Outcome of Early Identification and Intervention on Infants with Hearing Loss Under Universal Hearing Screening Program

Watcharapol Poonual MD*, Niramon Navacharoen MD**,
Jaran Kangsanarak MD**, Sirianong Namwongprom MD, PhD*,***

** Clinical Epidemiology Program, Faculty of Medicine, Chiang Mai University, Thailand*
*** Department of Otolaryngology, Faculty of Medicine, Chiang Mai University, Thailand*
**** Department of Radiology, Faculty of Medicine, Chiang Mai University, Thailand*

Objective: *To determine the outcome of early identification and intervention of hearing loss children.*
Material and Method: *An analytic prospective study. All neonates were screened withTEOAE/ABR. All infants were diagnosed and started early intervention at sixth month and followed for hearing and developmental evaluation until eighteen months of age.*
Results: *Three thousand one hundred twenty neonates underwent hearing screening tests. One hundred and three infants had abnormal of 6 months of age and were diagnosed with congenital hearing loss (89 mild hearing loss, 12 moderate hearing loss, 1 moderate-severe hearing loss and 1 profound hearing loss). They received early intervention (8 hearing aid fitting (0.3%), 103 auditory training (3.3%), 103 counseling (3.3%) and 103 combine (3.3%) at 6 months of age). During follow up, eighty nine infants who had abnormal initial hearing tests were found to have normal hearing at eighteen months of age, Only Fourteen infants (0.4%) had permanent hearing loss. There were 7, 5, 1 and 1 infants in the mild, moderate, moderate-severe and profound hearing loss groups. The interventions offered to infants with different levels of hearing impairment were 5 hearing aid fittings (35.7%), 14 auditory training (100%), 14 counseling (100%) and 14 combination of three methods (100%). The development after 12 months follow up in infants with different levels of hearing impairment were 14 auditory improvement (100%), 14 speech improvement (100%) and 5 language improvement (35.7%). The common risk factors ranked in order of frequency are craniofacial anomalies(RR 2.57, 95%CI 1.49-4.43), ototoxic exposure(RR 4.71, 95%CI 1.94-11.46), severe hyperbilirubinemia (RR 2.10, 95%CI 1.08-4.06), low APGAR score at 5 minutes (RR 2.42, 95%CI 1.03-5.68) and sepsis (RR 2.02, 95%CI 1.01-4.03).*
Conclusion: *Continuing evaluation of hearing and development during follow-up is important in children with abnormal hearing tests. Early intervention can prevent acoustic deprivation and improve language development.*

Keywords: *Hearing loss, Intervention, Auditory development, Speech development, Language development*

J Med Assoc Thai 2017; 100 (2): 197-206
Full text. e-Journal : *http://www.jmatonline.com*

Universal newborn hearing screening is essential to the normal speech and language development in the large number of infants born with hearing loss in the United States each year[1-4]. Children identified when they are older than 6 months can have speech and language delays. Children identified when they are younger than 6 months do not have these delays and are equal to their hearing peers in terms of speech and language. Early identification and intervention can prevent severe psychosocial, educational, and linguistic repercussions. Intervention at or before 6 months of age allows a child with impaired hearing to develop normal speech and language, alongside his or her hearing peers[5-9]. The infants with hearing loss receive timely and appropriate diagnostic and intervention services, will have positive speech, language and listening outcomes[10-15]. A baby identified with a hearing loss should be fit with hearing aids (if appropriate) and enrolled in an early intervention program well before

Correspondence to:
Poonual W, Otolaryngology Department, Uttaradit Hospital, Mueang District, Uttaradit 53000, Thailand.
Phone: +66-81-8062862, Fax: +66-55-411543
E-mail: poonual@gmail.com

6 months of age could have a significant impact on the development of receptive and expressive language[16]. The Screening Tests refered to the previous study[17].

Early intervention

Hearing aid fitting: Otolaryngologist and Audiologist would select the suitable hearing aid with level and type of hearing loss. The infants were followed hearing response after hearing aid fitting and evaluation the development.

Auditory training: The hearing loss infants had to learn characteristic of environmental sound which is the basic process to learn more about the speech and language development.

Counseling: All care givers were informed the pathophysiology of hearing loss by otolaryngologist and audiologist and studied the process improving the hearing of their child. The speech-language pathologists can provide parents with knowledge to make informed decisions.

Combine: Some infants received combine treatment: Hearing aid fitting, Auditory training and Counseling.

Development evaluation

Auditory development

The auditory middle latency response seems to have a relatively long developmental time course, extending through the first decade of life. Characteristics of each auditory component change developmentally not only with respect to waveform morphology but also with respect to response reliability, dependence on awareness state, and stimulus rate. The complex changes may be a result of multiple generating systems that show multiple time courses of development and auditory perception, (McGee, Therese; Kraus, Nina,1996).

