Neonatal screening for hearing loss: pilot study from a tertiary care centre

M. John · A. Balraj · M. Kurien

Abstract Many developed countries have well established universal neonatal hearing screening programs. In India, the viability of such a program, in an already overburdened health system is indeed a challenge. This cross sectional study was undertaken to evaluate the possible burden of hearing loss among neonates born at a tertiary care hospital in Southern India. Five hundred neonates were screened with automated distortion product otoacoustic emission (aDPOAE) for hearing loss, 9.2% of whom had one or more high risk factors. Although 6.4% had hearing loss at initial assessment, only 1.6% had hearing loss on retesting with aDPOAE. Retesting with OAE before an automated Auditory brainstem response (aABR) helped to exclude patients without hearing loss. The frequency of moderate to moderately severe hearing loss in this study was 0.6%. This pilot study underscores the importance of the introduction of screening for congenital deafness in specialized centers in India, despite its challenges.

Keywords Neonatal hearing loss · Screening · Otoacoustic emission · Auditory brainstem response

Introduction

Hearing loss in children constitutes a considerable handicap because it is an invisible disability and compromises optimal development and personal achievement of a child. Congenital sensorineural hearing impairment has been estimated at 1.2–5.7/1000 live births [1–5]. The prevalence of hearing loss in infants is more than twice that of other screened newborn disorders like congenital hypothyroidism and phenylketonuria [6]. In addition, 50% of children with moderate to profound congenital hearing loss exhibit no risk factors for hearing loss [6–10]. Early detection followed by appropriate treatment provides the best chance for maximizing the critical period of hearing, to avail of the resources to improve hearing and oral communication skills. On the other hand, late detection and treatment leaves the child with poor speech development and school achievement.

Screening of neonates is done using automated Distortion product otoacoustic emission (aDPOAE) and automated Auditory Brainstem Response (aABR). aDPOAE is much quicker and easier to perform than aABR. When screening is done by aDPOAE followed by aABR (Fig. 1) referral rates can be minimized [11].

This study was undertaken in order to detect the frequency of congenital hearing loss among neonates in a tertiary care centre. The study identifies the challenges faced in determining hearing loss at an early age, an important yet less recognized disability. This is among the first few articles from India, evaluating a neonatal hearing screening programme.

Materials and methods

Among the 3909 births at Christian Medical College Hospital (CMC), Vellore from February 2005 to July 2005, 500 newborns were included in this study. In order to qualify for

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Fig. 1 Screening algorithm

the study, they had to be born in CMC and had to be asleep during an eight hour working day when they could be tested for the presence of congenital sensorineural hearing loss. Also included were births in CMC admitted in Neonatal Intensive Care Unit (NICU). Using a pretested questionnaire [12], potential risk factors were extracted from the patient records and the cases were grouped as normal or high risk. Both the normal and high risk underwent screening for hearing loss during their neonatal period using aDPOAE as the screening tool. Neonates who failed the initial screening were subjected to repeat testing with aDPOAE. This automated OAE (SMART DPOAE, Intelligent Hearing Systems Distortion Product Otoacoustic Emission System Version 4.X) is a complete DP OAE acquisition and analysis system that gives a 'pass' or 'refer' result. Absence of emissions using repeat DPOAE were tested with aABR before they were discharged from the hospital. The automated ABR (SMART Screener Automated ABR Hearing

Screening System Version 5.X) gives a statistical measure of waveform reliability and also provides with 'pass' or 'refer' outcome. Screening was done by trained screeners under the supervision of an experienced audiologist specialised in pediatric audiometry. Subjects who failed re-screening by aABR were scheduled for a reexamination with diagnostic ABR three months later, for confirmation of diagnosis and further intervention.

Data from the questionnaire and results of the tests were entered in EXCEL and analyzed using Statistical Programme for Social Science (SPSS – Version 11).

Results

Among the five hundred neonates in this study, 241(48.2%) were males and 259 (51.8%) were females; 95.6% of whom were from the nursery and the rest were from Neonatal

Intensive Care Unit (ICU). The distribution of babies with potential risk factors is shown in Table 1.

Figure 1 shows the schema used for screening and the numbers screened. Of the five hundred (including high risk neonates) who underwent initial screening with aDPOAE, 32 (6.4%) had a negative response (Table 2). On repeat testing of the 32 with aDPOAE, 8 (25%) continued to have a negative response (Table 3). Further testing with aABR before discharge showed 3 had no response at 40dB threshold level, but when tested at 70dB threshold level, they all passed the hearing testing (Table 4).

