Section: ENT

Original Research Article

AN EVALUATION STUDY ON HEARING IN HIGH-RISK INFANTS USING DPOAE AND AABR

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Abstract

Background: Hearing loss occurs when the ear's ability to convert sound into nerve impulses is hindered. Sensorineural hearing loss results from damage to the auditory nerve or central pathway. Acoustic Neuropathy Spectrum Disorder includes various diseases affecting hearing. Early screening and intervention in newborns can lead to improved developmental outcomes. Congenital hearing loss is common and should be treated accordingly. Unfortunately, many hospitals in India lack hearing screenings for newborns. Early detection and treatment before six months of age yield better results. Delayed auditory input can cause significant developmental delays. Aim of the study is to assess the prevalence and severity of hearing impairment among high risk infants using DPOAE and AABR in tertiary care hospital, Chennai. **Materials and Methods:** This cross sectional study was done on 100 High risk infants who were on follow-up attending the paediatric outpatient department and referred to our department of ENT for hearing Assessment. The case history and clinical examination including otoscopy were done for all cases. After getting informed and written consent from parents of the infants were subjected to screening simultaneously with both Distortion product otoacoustic emissions (DPOAE) and Auditory brainstem response (AABR). **Result:** The age of the study group ranged between 1 month to 12 months. 42 babies (42%) were male and 58 babies (58%) were female. The incidence rate is 4.0%. Of the 12 risk factors screened, 13.46% (7 out of 52) of babies with severe birth asphyxia and 100%(2 out of 2) of babies with family history of hearing loss had hearing impairment. **Conclusion:** Early detection and intervention will help deaf children develop language skills during the critical period of neural plasticity.

INTRODUCTION

Congenital hearing loss arises when the ear's ability to transfer the vibratory mechanical wave of sound into electrical energy in the form of nerve impulses is hindered. Sensorineural hearing loss occurs when parts of the auditory nerve or the central auditory pathway are damaged. Disorders of the Auditory Nervous System. Acoustic Neuropathy Spectrum Disorder encompasses a wide variety of clinical diseases marked by otoacoustic emissions and a cochlear microphonic in conjunction with aberrant or absent auditory brainstem responses, which leads in impaired speech discrimination.[1]

Neonatal hearing surveillance are readily available in the majority of industrialised nations for children born with this common problem. Within a month of birth, these investigations are carried out to test all infants. Improved developmental outcomes later in infancy are made possible by early diagnosis, early intervention, and early therapy. Neonatal hearing screening program may miss children having progressive hearing loss since it is possible for hearing loss to progress over time. At-risk newborns should be screened again at regular intervals. Congenital hearing loss is treated medically and supportively depending on the cause and kind of hearing loss.

Most hospitals in India now do not do hearing screenings on newborns. The prevalence of congenital hearing loss in newborns exceeds the prevalence of all metabolic diseases now detected through blood tests. Profound hearing loss is among the most common birth defects, accounting for around a quarter of all cases. Approximately one in every thousand newborns is born profoundly deaf, with severe or profound bilateral hearing loss accounting for four times as many births. In comparison to the general population, neonates in intensive care facilities have a 10–20-fold increased risk of substantial hearing loss.[2]

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The National Institutes of Health (NIH) released a consensus statement in 1993 recommending universal newborn hearing screening from the age of three months. The statement also suggested using otoacoustic emission as a screening tool.[3]

Hearing loss affects 1 to 6 people in every 1000, and high-risk screening only finds half of the babies with the condition. In addition, the average age of diagnosis for children with hearing loss is 2.5 years old. Eventually, early detection and treatment of hearing loss by 6 months will lead to better outcomes.[3]

Absence of auditory input during the child's first year of life, which is important for brain development, causes major delays in the child's overall development. High-risk newborns have a greater chance of suffering from substantial hearing loss than the general public.

The purpose of this study is to determine the prevalence as well as severity of hearing impairment in high-risk newborns by utilizing the DPOAE and AABR tests.

