Indian J Otolaryngol Head Neck Surg
(November 2019) 71(Suppl 2):S1296–S1299; https://doi.org/10.1007/s12070-018-1352-1

ORIGINAL ARTICLE

Newborn Hearing Screening: Time to Act!

Ramchander Bishnoi[1] · Surendra Baghel[1] · Sunita Agarwal[1] · Shitanshu Sharma[1]

Received: 21 September 2017 / Accepted: 6 April 2018 / Published online: 17 April 2018

Abstract The present study was carried out with the aim of assessing the outcomes of otoacoustic hearing screening in newborns coupled with the three stage protocol. It was a hospital based observational study which was conducted over a time period of twelve months at a tertiary care institute to screen 2000 live neonates for congenital hearing impairment using OAE, followed up by tympanometry and BERA, if required. 2000 neonates were screened for hearing impairment. 406 were in high risk group and the rest in non-high risk group. Seven neonates had absent V wave on BERA. Five of them were high risk babies and the rest two were non-high risk ones. In order to ensure that early detection and effective intervention are possible for all neonates with hearing impairment, UNHS should be performed. Three stage UNHS protocol using OAE and BERA showed that the implementation of UNHS for congenital childhood hearing loss for all neonates would be beneficial.

Keywords Deafness · Infant · Newborn · Hearing tests · Evoked potentials · Auditory · Brain stem · Audiometry · Evoked response · Otoacoustic emissions · Spontaneous

Introduction

Hearing does not only make us aware of our surroundings but it also plays a major role in developing speech and language. The prevalence of mild to profound hearing loss is reported to be between 1.1 and 6 per 1000 live-births and prevalence of hearing loss is estimated to be between 2.5 and 10% among high-risk infants [1]. Many countries of the world screen infants with risk factors but as this group comprises only 50% of hearing challenged infants it misses out the rest 50% infants who are from the group without any risk factors. Human nervous system has plasticity and hence interventions in hearing challenged individuals should be instituted as early as possible so as to prevent the auditory deficit causing the speech and language pathology. In the early stages of child development speech and language develops but due to the absence of a routine screening program many children remain undiagnosed till the age of 3–4 years losing the advantage of early "golden period". It is the health providers who need to develop mechanism to diagnose and institute a timely intervention to prevent the menace. Six months of age was the critical cutoff period for early identification that would achieve normal speech and language development [2]. This study was conducted to fulfill the need of screening of newborn to pick up deaf child at the earliest and institute a protocol for early intervention.

OAE screening followed by confirmation by BERA remains the mainstay of universal hearing screening protocol.

American Academy of Audiology Childhood Hearing Screening Guidelines [3] issued in September 2011 mentions a hearing screening guideline wherein they have stated that tympanometry must be included in hearing screening of newborns who have failed the first screening test. This was the mainstay of our study.

✉ Shitanshu Sharma
drshitanshusharma@gmail.com

[1] Department of Otorhinolaryngology and Head Neck Surgery, SMS Medical College and Hospital, Jaipur, Rajasthan 302004, India

Materials and Method

This study was conducted at a tertiary care hospital where in we screened 2000 newborns. All the neonates were tested within 48 h of birth. A detailed history including the family history was recorded.

The newborns were then classified in either the normal group or those having high risk group according to the JCIH guidelines 2007. The mothers 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 mothers. The babies underwent a routine ENT examination consisting of inspection of the pre-aural, pinna, and post aural region. Occluding wax or debris were gently cleaned using cotton tipped swab and otoscopic examination was conducted.

The newborns were then tested with OAE machine. The results were interpreted as either 'Pass' or 'Refer'. Those who had 'refer' in the first stage were tested for any middle ear pathology using tympanometry. The newborns who had 'refer' in the first stage screening as well as 'A' type tympanogram signifying no middle ear pathology were subjected to the 2nd OAE testing within the first month. Newborns with 'refer' in the first OAE and 'B' type tympanogram were treated for serous otitis media and then were retested with 2nd OAE. Those who had 'refer' at 2nd OAE underwent BERA, the result of which was either presence or absence of V wave. Absence of the V wave was considered as confirmatory for congenital hearing loss.

Results

The present study was conducted on 2000 infants among whom 50.5% (1010) were females and 49.5% (990) were males. 1594 infants (79.7%) were without risk factors and 406 infants (20.3%) had risk factors. In group of infants without any risk factors 144 (7.2%) had 'refer' on first OAE screening. In the high risk group 41 (2.05%) infants had 'refer' on first screening. In tympanometry 12 (0.6%) had a type B tympanogram in the normal group whereas 11 (0.55%) had the same findings in the high risk group. 11 (0.55%) infants from the normal group and 4 (0.2%) from the high risk group were lost to follow up. On second OAE screening 16 (0.8%) infants without any risk factors had a 'refer' and 14 (0.7%) infants from the high risk group had 'refer'. These 30 (1.5%) infants were subjected to BERA in which 7 (0.35%) infants failed—2 were from the group of without risk factors and rest 5 with risk factors.