Speech development

Speech of babbling and early word productions from 9 to 24 months. The speech focuses on the vocal and verbal development and the other displayed an unusual pattern of sound preference in his babbles. The atypical babbling may be associated with delays in the acquisition of meaningful speech, (Carol Stoel-Gammon, 2016).

Language development

The child learns through exploring his word in interaction with other people. The quality of learning is thus seen to depend on what both participants contribute to the interaction, (Gordon wells,1999).

Material and Method

The present research was approved by the Faculty of Medicine Ethics Committee Chiang Mai University, Thailand with informed consent obtained in all cases. Upon passing the otologic examination, they underwent an audiometric examination using an assessment tool using a transitory evoked otoacoustic emissions (Non linear Click stimuli 60 Hz, intensity 70-84 dB SPL, rate 60 time/sec, frequency 1.5 – 4.5 kHz, Noise-Weighted Averaging evaluation method). The degree of hearing impairment will be based on the criteria developed by the World Health Organization (WHO). 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 and a failure or "refer" result was recorded when the 10 dB signal-to-noise ratio was not achieved. All the infants who "referred" on initial screening were advised to follow-up for a repeat screening (re-screen) at least 1 month after discharge with AABR (linear Click stimuli 80 Hz, intensity 35 , 40 and 45 dB nHL, rate 80 time/sec, Impedance Test : 1 – 99 kΩ, Noise-Weighted Averaging and Template matching evaluation method). If the results were still abnormal, they were reassessed with conventional ABR at second or third month of age. Infants who had abnormal results were diagnosed and started early intervention, they were followed up hearing with ABR and developmental evaluation (auditory, speech and language) at 6 months of age. Children identification, risk factors of hearing impairment, screening results with OAEs, AABR and conventional ABR were gathered and reviewed.

Ethical consideration

The present study was approved by the Research Ethics Committee 3, Faculty of Medicine, Chiang Mai University (COM-11-02-16-13-X) and the Ethical Review Committee for Research in Human Subjects, Uttaradit Hospital, Thailand (Ref. no. 49/2553). The name of the caregiver of newborn consent forms was required in the present prospective data, which remained confidential and omitted in all

Table 1. Newborn general characteristics (Each characteristics n=3,120)

Characteristics	All n (%)
Maternal age (year)	
<20	64 (2.1)
20-35	2,988 (95.8)
>35	68 (2.2)
Maternal diseases	
Yes	49 (1.6)
No	3,071 (98.4)
Delivery route	
Normal labor	2,379 (76.2)
Vacuum extraction	31 (1.0)
Forceps extraction	77 (2.5)
Cesarean section	632 (20.3)
Newborn gender	
Male	1,534 (49.2)
Female	1,586 (50.8)
Birth weight (gram)	
<1,500	66 (2.1)
1,500-2,500	317 (10.2)
>2,500	2,737 (87.7)
APGAR score	
Normal	2,973 (95.3)
Abnormal	147 (4.7)

Table 2. Short term follow up (assessed at 6 months) in each hearing impaired newborn

Development	Mild (n = 89)	Moderate (n = 12)	Moderate-severe (n = 1)	Severe (n = 0)	Profound (n = 1)
	n (%)	n (%)	n (%)	n (%)	n (%)
Auditory development					
Improve	89 (100)	12 (100)	1 (100)	0 (0)	1 (100)
Not improve	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Speech development					
Improve	89 (100)	12 (100)	1 (100)	0 (0)	1 (100)
Not improve	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Language development					
Improve	79 (88.8)	6 (50.0)	1 (100)	0 (0)	0 (0)
Not improve	10 (11.2)	6 (50.0)	0 (0)	0 (0)	1 (100)

process of data management. The author received no outside grants and reported no conflicts of interests.

Study procedure

The details of study design, study population, and inclusion/exclusion criteria were showed and published elsewhere[17]. This was a prospective study designed to determine the outcome of early identification and intervention of infants in Uttaradit Hospital, Budhachinarat Hospital and Sawanpracharuk Hospital, the tertiary hospital located in northern Thailand from November 1st, 2010 to May 31st, 2012. The hearing of all newborns was screened in a two-tier process: transitory evoked otoacoustic emissions (AccuScreen

Table 3. Short term follow up (assessed at 18 months) in each hearing impaired infant

