

Hearing Screening of Newborns and Infants by Otoacoustic Emission

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Introduction: This study was undertaken to assess the hearing of newborns and infants using otoacoustic emission as a screening tool. Screening of hearing impairment in infants is done before the third month of life, and intervention, if any, required by the age of 6 months is of prime importance. The aim of this study was to screen 215 newborns for hearing.

Materials and Methods: About 215 neonates and infants were included after a thorough ENT examination and history taking. Two stage DPOAE was done on the newborns with 2, 3, 4, and 6 kHz frequencies in both ears. Newborns who failed the first OAE in any ear were tested for a second OAE in both ears within 15 days to 3 months.

Result: Out of 215 cases, 10.2% (n = 22) babies had referred results for 1st DPOAE in which low birth weight, prematurity, respiratory distress syndrome, post-natal sepsis, and maternal anemia and pregnancy-induced hypertension were among the identified infantile and maternal risk factors respectively. For these infants, repeated DPOAE screening was done. On repeat DPOAE testing, all babies passed the DPOAE 2nd test.

Conclusion: This study was an attempt to show the importance of developing a hearing screen with DPOAE when repeated appropriately. The hearing of all infants should be screened at no later than one month of age; those that do not pass screening should have a comprehensive audiological evaluation at no later than three months of age, and infants with confirmed hearing loss should receive appropriate intervention by six months of age.

Introduction

Speech sound detection begins in intra-uterine life, an important step in language acquisition. Speaking and hearing are interrelated functions. Auditory experiences are of prime importance, especially before the age of 2, as this age is critical for language acquisition.¹⁻³ OAE is a simple, quick, and objective method for hearing screening in newborns. In OAE an auditory stimulus is given to the baby, in its response, acoustic signals are produced from the cochlea are detected by a probe or microphone placed in the external ear canal. Sensorineural hearing loss is divided into non-syndromic sensorineural hearing loss and syndromic sensorineural hearing loss.⁴ Two-thirds of congenital hearing loss are non-syndromic. This study was undertaken to detect the frequency of hearing loss using distortion product otoacoustic emission (DPOAE) as a screening tool.

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Materials and Methods

This study was carried out on a total 215 newborns and infants after their parents gave written and informed consent, attending the ENT OPD and those delivered in the hospital itself for the period of 2 years. The study did not include babies who required intensive care management during the acute phase. However, they were included after stabilization or before discharge. 2 stage OAE was carried out on the newborns and infants in both ears after their history was taken, and a thorough clinical and ontological examination was performed. Those who failed (referred) 1st OAE in any ear, were examined for 2nd OAE in 15 days to 1 year in both ears. Those who failed 2nd OAE were considered for BERA.

Results

About 215 newborns and infants underwent thorough examination and had normal external ear and intact tympanic membranes. Out of 215 cases, 193 (89.8%)

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passed their first OAE test, while 22 (10.2%) failed their first OAE test, who on further follow-up underwent second DPOAE, and passed the test (Table 1). The study had 97 (45.1%) male and 118 (54.9%) female babies. Out of 22 (10.2%) babies who failed their first OAE test, 16 (16.5%) were male babies, while female babies were 6 (5.1%). With *p-value* of 0.006, significant difference was seen among males and females failing their first DPOAE. A total of 53 (24.7%) were low birth weight (LBW) babies (birth weight <2.5 Kgs) and 10 (4.7%) babies were VLBW i.e. birth weight <2 Kgs. 22 (10.2%) babies who failed their first DPOAE included 7 (4.6%) babies with normal birth weight, 8 and 7 babies were LBW and VLBW, respectively. Birth weight with *p-value* of 0.000 called it a significant risk factor (Table 2). About 14 (24.1%) preterm babies from total of 58 preterm babies in this study, failed their first DPOAE. On applying the Chi-square test, a period of gestation <36 weeks was found to be a significant risk factor for failing first DPOAE (Table 3). Anaemia in pregnancy, pregnancy-induced hypertension, gestational diabetes and thyroid disease were the maternal complications (Table 4). A total of 27 (12.6%) mothers had anaemia, while the second most common maternal complication was pregnancy-induced hypertension which was found in around 10 (4.7%) mothers. In 26 babies born to anaemic mothers (n = 27), passed their first DPOAE and only 1 baby failed first DPOAE. A *p-value* of 0.231 made this risk factor insignificant. Pregnancy-induced hypertension was found in mothers of 10 babies out of which 2 failed their first DPOAE. With *p-value* of 0.297, PIH was significant as risk factor (Table 5). Intra uterine growth retardation was seen in 1 baby out of 215 and he failed the first DPOAE test. However, passed the second test.

Discussion

All infants and newborns were subjected to the first DPOAE test, and those who failed their first DPOAE test underwent the second DPOAE test. In the present study out of 215 babies, 193 (89.8%) babies passed their first DPOAE, while 22 (10.2%) babies failed their first DPOAE test (Table 1).

