NEWBORN HEARING SCREENING USING THE EVOKED OTOACOUSTIC EMISSION: THE PHILIPPINE GENERAL HOSPITAL EXPERIENCE

Maria Rina T R Quintos[1,3], Pura Flor D Isleta[2], Charlotte C Chiong[3], Generoso T Abes[3]

[1]National Institutes of Health, [2]Department of Pediatrics, Section of Neonatology, UP-PGH; [3]Department of Otorhinolaryngology, UP-PGH

Abstract. The evoked otoacoustic emission (EOAE) test is a universally well-known and established procedure for screening the hearing of babies during the newborn period. It has been documented in foreign literature that the prevalence of hearing loss is significantly higher in high-risk neonates. In the Philippine General Hospital, 301 high-risk neonates and 105 non high-risk neonates were screened for hearing loss using the EOAE during a period of one year from March 2000 to March 2001. The initial failure rate in the high-risk population was 33% and 11% in the non high-risk population.

INTRODUCTION

Screening for hearing loss in the newborn period using either the evoked otoacoustic emission (EOAE) or the automated/auditory brainstem response (A/ABR) test has raised the standard of care for the newborn in many hospitals in the United States, Europe and Asia. This is because studies show that hearing loss is a common disability in the newborn period (The Colorado Department of Health, 1996) and that early diagnosis of hearing loss and early habilitation of the hearing impaired is possible with the rapidly advancing technology (Mehl and Thomson, 1998). Early diagnosis and habilitation lead to improved speech and language development, educational attainment and psychological health of the individual (Moore, 1991), which later on may translate to a better financial situation and reliable manpower for the country. Although hearing loss is understandably more common in the high-risk population (Hall, 1992), 50% of children with severe hearing loss have no high-risk factors (Mauk *et al,* 1991). This is the reason why the American Academy of Pediatrics Joint Committee on Infant Hearing in 1999 advocated the early identification of hearing loss in children (Joint Committee on Infant Hearing, 1995) and the National Institutes of Health (NIH) of the United States in 1993 also issued a consensus statement recommending **universal screening** for all infants prior to discharge (National Institutes of Health NIH Consensus Statement, 1993). Before implementing such a program in the Philippines, it is recommended and prudent to screen a smaller population first where the disease under scrutiny is more prevalent. This will give us an idea of the prevalence of hearing loss in that particular hospital setting, the personnel that need to be involved, the mechanics of the procedure and the feasibility of the program in general.

In this study we aim to determine the hearing screening initial failure rate in the high-risk and non high-risk population in the PGH NICU for a period of 1 year.

MATERIALS AND METHODS

The hearing of high-risk infants referred by the Department of Pediatrics, Section of Neonatology from March 2000 to March 2001 were screened prior to discharge by trained personnel using the evoked otoacoustic emission (EOAE) device (*Audiopath* manufactured by Welch Allyn). This particular instrument is fully automated with a fixed testing protocol and Pass/Refer template which can detect at least a mild hearing loss. At the same time, newborn babies, who had no risk factors (non high-risk) were also referred by their concerned pediatricians (primarily due to prematurity) and they were also screened. The neonates were tested while they were sleeping or resting quietly. There were a total of 455 neonates screened. Three hundred and one had high risk factors while 150 did not. A high-risk infant was defined as an infant with any one of the following high-risk factors (Table 1): family history of hereditary childhood sensorineural hearing loss, in utero infections (TORCH), craniofacial anomalies, birth weight less than 1500 g, hyperbilirubinemia requiring exchange transfusion, use of ototoxic medication, bacterial meningitis, Apgar score of 0-4 at 1 minute or 0-6 at 5 minutes, mechanical ventilation of 5 days or longer, stigmata

associated with a syndrome known to include sensorineural and or conductive hearing loss. A "pass" result was recorded for an ear which showed a signal-to-noise ratio of 10 dB with an averaged noise floor value of –20 dB before the maximum number of samples collected equals 500 and a failure or "refer" result was recorded when the 10 dB signal-to-noise ratio was not achieved. All the high-risk infants who "referred" on initial screening were advised to follow-up for a repeat screening (re-screen) at least 1 month after discharge.

Table 1. High risk registry: JCIH 1994.

- Family history of hereditary childhood sensorineural hearing loss
- *In utero* inferction (eg TORCH)
- Craniofacial abnormalities
- Birthweight < 1,500g
- Hyperbilirubinemia at serum level requiring exchange transfusion
- Ototoxic medication including, but not limited to the aminoglycosides used in multiple course or in combination with loop diuretics
- Bacterial Meningitis
- APGAR scores of 0-4 at 1minute or 0-6 at 5 minutes
- Mechanical ventilation for greater than or equal to 5 days
- Stigmata or other findings associated with a syndrome known to include sensorineural and/or conductive hearing loss

RESULTS

A total of 455 infants were referred for screening. Three hundred and one of these neonates had the high-risk factors and 150 did not. For the high-risk population, 100 infants (33%) "referred" for both ears, (155) 52% "passed" the screen for both ears, and 15% "passed" in only one ear (and "referred" on the other) (Table 2). For the non high-risk population, 116 infants (77%) "passed" the screen for both ears, 16 (11%) "referred" and 18 (12%) "passed" in only one ear (Table 3). Out of the 180 newborns with at least one ear "referring" only 15 (8%) followed up in the High Risk Clinic. In 12 of these neonates who "referred" for both ears initially, 9 (75%) "passed" for both ears on re-screen, 1 (8%)"passed" for one ear only and 2 (15%) still "referred" for both ears. Three neonates of the 15 who followed up at the High Risk Clinic "referred" in only one ear and on retest 100% "passed" for both ears (Table 4). None of the non high-risk newborns who referred in at least 1 ear followed-up in the High Risk Clinic for re-screening.