Discussion

The study was carried out to underscore the importance of neonatal hearing screening. It is evident that many infants have congenital hearing loss and due to absence of a well structured hearing screening program they are left undiagnosed. In our study 2000 infants were subjected to the screening protocol. Tables 1 and 2 depicts the high risk factors which were identified in 406 babies and included family history of congenital deafness in 2 babies (0.1%), low birth weight in 366 babies (18.3%), asphyxia in 12 (0.6%) and hyper-bilirubinemia in 26 babies (5.5%). Samaddar et al. [4] had 336 infants with risk factors out of 1182 infants i.e. 28.4%. Weichbold et al. [5] conducted a study of 538 babies with hearing loss. They found that family history was present in 11 babies, craniofacial malformation in two babies, syndromic association in one baby. No case of low birth weight < 1500 gm, hyperbilirubinemia or ear anomalies were seen. One baby was subjected to mechanical ventilation, and cardiorespiratory pathology was found in two babies.

The birth weights of the babies varied from 1.5 to 4.1 kg in our study. No significant correlation was found between occurrence of hearing loss and low birth weight in our study. Jewel et al. [6], Abraham et al. [7], Samaddar et al. [4] also did not found any significant co-relation between birth weight and prevalence of hearing loss.

The protocol used in our study was put forward by the American Academy of Audiology Childhood Hearing Screening Guidelines [3] in September 2011 wherein they have stated that tympanometry must be included in hearing screening of newborns who have 'refer' in the first screening test.

Otoacoustic emissions screening was conducted for 1594 normal babies on day 1 after birth, 1450 babies (90.96%) passed the first screening test, 144 (9.04%) had 'refer'. Out of 406 newborns with high risk who underwent OAE screening 365 (89.99%) passed and 41 (10.01%) had 'refer'. In a study conducted by Kurt A Stone, Brian et al. [8] of 1002 infants, 111 failed the initial screening (11.2%). Abraham et al. [7] found that out of 2031 babies who had risk factors 234 had 'refer' in the first screen (11.52%). Both the studies had almost similar result as our study. But the results show that there is almost an equal incidence of failing in the first OAE screen in both the groups irrespective of presence or absence of the risk factors.

Infants who failed in OAE 1, tympanometry was conducted in which 12 from the normal group and 11 from the high risk group had B type of tympanogram. All these 23 infants were treated for middle ear effusion for 10 weeks and were retested with OAE and all of them passed signifying that they had failed the first OAE screen due to

middle ear effusion and would have failed the second screen also as it was planned after 1 month leading to futile exercise of BERA testing in such a large number of patients. So, including tympanometry to the screening protocol saves lots of effort and cost by eliminating false refer results in OAE screening due to middle ear pathology. Table 3 lists the results of audiological tests in infants who had "refer" in the first OAE testing.

The second OAE testing was conducted for the 121 babies without high risk factors who had 'refer' in the first test. 105 babies (86.77%) passed the second OAE screening and 16 babies (13.22%) had 'refer'. 26 patients in the high risk group were subjected to second OAE testing out of these 12 (46.15%) passed and 14 (53.84%) were labelled as 'refer'. The percentage of babies who failed the second screening test was higher in the high risk group with majority of the babies had "refer". In the study conducted by De Capua and De Felice [9] 11.65% of the babies failed the second OAE retesting. Their percentage is quite low as compared to our study.

BERA was conducted for those babies who had refer in OAE 2. So a total of 30 babies were subjected to BERA. Out of those subjected to the confirmatory BERA test, 7 babies failed.

In our study of the 7 babies who failed the screening programme. Out of these 7 infants 5 belonged to the high risk group. 2 were diagnosed to have hyperbilirubinemia, 2 babies had positive family history, 1 had asphyxia and 2 babies had no risk factors.

Abraham et al. [7] 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 81 without any risk factor failed.

Samaddar et al. [4] had BERA fail in 0.35% infants in the non high risk group and 1.79% in the high risk group.

Kathleen et al. [10] studied 301 children, in whom 68.1% had a definite or probable 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.

In a study carried out by Jewel et al. [6] at a tertiary care hospital in northern India calculated the possible burden of hearing disability in babies born at a tertiary care hospital in Northwest India. One thousand newborns were screened using Transient Evoked Otoacoustic Emissions (TEOAE) and 28.6% of them had risk factors. Four out of one thousand were detected with hearing loss. Brain Stem Evoked Response (BERA) was used to confirm and determine the extent and the type of deafness in the neonates who were screened positive (Tables 1, 2, 3).

Table 1 High risk and non hisgh risk infants: sex distribution

Screened neonates	Non high risk	High risk	Total
Males	793	197	990
Females	801	209	1010

Table 2 Various risk factors

Risk factors	Number of infants
Birth weight less than 2.5 kg	366
Hyperbilirubinemia	26
Asphyxia	12
Positive family history	2
Total	406

Table 3 Results of audiological tests in infants who had "refer" in first OAE testing

	OAE 1 (refer)	Tympanometry (B-type)	OAE 2 (refer)	BERA (absence of V wave)
Non high risk	144	12	16	2
High risk	41	11	14	5
Total	185	23	30	7

After undertaking this study we found that 2 babies without risk factors had absent V wave in the BERA pinning the importance to the fact that screening programs should include normal babies also and not only those who had risk factors.

