

## Early Detection of Hearing Loss in Neonate by Otoacoustic Emissions in Tertiary Care Hospital

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### Abstract

**Introduction:** Hearing in human plays a significant role in communication. Hearing loss affects the social and cognitive development of the child. Henceforth early identification and intervention by screening test like Otoacoustic emission becomes an absolute necessity in neonates. The objective of this study is to detect the hearing loss in new-born at early stage.

**Materials and Methods:** All the neonates born in a tertiary care centre were screened by OAE test during October 2021 to October 2022. A detailed maternal and birth history was taken.

**Result:** Total of 154 neonates were screened with OAE test in both ears. 62 males and 76 female infants had bilateral PASS result. About 6 males and 10 females had REFER result on OAE. It was observed that 33% neonates with in utero infection, 28% of hyperbilirubinemia neonates had REFER in OAE, while 25% of neonates with meconium stain, 25% with low apgar score, 25% with family history of childhood Sensorineural hearing loss, Low birth weight neonates 10% had REFER in OAE. Less than 7% of neonates with preterm birth, intensive care and maternal co-morbidity had REFER in OAE.

**Conclusion:** OAE is a non-invasive, easily available, quick screening test for hearing it helps to early detect hearing loss in neonates.

**Keywords:** Apgar, Hyperbilirubinemia, Otoacoustic Emission, SNHL.

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### Introduction

Hearing loss is the most common congenital factor seen in 0.1–0.2% infants.[1]Auditory stimulation is needed in early months of life for preservation of neural connections in auditory pathways.

[2]Infants hearing screening programs are helpful to find all cases with mild-severe hearing loss (>35–40 dB HL).According to WHO, 360 million people have moderate

to profound hearing loss worldwide, which makes them disable.[3]

For effective treatment, congenital or perinatal hearing loss should be recognized within three months of birth, with formal diagnosis and initiation of early intervention beginning before the 6th month of age. [4]

Otoacoustic emissions (OAEs) are biological phenomena generated in the normal cochlea when the cochlea processes an incoming auditory impulse that takes place in the outer hair cells (OHCs). OAEs are a by-product of the cochlear amplifier.

The biomechanical activity of the cochlear amplifier generates a mechanical energy part of which escapes from the cochlear amplifier mechanism and travels backward through the cochlea from the OHCs towards the base of the cochlea where it causes an up and down motion of the basilar membrane. This movement generates a differential oscillating fluid pressure in the compartments above and below the basilar membrane which in turn is transferred to the oval window and the round window membrane. This causes a vibration of the middle ear ossicles and the eardrum and results in the OAE being picked up by the sensitive microphone placed deep in external auditory meatus.

#### **Different forms of OAEs:**

OAEs are of many types and are classified into different categories depending on the following:

1. Whether the OAE is generated by presenting a sound stimulus to the ear (evoked OAE) or is being generated by itself even without any sound being presented to the ear (spontaneous OAE)
2. Whether the OAE that this is being generated on presenting a sound stimulus to the ear is being recorded at the same time when the sound is being presented (stimulus frequency OAE

and distortion product OAE) or is being recorded immediately after a brief sound is being presented (transient OAE)

3. Whether the OAE is being evoked by a click sound or a single pure tone sound (transient -evoked OAE or TEOAE) or a combination of different pure tone sounds (distortion product OAE or DPOAE).

The OAE test is a non -invasive test, objective easily repeatable, reliable and very fast test that can be carried out by any trained person not necessarily a clinician or an audiologist.

TEOAE test, the PASS signifies TEOAE value of above 6 dB SPL across all frequencies. The result 'REFER' signifies that hearing impairment is probable and that other hearing tests need to be done to confirm hearing impairment and also to find out the extent of the impairment.

In DPOAE test the PASS signifies an SNR of 6 dB SPL or a DPOAE response magnitude within the specified normative data. If SNR of OAE elicited is less than 6 dB in DPOAE test or is 'absent' or 'abnormal' but present in DPOAE test, then the result is expressed as REFER. [5]

OAE and automated ABR (AABR) are hearing screening methods. Both OAE and ABR are non-subjective, cost-effective, safe, and non-invasive. OAE is a less time-consuming and money-saving test as it does not require the use of the electrode. Otoacoustic emission test can be done in OPD in awake infants and ABR requires the infant sleep. The results are in form of "PASS" and "REFER". PASS means no hearing loss whereas REFER means that there is a need for further assessment. In comparison to OAE, ABR tests are more time-consuming and are expensive. ABRs are more sensitive than OAEs. As an ABR is a reliable and objective test but difficult to perform, otoacoustic emission is a practicable screening modality.[6]

## Material And Method

All neonates born in the tertiary centre were screened by OAE test before discharge. The detail and meticulous maternal and neonatal history were taken e.g., maternal co-morbidities, birth type, prematurity, birth weight, intensive care stay, APGAR scoring. OAE test result was

interpreted and the data was collected and tabulated.