Development	Mild (n = 7)	Moderate (n = 5)	Moderate-severe (n = 1)	Severe (n = 0)	Profound (n = 1)	Total (n = 14)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Auditory development						
Improve	7 (100)	5 (100)	1 (100)	- -	1 (100)	14 (100)
Not improve	0 (0)	0 (0)	0 (0)	- -	0 (0)	0 (0)
Speech development						
Improve	7 (100)	5 (100)	1 (100)	- -	1 (100)	14 (100)
Not improve	0 (0)	0 (0)	0 (0)	- -	0 (0)	0 (0)
Language development						
Improve	3 (42.9)	2 (40.0)	0 (0)	- -	0 (0)	5 (35.7)
Not improve	4 (57.1)	3 (60.0)	1 (100)	- -	1 (100)	9 (64.3)

Table 4. Relative risk of risk factors in infants with hearing loss

Risk factors	RR	95%CI
Maternal risks		
Maternal diseases	0.87	0.32-2.32
Intrauterine infection	2.97	0.91-9.69
Family history of congenital sensorineural hearing loss	1.91	0.93-3.94
Maternal age (year)		
Teenage (<20)	2.03	0.78-5.32
Old age (>35)	1.20	0.63-2.30
Neonatal risks		
Birth weight (gram)		
Very low birth weight(<1,500)	1.64	0.72-3.72
low birth weight (1,500-2,500)	1.37	0.65-2.90
Low APGAR score at 5 minutes	2.42	1.03-5.68
Craniofacial anomalies	2.57	1.49-4.43
Use of breathing machine >5 days	1.77	0.75-4.14
Meningitis	0.98	0.50-1.93
Sepsis	2.02	1.01-4.03
Ototoxic exposure	4.71	1.94-11.46
Severe hyperbilirubinemia	2.10	1.08-4.06

GN Otometrics, PATH medical GmbH, Germering, Germany) before hospital discharge or within 1 month, and followed by automated auditory brainstem responses (Madsen AccuScreen Otometrics, PATH medical GmbH, Germering, Germany) examination at 3 months in case they failed TEOAE. Infants who had abnormal AABR results were referred to otologists and audiologist for further evaluation with conventional ABR (Sentiero Advanced Otometrics, PATH medical GmbH, Germering, Germany) at 6 months. The abnormal hearing infants at 6 months of age were managed with early intervention (hearing aid fitting in moderate or above sensorineural hearing loss cases, auditory training in all hearing loss cases, counseling (A critical contribution of early intervention is its role in supporting parents to develop effective communication strategies with their infants, as well as to offer support during a time of increased stress. Parent–child interaction styles are an important influence on child development, and parental communication and interaction have significant effects on language acquisition)

Table 5. The details of fourteen infants (assessed at 18 month) with abnormal hearing tests

No.	Patient data	Risk factors	Side/severity	Type	Development
1.	Male, 32 wk, 1,740 g RHD, Anemia IUI, RDS, microtia	Premature, MD IUI, RDS, CFA	Both/mild	SNHL 45 dB	Normal
2.	Male, 39 WK, 3,580 g IUI	IUI	Rt/moderate Lt/profound	SNHL 55 dB SNHL>90 dB	Delay
3.	Female, 38 wk, 3,470 g	No	Both/moderate	SNHL 60 dB	Normal
4.	Male, 37 wk, 2,690 g Apgar 4, ventilator 8 days, gentamycin 7 days, pneumonia Hyperbilirubinemia 28 mg/dl	Apg Vent Med, sepsis Hyperbil	Both/moderate severe	SNHL 65 dB	Delay
5.	Female, 36 wk, 3,080 g Apgar 5, ventilator 7 days, gentamycin 7 days, pneumonia Hyperbilirubinemia 30 mg/dl	Apg Vent Med, sepsis Hyperbil	Both/moderate	SNHL 60 dB	Delay
6.	Male, 38 wk, 3,100 g Apgar2, maternal age 36 years, gentamycin 7 days, pneumonia Hyperbilirubinemia 40 mg/dl	Apg Mage Med, sepsis Hyperbil	Rt/mild Lt/moderate	SNHL 45 dB SNHL 55 dB	Normal
7.	Female, 39 wk, 2,700 g, Family history of hearing loss Apgar 4, ventilator 7 days, gentamycin 7 days, meningitis Hyperbilirubinemia 32 mg/dl	FHOL Apg Vent Med, Mg, sepsis Hyperbil	Both/moderate	SNHL 65 dB	Delay
8.	Female, 40 wk, 1,250 g, Maternal age 36 years, Apgar 5, ventilator 7 days, gentamycin 7 days, pneumonia Hyperbilirubinemia 27 mg/dl	BW Apg Mage Med, sepsis Hyperbil	Both/mild	SNHL 45 dB	Delay
9.	Male, 40 wk, 3,100 g Apgar 2, RDS, sepsis gentamycin 7 days, Hyperbilirubinemia 40 mg/dl	Apg RDS Med, sepsis Hyperbil	Both/mild	SNHL 45 dB	Normal
10	Male, 39 wk, 2,900 g Maternal hearing loss, Apgar 4, ventilator 7 days, Meningitis, gentamycin 7 days, Hyperbilirubinemia 30 mg/dl	Apg FHOL Vent, Mg, Med, sepsis Hyperbil	Both/moderate	SNHL 60 dB	Delay
11.	Female, 40 wk, 3,500 g, Apgar 5, Hyperbilirubinemia 28 mg/dl	Apg Hyperbil	Both/mild	Mixed 45 dB	Delay
12.	Male, 40 wk, 3,290 g, Cleft lip & Cleft palate Apgar 4, ventilator 7 days, Meningitis, gentamycin 7 days, Hyperbilirubinemia 28 mg/dl	Apg CFA Vent, Mg, Med, sepsis Hyperbil	Rt/mild Lt/moderate	SNHL 40 dB Mixed 60 dB	Delay
13.	Female, 41 wk, 3,400 g, Preauricular skin tag both ears, Choanal atresia, Apgar 2, ventilator 7 days, gentamycin 7 days,	Apg, CFA, Vent, Med	Both/moderate	SNHL 65 dB	Normal
14.	Female, 40 wk, 3,000 g, Family history of congenital hearing loss	FHOL	Rt/mild Lt/moderate	SNHL 40 dB SNHL 65 dB	Normal

