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Assessment of Outcome of Hearing Screening In Newborn Using Otoacoustic Emission and Brainstem Evoked Response Audiometry

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Abstract

Background: To evaluate the hearing in high-risk neonates using otoacoustic emission and Brainstem Evoked Response Audiometry (BERA) for the early detection of hearing loss which would otherwise go unnoticed till about 2-3 years.

Methods: The present study Hospital Based Observational Descriptive study comprises of 500 New Borns of NICU and indoor and outdoor infants in the department of Otorhinolaryngology and Department of Paediatrics at SP Medical College & Hospital, BIKANER from April 2017 to September 2018

Results: Among 500,394 infants (78.8%) were without risk factors), 36 (9.13%) had 'refer' in the first OAE screening, and 106 infants (21.2%) had risk factors), 18 (16.98%) infants had 'refer' in the first screening. 1 (0.25%) infant among from the normal group and 1(0.94%) among from the high-risk group was lost to follow up. In tympanometry 3 (0.76%) had a type B tympanogram among in the normal group whereas 5 (4.71%) had the same findings in the high-risk group. In the second OAE screen 4 (1.01%) infants among without any risk factors had a 'refer' and 5 (4.71%) infants among from the high-risk group had 'refer'. These 9 (1.8%) infants from total (n=498) were subjected to BERA in which 4 (0.8%) infants failed - 1 was from the group of without risk factors and rest 3 with risk factors.

Conclusion: After undertaking this study we found that 1 babies without risk factors had absent V wave in the BERA pinning the importance to the fact that screening programmes should include normal babies also and not only those who had risk factors.

Keywords: BERA, Audiometry, Otoacoustic emission.

Introduction

Communication is easily overlooked, but the ability to communicate effectively is necessary to carry out the thoughts and visions of an organization to the people, to convey directions and provide synchronization.

Neonatal Hearing Loss[1]

Causes for hearing loss can be broadly classified as causes for conductive hearing loss and causes for sensorineural hearing loss.

Conductive Deafness

1) Congenital Disorders:

A) Genetic abnormality of external or middle ear:

i)Deafness present at birth: Down syndrome, Crouzon's Syndrome, Marfan's Syndrome, Treacher Collins Syndrome, Pierre Robin Syndrome, Achondroplasia, Duane Syndrome, Alpert's Syndrome, Otopalatodigital Syndrome

ii) Deafness appearing in childhood: Osteogenesis Imperfecta

B) Congenital disorders predisposing to otitis media with effusion or infection:

Cystic fibrosis, Immotile cilia syndrome, Cleft palate, Immune deficiency disease

C) Miscellaneous disorders: Isolated malformations, Congenital Cholesteatoma, Rhabdomyosarcoma, Fibrous dysplasia, Goldenhar's syndrome

D) Acquired Causes:

i) Otitis Externa, Acute (suppurative) Otitis Media, Chronic (suppurative) Otitis Media, Acute Otitis Media with effusion, Chronic Otitis Media with effusion.

Sensorineural Deafness

1) Congenital disorders:

A) Genetic-1) Deafness present at birth: Deafness alone, Syndrome associated with deafness 2) Deafness appearing in childhood: Deafness alone, Syndrome associated with deafness

B) Non-genetic-1) Due to intrauterine disease; Infection, Ototoxic Drugs 2) Perinatal Disorders: Hyperbilirubinemia, Hypoxia Preterm delivery and low birth weight3) Acquired conditions: a) Infections, complications of otitis media Viral labyrinthitis due to mumps, measles, herpes simplex, varicella zoster, influenza virus b) Immunization c) Autoimmune Deafness d) Meningitis e) Ototoxic drugs f) Trauma g) Metabolic disease.

1. Subjective Methods Hearing Assessment

A) Behavioural Observation (4months-2.5Years)

B) Crib-O-Gram

C) Auditory Response Cradle (ARC)

D) Visual Reinforcement Audiometry (children between 6 months and 2.5 years)

E) Conditioned Play Audiometry (children 2.5 to 5 years)

2. Objective Methods

A) Conventional Audiometry (Adult type)

B) Tympanometry[2]

C) Auditory brainstem

D) Otoacoustic Emissions

Material & Methods

The present study was conducted on New Borns of NICU and indoor and outdoor infants in the department of Otorhinolaryngology and Department of Paediatrics at SP Medical College & Hospital, Bikaner.

