

Otoacoustic emission study among preterm babies

K.S. Gangadhara, Amrutha V. Bhat* and S. Sridhara

Department of ENT, McGann Teaching District Hospital, Shimoga Institute of Medical Sciences, N.H.206, Sagara Road, Shivamogga-577201, Karnataka, India

Received: 30th July 2022; Accepted: 05th June 2023; Published: 01st October 2023

Abstract: *Background:* Preterm birth is often cited as an important risk factor for hearing loss in the baby. Hearing screening of term and preterm babies was done within 24-48 hours of delivery using otoacoustic emissions. Babies who failed the screening were recalled for further testing. *Objective:* To study the otoacoustic emission testing results among term and preterm babies. *Methods:* A prospective institutional based study was conducted between December 2018 and May 2020. All term and preterm babies were screened for hearing impairment using handheld OAE apparatus within 24-48 hours of delivery. Any baby with a “refer” result in the OAE study was recalled for a repeat OAE testing after a month. This was repeated two more times if the baby failed the test every time. In case of failing the test for the third time, the baby was sent for brainstem evoked response audiometry (BERA) for confirmation of hearing loss. *Results:* Screening was done for 259 babies who were born preterm and 13967 term babies. Among the preterm babies, 92 babies passed the hearing screening the first time. Remaining babies were referred for further follow up. Ultimately, 3 babies had to be referred for BERA and 1 baby had confirmed hearing loss. *Conclusions:* Preterm babies are often quoted to have a higher risk of developing hearing loss when compared to term babies. Early screening for hearing loss among such babies will help in early recognition and intervention that will help the baby to deal with the handicap.

Keywords: Hearing Screening, Preterm Babies, Otoacoustic Emissions

Introduction

The WHO defines preterm birth as babies born alive before 37 completed weeks of gestation or fewer than 259 days of gestation since the first day of a woman’s last menstrual period. Every year, around 15 million babies are born preterm. In the year 2018, WHO India was among the top 10 countries with the greatest number of preterm births [1].

Preterm birth is often cited as an important risk factor for hearing loss in the baby. Various reasons given for the same are interruption in the neurodevelopmental phase due to preterm delivery, increased infection among preterm newborns and usage of ototoxic antibiotics for the same, exposure to various frequencies of sounds or noise in the NICU, etc [2-3]. Premature babies, in general are given special care and their development is keenly observed. Paying attention towards their hearing by early hearing screening of such infants will help in better outcomes in future [4].

Aims: To study the otoacoustic emission testing results among term and preterm babies

Material and Methods

The study was carried out between December 2018 and May 2020 after the approval of institutional ethical committee. A total of 14226 babies were screened, of which 259 babies were born preterm.

Inclusion criteria: All the babies born in the hospital during the study period

Exclusion criteria:

1. Babies requiring urgent referral to higher centres
2. Discharge against medical advice
3. Death of baby before discharge from hospital

Most of the preterm babies required NICU (neonatal intensive care unit) admission and

were screened in the NICU. The babies left to be by the mother’s side were screened in the postnatal ward.

A soft probe tip of size enough to achieve seal was inserted into the external auditory canal of the baby and DPOAE (distortion product otoacoustic emission) was recorded for both ears separately using a hand held OAE apparatus. No further testing was done for babies with a “pass” result. The babies who failed the first screening were recalled for repeat OAE after one month and if they failed the test again, they were asked to come again after a month. In case of a “refer” result on the third time, such babies were referred for BERA.

Results

A total of 259 preterm babies were screened within 24-48 hours of birth. 167 babies had a “refer” result and were requested to come for a second OAE testing. In comparison, out of the 13,967 term babies that were screened only 990 babies had a “refer” result. When chi-square test was applied on this data to test for the significance of the values, preterm birth appeared to be an independent risk factor for hearing loss in the newborn(Table 1).

Preterm	Pass	Refer	Total
Yes	92	167	259
No	12977	990	13967
Total	13069	1157	14226

On applying the chi-square test, the result is significant with p-value <0.00001. Hence, preterm delivery is an independent risk factor for failing the first OAE screening.

In the second OAE, out of the 167 babies screened, only 31 babies failed the test and the rest 136 babies passed the test (Table 2).

Preterm	Pass	Refer	Total
Yes	136	31	167
No	858	132	990
Total	994	163	1157

Chi-square test was applied to the statistical data and there was no significant difference observed between the outcomes in both groups.