MD = maternal disease, IUI = intrauterine infection, RDS = respiratory distress syndrome, CFA = craniofacial anomalies, Apg = Apgar scores, Vent = ventilator > 5 days, Med = medications, Hyperbil = hyperbilirubinemia, FHOL = family history of hearing loss, SNHL= sensorineural hearing loss, Mixed = mixed conductive hearing loss with sensorineural hearing loss, Rt = right side, Lt = left side, dB= decibel, mild= mild hearing loss (30-49 dB), moderate = moderate hearing loss (50-60 dB), moderate-severe= moderate severe hearing loss(61-70 dB), profound= profound hearing loss (>90 dB)

in all hearing loss cases then followed for hearing and developmental evaluation (auditory, speech and language) at eighteen months of age. This screening involved both normal group and high risk group criteria stated by the American Academy of Pediatrics Joint Committee on Infant Hearing[18-22].

Results

For eighteen months from November 1st, 2010 to May 31st, 2012, 3,120 newborns were screened with the TEOAE. There were 1,534 boys (49.2%) and 1,586 girls (50.8%). The ages when screening took place ranged from one day to 30 days. There were 233 infants (7.5%) that failed the OAEs, 175 right ears (5.6%) and 190 left ears (6.1%). After following with AABR at the third month of age, 135 infants (4.3%) failed and were confirmed with ABR at 3 and 6 months of age. One hundred and three infants (3.3%) had abnormal hearing result and were diagnosed with congenital hearing loss (89 mild hearing loss, 12 moderate hearing loss, 1 moderate-severe hearing loss and 1 profound hearing loss) as shown in Fig 1. They received early intervention (8 hearing aid fitting (0.3%), 103 auditory training (3.3%), 103 counseling (3.3%) and 103 combine(3.3%) at 6 months of age). (Table 2) All hearing loss infants were later confirmed by ABR at age 18 months. Eighty nine infants passed the test and left only 14 infants (0.4%) with hearing loss, 7 mild loss (0.2%), 5 moderate loss (0.1%), 1 severe and 1 profound deafness. The interventions offered to infants with different levels of hearing impairment were 5 hearing aid fittings (35.7%), 14 auditory training (100%), 14 counseling (100%) and 14 combine three methods (100%). The development after 12 months follow up in infants with different levels of hearing impairment were 14 auditory improvement (100%), 14 speech improvement (100%) and 5 language improvement (35.7%), (Table 3). The common risk factors ranked in order of frequency were craniofacial anomalies (RR 2.57, 95%CI 1.49-4.43), ototoxic exposure(RR 4.71, 95%CI 1.94-11.46), severe hyperbilirubinemia(RR 2.10, 95%CI 1.08-4.06), low APGAR score at 5 minutes (RR 2.42, 95%CI 1.03-5.68) and sepsis (RR 2.02, 95%CI 1.01-4.03), (Table 4). The details of fourteen infants with abnormal hearing screening were shown in Table 5.

Data Analysis

Descriptive statistics was used to present characteristics of newborns included in the present study. The frequencies and percentages of the categorical data were presented. The risk factors were analyzed using regression for risk ratio.