Study Period: From April 2017 to September 2018

Type of Study: Hospital Based Observational Descriptive study

Inclusion criteria:

1) Babies who were delivered in this hospital were included in the study.

2) Those babies who reported to the department of ENT and the department of Paediatrics were included in the study.

3) Those babies who required intensive care were not included in the study during the acute phase. However, they were included after stabilization or before discharge.

Exclusion criteria: Babies whose mother (parent) not gives consented. Babies with acute illness admitted to NICU.

Procedure of the test: The parents were counselled regarding congenital hearing loss and the need for early diagnosis and intervention prior to the test. Written informed consent was obtained from the

parents. The babies underwent a routine ENT examination consisting of inspection of the pre-aural, pinna, and post aural region. Occluding wax or debris was gently cleaned using cotton tipped swab and otoscopic examination of the tympanic membrane was conducted using Welch-Allyn 05259-M Series Otoscope with plastic speculums.

Sequence of the testing: The first test was done using Distortion Product Otoacoustic Emissions. The probe was fitted with a standardized infant ear tip kit. The two sizes used in the newborn age group were selected with the help of the ear tip selector guide and they were of 3.5mm (yellow) and 4.0mm (pink) tips. These probes are made of soft rubber. The ear tip was gently inserted into the right ear by a gentle traction on the pinna in a backward and downward direction. Once the probe tip was in place the test was started. First the probe fit and seal was checked followed by any extrinsic noise levels in a systematic computerized manner pre loaded in the software. The frequencies tested ranged from 1-8 khz, 65/55 db. The test stopped after the collection of data for these frequencies. The graph was plotted simultaneously along with the acquisition of data. Instrumentation: The machine used for this test was the Neurosoft Neuroaudio with PC Software. The software was connected to a computer for data collection and data analysis. The system was calibrated using the calibration mode in the software. Daily calibration of the Otoacoustic emission probe was performed to ensure the infants were screened with a functioning probe. During the measurement, two pure tone stimuli (f1 and f2), where f2 was higher than f1 were presented with f1/ f2 ratio at approximately 1.22 (range 1.21 to 1.23) to obtain a robust DPOAE response in human's ears. The f2 frequencies were tested in a 2 point per octave manner, from 2 kHz to 6 kHz. Two stimuli were presented at an asymmetrical intensity level of L1= 65 dBSPL and the second intensity, L2= 55 DBSPL (such that L1>L2). With the probe tip in place and the check fit procedure passed, DPOAEs were initiated. The DPOAE amplitude and noise floor adjacent frequency regions of distortion product 2f1-f2 were recorded.

Observation

This study was conducted in S.P.M.C attached PBM Hospital, Bikaner. The study was aimed for Hearing Screening in newborns based on a two stage otoacoustic hearing screening protocol.

Table 1. Comparison of findings of OAE 1 st Screening in HRF and Normal Babies

1st OAE finding	HRF Infants	Normal Infants	Total
Passed	88(83.02%)	358(90.87%)	446(89.2%)
Failed	18(16.98%)	36(9.13%)	54(10.8%)
Total	106	394	500

Table 2. Comparison of Tympanometry findings in 1st OAE Refer

Tympanometry	HRF Infants	Normal Infants	Total
Middle ear pathology	3(8.57%)	5(29.43%)	8(15.38%)
Normal	32(91.43%)	12(70.57%)	44(84.62%)
Total	35	17	52

Table 3. Comparison of findings of OAE 2nd Screening in High Risk Infants and Normal Infants

Second OAE Finding	HRF Infants	Normal Infants	Total
Passed	7(58.33%)	28(87.5%)	35(80.0%)
Failed	5(41.67%)	4(12.5%)	9(20.0%)
Total	12	32	44

Table 4. Comparison of BERA in High Risk Infants and Normal Infants

BERA	HRF Infants	Normal Infants	Total
Passed	2 (40.0%)	3(75.0%)	5 (55.56%)
Failed	3 (60.0%)	1 (25.0%)	4 (44.44%)
Total	5	4	9

Table 5. Comparison of BERA findings among total infants (n=500)

BERA	HRF Infants	Normal Infants	Total
Passed	102 (98.12%)	392 (99.75%)	494 (99.4%)
Failed	3 (1.88%)	1 (0.25%)	4 (0.6%)
Total	105	393	498

Chi- Square =7.0448with 1 degree of freedom; p= 0.00795

* Out of these infants 2 were lost follow up so final infants who were included in study 498.

