Section: ENT

Original Research Article

A COMPARITIVE STUDY OF OTOACOUSTIC EMISSIONS IN PRE TERM AND TERM INFANTS

Spandana Kandra[1], G B Sreenivas[2], Aditya Kanchumurthy[3], Peter Mummidivarapu[4], K. Ravi[5]

[1]Assistant professor, Department of ENT, SMC Vijayawada, India.
[2]Assistant Professor, Department of ENT, SMC Vijayawada, India.
[3]Assistant Professor, Department of ENT, SMC Vijayawada, India.
[4]Senior Resident Department of ENT, SMC Vijayawada, India.
[5]Professor & HOD, Department of ENT, SMC Vijayawada, India.

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Corresponding Author:
Dr. Peter Mummidivarapu,
Email: petermsent@gmail.com.

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Abstract

Background: Hearing impairment in children across the world constitutes a particularly serious obstacle to their optimal development and education, including language acquisition. According to a range of studies and surveys conducted in different countries, around 0.5 to 5 in every 1000 neonates and infants have congenital or early childhood onset sensorineural deafness or severe-to-profound hearing impairment. In our study preterm neonates and term neonates were screened using otoacoustic emissions, results showed that preterm infants were at more risk for developing hearing loss than term infants. So, early screening with OAE effectively improves the chances of early diagnosis and hence infants can be rehabilitated early. Preterm infants were having more suppressed OAE than term infants. This screening using OAE ensures appropriate usage of health services for neonates in need and thereby helps diagnose hearing loss early and begin rehabilitation early which changes the life of the child drastically helping them to lead a near normal life.

INTRODUCTION

Hearing is the most important sense. It is the first and most important step in learning language. Without hearing there is no speech. Language is also important for acquiring social skills, developing proper emotional support and in advanced learning and academic achievement. Future employment and quality of life are to a greater extent depends upon the early detection and rehabilitation of hearing loss. It is crucial to timely diagnose hearing impairment in infants since hearing loss if corrected at the right time, can improve the quality of life and can prevent further deterioration of hearing loss by taking proper precautions. Prevalence of newborn and infant hearing loss is between 1.5 to 6 per 1000 live birth.[1]

The WHO estimated in 2005 that there were 278 million people worldwide with bilateral moderate to profound hearing loss of whom 62 million had deafness that began in childhood.[2]

Oto Acoustic Emissions (OAE) are acoustic signals emitted from cochlea to the middle ear and into the external ear where they are recorded. They are produced by active mechanical contraction of the outer hair cells [3]. In many countries OAE is being used as a screening tool to detect hearing loss.

There are four types of OAEs:

- Spontaneous OAEs (SOAE),
- Transient evoked OAEs (TOAE),
- Distortion product OAEs (DPOAE),
- Stimulus frequency OAEs (SFOAE).

SPONTANEOUS OTOACOUSTIC EMISSIONS (SOAES)

They are measured in the absence of external stimulation. They can be measured by viewing what is recorded by the microphone in the frequency domain. SOAEs appear as pure tone like signals coming from the ear. The ear has multiple SOAEs, that is, SOAEs at more than one frequency. SOAEs are measurable in approximately 50% of normal-hearing children and adults.

TRANSIENT-EVOKED OTOACOUSTIC EMISSIONS

Transient-evoked otoacoustic emissions (TEOAEs) were the first type of OAE reported in the literature. As their name suggests, TEOAEs are measured after the presentation of a transient or brief stimulus.

DISTORTION PRODUCT OTOACOUSTIC EMISSIONS

DPOAEs are generated in the cochlea in response to two simultaneous pure-tone stimuli (primary tones). The primary tones (f1 and f2) are separated in frequency within one-third octave (typically f2 = f1-1.2) and the distortion product is then typically at a frequency of 2f1-f2 (the cubic-difference tone).