Discussion

Speech and language development cannot develop without adequate sound stimulation to auditory pathway. It is important to identify hearing loss as early as possible, because neonates start learning how to use sound as soon as they are born[23]. Listening in the first months of life prepares neonates to speak. By their first birthday, neonates are already learning what words mean. Infants start by babbling, using many of the sounds they hear spoken around them. These early steps are building blocks for communication. Infants learn to talk by listening to their families talk around them. Imagine that an infant has a hearing loss, but no one knows about it. This can lead to slow development of auditory, speech and language. These delays can lead to problems in school later on[24-26]. Universal hearing screening need not detect all cases of congenital hearing loss, it only provides an indication of the baby's hearing at the time of the screening[27]. Mild hearing loss and hearing loss outside the main speech frequencies may not be detected. Hearing impairment may develop after the neonatal period and therefore, it is crucial for the pediatrician to encourage parents to continue to have their child's hearing checked. The pediatrician should maintain a high index of suspicion if there were manifestations of hearing loss such as speech and language delay. Any parental concern regarding a child's hearing should also be thoroughly investigated. Physicians should familiarize themselves with local referral resources for hearing impaired children[28]. According to the purpose, pediatric otolaryngologists, audiologists, and speech and language pathologists with special training and experience caring for children should be consulted for diagnosis, counseling, and treatment, if needed. Communication among professionals is essential to ensure appropriate management of the hearing impaired child. It is crucial to understand factors which delay the commencement of aural habilitation in children[29]. Alleviating the factors will help reducing the delay to an extent in developing country like Thailand where universal newborn hearing screening programs is yet to begin at a national level. The present study aimed to find age of suspicion, identification and in-

tervention availed for children with hearing loss who approached hearing evaluation conducted in northern of the country. Data was obtained from evaluation of 14 infants with mild, moderate, moderate-severe and profound degree of hearing impairment, presented as a complaint of not being able to speak and hear. The family members, mostly mothers, suspected hearing loss in the children at a mean age of 1.5 years when the children did not respond to name-call, clap and vehicle horns[30]. However the parents consulted any doctor primarily a specialist by an average age of 2.4 years. As many as 21% of the doctors during the first visit assured the parents not to worry as the child would learn language with age and only 33.4% were referred for aural rehabilitation[31]. Finding hearing loss early can help prevent delays in speaking and learning. The present study showed that 103 hearing loss infants (89 mild, 12 moderate, 1 moderate-severe and 1 profound hearing loss) after received treatment (8 hearing aid fitting (0.3%), 103 auditory training (3.3%), 103 counseling (3.3%) and 103 combine (3.3%) at 6 months of age, and followed up twelve months later. The present study found an interesting results, among 103 infants who showed hearing loss at 6 month of age and promptly started intervention, only 14 cases (0.4%) showed hearing loss at 18 months old. There were 7 mild loss (0.2%), 5 moderate loss (0.1%), 1 severe and 1 profound deafness. The 89 final normal hearing infants probably due to immaturity of the hearing system before 1 year old or the false positive of the tests[22,32]. The present study did not test hearing on infants at 12 months of age due to the limitation of fund. We thought that if all hearing loss infants were hearing tested at 12 months of age, we might get more informations. The early interventions offered to infants with different levels of hearing impairment were: 5 hearing aid fittings (35.7%), 14 auditory training (100%), 14 counseling (100%) and 14 combine three methods (100%). The development after short term follow up were: 14 auditory improvement (100%), 14 speech improvement (100%) and 5 language improvement (35.7%). All infants received ongoing developmental surveillance, regardless of initial hearing screening outcomes. None of those infants who had normal hearing screen was found to have hearing loss at eighteen months old. The fact that only six of fourteen infants who had abnormal hearing tests were followed up after intervention to have normal development but the eight left had delayed language development. Continuing evaluation of child's development during follow-up and completion of the intervention process is important. The goal of detecting significant congenital and early –onset hearing loss before 3 months of age with a follow-up intervention by 6 months of age as recommended should be considered with caution since there is evidence from the present study that some premature infants with initial abnormal hearing tests results have normal hearing and development later in life. The clinically and statistically important indicators resulted from the present study may be helpful for future preventions and reduction of handicap people.