Discussion

We used a two stage OAE protocol, where in neonates were subjected to 2 stages of otoacoustic emission screening and tympanometry. One of which was performed at one week of birth and the other was conducted for only those who had 'refer' in the first screening programme. Tympanometry was done to assess the middle ear pathology. Those babies who had 'refer' in the second stage were subjected to diagnostic Brainstem Evoked Response Audiometry.

This protocol was put forward by the American Academy of Audiology Childhood Hearing Screening Guidelines [3] in September 2011 which mentions a hearing screening guideline where in they have stated that tympanometry must be included in hearing screening of newborns who have had 'refer' in the first screening test.

Otoacoustic emissions screening was conducted for 394 normal babies in first week after birth, in most of the cases, 358 babies (90.86%) passed the first screening test, 36 (9.13%) babies had ` 81 refer in which 22 babies(5.58%) had 'refer' in both the ears. 6 babies (1.52%) in the left ear. 8 babies (2.03%) in the right ear. Those babies who had 'refer' the second test were screened again with in a period of one month. In a study conducted by Abraham K Paul[4] 724 (9.0%) babies out of 8134 babies had 'refer' in the first screening test, Which is almost equal to what we had in our study. SaikatSamaddar et al[5] had refer in 7.8% neonates which is quite lower than what we had in our study.

Tympanometry was planned for 36 babies who had 'refer' in the first screening test to rule out any middle ear pathology. Out of these 1 was lost to follow up. In the remaining 35 patients 3 patients had B type of tympanogram indicating middle ear effusion. Rest 32 patients had a normal tympanogram. In a study conducted by Kurt A Stone, Brian D Smith et al,18 of 1002 infants, 111 failed the initial screen (11.2%). When screening was repeated, only 2 infants failed. One infant failed the second screen and a tympanogram. He was treated and he passed a third use of DPOAE. An additional infant failed the repeat screen but passed the tympanogram. Hence doing tympanometry could save cost in screening procedures for hearing loss as it may exclude the patients who failed OAE due to middle ear pathology.

The second OAE testing was conducted for the 32 babies who had 'refer' in the first test. 28 babies (7.1%) passed the second OAE screening and 4 babies (1.01%) had 'refer'. All the 106 high risk babies were subjected to OAE test. Out of these, 18 (16.98%) babies had 'refer' in the OAE test and the remaining 88 (83.12%) passed the test. Of these 18 babies 1 was lost to follow up remaining 17 underwent tympanometry of which 12 passed the test and 5 babies had B type of tympanogram. 12 patients were subjected to second OAE testing out of these 7(6.6%) passed and 5 (4.7%) were labelled as 'refer'.

Abraham et al[5] found that out of 2031 babies who had risk factors 234 had 'refer' in the first screen and finally 78 patients had 'refer' in the second screen.

This study can be compared to our study as the results are similar. In the high risk group SaikatSamaddar et al[5]1 st

stage TEOAE screening yielded 7.40% 'Refer', declining to 2.97% in the 2 nd stage TEOAE screening

BERA was conducted for those babies who had refer in OAE2.So a total of 9 babies were subjected to BERA. Out of those subjected to the confirmatory BERA test, 4 babies failed. In our study of the 4 babies who failed the screening programme, 3 from high risk (1.88%) one was diagnosed to have hyper bilirubinemia, one babies had positive family history , 1 babies had preterm + asphyxia + neonatal seizure and 1(.25%)babies had no risk factors. Abraham et al conducted BERA in 159 patients who had 'refer' in the second screen. Out of these 159 patients, 21 patients with risk factors failed and 8 out of 81without any risk factor failed.

Saikat Samaddar et al[5] had BERA fail in 0.35% infants in the non high risk group and 1.79% in the high risk group.

Katheleen Billings et al[6]studied 301 children, in whom 68.1% had a definite orprobable cause of their SNHL identified 18.9% had 1 or more possible causes; 31.9%, no obvious cause. A family history of SNHL or prematurity and/or complicated perinatal course was found in 28.6% of patients. Named syndromes, multiple congenital anomalies, meningitis, or prenatal maternal factors, including maternal prenatal substance abuse was present in another 38.5%. However, syndromes commonly reported to be associated with SNHL, such as Waardenburg syndrome, were seen in less than 1% of patients.

Conclusion

After undertaking this study we found that 1 babies without risk factors had absent V wave in the BERA pinning the importance to the fact that screening programmes should include normal babies also and not only those who had risk factors.

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