

“UNIVERSAL HEARING SCREENING OF NEWBORNS USING OTOACOUSTIC EMISSIONS AND BRAINSTEM EVOKED RESPONSE.”

Otorhinolaryngology

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ABSTRACT

Objective: This study is aimed to screen the Neonate for earlier diagnosis of hearing loss. To assess the relationship between the hearing loss and risk factor in neonate. Early intervention and rehabilitation to prevent hearing loss related disabilities. **Subjects And Methods:** 50 high risk newborn cases with history of any birth complication or GDD, coming to the Department of ENT, Maharaja Yashwantrao Holkar Hospital, Indore, were selected. 1st OAE was done in 28 days followed by 2nd OAE in next 1 month and BERA 3 months later. **Results:** In our study, a total of 50 newborns were initially screened for hearing loss by otoacoustic emission test. Out of that 34 newborns pass the initial OAE Test and 16 newborn reported with hearing Impairment. Newborns who were reported in initial screening were rescreened by 2nd OAE screening and 5 newborns were Referred. The significant risk factor associated with hearing impairment were low birth weight, ototoxic medication during pregnancy, hyperbilirubinemia, APGAR score 1 min, APGAR score 5 min, and bacterial meningitis. After 3 months BERA test was done on the Referred neonates and 3 neonates (8.3%) in high risk category found to be having severe hearing impairment. **Conclusion:** Those patients who showed BERA result as severe to profound deafness were further counseled for auditory rehabilitation and hearing aid trial for 3 month, followed by radiological work up for cochlear implantation. The core goal of the study was to emphasize the importance of universal newborns hearing screening for early diagnosis & intervention in newborns in the term of auditory rehabilitation as every child is precious and hearing is their fundamental right.

KEYWORDS

Otoacoustic Emissions, Brainstem Evoked Response.

INTRODUCTION

The sense of hearing is the most empowered sense among the all five senses in human being.

According to World Health Organization¹ 2019, 5% of the total world population have hearing loss disability (432 million adults and 34 million children).

It is estimated that hearing loss occurs in about 2 to 3 of every 1000 newborns and failure to screen or test the new born early results in the hearing impairment as a hidden disability.²

The causes of the hearing loss can be congenital or acquired. Congenital causes lead to hearing loss soon after the birth and it can be caused by hereditary and non-hereditary, genetic or due to certain complication occurring during the pregnancy and child birth & acquired causes may lead to hearing loss at any time.

As per the Joint Committee on Infant Hearing Position Statement, the risk factor are family history of hereditary childhood SNHL, Congenital, perinatal, toxoplasma, rubella, cytomegalovirus, and herpes (TORCH) infection, Craniofacial anomalies, Birth weight <1500g, hyperbilirubinemia more than 15mg/dl, ototoxic medication, mechanical ventilation more than 5 days or longer, post natal asphyxia.³

If the hearing impairment is not detected early, there will not be stimulation of the brain's hearing centers which affect the maturation and development of hearing and a hearing impaired child develops psychological social educational and even cognitive problems. It happens even if the child is partially hearing impaired and not totally deaf.

The best way to prevent the impact of hearing loss is early detection and intervention by the Universal Newborn Hearing Screening

programme which aims to identify hearing loss early in newborns so they can be rehabilitated.

For early detection and intervention, steps taken in the Universal Newborn hearing Screening Programme recommends that child should undergo two stage OAE test if initial OAE reports as Refer, then rescreening with OAE must be done after one month and the child who still reports as Refer from 2nd OAE screening is finally tested by ABR/BERA after 3-4 months.⁴

No single test can detect all the failure pattern in the auditory system. Therefore, using of two tests for screening of the new born for the deafness is recommended.

METHODS:

Study Subjects

50 high risk newborn cases with history of any birth complication or GDD, coming to the Department of ENT, Maharaja Yashwantrao Holkar Hospital, Indore, were selected. 1st OAE was done in 28 days followed by 2nd OAE in next 1 month and BERA 3 months later.

Inclusion Criteria

- Patients giving consent for study.
- Patients with history of any birth complication or GDD.

