Original Research Paper

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STUDY OF SCREENING OF HEARING LOSS IN INFANTS BY OTOACOUSTIC EMISSIONS/ BRAINSTEM EVOKED RESPONSE AUDIOMETRY

Dr. V.P Narvey

Dr. Megha Saluja* *Corresponding Author

Dr. Neetu Sharma

Dr. Deepak Parmar

Dr. Abhishek Goyal

ABSTRACT **Aim –**Screening of hearing loss in risk infants by OAE/ BERA. **Methodology** –Prospective Observational study was conducted to assess the prevalence of hearing loss in risk infants admitted to NICU or attending ENT OPD AT GRMC, Gwalior, Madhya Pradesh, India from November 2019 to September 2021. Auditory function was examined by Otoacoustic emissions (OAE) followed by Brainstem evoked response audiometry (BERA). **Results –** Among 200 infants with risk factors, prevalence of hearing impairment was 4% (8/192). Infants with severe birth asphyxia 16.6% (6/36) and hyperbilirubinemia 10% (2/20) were more prone to develop hearing impairment. **Conclusion –** After two staged screening with OAE followed by BERA the prevalence of hearing impairment in risk infants was 4%. Although universal hearing screening programs are warranted but in developing countries with limited infrastructure and lack of awareness hearing loss can be identified based on risk factors to estimate the possible burden of disease as early as possible in order to refer for diagnosis, treatment and rehabilitation.

KEYWORDS :

Introduction

Hearing is a vital part of a newborns contact with his environment. The ability to communicate, acquire skills and academic performance all greatly depends on ability to hear.[1]As in the first year of life, during the brain development, absence of auditory experience significantly retards the child's overall development. Therefore early identification of hearing loss and timely intervention and rehabilitation, speech therapist assistance and acceptance in society play a significant role in managing hearing loss.[2] The hearing loss in infants should be detected promptly and appropriate audiologic rehabilitation should be instituted early, to take advantage of the plasticity of developing the sensory system (critical period 0-3 years). This can leads to normal speech and speech development, social, emotional and cognitive development and academic achievement[6,7] Because of limited infrastructure less number of studies are available in India and even less in Madhya Pradesh on prevalence of hearing loss in infants. Keeping this status of unavailability of such data from the state this study was planned to screen the possible burden of hearing loss by OAE and BERA among the infants with risk factors attending GRMC Gwalior. Proper approach in screening helps in taking timely intervention and guidelines for treatment .

Method:

Study design: observational study

Duration- November 2019 to september 2021

Methods of collection of data

All the infants attending ENT OPD at Madhav dispensary and those referred from pediatrics for hearing assessment and those newborns and infants admitted in NICU and SNCU with the following risks factors were enrolled in the study

1. Apgar scores of 0- 4 at 1 minute; 0-6 at 5 minutes.
2. Hyperbilirubinemia at a serum level requiring exchange transfusion
3. Ototoxic medications – Aminoglycosides and Loop diuretics used for >5 days
4. Mechanical ventilation lasting 5 days or longer
5. Bacterial meningitis.
6. In utero infections by TORCH group of organisms.
7. Infants with GDD (Global Developmental Delay)

INCLUSION CRITERIA :

1. Parents who have accepted to sign consent for the study.
2. Those who have definite history of acute birth asphyxia.
3. All term neonates with birth weight >2.5kgms.
4. Those newborns or infants (upto1year of age) who required intensive care management were not included in the study in acute phase. However they were included after stabilization or before discharge.

EXCLUSION CRITERIA :

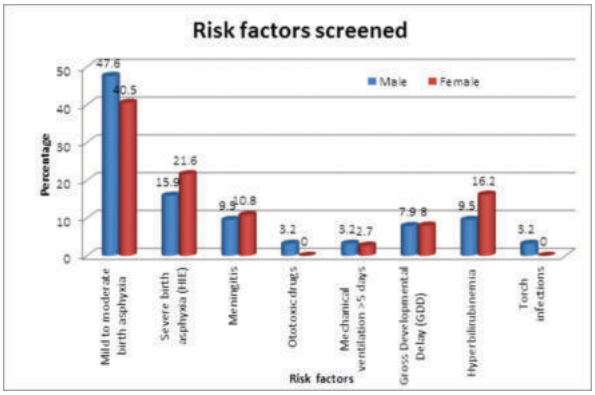
1. Parents who have not accepted to sign the consent form.
2. Patients with actively discharging ear or with dermatological local skin infections.
3. Patients with family history of hearing loss or congenital hearing disorders.
4. All preterm neonates and those with low birth weight babies.
5. Patients with multiple disorders.

