic drug intake, kinship marriage of parents, hyperbilirubinemia, and birth weight of <1500 grams and the hearing loss in neonates was seen in the present study.

Conclusion: Considering its limitations, the present study concludes that hearing loss has a high prevalence in neonates admitted to NICU. Hence, a screening for hearing is recommended for all in the NICU. Also, it is vital to implement a plan for early diagnosis and management of hearing loss in the neonates.

Keywords: automated auditory brain stem response**,** neonate, stem response**,** hearing screening, risk factors, transient evoked otoacoustic emissions

INTRODUCTION

It is vital to detect and treat the hearing loss in the children and infants at an early stage which can help in reducing the adverse effects of hearing loss in these subjects. Any retard in the diagnosis of the hearing loss in infants and children can have adverse outcomes concerning the child's development related to the cognitive skills, language, and speech of the subjects affected.[1]

In nearly 80% o the affected subjects, the hearing loss is either congenital or is acquired in the infancy stage. In nearly 1% to 3% of the subjects with hearing loss, deafness recorded is bilateral and in approximately 2% to 4% of the subjects, the deafness is acquired in the ICU (intensive care units) with more prevalence than common diseases such as phenylketonuria and hypothyroidism. In high-risk infants, the frequency of hearing loss is 10-20 times or 10-50 times higher compared the infants with no risk factor for the loss of hearing.[2,3]

JCIH (Joint Committee of Infant Hearing) in 1994, 2000, and 2007 had published the associated risk factors for the loss of hearing and suggested standard criteria to identify the hearing loss in these subjects.[4] However, the effect of these risk factors on the incidence of the hearing loss can only be identified by literature studies. The risk factors reported by JCIH are furosemide and aminoglycosides treatment, hypoglycemia, asphyxia, jaundice, meningitis, ventilation, seizures, Apgar scores <3 and 6 in 1 and 5 minutes respectively, hypoxia, prematurity, and birth weight <1250 grams. In the infants admitted to the NICU (neonatal intensive care unit), brainstem disorders and hearing loss are more common ailments.[5]

A need for having a comprehensive screening program for hearing loss in infants after birth and prior to hospital discharge has been emphasized and addressed by various organizations. Neonatal screening for hearing was only performed for neonates at high risk until 1990 which helped in assessing and detecting the hearing loss in 50% of the affected subjects. JCIH in 2000 recommended that screening program for hearing loss should be done for all the infant subjects for early detection and intervention of the hearing loss.[6]

JCIH recommends that Transient Evoked Otoacoustic Emission (TEOAE) and AABR (Automated Auditory Brainstem Response) tests should be performed in all the neonates to screen them for the hearing loss. TEOAE utilize the Otoacoustic emission which is an appropriate, rapid, and non-invasive method for assessment of the cochlear function. Various adverse effects concerning the cognitive development, language, speech, welfare, social, and family can be prevented by the early detection of the hearing problem in the infants. The vital role of hearing loss assessment in infants has been focused for a longer time now with the two main objectives. The long-term objective being improvement in the cognitive development,

language, and speech of the subject, whereas, the short-term goal being early detection of the hearing loss.[7,8]

Hence, the present study was aimed to identify the vital risk factors and to assess the prevalence of the hearing loss in the NICU (neonatal intensive care unit) in Indian Hospital.

MATERIALS AND METHODS

The present cross-sectional descriptive clinical study was aimed to identify the vital risk factors and to assess the prevalence of the hearing loss in the NICU (neonatal intensive care unit) kin Indian Hospital. The present study was done at Department of ENT, Government Mohan Kumaramangalam Medical College, Salem, Tamil Nadu. The study population was comprised by the neonates admitted to the NICU (neonatal intensive care unit) of the hospital. The neonates were only included after the verbal and written informed consent was taken from the parents of the neonates.

The study included 265 neonates from both the genders admitted to the NICU (neonatal intensive care units) of the hospital that were screened and selected for the study. In the presents study, both OAE (Oto-Acoustic Emission) ad AABR hearing tests were conducted same day and simultaneously for the neonates.