We have selected four studies that are similar to our study. In the Nikita Chaudhary *et al.* study, 709 babies were screened. In a study by James W. Hall *et al.*, 600 ears were screened. Another study conducted by John Jewell *et al.*, 1600 babies were screened. In a study conducted by Inae Costa Rechia *et al.* 140 infants were screened. Different criteria were taken are as follows (Table 1):

In this study, 48 babies were preterm and also had birth weight less than 2.5 Kgs, out of which 14 (29.2%)

Table 1: First DPOAE distribution of cases in various studies

Distribution	Nikita Chaudhary <i>et al.</i> ⁵	James W. Hall <i>et al.</i> ⁶	John Jewell <i>et al.</i> ⁷	Inae Costa Rechia <i>et al.</i> ⁸	Our study
Passed first DPOAE	690 97.32%	590 98.33%	940 94%	124 88.571%	193 89.8%
Failed first DPOAE	19 2.68%	10 1.67%	60 6%	16 11.499%	22 10.2%
Total	709	600	1000	140	215

Table 2: Association between first DPOAE and birth weight in various studies

Studies	Total number of cases that failed first DPOAE	Birth weight >2.5 kgs	Birth weight <2.5 kgs	Birth weight <1.5 kgs
Nikita Chaudhary <i>et al.</i> ⁵	19	17	02	00
John Jewell <i>et al.</i> ⁷	42	06	00	36
Our study	22	07	08	07

Table 3: Distribution of period of gestation among cases in various studies

Period of gestation	Nikita Chaudhary <i>et al.</i> ⁵	Our study
Term	572 80.68%	157 73%
Preterm	137 19.322%	58 27%
Total cases	709	215

Table 4: Association between first DPOAE and period of gestation among cases in various studies

Studies	Nikita Chaudhary <i>et al.</i> ⁵	Our study
Total number of cases that failed first DPOAE	19	22
Term babies	11	08
Preterm babies	08	14

Table 5: Distribution of maternal complications among cases in various studies

Maternal complications	Nikita Chaudhary <i>et al.</i> ⁵	Our study
Anemia	09	27
Pregnancy induced hypertension	09	10
Thyroid disorders	05	03
Gestational diabetes	00	01

Table 6: Distribution of post-natal complications among cases and their association with first DPOAE in various studies

	<i>Jaundice</i>		<i>Meningitis</i>		<i>Rds</i>		<i>Sepsis</i>		<i>Msl</i>	
John Jewel1 <i>et al.</i> ⁷	Total	53	Total	02	Total	00	Total	00	Total	00
	Pass	52	Pass	01	Pass	00	Pass	00	Pass	00
	Fail	01	Fail	01	Fail	00	Fail	00	Fail	00
Inae Costa Rechia <i>et al.</i> ⁸	Total	19	Total	00	Total	00	Total	00	Total	00
	Pass	14	Pass	00	Pass	00	Pass	00	Pass	00
	Fail	05	Fail	00	Fail	00	Fail	00	Fail	00
Nikita Chaudhary <i>et al.</i> ⁵	Total	15	Total	01	Total	00	Total	00	Total	00
	Pass	07	Pass	01	Pass	00	Pass	00	Pass	00
	Fail	08	Fail	00	Fail	00	Fail	00	Fail	00
Our study	Total	01	Total	01	Total	08	Total	07	Total	02
	Pass	00	Pass	01	Pass	03	Pass	03	Pass	01
	Fail	01	Fail	00	Fail	05	Fail	04	Fail	01

Table 7: Familial history of deafness and their association with first DPOAE in various studies

<i>Inae Costa Rechia et al.</i> ⁸		<i>John Jewel1 et al.</i> ⁷		<i>Our Study</i>	
Total	Pass	Total	Pass	Total	Pass
05	05	05	05	02	02

babies failed their first DPOAE. With a *p-value* of 0.000, this combined risk factor association becomes significant (Table 2). Commonly associated post-natal complications in this study were respiratory distress syndrome (RDS), sepsis, jaundice, bilirubin encephalopathy, thrombocytopenia, meconium-stained liquor, meningitis, hypoxic-ischemic encephalopathy (HIE) and pre renal failure. Most common post-natal complication was found to be RDS counted for 8 (3.7%) babies. The second most common was sepsis which was seen in 7 (3.3%) babies. On considering each post-natal complication, out of 8 babies who had RDS as an associated risk factor, 5 (62.6%) failed their first DPOAE, while 3 passed it. The second most common associated risk factor was sepsis and out 7 babies who had sepsis, 4 failed their first DPOAE. Both these factors had *p-value* of 0.000, making them significant risk factors for neonatal hearing. 1 baby each had jaundice and bilirubin encephalopathy as associated risk factors but failed the first DPOAE test. Both the factors had *p-value*<.05, therefore significant (Table 6).

In this study, a total of 215 newborns and infants were included and tested for DPOAE. The test was carried out in newborns within two days of their birth to 1 year of age. About 183 (85.12%) of babies were tested between two to seven days of their birth, 13 (6.05%) babies were

examined between 8 to 15 days of their birth, 13 (6.05%) babies were tested between 16 to 30 days of their birth, and 6 (2.79%) babies were tested after one month till six months of their age. Some of the babies were admitted in Neonatal Intensive Care Units (NICU) because of some post-natal complications, so they were tested after they recovered from illness or when they were discharged from NICU.

Conclusion

Ralph Waldo Emerson said, "A hearing ear is close to a speaking tongue." Newborn Hearing Screening is vital in recognizing babies born with congenital hearing loss. Two-staged DPOAE is an easy, cost-effective and reliable method of testing a large number of infants for hearing loss (Table 7). In our study, 215 babies were subjected to the first DPOAE test, out of which 22 (10.2%) babies failed their first test. All 22 babies passed the second stage DPOAE. Birth weight <2.5 kgs and preterm were common risk factors associated. Maternal anemia and pregnancy-induced hypertension were commonly seen among maternal complications affecting the hearing of the baby. Respiratory distress syndrome and sepsis had considerable risk as post-natal complications affecting hearing.

This study was an attempt to show the importance of developing a hearing screen with DPOAE when repeated appropriately. The hearing of all infants should be screened at no later than one month of age; those that do not pass screening should have a comprehensive audiological evaluation at no later than three months of age and infants with confirmed hearing loss should receive appropriate intervention latest by six months of age.

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