Newborn Hearing Screening at Rajavithi Hospital, Thailand: Hearing Loss in Infants Not Admitting in Intensive Care Unit

Viruch Tungvachirakul MD*,
Supranee Boonmee RN**, Tawipa Nualmoosik***,
Jaruwan Kamjohnjiraphun MSc***, Winya Siripala RN**,
Watanee Sanghirun RN**, Supanee mungpol RN**,
Araya pangkul RN**, Manus Potaporn MD*

** Center of Excellence in Otolaryngology, Rajavithi Hospital, College of Medicine, Rangsit University, Bangkok, Thailand*
***** Department of Nursing, Rajavithi Hospital, Bangkok, Thailand***
****** Center of Excellence in Otolaryngology, Rajavithi Hospital, Bangkok, Thailand***

Background: *Approximately one to two per 1000 newborns have hearing loss. Delay in detection of this disability leads to impaired development and may prevent the acquisition of speech. Early screening of hearing in newborns results in children receiving early language rehabilitation.*
Objective: *Determine the incidence of infants hearing loss in infants not requiring intensive care.*
Material and Method: *A prospective descriptive study in hearing loss in infants not requiring intensive care in rajavithi hospital between 17th January 2008 to 23rd December 2009. Infants were screened with otoacoustic emissions (OAE), the results were divided into two groups, "pass" and "refer". The infants who failed the screening test were referred for further checks with second OAE and if they failed again, then the authors reassessed them with Auditory Steady State Response Test (ASSR).*
Results: *There were 508 newborns that needed intensive care out of 5,190 live births. 639 excluded because of unwilling to join the project. Therefore 4,043 newborns were included in the study. There were 246 (6.1%) newborns who failed the first screening test but only 189 newborns were tested in second OAE because 57 newborns were lost to follow-up. Twenty one newborns (11.1%) failed the second test. There were 15 newborn using ASSR for hearing threshold (6 newborns were lost to follow-up). There were 11 newborn was normal hearing, 2 newborn (rate 49.5: 100,000) was mild hearing and moderate to severe hearing.*
Conclusion: *The incidence of moderate to severe hearing loss in newborns who did not require intensive care was very low (rate 49.5: 100,000). However, screening all newborns with OAE is still valuable because of severe impact to quality of life of late detection of hearing loss. Evaluation of hearing by ASSR was reliable.*

Keywords: *Newborn hearing screening, Otoaccoustic emission, Auditory brain stem evoked response, Auditory steady state response*

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Hearing is an important pre-requisite for normal speech and language development. In the past, it was thought that ability to read came from ability to see, but more recent research indicates that the primary reading center is located in the hearing part of the brain[1]. Profound hearing loss in newborns may result in the child becoming deaf and dumb. These disabilities prevent the child from achieving its full potential and create a financial burden for society, because the child needs special education. In addition, the earning potential of these individuals in later life is impaired.

Hearing loss in newborns is not uncommon but is often detected late because it is not obvious. in the very child, such that most children are seen by doctors until they are 1-2 years old. A previous study showed the incidence of hearing loss is as high as 1-2 newborns per 1,000 live births[2-4]. There are approximately 6,000 live births in Rajavithi hospital each year, so it can be

Correspondence to:
Tungvachirakul V, Center of Excellence in Otolaryngology, Rajavithi Hospital, 2 Phyathai Road, Ratchathewi, Bangkok 10400, Thailand.
Phone: 0-2354-8108-37 ext. 2303, Fax: 0-2354-8100
E-mail: virucht@gmail.com

anticipated that at least 10 newborns would suffer from hearing loss a year.

The incidence of hearing loss among high risk newborns in Thailand is 6.4 per 1,000 live births[5], determined using criteria defined by the American Academy of Pediatrics Joint Committee on Infant Hearing Criteria (1994). However, there is a paucity of data for normal and non-high risk newborns. We therefore focused this study on the non-high risk newborn group with the expectation that the incidence of hearing loss in this group would lower than that in high risk infants.

Material and Method

The study was approved by the Research Ethics Committee of the Rajavithi hospital. We included all newborns that did not require intensive care during the two year study period (17th January 2008 to 23rd December 2009). The study was explained to the children's' caretakers, mostly often their parents, and informed consent was obtained.

The Distortion Product Otoaccoustic Emission Test (DPOAE) and transient Otoacoustic emission (TOAE) was carried out during 24-48 hours of delivery. The equipment used produces one of two results, namely 'pass' or 'refer'. If the result was 'refer', the test was repeated at one month. If the result was unchanged, the child's ears were cleaned by an otolaryngologist and the Auditory Steady State Response Test (ASSR) was conducted within 3 months. The criteria for high risk newborns according to the American Academy of pediatrics joint committee on infant hearing 1994[6] were; preterm, neonatal sepsis, hypoxia, jaundice, craniofacial anomalies, ototoxic drug and needed ventilator support. All the children were reviewed at 6 months. Children with confirmed hearing loss received continuing hearing rehabilitation at the central of excellence in otolaryngology, Rajavithi hospital.