Exclusion Criteria

- Patient not giving consent for study.

Ethical Approval

Detailed information about the study was provided for participants, and written informed consent was obtained from each one.

Procedure:

- Fifty newborns with history of any birth complication or GDD were included in the study.

- A detailed history was taken, and patients fulfilling the inclusion criteria were taken in the study.
- The patient's history was followed by general physical, clinical otorhinolaryngological examination.
- OAE was done in 1st 28 days followed by 2nd OAE in next 1 month and BERA 3 months later.

RESULTS

During the study period, 50 newborns were recruited to the study. Out of 50 newborns, 20 (40%) were high risk and 30 (60%) were low risk. Male neonates were 30 (60%) and female were 20 (40%).

Initial 1st screening was done by OAE in total 50 newborns of which 34(70%) newborn were reported as pass while 16(30%) were reported as 'Refer'.

The association between screening on 1st OAE (within 28 days of birth) & risk factors was found to be significant ($p < 0.05$).

In patient having high risk, 5 were reported as pass while 5 showed Refer result on 1st OAE. Similarly, in patient having low risk 30 (85%) were reported Pass while, 15(40%) showed Refer result on 1st OAE.

The screening result through 2nd OAE in 16 neonates who were reported as Refer on 1st screening of OAE, on 2nd OAE 11(70%) were reported as pass & 5 (30%) were reported as Refer.

The most commonly found risk factor were low birth weight (40%), hyperbilirubinemia (10%), low APGAR score (10%), and bacterial meningitis (20%).

Patient having high risk out of total 2, 1(50%) reported as severe to profound deafness & 1(50%) within normal limit result on BERA. While in total 3 patients with low risk showed 2 (66.7%) reported severe to profound deafness and 1(33.3%) reported within normal limit result on BERA test.

DISCUSSION

In the present study out of 50 cases, 30 (60.0%) cases were male and 20 (40.0%) cases were female. Male to female ratio was 3:2. High risk were 20(40%) and 30(60%) newborns with low risk.

A total of 50 newborns were initially screened for hearing loss by Otoacoustic emission test. Out of that 34 newborns pass the initial OAE Test and 16 newborn reported as Refer, which was similar to the hearing Impairment found in the study of Farhat et al⁵ 2014 who enrolled 8987 newborns and reported 1231 (19.7%) failed initial screening.

Newborns who were reported as Refer in initial screening were rescreened by 2nd OAE screening after 1 month in which 11 newborns as Pass and 5 newborns were Referred.

The 2nd OAE result was nearly close to the study of Ann Mary⁶ 2013 where among 9448 were screened for hearing deficit in which 863 neonates (9.1%) failed and 8585 neonates passed in initial screening in 2nd OAE 164 neonates failed and 549 passed.

Farhat et al⁵ 2014- second stage OAE done on 1231 neonates 712 neonates (57.8%) passed and 519 neonates (42.2%) failed.

In the present study the association of hearing impairment with risk factor analyzed in which the association between screening result for male on 1st OAE (with in 28 day of birth) & risk factor which was found to be significant ($P < 0.05$) for male and female newborns.

The significant risk factor associated with hearing impairment whose p value found to be < 0.05 were low birth weight, ototoxic medication during pregnancy, hyperbilirubinemia, APGAR score 1 min, APGAR score 5 min, and bacterial meningitis which can be correlated with the following studies.

Rajnikant Patel et al⁷ 2009-concluded from the study that the newborn who born with low birth weight < 1.5 kg were 2.341 times more prone for developing hearing impairment and in our study hearing impairment were 4 time more.

Augustine et al⁸ 2013-revealed that hearing loss due to low APGAR

score was 3.4% and in our study it was 3%. Gouri Z et al⁹ 2015- studied 415 babies in which, 22 neonates showed abnormal OAE examination. Low APGAR score contribution 16.7%. Augestien et al⁸ 2013- concluded that hearing loss due to deranged bilirubin level was 5.2% and in our study it was found to be 3%.