The Table 4 shows BERA findings in the whole sample size after stepwise OAE1-TYMP-OAE2-ABR screening. Among 402 high risk babies, 5 (0.35%) babies were deaf and among 1594 babies with no associated risk factors 2 (0.125%) were deaf. Overall in the sample size of 2000 babies, 7 (0.35%) babies were deaf and on application of Chi Square Test this difference was significant statistically with a p value of 0.004, thus making strong the need for a screening process for deafness in high risk associated births.

The results are significant from statistics point of view and favours screening in newborns with high risk factors

Table 4 Results of BERA

BERA	High risk infants	Normal infants	Total
Failed	5 (35.71%)	2 (12.5%)	7 (23.33%)
Passed	9 (64.29%)	14 (87.5%)	23 (76.67%)
Total	14	16	30

Chi-Square = 1.139 with 1 degree of freedom; p = 0.286

but as hearing impairment causes a deleterious effect on the life of a child, a timely diagnosis drastically changes the quality of life of even a single patient and his parents who has been diagnosed early by the screening schedule and hence screening should include all the newborns irrespective of the fact whether they have high risk factors or not.

Kanan and Pensi [11] reported a prevalence of 10.42 per 1000 births for Central nervous system anomalies, 3.17 per 1000 births for multiple congenital anomalies, 2.95 per 1000 births for musculoskeletal anomalies, 2.49 per 1000 births for gastrointestinal system anomalies and 2.27 per 1000 births for cardiovascular anomalies. In our study, the prevalence for deafness was 3.5 per 1000 births thus warranting a need for screening programme for hearing.

Such a high incidence of hearing impairement in newborns makes this problem second just to CNS anomaly in number of incidences per 1000 newborn. All the other congenital anomalies are difficult to prevent, manage and prognosis is not that good. Whereas if hearing impairment is detected at such an early stage we could easily get rid of this problem as recent advances in otology has ensured that early detection and treatment institution can overcome morbidity caused by deafness.

This study was conducted as an attempt to use otoacoustic emissions for testing newborn hearing in our hospital and to derive the normative values for DPOAE in our testing surroundings. The results of this study can be used to initiate universal newborn hearing screening. However, because of a relatively small sample size, fallacies in comparison to larger studies are unavoidable.

Conclusion

Such a high incidence of hearing impairment in our study pins the importance to the fact that universal newborn hearing screening should be instituted and should be carried out meticulously as the stakes are very high. At apparently no cost we are getting priceless results. We should not ignore a menace which can be prevented with effectively no expensive equipment and training. Such low cost opportunity is a blessing as the returns are very promising.

Compliance with Ethical Standards

Conflict of interest All the authors declare that they have no conflict of interests.

References

1. Fortnum H, Davis A (1997) Epidemiology of permanent hearing impairment in Trent region, 1985–1993. Bri J Audio 31:409–446
2. Ewing IR, Ewing AWG (1944) The ascertainment of deafness in infancy and early childhood. J Laryngol Otol 1:309–333
3. American academy of audiology childhood hearing screening guidelines (2011) http://www.cdc.gov/ncbddd/hearingloss/documents/AAA_Childhood%20Hearing%20Guidelines_2011.pdf. Accessed 20 Feb 2017
4. Samaddar S et al (2015) Universal neonatal hearing screening—a necessity and not a choice. Bengal J Otolaryngol Head Neck Surg [Sl] 23(1):1–6 **(ISSN 2395-2407)**
5. Weichbold V, Nekahm-Heis D, Welzl-Mueller K (2006) Universal newborn hearing screening and postnatal hearing loss. Pediatrics 117:e631–e636
6. Jewel J, Varghese PV, Singh T, Varghese A (2013) Newborn hearing screening—experience at a tertiary hospital in Northwest India. Int J Otolaryngol Head Neck Surg 2:211–214
7. Paul AK (2011) Early identification of hearing loss and centralized newborn hearing screening facility—the Cochin experience. Indian Pediatr 48:355–359
8. Kurt AS, Brian DS, Jeanie ML, Leroy AC, Mary Beth McLellan RN (2000) Universal newborn hearing screening. J Fam Pract 49(11):1012–1016
9. De Capua B, De Felice C (2003) Newborn hearing screening by transient evoked otoacoustic emissions: analysis of response as a function of risk factors. Acta Otorhinolaryngol Ital 23:16–20
10. Kathleen RB, Margaret AK (1999) Causes of pediatric sensorineural hearing loss. Yesterday and today. Arch Otolaryngol Head Neck Surg 125:517–521
11. Kanan S, Pensi CA (2013) Study of incidence of congenital anomalies in new borns. Gujarat Med J 68(2):97–99