Hearing screening tests are currently composed of three components:

1. Evoked Otoacoustic Emissions (TEOAE, DPOAE).

2. Auditory Brainstem Response (ABR, AABR, BAER, ABAER).

3. A combination of the above.

The sound is transmitted through middle ear to the hair cells of the inner ear. Part of the transmitted sound is reflected back into ear canal and is detected by a sensor inside the equipment. The result are presented as a red light (refer) or a green light (pass) A green light does not mean normal hearing, as the newborn might have mild degree of hearing loss or auditory neuropathy. A red light suggests that the newborn has a hearing threshold greater than 35 decibel for that frequency. However, a false positive result may be obtained if there is debris or fluid in the ear canal. Therefore, a repeated test for each ear within 12 hours of delivery and one month later are required.

If the second result is still "refer", Auditory Steady State Response testing (ASSR) is required. This test detects the hearing response within the brain stem when stimulated by specific frequencies. The hearing threshold can be determined for different frequencies at the same time, with a sensitivity 100% and a specificity 95% [7]. In order to increase reliability of the test, the newborn needs to be in a deep sleep and have normal ear drums and no obstruction within the ear canal. With this test, the tester should check the light status beforehand and regularly check that the electrode pad is adhering correctly to the skin and be cautious for possible interfering waves throughout the test. The results were summarized in frequency and percentage.

Results

There were 508 newborns who needed intensive care out of 5,190 live births. Six hundred and thirty-nine were excluded because of inadequate follow up. Therefore, 4,043 newborns were included in the study (77.9% of all newborns). There were 246 newborns (6.1% of eligible newborns) who failed the first screening test. Of these, fifty seven newborns were lost to follow up (23.2%), as shown in Table 1. Twenty-one newborns (11.1% of those with suspected hearing loss newborns from the first test) needed a further hearing screen, using ASSR. Varying degrees of hearing loss were detected in fifteen of these infants, as shown in Table 2. The risk factor for sensorineural hearing loss in our study the patients with risk factor for sensorineural hearing loss are 88 (2.2%) newborns out of 4,043 live births. The most common risk factor we found is Ototoxic medication 77 (87.5%) newborns. No sensorineural hearing loss found in newborns that have risk factor as shown in Table 3.

Discussion

Language development in hearing impaired newborns who receive rehabilitation in first six months of life is significantly better than that for those who do not get it until later [8]. Early detection and effective rehabilitation will decrease the number of hearing-disabled people and/or their degree of disability.

Table 1. Result of first and second OAE test

Test	N	Loss	PassN(%)	referN(%)
First OAE test	4043	-	3797(93.9)	246(6.1)
Second OAE test	246	57	168(89.9)	21(11.1)

OAE = Otoacoustic emissions
ASSR = Auditory steady state response test

Table 2. ASSR for hearing threshold in infants who has refer second OAE test (n = 21)

Result	n (%)	Incidence rate: 100,000
Normal hearing	11 (73.3)	-
Mild hearing loss	2 (13.3)	49.5
Moderate to severe h earing loss	2 (13.3)	49.5
Lost follow-up	6	-

OAE = Otoacoustic emissions
ASSR = Auditory steady state response test

Table 3. Risk factors for sensorineural hearing loss (n = 88)

Risk factor	n (%)
Family history	3 (3.4)
In utero infection	1 (1.1)
Craniofacial anomaly	5 (5.7)
Low birth weight	0
Hyperbilirubinemia	0
Ototoxic medication	77 (87.5)
Premature birth	0
Low apgar score	2 (2.3)
Prolong intubation	0
Stigmata or other findings associated with a syndromes associated with congenital hearing loss	0

Therefore, universal hearing screening for newborn is desirable.

Screening hearing loss with ABR or OAE can detect abnormality of hearing up to 80%-90% of the time, in comparison with the gold standard (Visual Reinforcement Audiometry)[9], which can only be successfully performed in patients between 8-12 months of age. The reliability of testing depends on equipment, tester's expertise and quality control. One study showed the correlation with the gold standard and ASSR was 0.86, 0.92, 0.94 and 0.95 at 500Hz, 1000Hz, 2000Hz and 4000Hz, respectively[10].