All neonates after inclusion in the study were screened using AABR and TEOAE for the hearing impairment. All the tests were performed by the Audiologists expert in the field. An 80dB SPL (sound pressure level) click stimulus was used for TEOAE test. The test took 1 minute to 3 minutes time for its conduction. The tests were conducted in a quiet room during breastfeeding or in sleep. The criteria considering TEOAE as pass was a signal to noise ratio of 6 dB in minimum three frequencies from 1000 Hz to 4000 Hz. Click stimuli at 35 dBnHL was used for conduction of AABR with presentation rate of 37.7/s and the alternating polarity. The electrodes for AABR were arranged in the following manner with positive electrode on the vertex, the ground electrode on contralateral mastoid, and negative electrode on the ipsilateral mastoid.

The neonate study subjects with the abnormal results in either ear or in the either test were considered as a fail. The subjects with the fails results were revaluated after the 2 weeks. Before screening for the second time, high frequency tympanometry was done, and subjects diagnosed with middle ear effusion were sent for medical management. Immittance measures were recorded using an audiometer. AABR and TEOAE were reassessed in subjects recorded for normal functioning of the middle ear.

Neonates assessed for the middle ear effusion were re-evaluated following the treatment. Subjects where risk factors were seen following the JCIH criteria for the hearing impairment were then reassessed at 6, 9, and 30 months of the age. Diagnostic ASSR and ABR was done for neonates with fail results in the second screening to evaluate the hearing loss degree and following the results, the rehabilitation was done. The subjects of age 3 months to 6 months were referred for the diagnostic ASSR and ABR. For ABR test, more stable results and better

refraction polarity is seen.[9] Intensity was decreased to assess the auditory threshold and tracing the V wave.

For the octave frequencies of 500 Hz to 4000 Hz, ASSR was done simultaneously for both the ears. The present study assessed an association between hearing loss and risk factors including the Apgar score <5 at one minute after birth, hypoglycemia, sepsis, ototoxic drugs, syndrome, asphyxia, mechanical ventilation >5 days, prematurity, hyperbilirubinemia requiring transfusion, kinship marriage of parents, hearing loss history in the family, and birth weight <1500 grams.

The collected information was analyzed statistically using SPSS software version 26.0 (IBM, Chicago, IL) and fisher's extract test and Chi-square test. The level of significance was kept at the p-value of <0.005.

RESULTS

The present cross-sectional descriptive clinical study was aimed to identify the vital risk factors and to assess the prevalence of the hearing loss in the NICU (neonatal intensive care unit) kin Indian Hospital. The study included 265 neonates from both the genders admitted to the NICU (neonatal intensive care units) of the hospital that were screened and selected for the study. In the present study, there were 48.67% (n=129) males and 51.32% (n=136) females in the present study. The age range of participants in the study was 0 days to 40 days with the mean age of 6.63±6.94 years.

In the present study, 265 subjects underwent the TEOAE and AABR tests. Among these subjects, in the first screening, 85.28% (n=226) subjects passed the exams and 14.71% (n=39) subjects failed the first screening and entered the second screening. In the second screening, 9.05% (n=24) subjects passed the test and 5.28% (n=14) subjects failed the exams. In the second screening, 2 subjects did not report. The subjects who failed the second screening were sent for ABR and ASSR as shown in Table 1.

ABR (Auditory Brainstem response) and ASSR (Auditory Steady-State Responses) was performed in the study subjects to assess the type of hearing loss. The results showed that neuropathy was seen in 1.13% (n=3) study subjects. The most common type of the hearing loss was sensorineural hearing loss (SNHL) which was seen in 2.64% (n=7) study subjects followed by CHL (conductive hearing loss) in 2.64% (n=4) study subjects, and one subject (0.37%) was missing from the hearing test as depicted in Table 2.

On assessing the relationship of the prevalence of the hearing loss and the risk factors in the study subjects, the results are summarized in Table 3. The asphyxia was seen in 93 subjects without hearing loss and 8 subjects with hearing loss. This was statistically significant with p=0.03. Also, a significant was seen concerning Apgar score of <5 which were significantly higher in subjects without hearing loss in 63 subjects and in 9 subjects with hearing loss with p<0.001. Ototoxic drug intake, kinship marriage of parents, hyperbilirubinemia, and birth weight of <1500 grams were also significantly higher in subjects without hearing loss with the

respective p-values of 0.04, 0.02, <0.001and <0.001. However, non-significant higher values were seen in subjects without hearing loss concerning hypoglycemia, syndrome, sepsis, ventilation >5 days, prematurity, and family history of hearing loss with the p-values of 0.65, 0.42, 0.09, 0.07, 0.92, and 0.07 respectively.