Problems Faced and Solutions

One challenge we initially faced was to get the infant who failed the first screen for retest after 2 weeks (AAP guidelines). This was solved by coinciding the immunization visit with that of screening. Performing test at that age period was a little time consuming because one has to wait for the baby to go to natural sleep. Another challenge was convincing parents (in some cases, grandparents) the need for ABR in babies with abnormal OAE. It required counseling and persuasion, which was time consuming. The biggest hurdle was convincing the need for fixing a hearing aid in ABR abnormal babies, probably due to the stigma attached to having a hearing aid. As the programme was gaining roots, these were becoming easier. Hearing problem might change after the neonatal period and therefore, it was crucial for the pediatrician to encourage parents to continue to have their child's hearing checked. The pediatrician should maintain a high index of suspicion if there were manifestations of hearing loss such as speech and language delay. Any parental concern regarding a child's hearing should also be thoroughly investigated. In the present study, we had instituted a practical model and a cost effective protocol for early identification of hearing loss and early intervention through a northen Thailand facility. This could be replicated in other parts of the country with the unified strength of physicians in every town.

Conclusion

The number of infants born with hearing loss in Thailand has been estimated to 8,000-16,000 each year[33]. With the ability to detect and diagnose an infant with hearing loss soon after birth, there is no

reason for any infants born with a hearing loss should experience anything but normal speech and language development as a result of early intervention. Early intervention during the first six months of life should be considered with caution because some infants can have false positive tests or transient hearing loss and subsequently have normal hearing and development. Early intervention can prevent acoustic deprivation and improve language development.

What is already known on this topic?

The goal of appropriate intervention between 3-6 months of age to minimize the impact of hearing loss on speech and language development. When follow until 18 month of life, we found 14 infants with abnormal hearing tests in both normal and high risk groups. The past study in Thailand was reported only the high risk newborn hearing screening for reducing the cost of the hospital. Then the outcome of delayed development of hearing loss children were not different.

What this study adds?

The present study confirms the benefit of early detection of hearing loss in both normal and high risk newborns. Early intervention during the first six months of life should be considered with caution because some infants can have false positive tests or transient hearing loss and subsequently have normal hearing and development. Early intervention can prevent acoustic deprivation and improve language development. This paper showed 14 infants (assessed at 18 month) with abnormal hearing tests and 8 of them had delayed development. This program leads to reduce the handicap people in developing country.

Acknowledgement

The authors wish to acknowledge the otolaryngologist of Budhachinarat Hospital, the otolaryngologist of Sawanpracharuk Hospital, and the director of Uttaradit Hospital, Budhachinarat Hospital and Swanpracharuk Hospital for their support in this research.

Ethical Approval

Ethical approval was approved by The Chiang Mai University Hospital, Uttaradit Hospital, Budhachinarat Hospital and Swanpracharuk Hospital Ethical Committee for clinical research.

Potential conflicts of interest

None.

References

1. US Preventive Services Task Force. Universal screening for hearing loss in newborns: US Preventive Services Task Force recommendation statement. Pediatrics 2008; 122: 143-8.
2. American Academy of Pediatrics, Joint Committee on Infant Hearing. Year 2007 position statement: principles and guidelines for early hearing detection and intervention programs. Pediatrics 2007; 120: 898-921.
3. American Academy of Pediatrics Joint Committee on Infant Hearing. Joint Committee on Infant Hearing 1994 Position Statement. Pediatrics 1995; 95: 152-6.
4. Kenna MA. Neonatal hearing screening. Pediatr Clin North Am 2003; 50: 301-13.
5. Thompson DC, McPhillips H, Davis RL, Lieu TL, Homer CJ, Helfand M. Universal newborn hearing screening: summary of evidence. JAMA 2001; 286: 2000-10.
6. Connolly JL, Carron JD, Roark SD. Universal newborn hearing screening: are we achieving the Joint Committee on Infant Hearing (JCIH) objectives? Laryngoscope 2005; 115: 232-6.
7. Ruben RJ. Early identification of hearing impairment in infants and young children. NIH Consens Statement 1993; 11: 17-9.
8. Clemens CJ, Davis SA, Bailey AR. The false-positive in universal newborn hearing screening. Pediatrics 2000; 106: E7.
9. Flynn M, Austin N, Flynn TS, Ford R, Buckland L. Universal Newborn Hearing Screening introduced to NICU infants in Canterbury Province, New Zealand. N Z Med J 2004; 117: U1183.
10. Russ SA, Kuo AA, Poulakis Z, Barker M, Rickards F, Saunders K, et al. Qualitative analysis of parents' experience with early detection of hearing loss. Arch Dis Child 2004; 89: 353-8.
11. Harrison M, Roush J, Wallace J. Trends in age of identification and intervention in infants with hearing loss. Ear Hear 2003; 24: 89-95.
12. Apuzzo ML, Yoshinaga-Itano C. Early identification of infants with significant hearing loss and the Minnesota Child Development Inventory. Semin Hear 1995; 16: 124-35.