## Observation And Results:

Over a period of 1 year 154 newborns were screened for hearing impairment with OAE test. There were 68 males and 86 females. The risk factors represented statistically as below (TABLE I)

**Table 1: Risk factors in infants and their OAE result.**

	TOTAL	%	PASS	%	REFER	%
SEX						
MALE	68	44	62	40	6	4
FEMALE	86	56	76	49	10	7
BIRTH TYPE						
VAGINAL	32	21	28	18	4	3
C-SECTION	122	79	110	71	12	8
INTENSIVE CARE						
YES	60	39	56	36	4	3
NO	94	61	82	53	12	8
Gestational age						
TERM	126	82	112	72	14	9
PRETERM	28	18	26	17	2	1
Low Birth Weight						
YES	40	26	36	23	4	3
NO	114	74	102	66	12	8
Meconium Stain						
YES	8	5	6	4	2	1
NO	146	95	132	86	14	9
Maternal Co-morbidity						
YES	32	21	30	19	2	1
NO	122	79	108	70	14	9
In utero infection						
YES	3	2	2	1	1	1
NO	151	98	136	88	15	9
Family History of childhood SNHL						
YES	4	3	3	2	1	1
NO	150	97	135	88	15	9
APGAR 0-4 1 min						
YES	4	3	3	2	1	1
NO	150	97	135	88	15	9
APGAR 0-6 5 mins						
YES	0	0	0	0	0	0
NO	154	100	138	90	16	10
Hyperbilirubinemia						
Yes	7	5	5	3	2	1
No	147	95	133	86	14	9

In the present study a total of 154 neonates were screened over a period of 1 year that

were born in the tertiary care hospital PMCH, Udaipur. About 62 males and 76

female infants had bilateral PASS result. About 6 males and 10 females had REFER result on OAE.

Among 122 neonates that were delivered surgically, 12 had REFER result in OAE while out of 32 neonates that were delivered without surgery, 4 had REFER result. About 60 neonates that had nicu stay history, 4 neonates had REFER and 56 had PASS. About 28 neonates were born preterm, 26 neonates had PASS result and 2 had REFER result in OAE. About 40 neonates had low birth weight out of those 36 neonates had PASS and 4 had REFER result in OAE.

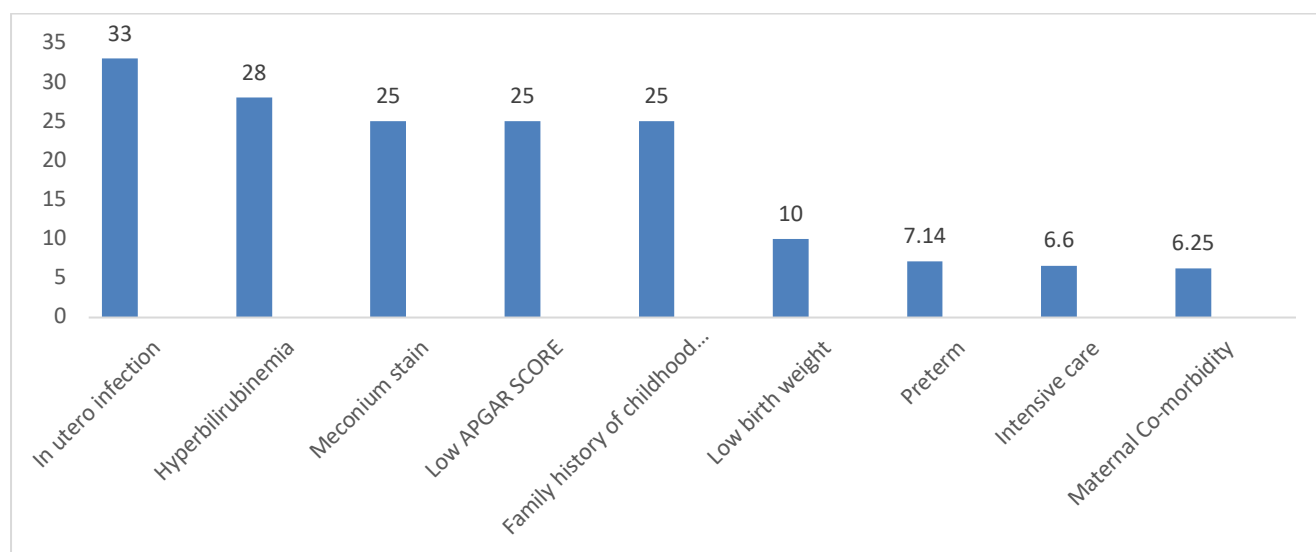
Out of 8 neonates that had meconium stain licar 6 had PASS result and 2 REFER

result in OAE. It was also observed that 32 mothers had associated co-morbidity, 30 had PASS result on OAE and 2 had REFER result on OAE. Out of 154 neonates, 3 neonates had in utero infection 1 had REFER and 2 had PASS result in OAE.