Table 2. EOAE "Pass" and "Refer" rates in the High-Risk population.

Both ears "Referred"	100	33%
Both ears "Passed"	155	52%
"Pass"/"Refer"	46	15%
Total	301	100%

Table 3. EOAE "Pass" and "Refer" rates in the Non-High-Risk population.

Both ears "Referred"	16	11%
Both ears "Passed"	116	77%
"Pass"/"Refer"	18	12%
Total	150	100%

Table 4. OPD Re-screen results in 15 infants who initially "Referred" in at least one ear.

Initial screen result	Re-screen result	Total
Both ears "Refer"	Both ears "Pass"	9
	Both ears "Refer"	2
	"Pass"/"Refer"	1
"Pass"/"Refer"	Both ears "Pass"	3
Total		15

DISCUSSION

The use of the EOAE for screening for hearing loss in the newborn period is recognized and accepted worldwide. It has a sensitivity of almost 100% and a specificity of greater than 93%. Prevalence of hearing loss in the newbom period has been documented to be about 1-3:1000 and in the high-risk population it is 2-4:100. Foreign literature has documented a 5-27% overall initial failure rate using the EOAE in newborn hearing screening. In our study, the initial failure rate in the high-risk population is 33% and 11% in the non-high risk population. It must be remembered that the EOAE test just like other hearing tests can be affected by environmental noise, internal noise (chewing and jaw movements, noisy breathing) and debris and fluid in the ear canal and middle ear respectively resulting in false positive results (American Academy of Pediatrics, 1999). The 9 out of 12 babies who "referred" on both ears on initial screening and then "passed" on both ears on follow up gives us an idea that the prevalence rate is probably lower than calculated.

Reasons for the high failure rate in this study include, first, the Philippine General Hospital is a tertiary hospital where the disadvantaged and very sick children are born. The population is comprised of neonates who are malnourished and underweight so that even after they are discharged it may take them some time to regain their health. Second, the Neonatal Intensive Care Unit (NICU), which keeps more than 40 babies at one time, is a noisy place. The machines responsible for monitoring these babies constantly make noise, the babies themselves cry and the NICU staff also adds to the noise while doing their work. These are the factors that may be responsible for the increased failure rate in the PGH NICU. The number of babies who followed-up for repeat screening was very disappointing. A registered nurse was tasked to call and/or telegram patients for follow–up and despite these arrangements, very few returned for re-screen. This may be because the PGH is a tertiary government hospital patients come from far flung areas, have no permanent residence and have no access to modern telecommunication devices. Out of the 180 babies who "referred" in at least one ear only 15 (8%) of the babies followed-up. The success of any screening program that will be implemented is dependent upon the babies who are followed-up, confirmed to have hearing loss and then habilitated. Screening is useless if those who are suspected to have hearing loss are lost to follow-up.

CONCLUSION

The newborn hearing screening initial failure rate using the EOAE in the high risk and non-high risk population is 33% and 11%, respectively. The high failure rate and the poor turn out for re-screening to confirm the presence of hearing loss should be addressed so that immediate habilitation can be implemented.

RECOMMENDATIONS

1. It is recommended that newborn hearing screening be done during the high-risk infant's first follow-up (after discharge) until such time when high failure rates in the PGH NICU can be minimized.
2. Building a soundproof room in the NICU where the infants can be wheeled in for the hearing screening will be beneficial in decreasing environmental noise and will decrease the initial failure rate.
3. The importance of newborn hearing screening prior to discharge must be disseminated to encourage parents to bring their children for follow-up.
4. Finding other means to screen for hearing loss so that infants who live far from the metropolis and without access to this new technology may have the re-screen done in their place of residence.

REFERENCES

American Academy of Pediatrics. Newborn and infant hearing loss: detection and intervention. *Pediatrics* 1999;103.

Hall JW. Handbook of Auditory Evoked Responses, 1992.

Joint Committee on Infant Hearing. *Pediatrics* 1995;95:152-6.

Mauk G, White K, Mortensen L, Behrens T. The effectiveness of screening programs based on high risk characteristics in early identification of hearing impairment. *Ear Hearing* 1991;8:153-63.

Mehl AL, Thomson V. Newborn hearing screening: the great omission. *Pediatrics* 1998;101.

Moore W. Managing the infant hearing impairment problem: the contribution of industry. *Semin Hearing* 1991;12:175-82.

National Institutes of Health NIH Consensus Statement. 1993;11:1-24.

The Colorado Department of Health, March 1996.