13. Robinshaw HM. Early intervention for hearing impairment: Identifying and measuring differences in the timing of communication and language development. Br J Audiol 1995; 29: 315-34.
14. Carney AE, Moeller MP. Treatment efficacy: hearing loss in children. J Speech Lang Hear Res 1998; 41: S61-S84.
15. American Academy of Pediatrics, Joint Committee on Infant Hearing. Year 2007 position statement: Principles and guidelines for early hearing detection and intervention programs. Pediatrics 2007; 120: 898-921.
16. Erenberg A, Lemons J, Sia C, Trunkel D, Ziring P. Newborn and infant hearing loss: detection and intervention.American Academy of Pediatrics. Task Force on Newborn and Infant Hearing. Pediatrics 1999; 103: 527-30.
17. Poonual W, Navacharoen N, Kangsanarak J, Namwongprom S. Risk factors for hearing loss in infants under universal hearing screening program in Northern Thailand. J Multidiscip Healthc 2016; 9: 1-5.
18. Hadad J Jr. Hearing loss. In: Behrman RE, Kliegman R, Jenson HB, editors. Nelson textbook of pediatrics. 17th ed. Philadelphia, PA: Saunders; 2004: 2129-34.
19. Yoshinaga-Itano C, Sedey AL, Coulter DK, Mehl AL. Language of early- and later-identified children with hearing loss. Pediatrics 1998; 102: 1161-71.
20. Yoshinaga-Itano C. Early intervention after universal neonatal hearing screening: impact on outcomes. Ment Retard Dev Disabil Res Rev 2003; 9: 252-66.
21. Clarke P, Iqbal M, Mitchell S. A comparison of transient-evoked otoacoustic emissions and automated auditory brainstem responses for pre-discharge neonatal hearing screening. Int J Audiol 2003; 42: 443-7.
22. Wrightson AS. Universal newborn hearing screening. Am Fam Physician 2007; 75: 1349-52.
23. Mehl AL, Thomson V. The Colorado newborn hearing screening project, 1992-1999: on the threshold of effective population-based universal newborn hearing screening. Pediatrics 2002; 109: E7.
24. White KR, Vohr BR, Behrens TR. Universal newborn hearing screening using transient evoked otoacoustic emissions: results of the Rhode Island Hearing Assessment Project. Semin Hear 1993; 14: 18-29.
25. U.S. Preventive Services Task Force (USPSTF). Newborn hearing screening: recommendations and rationale. Rockville, MD: USPSTF; 2007.
26. U. S. National Institutes of Health, Office of Medical Applications Research, U.S. National Institute on Deafness and Other Communication Disorders. Consensus development conference on early identification of hearing impairment in infants and children. NIH Consensus Development Conference, National Institutes of Health, Bethesda, MD; March 1-3, 1993: 1-24.
27. Joint Committee on Infant Hearing, American Academy of Audiology, American Academy of Pediatrics, American Speech-Language-Hearing Association, and Directors of Speech and Hearing Programs in State Health and Welfare Agencies. Year 2000 position statement: principles and guidelines for early hearing detection and intervention programs. Pediatrics 2000; 106: 798-817.
28. Anderson KL. Childhood hearing screening guidelines. Minneapolis, MN: American Academy of Audiology; 2011.
29. The American Speech-Language-Hearing Association (ASHA). American Speech-Language-Hearing Panel. Guidelines for audiologic screening. Rockville, MD: ASHA; 1997.
30. Northern JL, Downs MP. Behavioral hearing testing. In: Northern JL, Downs MP, editors. Hearing in children. 5th ed. Baltimore: Lippincott Williams &Wilkins 2002: 159-206.
31. Khaimook W, Chayarpham S, Dissaneevate S. The high-risk neonatal hearing screening program in Songklanagarind Hospital. J Med Assoc Thai 2008; 91: 1038-42.
32. Rout N, Singh U. Age of suspicion, identification and intervention for rural Indian children with hearing loss. E J Med 2010; 15: 97-102.
33. Prasansuk S. Incidence/prevalence of sensorineural hearing impairment in Thailand and Southeast Asia. Audiology 2000; 39: 207-11.