MATERIALS AND METHODS

The present study was conducted in the Department of Otorhinolaryngology in our college from September 2020 to September 2021.The study was done on High risk infants who were on follow up attending the pediatric OPD in our College, and referred to our department of ENT and Head and Neck surgery for hearing Assessment. High risk infants referred to the department of ENT between September 2020 to September 2021 were evaluated for hearing loss by DPOAE and AABR. The case history and clinical examination including otoscopy will be done for all cases. After getting informed and written consent from parents infants were subjected to screening simultaneously with both DPOAE and AABR.

Infants with at least one of the following high-risk factors like , Parental or caregiver concern regarding hearing, speech, language, and/or developmental delay , Family history of congenital or delayed onset childhood sensorineural hearing loss, Maternal infections-toxoplasmosis, syphilis, rubella, cytomegalovirus, herpes Craniofacial abnormalities, Birth weight <1500g, Hyperbilirubinemia at a level exceeding indication for exchange transfusion, Ototoxic drugs (aminoglycosides) during NICU / PUCU admission, Bacterial meningitis, Severe respiratory depression at birth (birth asphyxia), Stigmata or other findings associated with a syndrome known to include Sensorineural hearing loss (e.g. Waardenburg or Ushers syndromes) were included.

High risk infants whose parents did not give consent and Infants on ventilator who were severely ill were excluded.

RESULTS

During this study,100 high risk babies were subjected to OAE testing.

The age of the study group ranged between 1 months to 12 months. 42 babies (42%) were male and 58 babies (58%) were female. The gestational age of the study group ranged between 38 to 42 weeks. Birth weight varied between 901g and 3492g.

Out of the 100 babies initially screened with OAE, 83 babies passed in the right ear, and 92 babies passed in the left ear, while 17 babies failed in the right ear, and 8 babies failed in the left ear. All 100 babies underwent AABR, with 96 passing in the right ear and 98 passing in the left ear, and only 4 babies failing in the right ear and 2 babies failing in the left ear. Additionally, 2 babies couldn't undergo OAE due to craniofacial malformation. Four babies were diagnosed to have hearing impairment out of 100 high risk babies. The incidence rate is 4.0% which is similar to other studies done (2.5 -10%) [4,5].

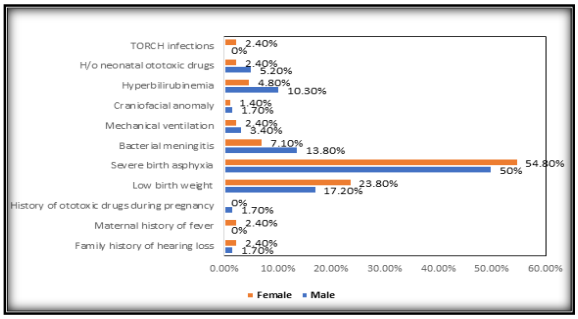

Figure 1: Distribution of risk factors among the study participants (N=100)

The distribution of risk factors were uniform in both the genders.

Fifty-two babies with severe birth asphyxia of which seven babies had hearing impairment in screening by OAE and three out of seven babies had hearing impairment in the AABR.

Table 1: Descriptive data variables of the study participants (N=100)

Variable	Minimum	Maximum	Mean	Std. Deviation
Age (months)	1	12	6.89	3.55
Gestational age at birth	38	42	39.91	1.33
Birth weight (grams)	901	3492	2422.85	707.01
Length	44.06	50.68	48.49	1.48
Head circumference	29.85	34.00	32.92	1.19
Chest circumference	26.62	32.92	30.85	1.58
Apgar 1 min	3	6	4.56	1.08
Apgar 5 mins	3	7	5.89	1.12
Peak level of total bilirubin	1.10	17.00	7.10	4.15

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Table 2: Distribution of screening of severe birth asphyxia (n=52)

Babies	Screening by OAE	AABR
Total babies	52	52
Normal hearing	45	49
Impairment in Right ear	7	3
Impairment in both ears	5	2

Table 3: Distribution of screening of low birth weight (n=20)

Babies	Screening by OAE	AABR
Total babies	20	20
Normal hearing	16	19
Impairment in Right ear	4	1
Impairment in both ears	1	0

Twenty babies with low birth weight of which four babies had hearing impairment in screening by OAE and one out of four baby had hearing impairment in the AABR.