Family history of childhood SNHL was seen in 4 patients out of those 1 had REFER and 3 had PASS. About 4 neonates had low apgar score in 1 min i.e., between 0-4 out of those 1 had REFER and 3 had PASS. No neonate had low apgar score in 5 min i.e., 0-6. About 7 neonates had hyperbilirubinemia 2 had REFER and 5 had PASS result in OAE test.

**Table 2: Distribution and Prevalence of risk factors in the studied population with REFER result.**

Risk factors	Percentage (in %)
In utero infection	33
Hyperbilirubinemia	28
Meconium stain	25
Low APGAR SCORE	25
Family history of childhood SNHL	25
Low birth weight	10
Preterm	7.14
Intensive care	6.6
Maternal Co-morbidity	6.25



**Fig 1: Showing contribution of each risk factors**

In our study it was observed (TABLE II ) distribution and prevalence of risk factors in the studied population with REFER result. The percentage of infants with the risk factor total out of number of infants with same risk factor was tabulated. It was observed that 33% neonates with in utero infection had REFER in OAE, 28% of hyperbilirubinemia neonates had REFER in OAE. We also found that 25% of neonates with meconium stain, 25% neonates with low apgar score, 25% neonates with family history of childhood SNHL had REFER result in OAE. It was observed that out of 10% low birth weight neonates had REFER in OAE. 7.14% of neonates with preterm birth, 6.6%

intensive care and 6.25% maternal co-morbidity had REFER in OAE.

### Discussion

Most sensitive neonatal hearing screening test is Otoacoustic emission which may have to be combined with other test. Risk factors in neonate and pregnancy such as prematurity, hyperbilirubinemia, in utero infection, low birth weight, low apgar score at 1 min and 5 min, meconium stain, maternal co morbidity, Family History of childhood SNHL and NICU care should also be considered prior to the test with detailed maternal and neonatal history and examination.

**Table 3: Comparison of contribution of risk factor with other studies**

Risk factors	Percentage (in %)	Karaca et al (%)	Kumar et al (%)	Jadia et al. (%)	Aiyer et al. (%)
Preterm	7.14	-	14.1		-
Low birth weight	10	26.5	16.8	16	21.4
Meconium stain	25		-		-
Low APGAR SCORE	25		-	16	13.3
Family history of childhood SNHL	25	16.2	-	3	100
Intensive care	6.6	15.6	14.1	13	-
Maternal Co-morbidity	6.25		-		-
In utero infection	33		-	3	-
Hyperbilirubinemia	28	11.9	-	16	28

In present study (Table III) About 62 males and 76 female infants had bilateral PASS result. About 6 males and 10 females had REFER result on OAE i.e male to female ratio 3:5. In the study by Chavan et al, 330 infants were screened 79 males and 55 female infants gave refer result on first OAE i.e male to female ratio 79:55. He also observed, 99% of infants with hearing impairment had risk factors as hearing loss was seen in infants with low birth weight, delayed birth cry, hyperbilirubinemia and NICU stay. [7]

In present study among 122 neonates that were delivered surgically, 12 had REFER result in OAE while out of 32 neonates that were delivered without surgery, 4 had

REFER result. In the study by Karaca et al. the occurrence of refer in infants with vaginal birth (17.5%) are more than caesarean section. [8]

In our study it was observed that 33% neonates with in utero infection had REFER in OAE, 28% of hyperbilirubinemia neonates had REFER in OAE. In the study by Jadia et al where percentage of hearing loss with low birth weight, low apgar score and hyperbilirubinemia was 16%. Mechanical ventilation contributed 13% of total hearing loss. Family history of childhood SNHL, In Utero Infection contributed 3% of total hearing loss. [9]

In our study we found that 25% of neonates with meconium stain, low apgar score, family history of childhood SNHL had REFER result in OAE. The findings correlate with the study by Aiyer et al they observed that 100% family history of childhood deafness, 28% of hyperbilirubinemia, 21.4% low birth weight, 13.3% low apgar score had hearing loss. [10]

It was observed that out of 40 Low birth weight neonates 10% had REFER in OAE and out of 28 preterm neontaes 7.14% had REFER finding the findings. The study by Kumar et al it was observed that low birth weight (16.8%), prematurity (14.1%) mechanical ventilation (14.1%) were identified as the major risk factors. [11]

In our study, 6.6% of neonates with intensive care and 6.25% of neonates with maternal co-morbidity had REFER in OAE.

### Conclusion

OAE is a non-invasive, easily available, quick screening test for hearing it helps to early detect hearing loss in neonates especially with high risk factors which are preventable and treatable. Early intervention in prelingual deafness will have good communication result in future.

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