John et al¹⁰ 2015- conducted study in Christian Medical College Vellore and evaluated 500 newborns, in which bacterial meningitis contributes 1.6% of total hearing loss.

After 3 month BERA test was done on the referred neonates through two stage OAE test in which 1 neonates (0.6%) in low risk category found to be severe hearing impaired and 3 neonates (8.3%) in high risk category found to be severe hearing impaired. On comparing between low risk and high risk neonates hearing impairment seen 13.8 times.

Mallikarjun S Tegnoor et al¹¹ - conclude incidence of hearing loss in high risk newborns is 12 times more commons than normal newborns. Overall result of BERA test on 10 neonates after 3 months in which 1 female neonates with high risk was found severe to profound deafness and in 9 male neonates, 3 male neonates with high risk found to be normal (60%) & 3 with low risk found to be normal (75%) and 2 male neonates were found severe to profound deafness (40%) & 1 male neonates with low risk found severe to profound deafness (25%).

Those patient who showed BERA result as severe to profound deafness were further counseled for hearing rehabilitation as hearing aid trial for 3 months followed by radiological work up for cochlear implantation and those who passed BERA test were followed after 6 month and found to be in normal limit.

CONCLUSION

Deafness if not detected early remains a lifelong disability with social, financial & functional implication.

From the present study, which included two stage hearing screening by Otoacoustic Emission test of 50 newborn & neonates and further testing of refer result patient with BERA/ABR test we concluded that- In this study 34 Newborn passed initial hearing screening and on rescreening of 16 newborns, 11 passed the test while 5 Refer neonates after one month from their 1st OAE. The probable explanation for this may be to the presence of fluid in middle ear or external auditory canal, immature development of the auditory pathway system at the time of birth. So, we recommend follow up and rescreening through two stage OAE is necessary to avoid the false positive.

The prevalence of hearing impairment found to be 0.528 Time more in high risk neonates as compare with low risk neonates in this study.

In high risk neonates, the significant risk factors associated with hearing impairment were low birth weight, ototoxic medication during pregnancy, hyperbilirubinemia, APGAR score 1 min, APGAR score 5 min, and bacterial meningitis.

Those patient who showed BERA result as severe to profound deafness were further counseled for auditory rehabilitation as hearing aid trial for 3 month followed by radiological work up for cochlear implantation.

The core goal of the study was to emphasis the importance of universal newborns hearing screening for early diagnosis & intervention in newborns in the term of auditory rehabilitation as every child is precious and hearing is their fundamental right.

We recommend that universal newborns hearing screening should be made mandatory in all set up before discharge of newborns & neonates.

Table:1 Gender Distribution Of The Study Population

SEX	Frequency	Percentage
Female	20	40
Male	30	60
Total	50	100

Table 2: Risk Distribution Of The Study Population

RISK	Frequency	Percentage
HIGH RISK	20	40

LOW RISK	30	60
Total	50	100

Table 3: Screening Result Through 1st Oae (within 28 Days Of Birth)

TOTAL NEWBORN		TEST PASS		TEST REFER	
N	%	N	%	N	%
50	100	34	70	16	30

Table 4: Association Between Screening Result On 1st Oae (within 28 Days Of Birth) & Risk Factors

RESULT ON 1ST OAE (WITHIN 28 DAYS OF BIRTH)	RISK FACTOR		TOTAL
	HIGH RISK	LOW RISK	
PASS	COUNT	4	30
	%	35%	85%
REFER	COUNT	6	10
	%	65%	15%
TOTAL	COUNT	10	40
	%	100%	100%

Table 5: Screening Result Through 2nd Oae At One Month From Initial Oae

NEWBORN REPORTED AS REFER IN 1ST OAE		TEST RESULT ON 2ND OAE PASS		TEST RESULT ON 2ND OAE REFER	
N	%	N	%	N	%
16	100	11	70%	5	30%