The incidence of hearing loss in this study group is low (0.5 per 1000 newborns) compared with the results of the study from Songkhanakarin, Thailand (6.4 per 1000 newborns)[5] and the study carried out by McClelland (4.2 per 1000 newborns)[11] and general newborns 6.7 per 1000 newborns[12], because they included high risk newborns who had at least one out of seven criteria according to American Academy of pediatrics joint committee on infant hearing 1994.
We included the newborns that did not need intensive care and most of them did not fall into any high risk group. A large proportion of high risk infants need intensive care. There were 88 newborns that were in the high risk group in our study, but none of them had hearing loss. The incidence of hearing loss is quite low (0.5 per 1000 live births) compared with high risk group (12.8 times higher than normal newborn). However, the number of hearing impaired children identified in our study was more in the (larger) normal newborn group. The strong points of our study are that we were able to include a large number of newborns and that we used ASSR, which has a high reliability compared with ABR. The pitfalls are that significant numbers of infants were lost follow up and that we were unable to identified auditory neuropathy.

Conclusion

The incidence of moderate to severe hearing loss in newborns who did not require intensive care was very low compared with those who required. However, screening all newborns with OAE is still valuable because of severe impact to quality of life of late detection of hearing loss. Evaluation of hearing by ASSR was reliable.

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Potential conflicts of interest

None.

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การตรวจคัดกรองการได้ยินในทารกแรกเกิดในโรงพยาบาลราชวิถี: การสูญเสียการได้ยิน ในทารกที่ไม่ต้องเข้าหอผู้ป่วยภาวะวิกฤติ

วิรัช ทุ่งวชิรกุล, สุปราณี บุญมี, เทวิภา นวลมุสิก, จารุวัลย์ กำจรจิระพันธ์, วิญญา ศิริพละ, วัฒนี แสงหิรัญ, สุภาณี มั่งพล, อารยา แพ่งกุล, มานัส โพธาภรณ์

ภูมิหลัง: *ความพิการทางด้านการได้ยินสามารถพบได้บ่อย 1-2 คนต่อทารกแรกเกิดมีชีพ 1,000 คน เป็นความพิการที่ตรวจพบได้ช้า ทำให้เด็กขาดโอกาสในการพัฒนาศักยภาพในการเรียนรู้การตรวจคัดกรอง ตั้งแต่แรกเกิดจะทำให้พบความพิการได้เร็วขึ้นทำให้เด็กได้รับ language habilitation เร็วขึ้น*

วัตถุประสงค์: *เพื่อศึกษาอุบัติการณ์การเกิดภาวะสูญเสียการได้ยินในทารกแรกเกิดที่ไม่ต้องการ การดูแลในหอ ผู้ป่วยภาวะวิกฤติ*

วัสดุและวิธีการ: *ทำการศึกษาแบบ prospective descriptive study โดยตรวจคัดกรองการได้ยินจากทารกแรกเกิดมีชีพที่ไม่ต้องการการดูแลในหอผู้ป่วยภาวะวิกฤติ ในช่วง วันที่17 มกราคม พ.ศ. 2551 ถึง 23 ธันวาคม พ.ศ. 2552*

ผลการศึกษา: *จากการศึกษาพบว่าในช่วงเวลาการศึกษามีเด็กเกิดมีชีพ 5,190 ราย ไม่เข้าเกณฑ์การศึกษาเนื่องจากต้องส่งตัวเข้ารักษาที่หอผู้ป่วยภาวะวิกฤติ จำนวน 508 ราย คงเหลือที่อยู่ในการศึกษา 4,043 ราย ผลการตรวจคัดกรองด้วย OAE (otoacoustic emissions) ครั้งแรก พบว่าไม่ผ่าน 246 ราย (6.1%) ส่งตรวจครั้งที่ 2 จำนวน 189 ราย ไม่ผ่าน 21 ราย (11.1%) ส่งตรวจ ASSR เพื่อหา ระดับเริ่มต้นของการได้ยิน จำนวน 15 ราย พบว่ามีการได้ยินในระดับปกติ 11 ราย ระดับเล็กน้อย 2 ราย และระดับปานกลางถึงรุนแรง 2 ราย คิดเป็นอุบัติการณ์ความผิดปกติของการได้ยินระดับเล็กน้อยและระดับปานกลางถึงรุนแรง คือ 49.5 รายต่อแสนประชากร*

สรุป: *อุบัติการณ์ความผิดปกติของการได้ยินระดับเล็กน้อยและระดับปานกลางถึงรุนแรง คือ 49.5 รายต่อแสนประชากร ซึ่งถือว่าอยู่ในระดับที่ต่ำ แต่เนื่องจากความผิดปกติของการได้ยินมีความสำคัญมากต่อคุณภาพชีวิต จึงยังควรมีการตรวจคัดกรองการได้ยินในทารกแรกเกิดทุกราย*