ผลลัพธ์ของการค้นหาทารกที่มีการสูญเสียการได้ยินและการให้การรักษาตั้งแต่ระยะแรกภายใต้โปรแกรมการตรวจคัดกรองแบบสากล

วัชรพล ภูนวล, นิรมล นาวาเจริญ, จรัล กังสนารักษ์, ศิริอนงค์ นามวงศ์พรหม

วัตถุประสงค์: *เพื่อศึกษาผลลัพธ์ของการตรวจทารกที่มีการสูญเสียการได้ยินและการให้การรักษาตั้งแต่ระยะแรก*

วัสดุและวิธีการ: *การศึกษาเชิงวิเคราะห์ โดยเก็บข้อมูลแบบไปข้างหน้า ทารกแรกเกิดทุกรายจะได้รับการตรวจคัดกรองการได้ยินด้วยเครื่องวัดเสียงสะท้อนจากหูชั้นใน เครื่องวัดเสียงสะท้อนจากก้านสมองแบบอัตโนมัติ และเครื่องวัดเสียงสะท้อนจากก้านสมองแบบทั่วไป เด็กทุกรายจะได้รับการตรวจวินิจฉัยและให้การรักษาตั้งแต่อายุ 6 เดือนพร้อมทั้งมีการติดตามพัฒนาการทางการได้ยินจนถึงอายุ 18 เดือน*

ผลการศึกษา: *ทารกแรกเกิด 3,120 ราย ได้รับการตรวจคัดกรองการได้ยินแบบสากลทั้งหมด มี 103 ราย ที่ผลการตรวจผิดปกติเมื่ออายุ 6 เดือน คือมีการวินิจฉัยว่ามีการสูญเสียการได้ยินในระดับเล็กน้อย 89 ราย เสียในระดับปานกลาง 12 ราย เสียในระดับปานกลางถึงมาก 1 ราย และเสียในระดับหนวกสนิท 1 ราย โดยที่ทุกรายจะได้รับการรักษาทันทีคือมี 8 รายได้รับการใส่เครื่องช่วยฟัง 103 รายได้รับการกระตุ้นพัฒนาการทางการได้ยินและได้รับคำปรึกษาเรื่องการกระตุ้นพัฒนาการทางการได้ยินอย่างถูกวิธีแก่ผู้ปกครองทั้งหมด จะได้รับการรักษา หลังจากติดตามไปจนถึงอายุ 12 และ 18 เดือนพบว่ามี 89 รายซึ่งตอนแรกมีผลการตรวจที่ผิดปกติมีผลการตรวจที่ดีขึ้นเป็นปกติ ในขณะที่มี 14 ราย (ร้อยละ 0.4) ที่มีการสูญเสียการได้ยินแบบถาวรคือมี 7, 5, 1 และ 1 รายที่มีการสูญเสียการได้ยินในระดับเล็กน้อย ปานกลาง ปานกลางถึงมากและระดับหนวกสนิท ตามลำดับ ทั้ง 14 รายได้รับการรักษาด้วยการใส่เครื่องช่วยฟัง 5 ราย ได้รับการฝึกการได้ยิน 14 ราย ผู้ปกครองที่มีเด็กสูญเสียการได้ยินได้รับการให้คำปรึกษาเพื่อการกระตุ้นพัฒนาการต่อที่บ้านอย่างถูกต้องทั้งหมด 14 ราย และได้ทั้งสองวิธีผสมไปพร้อมกัน 14 ราย หลังจากติดตามการรักษาไปอีก 12 เดือน เด็กมีพัฒนาการทางการได้ยินดีกว่าเดิมทุกราย มีพัฒนาการการออกเสียงตามอย่างถูกต้องทุกราย และมีการใช้ภาษาได้ถูกต้องเพียง 5 รายคิดเป็น 35.7% ปัจจัยเสี่ยงที่สำคัญที่พบคือ ทารกมีความพิการของใบหน้าและศีรษะ การได้ยาปฏิชีวนะที่ทำลายประสาทหูขณะเกิดการติดเชื้อหลังคลอด ทารกมีภาวะตัวเหลืองระดับมาก คะแนนการวัดสัญญาณชีพที่ 5 นาที ทารกมีการใช้เครื่องช่วยหายใจในหอผู้ป่วยหนักมากกว่า 5 วัน น้ำหนักแรกเกิดระดับน้อยมากและทารกมีการติดเชื้อในกระแสเลือด*

สรุป: *การประเมินการได้ยินและกระตุ้นพัฒนาการอย่างต่อเนื่องในเด็กที่มีผลการตรวจคัดกรองการได้ยินที่ผิดปกติมีความสำคัญเป็นอย่างมากต่อเด็กที่มีการสูญเสียการได้ยิน การให้การรักษาตั้งแต่ระยะ 6 เดือนแรกควรให้ความระมัดระวังเพราะอาจมีทารกบางคนที่มีผลการตรวจที่เป็นผลบวกปลอมหรือมีภาวะการสูญเสียการได้ยินแบบชั่วคราวซึ่งอาจมีอาการและพัฒนาการดีขึ้นในระยะต่อมา*