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DPOAEs are also found at other frequencies (e.g. f2-f1, 2f2-f1), but 2f1-f2 has most often been used because it is the largest.

STIMULUS FREQUENCY OTOACOUSTIC EMISSIONS

Stimulus frequency otoacoustic emissions (SFOAEs) occur at the same frequency and at the same time as a continuous pure tone applied to the ear. Because the stimulus and SFOAE are occurring at the same time and at the same frequency, specialized measurement techniques must be used to extract the SFOAE from the evoking stimulus.

This study is conducted in our institute among preterm term infants satisfying the inclusion criteria.

Aims and Objectives of Study

To assess hearing impairment in the pre term and term infants using Oto Acoustic Emissions (OAE).

To know the impact of gestational age on oto acoustic emissions in pre term and term neonates.

MATERIALS AND METHODS

Source of Data

The study was conducted on neonates in the department of ENT satisfying the inclusion criteria in Government General Hospital, Vijayawada from January 2023 to November 2023.

Methods of Collection of Data

Study design

Hospital based Prospective Study.

Place of study

Department of ENT, Government General Hospital, Vijayawada.

Study sample size

50 pre term neonates and 50 term neonates satisfying the inclusion criteria were included in the study and it was carried out for the above mentioned time period.

Inclusion Criteria

- Gestational age <37 weeks (for test group)
- Healthy term neonates (for control group)

Exclusion Criteria

- Babies with craniofacial anomalies.
- Hyperbilirubinemia with levels greater than 10 mg/dl.
- Bacterial meningitis.
- Family history of congenital or delayed onset childhood sensorineural hearing loss.
- Known or suspected congenital infection.
- Ototoxic medications used more than 5 days.

Methodology

Clearance and approval from the institutional ethical committee was obtained, neonates fulfilling the inclusion criteria/exclusion criteria were included in the study after obtaining written informed consent from their parents.

Name, gestational age, sex, birth weight, In Patient number, admitting diagnosis, the period of hospitalization and possible risk factors for hearing impairment were recorded.

These pre term and term neonates were screened for hearing loss using Otoacoustic emissions. The OAE equipment used was precaliberated and assessed the hearing in a minimum of 4 frequencies 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz and results were displayed and compared. Evoked OAE is absent when hearing loss is more than 30 – 35 dB SPL which is indicated as fail by the analyzer [4]. OtoAcoustic emission test was done on neonates satisfying the inclusion criteria and the results were tabulated.

Statistical Method

Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean and SD (Min-Max) and results on categorical measurements are presented in number and percentage (%).

RESULTS AND DISCUSSION

Study population was grouped into preterm (< 37 weeks), term (39- 40 weeks) [5]. Preterm infants were 50(50%), and term was 50(50%) among the study population. Mean gestational age was 34.88±3.61 weeks.

TERM	NO OF INFANTS
PRETERM	50(50%)
TERM	50(50%)

Out of the 50 PRE TERM infants studied (50%) were male and (50%) were females.

Pre term Infants were grouped in very low birth weight babies (<1.5kg), low birth weight babies (>1.5 kg -<2.5 kg).

Birth weight	No of infants
Very low birth weight(VLBW)	20(40%)
Low birth weight(LBW)	30(60%)

Infants born with a birth weight less than 1500 g are defined as very low birth weight (VLBW) infants [6].Out of the 20 infants observed in the study 20(40%) infants were under the very low birth weight category and 30(60%) were low birth weight category.

Otoacoustic emissions were analyzed in the infants in both the ears separately and the results were tabulated.

Among the 50 pre term infants studied 39 (78%) were having OAE and 11(22%) were showing absent OAE.