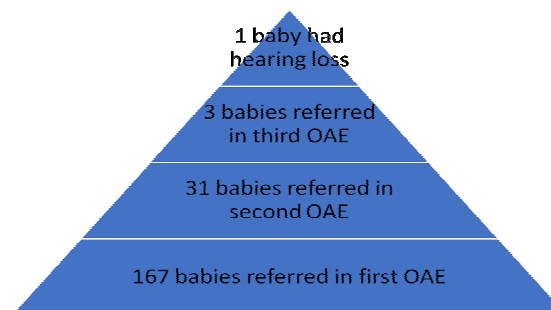
The 31 babies were recalled for the third OAE. 30 babies appeared for the third OAE testing and among them 27 babies passed the test and 3 failed. One of these three babies had hearing loss when tested through BERA (Table 3).

Preterm	Pass	Refer	Total
Yes	27	3	30
No	111	17	128
Total	138	20	158

Chi-square test was applied and a p-value of 0.62 was obtained, hence result is not significant.

The hearing screening results of preterm babies are depicted in figure 1. On applying the chi-square test on the data obtained in the subsequent OAE testing, there was no significant difference in the OAE results of preterm and term babies.

Fig-1: Hearing screening results among preterm babies



Discussion

In an analysis conducted by Katarzyna Wroblewska-Seniuk, it was concluded that hearing impairment is a severe consequence of prematurity. Important risk factors were found to be cranio-facial malformations, very low birth weight, low apgar score and mechanical ventilation [5].

A study conducted by Achal Gulati et al showed a high prevalence of hearing loss in preterm infants <34 weeks of age [6]. The prevalence of neonatal hearing loss was found to increase with decreasing week of gestation and decreasing birth weight in a study conducted by Paula van Dommelen et al [7].

In another study by Elaine S Marlow et al, it was found that preterm babies with sensorineural hearing loss had had longer periods of intubation, ventilation, oxygen treatment, acidosis and were more often treated with dopamine or furosemide [8]. Another risk factor put forward for hearing loss in preterm babies is the noise generated by mechanical equipment beside the baby's ear in the neonatal intensive care unit [9-10]. Several risk factors contributing to hearing loss in infants were put forth by Kathy Chant et al in their study [11].

Similarly in our study, a strong association was seen between prematurity and failure in the first OAE screening (Table-1). But no such association was seen in subsequent testing (Table 2, Table 3).

A study conducted by Jung Ho et al analysed the factors associated with discrepancies between screening and confirmatory test results of hearing impairments in preterm infants. It was found that if hearing loss was due to usage of loop diuretics or mechanical ventilation and subsequent Eustachian tube dysfunction, the hearing improved over a period of time [12]. In another study by Mirko Alde et al, a long audiological follow up of 138 preterm infants with hearing loss showed improvement in hearing among 81 babies. Higher improvement was seen in babies who were breast fed [13].

G. Tognola et al conducted a study which indicated that OAEs were not fully developed in preterm infants, whereas after 38 weeks post conception, OAE properties appeared to be very similar to those of term newborns [14]. This could also be a reason for getting a pass result in subsequent screening tests in our study. In a study by S. Frezza et al, 32 of 239 preterm babies

showed hearing loss initially but in subsequent visits fifteen of 32 children with an initial finding of bilateral HL showed a normalisation of hearing threshold evaluations [15]. This was the case in our study as well, as several babies referred in the initial OAE were found to have normal hearing in subsequent visits. This may be due to an overall improvement in the general condition of the baby.

Conclusion

The ear is completely developed by 32-35 weeks of gestation. But the neurodevelopmental process involved in hearing continues to develop in the early childhood. Therefore, the type of sound exposure in early life plays a role in the hearing outcome of a person. In cases of extreme preterm birth (28 weeks of gestation), the complications associated are higher- the number of days in the neonatal intensive care unit, use of assisted ventilation will be higher compared to moderate to late preterm (nearing 37 weeks). Preterm babies are also prone to various infections and thus more often require potent systemic antibiotics much earlier in life.

The present study saw a significant association between preterm birth and failure in first hearing screening. But on subsequent testing, no such association was seen. This might be due to the improvement in the care of preterm babies, usage of non-ototoxic antibiotics or lesser comorbidities in the child. Thus, this study could not establish preterm birth as an independent risk factor for hearing loss in the baby. But preterm babies need more attention because of the other associated comorbidities and also the possible neurodevelopmental delay.

The study emphasises the importance of hearing screening in early life irrespective of the period of gestation for early intervention so that no child is deprived of the gift of hearing.