Special investigations

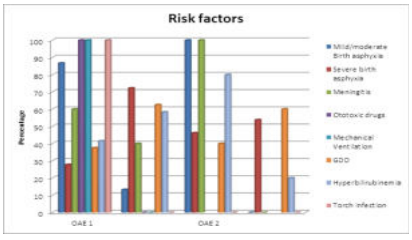
a. Otoacoustic emission

b. Brain stem evoked response audiometry

Risk factors Screened	No of male	No of female	Chi square	P value
Mild to moderate birth asphyxia	60 (47.6%)	30 (40.5%)	0.472	0.331
Severe birth asphyxia (HIE)	20 (15.9%)	16 (21.6%0	0.522	0.307
Meningitis	12 (9.5%)	8 (10.8%)	0.043	0.770
Ototoxic drugs	4 (3.2%)	0 (0%)	1.199	0.122
Gross Developmental Delay (GDD)	10 (7.9%)	6 (8%)	0.001	0.966
Hyperbilirubinemia	12 (9.5%)	12 (16.2%)	0.989	0.160
Torch infections	4 (3.2%)	0 (0%)	1.99	0.122

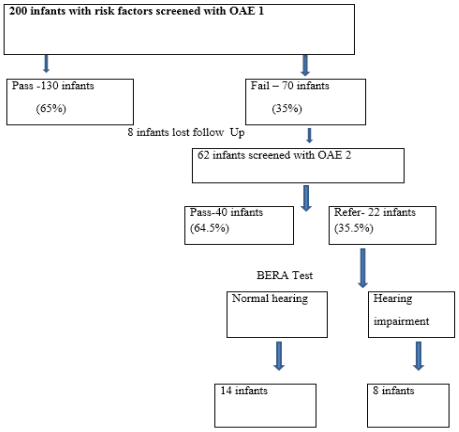


Risk factors	OAE 1			OAE 2		
	Normal hearing	Impaired hearing	p value	Normal hearing	Impaired hearing	P Value
Mild/moderate Birth asphyxia	86.7%	13.3%	<0.01	100%	0%	0.080
Severe birth asphyxia	27.8%	72.2%	0.001	46.2%	53.8%	0.010
meningitis	60%	40%	0.184	100%	0%	0.080
Ototoxic drugs	100%	0%	0.333			
Mechanical Ventilation	100%	0%	0.189			
GDD	37.5%	62.5%	0.047	40%	60%	0.055
Hyperbiliru binemia	41.5%	58.3%	0.00	80%	20%	0.461
Torch infection	100%	0%	0.333			



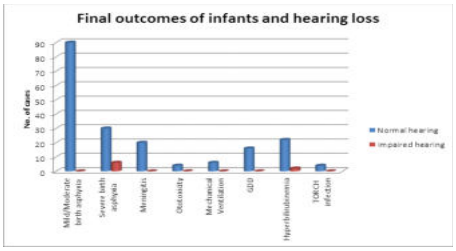
Degree of hearing loss by BERA

Risk factor	Tracing of wave in right ear	Tracing of v wave in left ear	Degree of hearing loss in right ear	Degree of hearing loss in left ear
Severe birth asphyxia	40dB	60dB	Mild HL	Moderately severe HL
Severe birth asphyxia	Not traced till 100db	Not traced till 100 dB	Profound HL	Profound HL
Severe birth asphyxia	40dB	30dB	Mild HL	Mild HL
Hyperbilirubinemia	80dB	Not traced till 100dB	Severe HL	Profound HL



Final outcomes of infants and hearing loss

Risk factor screened	Total no of cases screened	No of cases with normal hearing	No of cases with impaired hearing	P value
Mild/Moderate birth asphyxia	90	90	0	0.009
Severe birth asphyxia	36	30	6	<0.01
Meningitis	20	20	0	1.00
Ototoxicity	4	4	0	1.0
Mechanical Ventilation	6	6	0	1.0
GDD	16	16	0	1.0
Hyperbilirubinemia	24	22	2	0.247
TORCH infection	4	4	0	1.0



Result-

During this study, 2 00 infants were subjected to OAE testing. The age of the study group ranged between day 1 to day 360 (1year). 126 infants (63%) were male and 74 infants (37%) were female.. 70 (35%) infants failed after the first screening. These include 12 infants with mild to moderate birth asphyxia), 26 infants with severe birth asphyxia , 8 infants with meningitis, 10 infants with GDD and 14 infants with hyperbilirubinemia . Statistically significant values were obtained in infants with mild to moderate birth asphyxia, severe birth asphyxia, global developmental delay and hyperbilirubinemia with p<0.01,p=0.001,p=0.047,p=0.00 respectively after screening by OAE-1. Total 8 (11.4%) infants (4 infant with mild to moderate birth asphyxia and 4 infant with hyperbilirubinemia) does not followed up for second OAE screening. 40 (64.5%) out of 62 infants passed the second screening test. Out of 62 infants 22 (35.4%) infants failed after the second screening by OAE-2 . 8 infants (p=0.080) each with mild to moderate birth asphyxia and meningitis,12 with severe birth asphyxia, 8 with hyper bilirubinemia, 4 with GDD passed OAE 2. 22 infants with severe birth asphyxia (p=0.010), global developmental delay (p=0.055), hyperbilirubinemia (p=0.461) were subjected to BERA. Out 22 infants, 14 infants had passed the BERA test and 8 (36.6%) infants had hearing impairment. Out of these 8 (4.1%) infants, 6 (3.1%) infants were with severe birth asphyxia and 2 (1.04%) with hyperbilirubinemia had hearing loss.