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Pre term infants(50)	OAE
39(78%)	PRESENT
11(22%)	ABSENT

Among the 39 pre term infants all were having suppressed OAE.
Among the 11 pre term Infants with absent OAEs in right ear alone were 2(18.2%), left ear alone were 0 (0%) and absent in both ears were 9(81.8%).

term infants(50)	OAE
47(85%)	PRESENT
3(15%)	ABSENT

Among the 50 term infants 47(94%) were showing OAE and 3(6%) were showing absent OAE.
Among 47 term infants 40 (85%) were having normal OAE and 7 (15%)were showing suppressed OAE.
In this study pre term infants were having suppressed OAE Than term infants, which showed that there is a negative impact of gestational age on OAE in pre term infants.
OAE screening is used widely in newborn hearing screening programs, holds great promise in screening neonates and infants for permanent hearing loss because it is: (a) objective and independent of child's behavior; (b) painless; (c) portable, reliable and efficient; (d) simple to administer with an appropriate protocol.[7]
In this study 100 neonates satisfying the inclusion criteria defined based on risk factors declared by Joint committee on infant hearing were screened using OAE. Out of the 100 infants studied 45(45%) were Female and 55(55%) were males which is similar to the study conducted by Suppiej A et al,[7] with a male predominance 53.89%. While analyzing the study population's gestational age, they were grouped into preterm (< 37 weeks), term (39-40weeks) and ,50 neonates were in the preterm group 50(50%) which was similar to the study conducted by Meyer.C et al8 42%, followed by term 50 %. Mean gestational age was 34.88±2.61 weeks which is similar to the study conducted by Meyer.C et al [8] with mean gestational age among the study group was 33.8±4.3 weeks and Suppiej.A et al,[7] with a mean of 34.88±3.61 weeks.
Among 50 pre term infants 20 (40%) neonates were in the very low birth weight category which constituted the least in our study population which is comparable to a similar study conducted by Meyer. Cetal,[8] with the incidence of very low birth weight babies 32.1%. Mean birth weight was 2.19±0.47 kg which correlates with the study conducted by Suppiej.Aet al,[7] with a mean 1.716±0.819kg.
Hearing loss is relatively common in the human population. Profound congenital hearing loss is estimated to occur in about 1 in 1000 births; approximately 50% of cases are thought to be due to environmental factors and the remainder to genetic causes.[9]
In two large-scale OAE screening studies reported previously, sensitivity was found to be 85%and 100%with specificity of 95% in both studies. Additionally, in a small-scale study of 110 children age 6 months to 15 years recovering from meningitis, OAE screening was found to be highly sensitive (100%) and reasonably specific (91%).

CONCLUSION

The study titled "a comparative study of oto acoustic emissions in pre term and term neonates" was conducted to assess hearing impairment in the pre term infants using Oto Acoustic Emissions (OAE) and to compare the magnitude of hearing loss among the study subjects.
This study was conducted in the Department of ENT, Government general hospital, Vijayawada, Andhra Pradesh, between the period of January 2023 to November 2023. In this study 100 neonates satisfying the inclusion criteria were screened using optoacoustic emissions after obtaining an informed written consent and neonates were subjected to the OAE., slight male preponderance was noted. Incidence of Preterm infants were 50(50%) followed, term babies were 50(50%) among the study population.
Among the 50 pre term infants studied 39 (78%) were having OAE and 11(22%) were showing absent OAE. Among the 11 pre term Infants with absent OAEs in right ear alone were 2(18.2%), left ear alone were 0 (0%) and absent in both ears were 9(81.8%). Among the 50 term infants 47(94%) were showing OAE AND 3(6%) were showing absent OAE. Among 47 term infants 40 (85%) were having normal oae and 7 (15%)were showing suppressed OAE. Infants with suppressed OAE were referred for further evaluation and rehabilitation. Results showed that PRE TERM infants were at more risk for developing hearing loss than term infants so early screening with OAE effectively improves the chances of early diagnosis.
Among the study population, 55 (55%) were male and 45 (45%) were females, showing that children with suppressed OAE can be rehabilitated early, making a marked change in their future. Also the OAE as screening procedure should be stream lined and definitive protocols should be made to improve the outcome of screening procedure.

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