Table 4: Distribution of screening of bacterial meningitis(n=11)

Babies	First screening by OAE	AABR
Total babies	11	11
Normal hearing	8	11
Impairment in Right ear	3	0
Impairment in both ears	1	0

Eleven babies with bacterial meningitis of which three babies had hearing impairment in first screening by OAE and all the eleven babies passed the AABR.

Table 5: Distribution of screening of mechanical ventilation (n=3)

Babies	First screening by OAE	AABR
Total babies	3	3
Normal hearing	2	3
Impairment in Right ear	1	0
Impairment in both ears	0	0

Three babies with mechanical ventilation was screened, one baby had hearing impairment in first screening by OAE and that three babies passed the AABR.

Table 6: Distribution of screening of craniofacial anomaly(n=2)

Babies	First screening by OAE
Total babies	2
Normal hearing	1
Impairment in Right ear	1
Impairment in both ears	0

Two of the babies were born with craniofacial malformation. OAE could not be performed on one baby due to atresia of the auditory canal. The other infant passed the OAE's initial screening.

Table 7: Distribution of screening of maternal history of fever with rash (n=1)

Babies	First screening by OAE
Total babies	1
Normal hearing	1
Impairment in Right ear	0
Impairment in both ears	0

One baby with maternal history of fever with rashes was screened and the baby passed the first screening by OAE.

Table 8: Distribution of screening of H/o ototoxic drugs during pregnancy (n=1)

Babies	First screening by OAE
Total babies	1
Normal hearing	1
Impairment in Right ear	0
Impairment in both ears	0

One baby with history of ototoxic drugs during pregnancy was screened and the baby passed the first screening by OAE.

Table 9: Distribution of screening of hyperbilirubinemia (n=8)

Babies	First screening by OAE	AABR
Total babies	8	8
Normal hearing	6	8
Impairment in Right ear	2	0
Impairment in both ears	1	0

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Eight babies screened for hyperbilirubinemia of which two babies had hearing impairment in first screening by OAE and the eight babies passed the AABR.

Table 10: Distribution of screening of H/o neonatal ototoxic drugs (n=4)

Babies	First screening by OAE
Total babies	4
Normal hearing	4
Impairment in Right ear	0
Impairment in both ears	0

Four babies with history of neonatal ototoxic drugs was screened and all the four babies passed the first screening by OAE.

Table 11: Distribution of screening of H/o seizures (n=3)

Babies	First screening by OAE	AABR
Total babies	3	3
Normal hearing	2	3
Impairment in Right ear	1	0
Impairment in both ears	1	0

Three babies screened for H/o seizures of which one baby had hearing impairment in first screening by OAE and three babies passed the AABR.

Table 12: Distribution of screening of H/o TORCH infections (n=1)

Babies	First screening by OAE
Total babies	1
Normal hearing	1
Impairment in Right ear	0
Impairment in both ears	0

One baby with history of torch infection was screened and the baby passed the first screening by OAE.

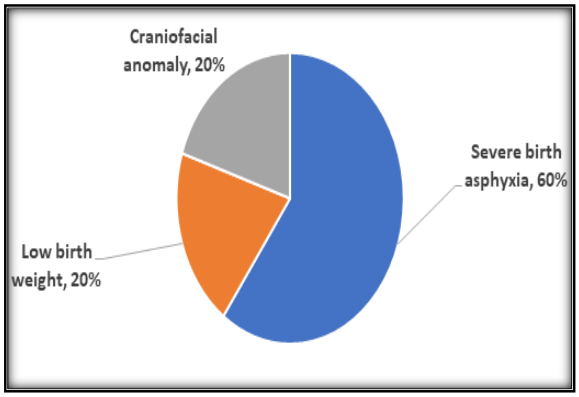

Figure 2: Distribution of risk factors of failed AABR screening tests (n=5)

Four babies were subjected to AABR and it was abnormal in all four babies.