Hearing impairment seen in infants at risk or not at risk. The prevalence ranges from 0.09 to 2.3% in low risk infants, and it ranges from 0.3% to 14.1%, in the high risk population. In this study, the proportion of hearing loss is 4.1% which is within the range of statistics.

Discussion

In this study all the infants with mild to moderate birth asphyxia had passed the screening test and none had hearing impairment .A study by Maqbool M et al1 who screened 26 infants with asphyxia, 2 infants had abnormal BERA response initially, but tested normal on follow-up which is in accordance with earlier study conducted by PK Mishra et al. both the studies have shown that transient neurological abnormalities can be seen in infants with mild to moderate asphyxia.

In this study, of the 36 infants with severe birth asphyxia 6 infants had hearing impairment in both the ears .A study by Christine Ohl et al7 who screened 12 babies with severe birth asphyxia and identified 4 babies with hearing impairment which is much higher than our study. In a study by Nagapoornima et al 4 who screened 51 babies with severe birth asphyxia and identified hearing impairment in 1 baby, which is much lower than our study. A study by Mallikarjun S et al screened 12 cases of severe birth asphyxia and identified 1 case with hearing loss which is lower than our study.

In the study by Mallikarjun et al, out of 5 babies with meningitis, 1 baby had hearing loss. In the Study by Nagapoornima et al 14 babies were screened with meningitis but none had hearing impairment as in our study.

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Finckh Kramer U et al concluded that aminoglycosides are not an important risk factor. Similar result were obtained by Hess M et al6 and our study also showed aminoglycosides are not a risk factor for hearing impairment.

In our study none of the infant with mechanical ventilation had hearing

impairment .In the study by Bielecki I et al (2011), 11.45% of hearing loss was identified in children subjected to mechanical ventilation for a period in excess of 5 days. M D Mohd Khairi et al15 concluded that mechanical ventilation of more than 5 days was not an independent risk factor for hearing impairment.

In our study none of the infant with Global Developmental Delay had hearing impairment. 10% of hearing loss was diagnosed in the children with the Global Developmental delay in the study conducted by T Stephen at al (2021). A study conducted by Maruthi M et al1 screened 121 children with GDD and identified 36 (29%) children with hearing loss and speech delay. Of the 24 infants, for whom exchange transfusion was done 2 infants were diagnosed with hearing impairment in BERA testing. Nagapoornima et al1 screened 38 babies with severe hyperbilirubinemia requiring exchange transfusion but none had hearing impairment. A study by Aseel Al-Meqbel et al1 detected 4(17%) of the 19 cases with hyperbilirubinemia ($p<0.05$) who had hearing loss. 2 Infants with TORCH infection was screened and both the infants passed the first screening by OAE. Nagpoornima et al1 screened 6 babies with TORCH infection bt none had hearing impairment as in our study. In the study by Tanuwijaya et al1, there were no correlation between TORCH infection and hearing loss.

So in our study of high risk screening, 8 infants had hearing impairment (4.1%) out of 192 and it is lower than the incidence of study by Anand S et al1 who identified 20 babies out of 254 high risk babies (7.8%).

Fakhree S H et al24 screened 150 high risk infants of whom 42 (28%) had hearing impairment.

Nagapoornima et al1 screened 279 high risk babies and identified 3 babies with hearing impairment (1.07%)

Mallikarjun S et al identified 6 babies with hearing impairment out of 100 high risk cases.

A study by Bhatt et al found that the incidence of SNHL in high risk newborns was 5%.

Conclusion

Of the 8 risk factors screened, only 2 risk factors (severe birth asphyxia and hyperbilirubinemia) were associated with hearing impairment. This study found that Global developmental Delay is not an independent risk factor for hearing loss. Hearing impairment is not seen in mild to moderate birth asphyxia infants, Meningitis, torch infections, Ventilated babies and those who received Ototoxic drugs probably due to early and effective management. Hence early identification and intervention will allow children with hearing to develop language skills during a period of neural plasticity that would otherwise be forfeited, banishing them into a world of social isolation and educational malaise. This study highlights the need of OAE and BERA for early identification of hearing loss and that although universal hearing screening programs are warranted but most of the cases with hearing loss can be identified on the risk factors and high risk screening can suffice in areas with limited resources.

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