Table 6:Association Between Risk Factor And Hearing Loss On 2nd Oae

RISK FACTORS		HEARING LOSS		
		PRESENT N=10	ABSENT N=40	TOTAL N=50
BIRTH WEIGHT(KGS)	<1.5	04	01	05
	>1.5	06	39	45
FAMILY HISTORY OF HEREDITARY CHILDHOOD SNHL	NO	10	37	47
	YES	00	03	03
INUTERO INFECTION(TORCH)	NO	09	37	46
	YES	01	03	04
CRANIOFACIAL ANOMALY	NO	10	38	48
	YES	00	02	02
OTOTOXIC MEDICATION DURING PREGNANCY	NO	08	38	46
	YES	02	02	04
HYPERBILIRUBIENEMIA	NO	07	38	45
	YES	03	02	05
APGAR SCORE 1MIN	<5	03	02	05
	>5	07	38	45
APGAR SCORE 5MIN	<7	02	03	05
	>7	08	37	45
MECHANICAL VENTILATION	NO	09	39	48
	YES	01	01	02
BACTERIAL MENINGITIS	NO	07	37	44
	YES	03	03	06
SYNDROME WITH SNHL	NO	10	39	49
	YES	00	01	01
GESTATIONAL AGE<37 WEEKS	NO	09	39	48
	YES	01	01	02

Table 7: Association Between Risk Factor And Bera Result After 3 Month From 2nd Oae

BERA RESULT AFTER 3 MONTH FROM 2ND OAE		RISK FACTORS HIGH RISK LOW RISK		TOTAL
SEVERE TO PROFOUND DEAFNESS	COUNT	1	2	3
	%	50.0%	66.7%	60.0%
WITH NORMAL LIMIT	COUNT	1	1	2
	%	50.0%	33.3%	40.0%
TOTAL	COUNT	2	3	5
	%	100%	100%	100%



Fig:1 Procedure Of Oae On Newborns.

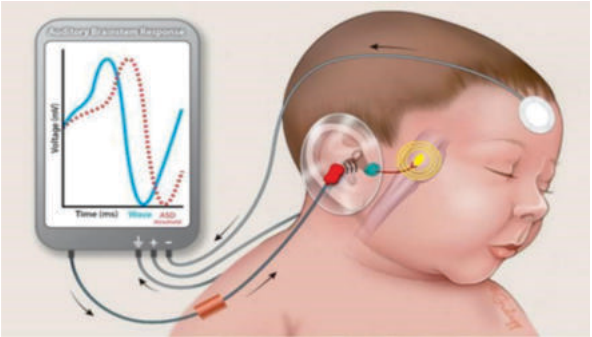


Figure:2 Bera

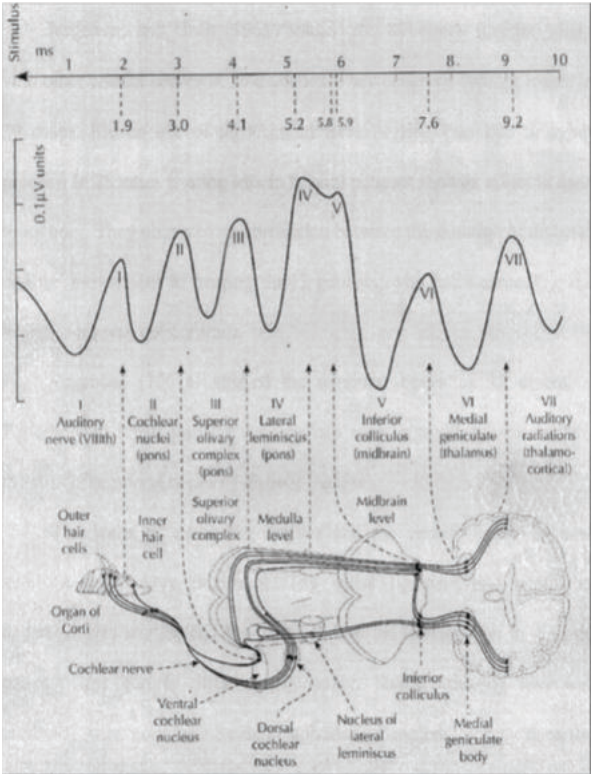


Figure:3 Origin Of Bera Waves

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