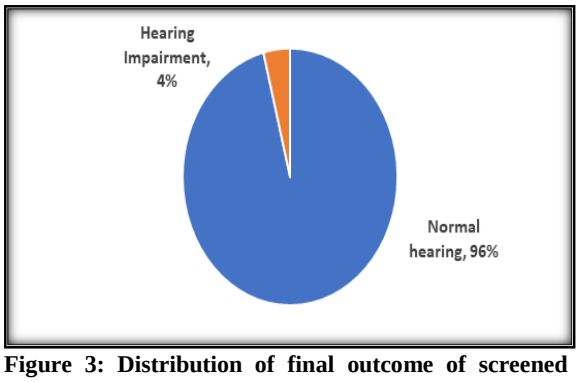

Figure 3: Distribution of final outcome of screened infants (N=100)

Total four babies had hearing impairment out of 100 babies screened.

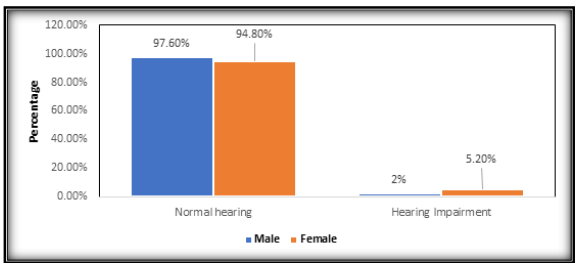

Figure 4: Distribution of final outcome of screened infants with gender (N=100)

Out of four babies who had hearing impairment, three were female babies and one was male baby.

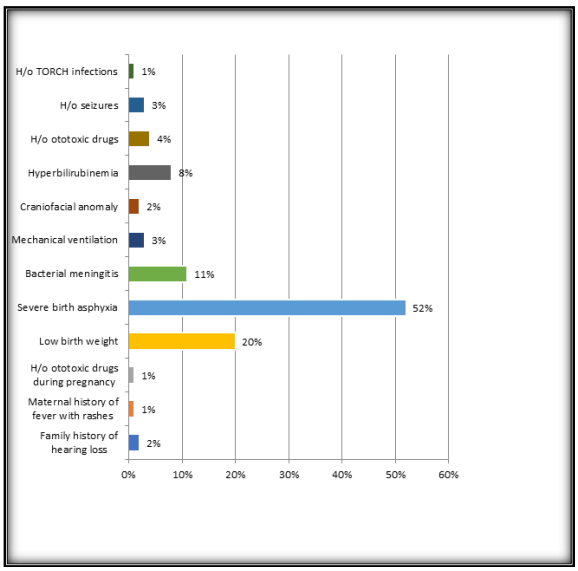

Figure 5: Distribution of final outcome of screened infants with risk factors (N=100)

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There is statistical significance in family history of hearing loss and severe birth asphyxia as significant risk factor for hearing impairment.

DISCUSSION

Prior to being discharged from the hospital where they were born, all new born should be screened for hearing loss. It's not always possible in a developing country like ours with limited resources. As a result, all new born with risk factors should have their hearing tested done at least .According to various statistics, a hearing impairment occurs in 2.5 percent to 10 percent of high-risk neonates.[4,5] As with other studies, this study found a 4.0% incidence rate.

In our study 100 babies were initially screened and subjected to OAE testing. A total of 17 babies failed at first screening by OAE on right ear and 8 babies on left ear. They include 7 with severe birth asphyxia, 4 babies with low birth weight, 3 babies had bacterial meningitis, one had history of mechanical ventilation, two needed transfusion because of hyperbilirubinemia and one had history of seizures. Total babies subjected to AABR were17. Out of which 13 babies passed AABR screening. Four babies failed after AABR tests. Among them three had severe birth asphyxia and one had low birth weight. The baby with craniofacial anomaly passes AABR and other four babies were diagnosed with hearing impairment. Four babies were diagnosed to have hearing impairment out of 100 high risk babies. The incidence rate is 4.0% which is similar to other studies done (2.5 -10%).[5]

Birth Asphyxia

In our study fifty two babies with severe birth asphyxia of which seven babies (13.46%) had hearing impairment in first screening by OAE and three out of seven babies had hearing impairment in the second screening by AABR. 86.54% had normal hearing out of 52 babies of birth asphyxia screened.