DISCUSSION

The present cross-sectional descriptive clinical study was aimed to identify the vital risk factors and to assess the prevalence of the hearing loss in the NICU (neonatal intensive care unit) kin Indian Hospital. The study included 265 neonates from both the genders admitted to the NICU (neonatal intensive care units) of the hospital that were screened and selected for the study. In the present study, there were 48.67% (n=129) males and 51.32% (n=136) females in the present study. The age range of participants in the study was 0 days to 40 days with the mean age of 6.63±6.94 years. These demographics were comparable to the previous studies of Zamani A et al[10] in 2004 and Maqbool M et al[11] in 2015 where authors assessed neonates with demographics similar to the present study.

265 subjects underwent the TEOAE and AABR tests in the present study. Among these subjects, in the first screening, 85.28% (n=226) subjects passed the exams and 14.71% (n=39) subjects failed the first screening and entered the second screening. In the second screening, 9.05% (n=24) subjects passed the test and 5.28% (n=14) subjects failed the exams. In the second screening, 2 subjects did not report. The subjects who failed the second screening were sent for ABR and ASSR. These findings were consistent with the previous studies of Gohari N et al[12] in 2020 and Amini A et al[13] in 2014 where authors reported similar screening results as reported by authors in the present study.

In the present study, ABR (Auditory Brainstem response) and ASSR (Auditory Steady-State Responses) were performed to assess the type of hearing loss. The results showed that neuropathy was seen in 1.13% (n=3) study subjects. The most common type of the hearing loss was sensorineural hearing loss (SNHL) which was seen in 2.64% (n=7) study subjects followed by CHL (conductive hearing loss) in 2.64% (n=4) study subjects, and one subject (0.37%) was missing from the hearing test. These results were in agreement with the studies of Alaee E et al[14] in 2015 and Boo N et al[15] in 2008 where authors reported the sensorineural hearing loss as the most common type of hearing loss assessed in the respective studies by the authors.

Concerning the relationship of the prevalence of the hearing loss and the risk factors in the study subjects, asphyxia was seen in 93 subjects without hearing loss and 8 subjects with hearing loss. This was statistically significant with p=0.03. Also, a significant was seen concerning Apgar score of <5 which were significantly higher in subjects without hearing loss in 63 subjects and in 9 subjects with hearing loss with p<0.001. Ototoxic drug intake, kinship marriage of parents, hyperbilirubinemia, and birth weight of <1500 grams were also significantly higher in subjects without hearing loss with the respective p-values of 0.04, 0.02, <0.001and <0.001. However, non-significant higher values were seen in subjects without hearing loss concerning

hypoglycemia, syndrome, sepsis, ventilation >5 days, prematurity, and family history of hearing loss with the p-values of 0.65, 0.42, 0.09, 0.07, 0.92, and 0.07 respectively. These results were in line with the studies of Driscoll C et al[16] in 2015 and Jayagobi PA et al[17] in 2002 where authors reported a significant association of Apgar score, Ototoxic drug intake, kinship marriage of parents, hyperbilirubinemia, and birth weight of <1500 grams and the hearing loss in neonates.

CONCLUSION

Considering its limitations, the present study concludes that hearing loss has a high prevalence in neonates admitted to NICU. Hence, a screening for hearing is recommended for all in the NICU. Also, it is vital to implement a plan for early diagnosis and management of hearing loss in the neonates.