Forty six newborns in five hundred had one or more risk factors. Among high risk newborns, initial aDPOAE screening failed in eight, which reduced to five on repeat screening with aDPOAE. Of these five, two had a negative response with aABR at 40dB.

Table 1 Distribution of potential risk factors among the 500 newborns who were screened for hearing loss

Risk factors	Frequency	Percentage (%)
Family history of hearing loss	7	1.4
Apgar score of 0–4 at 1 mt	9	1.8
Apgar score of 0–6 at 5 mt	4	0.8
Birth weight less than 1500 gm	26	5.2
Hyperbilirubinemia requiring blood transfusions	2	0.4
Total	46	9.2

Table 2 Initial screening of all study newborns with aDPOAE

DPOAE	Frequency	Percentage (%)
Present	468	93.6
Absent	32	6.4
Total	500	100

Table 3 Repeat aDPOAE of the 32 newborns who had failed initial aDPOAE

	Frequency	Percentage %
Present	24	75
Absent	8	25
Total	32	100

Two neonates did not cooperate for testing on one ear

Table 4 Results of aABR at 40 dB and 70 dB in neonates who failed repeat aDPOAE testing

aABR	aABR at 40dB		aABR at 70dB	
	Frequency	Percentage %	Frequency	Percentage %
Response	5	62.5	8	100
No response	3	37.5	0	0
Total	8	100	8	100

One neonate did not cooperate for testing in one ear

Discussion

In 1994, the Joint Committee on Infant Hearing (JCIH) established in the US recommended screening of high risk babies for hearing loss using High Risk Registry [12]. Several studies thereafter suggested that up to 50% of all the children with congenital hearing loss have no risk factors and would be missed by screening only those at high risk [6–9]. Universal Screening of all infants for hearing loss within the first few months of life hence became the accepted strategy [8].

Currently acceptable methodologies for physiological screening include Oto Acoustic Emissions (OAE) and Auditory Brainstem Response (ABR). Both are non invasive, quick and easy to perform and each assesses hearing differently. OAE measures sound waves generated in the inner ear in response to clicks or tone bursts emitted and recorded through miniature microphones placed in the external ear canal of the infant. Although OAE screening is quicker and easier to perform than ABR, it may be affected by debris or fluid in the external or middle ear resulting in referral rates of 5 to 20%, when screening is performed in the first 24 hours after birth [8]. ABR measures the electroencephalographic waves generated in response to clicks by three electrodes placed on the infant's scalp. ABR screening requires the infant to be in a quiet state, but it is not affected by middle or external ear debris. Referral rates less than 4% maybe achieved when OAE combined with automated ABR in a two step screening system [8].

All the newborns in this study were screened with DPOAE and the test was repeated for those who failed the initial screening. The initial failure rate of 6.4% was reduced to 1.6% on repeat testing with OAE. Since OAE is quick and cost effective compared to ABR, retesting with OAE makes the universal screening programme more sustainable especially when there are large numbers of newborns like in a developing country.

The neonates who did not respond on re-screening with aDPOAE were tested with aABR at 40 dB threshold and three did not pass the test. Thus we could conclude that the frequency of moderate to moderately severe sensorineural hearing loss in our study population was 0.6%. While all three passed when tested with aABR at 70dB, two of the three had low birth weight of less than 1500gms and the third had consanguineous parents.

Among the challenges faced during our neonatal hearing screening were finding a relatively noiseless surrounding (a sound proof room would have been ideal). The equipment (aDPOAE and aABR machines) were not a portable; and therefore it required the newborn to be brought to the testing room for the assessment. Although only those sleeping qualified for the testing, they invariably woke up during the transfer to the testing room. The placement of probes and electrodes also invariably woke the sleeping neonate resulting in increasing the average time taken for testing, with some cases taking up to 30 minutes or more. Getting parents back for follow up testing was another challenge probably because the parents did not perceive there was a problem (not apparent when the child is so small), highlighting the importance of counseling and antenatal education of parents before the baby is born.

Conclusion

This article is one among the first few articles from a developing country like India on neonatal hearing screening. When aDPOAE is used as hearing screening in neonates, initial absent response of 6.4% was reduced to 1.6 % on retesting with aDPOAE. This emphasizes the need of retesting with OAE before doing aABR. The frequency of moderate to moderately severe hearing loss in our study population was 0.6%. In a developing country like India, starting and sustaining a neonatal hearing screening project remains a challenge.

Acknowledgements We would like to thank Dr. Vinohar Balraj, Professor in Community Medicine, Christian Medical College, Vellore, for helping with the preparation of this article.

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