Among 51 babies who had suffered severe asphyxia during birth, one had hearing loss, according to a study by Nagapoornima et al.[6] Similar to study by Christine Ohl et al our study found four babies with hearing impairment after screening 12 babies who had suffered severe birth asphyxia.[7]

Low Birth Weight

In our study twenty babies with low birth weight of which four babies had hearing impairment in first screening by OAE and one out of four baby had hearing impairment in the second screening by AABR. We found no association of low birth weight with hearing impairment.

Low birth weight (LBW) was not linked to hearing impairment in Christine Ohl et al[7] study, which found babies with LBW had normal hearing. We found that LBW was not associated with hearing loss in studies by Finckh Kramer U et al, and Hess M et al.[8,9]

Bacterial Meningitis

In our study eleven babies with bacterial meningitis of which three babies had hearing impairment in first screening by OAE and all the three babies passed the second screening by AABR.

Despite screening 14 meningitis babies in our study, none of them had hearing impairment, as in study by Nagapoornima et al.[6]

Hyperbilirubinemia

In our study eight babies screened for hyperbilirubinemia of which two babies had hearing impairment in first screening by OAE and the two babies passed the second screening by AABR.

In consensus with our study Nagapoornima et al[6] looked for hearing impairment in 38 babies with severe hyperbilirubinemia who needed exchange transfusions, no such issues were found in her study. This is because hyperbilirubinemia was discovered early and treated effectively.[6]

Ototoxic Drugs

In our study four babies with history of neonatal ototoxic drugs was screened and all the four babies passed the first screening by OAE. One baby with history of ototoxic drugs during pregnancy was screened and the baby passed the first screening by AABR.

According to Finckh Kramer U et al, aminoglycosides do not pose a significant health risk.[6,8] It was found that aminoglycoside use did not increase the risk of hearing loss by Hess M et al.[9]

Mechanical Ventilation

In our study three babies with mechanical ventilation was screened, one baby had hearing impairment in first screening by OAE and that one baby passed the second screening by AABR.

M D MohdKhairi et al conducted a 2-stage hearing assessment in 401 at-risk neonates and concluded that mechanical ventilation for more than 5 days was not an independent risk factor for hearing impairment.[10]

Craniofacial Malformation

In our study two of the babies were born with craniofacial malformation. OAE could not be performed on one baby due to atresia of the auditory canal. The other infant passed the OAE's initial screening.

Nagapoornima et al[6] screened 24 babies with craniofacial malformation but found no evidence of hearing impairment, whereas in our study, one of the two (50%) babies with craniofacial malformation had hearing impairment.

TORCH Infection

In our study one baby with history of TORCH infection was screened and the baby passed the first screening by OAE. Six babies were screened by Nagapoornima et al for the TORCH infection, but none of them had hearing loss, as was the case in our research.[6]

So in our study of 100 babies screened, 4 babies had hearing impairment (4.0%) and it is exceeding the incidence found by Nagapoornima et al, who found three high-risk babies in a sample of 279 (1.07 percent).[6]

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We found 4.55 percent of the 1461 at-risk babies to be having hearing impairment, in Christine Ohl et al which is similar to our study findings.[7]

Finckh Kramer U et al examined 1062 at-risk newborns and found that only 1.3% of them had hearing impairment, which is lower than the percentage found in our investigation.[8]

Around 150 high-risk infants were screened by Sayed Hossein Fakhraee et al, and 42 of them (or 28% of the total) had varying degrees of hearing loss.[9-11]

CONCLUSION

In this study of 100 babies were screened, 4 babies (4.0%) had hearing impairment.

Of the 12 risk factors screened, severe birth asphyxia, family history of hearing loss seem to be associated with hearing impairment.

13.46%(7 out of 52) of babies with severe birth asphyxia and 100%(2 out of 2) of babies with family history of hearing loss had hearing impairment.

Meningitis, hyperbilirubinemia, ventilated babies, and those who received ototoxic drugs did not show any hearing impairment, which is most likely due to early and effective treatment.

It is for this reason that early detection and intervention will help deaf and hard of hearing kids develop language skills during the critical period of neural plasticity, preventing them from being cast into a socially isolated existence and an educational future full of misery.

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