Financial Support and sponsorship: Nil

Conflicts of interest: There are no conflicts of interest.

References

- World Health Organization. Preterm birth [Internet]. Preterm Birth. World Health Organization: WHO. 2023. Available from: <https://www.who.int/news-room/fact-sheets/detail/preterm-birth>
- Korres S, Nikolopoulos TP, Komkotou V, Balatsouras D, Kandiloros D, Constantinou D, et al. Newborn Hearing Screening: Effectiveness, Importance of High-Risk Factors, and Characteristics of Infants in the Neonatal Intensive Care Unit and Well-Baby Nursery. *Otology & Neurotology*. 2005; 26(6):1186-1190.
- Newsroom [Internet]. *American Academy of Audiology*. [cited 2023 Aug 15]. Available from: <https://www.audiology.org/why-do-so-many-preemies-have-hearing-loss/>
- Vohr BR. Language and hearing outcomes of preterm infants. *Seminars in Perinatology*. 2016; 40(8):510-519.
- Wroblewska-Seniuk K, Greczka G, Dabrowski P, Szyfter-Harris J, Mazela J. Hearing impairment in premature newborns - Analysis based on the national hearing screening database in Poland. Parikh NA, editor. *PLOS ONE*. 2017; 12(9):e0184359.
- Gulati A, Sakthivel P, Singh I, Ramji S. The Hearing Status of Preterm Infant's ≤ 34 Weeks as Revealed by Otoacoustic Emissions (OAE) Screening and Diagnostic Brainstem Evoked Response Audiometry (BERA): A Tertiary Center Experience. *Indian J Otolaryngol Head Neck Surg*. 2022; 74(Suppl 1):178-183.
- van Dommelen P, Verkerk P, van Straaten H. O-036 Hearing Loss By Week Of Gestation And Categories Of Birth Weight In Very Preterm Neonates: A Population-based Study. *Archives of Disease in Childhood*. 2014; 99(Suppl 2):A35.2-A35.
- Marlow ES. Sensorineural hearing loss and prematurity. *Archives of Disease in Childhood - Fetal and Neonatal Edition* [Internet]. 2000 Mar 1 [cited 2019 Feb 10]; 82(2):141F144.
- Borradori C, Fawer CL, Buclin T, Calame A. Risk factors of sensorineural hearing loss in preterm infants. *Biol Neonate*. 1997; 71(1):1-10.
- Anagnostakis D, Messaritakis J, Mandyla H. Risk factors of sensorineural hearing loss in preterm infants. *Biol Neonate* 1997; 71:1-10. *Biol Neonate*. 1997; 72(5):327-328.
- Chant K, Bitner-Glindzicz M, Marlow N. Cumulative risk factors contributing to hearing loss in preterm infants. *Archives of Disease in Childhood - Fetal and Neonatal Edition*. 2022; fetalneonatal-2022-324331.
- Han JH, Shin JE, Lee SM, Eun HS, Park MS, Park KI. Hearing Impairments in Preterm Infants: Factors Associated with Discrepancies between Screening and Confirmatory Test Results. *Neonatal Medicine*. 2020; 27(3):126-132.
- Aldè M, Di Berardino F, Ambrosetti U, Barozzi S, Piatti G, Consonni D et al. Hearing outcomes in preterm infants with confirmed hearing loss. *International Journal of Pediatric Otorhinolaryngology*. 2022; 161:111262.
- Tognola G, Parazzini M, de Jager P, Briennesse P, Ravazzani P, Grandori F. Cochlear maturation and otoacoustic emissions in preterm infants: a time-frequency approach. *Hearing Research*. 2005; 199(1-2):71-80.
- Frezza S, Catenazzi P, Gallus R, Gallini F, Fioretti M, Anzivino R et al. Hearing loss in very preterm infants: should we wait or treat?. *Acta Otorhinolaryngologica Italica*. 2019; 39(4):257-262.

Cite this article as: Gangadhara KS, Bhat AV and Sridhara S. Otoacoustic emission study among preterm babies. *Al Ameen J Med Sci* 2023; 16(4):330-333.

This is an open access article distributed under the terms of the Creative Commons Attribution-Non Commercial (CC BY-NC 4.0) License, which allows others to remix, adapt and build upon this work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

*All correspondences to: Dr. Amrutha V. Bhat, Resident, Department of ENT, McGann Teaching District Hospital, Shimoga Institute of Medical Sciences, N.H.206, Sagara Road, Shivamogga-577201, Karnataka, India. E-mail: amruthavbhat@gmail.com