REFERENCES

1. De Capua B, De Felice C, Costantini D, Bagnoli F, Passali D: Newborn hearing screening by transient evoked otoacoustic emissions: analysis of response as a function of risk factors. Acta Otorhinolaryngol Ital. 2003;23:16-20.
2. Jakubikova J, Kabatova Z, Pavlovcinova G, Profant M: Newborn hearing screening and strategy for early detection of hearing loss in infants. Int J Pediatr Otorhinolaryngol. 2009;73:607-12.
3. Khairy MA, Abuelhamed WA, Ahmed RS, El Fouly HES, Elhawary IM: Hearing loss among high-risk newborns admitted to a tertiary Neonatal Intensive Care Unit. J Matern Fetal Neonatal Med. 2018;31:1756-61.
4. Hille ET, Van Straaten H, Verkerk PH, Group DNNHSW: Prevalence and independent risk factors for hearing loss in NICU infants. Acta Paediatr. 2007;96:1155-8.
5. Bielecki I, Horbulewicz A, Wolan T: Risk factors associated with hearing loss in infants: an analysis of 5282 referred neonates. Int J Pediatr Otorhinolaryngol. 2011;75:925-30.
6. Ohl C, Dornier L, Czajka C, Chobaut J-C, Tavernier L: Newborn hearing screening on infants at risk .Int J Pediatr Otorhinolaryngol. 2009;73:1691-5.
7. Taghdiri MM, Eghbalian F, Emami F, et al.: Auditory evaluation of high -isk newborns by automated auditory brain stem response. Iran J Ped. 2008;18:330-4.
8. Rai N, Thakur N: Universal screening of newborns to detect hearing impairment—is it necessary? .Int J Pediatr Otorhinolaryngol. 2013;77:1036-41.
9. Abou Alfazi R, Bagheri H, Soltani AH: The Effects of Polarity of Click Stimulation on Auditory Brainstem Responses (ABR) in Patients With Cochlear and Retro-Cochlear Disorders in Amiralam and Resalat Hospitals 1995-97. Tehran Uni Med J. 2002;60:192-202.
10. Zamani A, Daneshjou K, Tak AA: Estimating the incidence of neonatal hearing loss in high-risk neonates. Acta Med Iran. 2004;42:176-80.

11. Maqbool M, Najar BA, Gattoo I, Chowdhary J: Screening for hearing impairment in high risk neonates: a hospital based study. J Clin Diagn Res. 2015;9:18-21.
12. Gohari N, Farahani F, Gharebaghy S, Alaei S, Ahmadi S, Mozafari Z: The prevalence of hearing loss in infants hospitalized in the neonatal intensive care units. Aud Vestib Res. 2020,
13. Amini E, Farahani ZK, Samani MR, et al.: Assessment of hearing loss by OAE in asphyxiated newborns. Iran Red Crescent Med J. 2014;16.
14. Alaee E, Sirati M, Taziki MH, Fouladinejad M: Risk factors for sensorineural hearing loss among high-risk infants in Golestan Province, Iran in 2010-2011. Iran Red Crescent Med J. 2015;17:10.
15. Boo N, Rohani A, Asma A: Detection of sensorineural hearing loss using automated auditory brainstem evoked response and transient-evoked otoacoustic emission in term neonates with severe hyperbilirubinaemia. Singapore Med J. 2008;49:209.
16. Driscoll C, Beswick R, Doherty E, D'Silva R, Cross A: The validity of family history as a risk factor in pediatric hearing loss. Int J Pediatr Otorhinolaryngol. 2015;79:654-9.
17. Jayagobi PA, Yeoh A, Hee KY, et al.: Hearing screening outcome in neonatal intensive care unit graduates from a tertiary care centre in Singapore. Child Care Health Dev. 2020;46:104-10.

TABLES

Auditory test	**Pass**		**Fail**		**Missing**	
	%	**n**	**%**	**n**	**%**	**n**
First screening	85.28	226	14.71	39	-	-
Second screening	9.05	24	5.28	14	0.75	2

Table 1: The first screening and second screening results in the study subjects

	Neuropathy		**CHL**		**SNHL**		**Missing**	
Hearing loss type	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**
ASSR, ABR	1.13	3	1.50	4	2.64	7	0.37	1

Table 2: Diagnostic hearing test results in the study subjects

	Factors	**Subjects with hearing loss**	**Subjects with hearing loss**	**p-value**
Asphyxia	Yes	8	93	**0.03**
	No	6	156	
Hypoglycemia	Yes	5	104	0.65
	No	8	146	
Syndrome	Yes	1	2	0.42
	No	13	247	
Sepsis	Yes	8	142	0.09
	No	5	108	
Apgar score <5	Yes	9	63	**<0.001**
	No	5	186	
Ventilation >5days	Yes	6	144	0.07

	No	8	105	
Ototoxic drugs	Yes	5	199	**0.04**
	No	9	50	
Prematurity	Yes	8	134	0.92
	No	6	115	
Hyperbilirubinemia	Yes	9	192	**<0.001**
	No	5	57	
Kinship marriage of parents	Yes	6	45	**0.02**
	No	8	203	
Family history of hearing loss	Yes	5	10	0.07
	No	9	239	
Birth weight <1500 grams	Yes	9	40	**<0.001**
	No	5	209	
Gender	Males	8	114	0.14
	Females	6	135	

Table 3: The relationship of risk factors and hearing loss prevalence in study subjects