Original Article

A universal newborn hearing screening in Iran

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Objective: In September 2002 University of Social Welfare & Rehabilitation Sciences established a pilot universal newborn hearing screening program in two crowded maternity hospital in Tehran. Our objective was to assess the feasibility of implementing universal newborn hearing screening in IRAN.

Method: Between September 2002 and March 2004 a total of 7718 newborns were screened for hearing loss prior to discharge from the wellborn nursery at Milad and Hedayat Hospitals. The average age of the subjects at the initial Screening test was 24hours. The program employed a three-stage hearing screening protocol using transient evoked otoacoustic emissions (TEOAE) screening with referral for diagnostic auditory brainstem response assessment.

Results: The overall pass rate at the time of hospital discharge was 92.3%, thus achieving an acceptable referral rate of 7.7% for diagnostic audiological assessments. Nine newborns were identified with permanent unilateral hearing impairment. Newborns identified with bilateral hearing loss were immediately referred to the SABA center for hearing aid assessment and fitting. Newborns as young as 5 weeks old were successfully fitted with hearing instruments and enrolled in the family center early intervention program at the SABA center

Conclusion: The frequency of bilateral congenital hearing loss requiring amplification in this population is shown to be approximately 0.001 newborns. This finding is consistent with previous researches, which have indicated hearing loss to be the most frequently occurring birth defect. Universal newborn hearing screening using TEOAEs proved to be a cost effective and feasible method of identifying congenital hearing loss in IRAN. The existence of many successful screening programs worldwide and the availability of fast, objective, reliable and inexpensive hearing screening procedures mean that universal neonatal hearing screening is becoming one of the standards of care.

Keywords: Congenital hearing impairments, Hearing screenings

Introduction:

The impact of permanent hearing impairment on a child and his or her family can be substantial and long term. It has been recognized that early detection and management of congenital hearing loss will help to lessen the impact of the condition on the child's social, emotional, intellectual and linguistic development (yoshinaga- Itano et al 1998, Sergi etal, 2001)

Yoshinaga- Itano et al. Showed that habilitation of hearing loss before the age of 6 months result in normal speech and language development, compared with habilitation started after 6 months (yoshinaga-Itano, 1994).

Since the early 1990s, controlled trials and clinical models of universal newborn hearing screening (UNHS) (Vohr et al. 1998) have demonstrated convincingly that UNHS results in earlier identification of and intervention for infants with congenital hearing loss. In addition, recent publications documenting the beneficial effects of early intervention on child development (Yoshinaga- Itano, 2006).

University of Social Welfare and Rehabilitation Sciences, established a universal new born hearing screening program in 2002 in response to joint Committee on Infant hearing (JCIH) year 2000 position statement in developing Comprehensive early

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hearing detection and intervention (EHDI) systems. This paper presents the results of the hearing Screening program in two crowded hospitals of Tehran city from September 2002 to March 2004. The objective of the screening was to assess the feasibility of UNHS in IRAN.

Materials and methods

Study Group: Between September 2002 and March 2004, the hearing screening program was implemented in two crowded hospitals in Milad and Hedayat Hospital. All well infants, hospitalized from 12 to 36 hours , were screened for hearing loss at age 3 to 36 hours prior to discharge form the wellborn nursery. Less than 1% of our total population represented deaths. A total number of 7718 newborns were screened. All medical ethics committees of the USWRS approved the study protocol.

All parents were informed before the TEOAE hearing screening with two brochures. In addition, parents were informed for the need to return for rescreening after discharge from the maternity hospital in case of a first failure.

Screening method: The TEOAE recordings were performed by an Echo – Screen device. The diagnostic ABR evaluation with threshold identification was performed by using path finder I (Cnicolet Biomedical Inc.). The standard procedure consisted of rarefaction clicks with frequency of 11.1 Hz, duration 100 (μs, filter settings 150-1500 Hz, analysis time 15 or 20 ms in case of wave V absent at 95 dB HL. As to the test of the Echo-Screen device, 7718 neonates were tested.

In the event of failure. Newborns with unilateral or bilateral hearing loss $\geq$ 40dB HL were referred for a comprehensive audiological assessment.

Those children who passed the screening were assumed to have normal hearing threshold at that time.

Screening Program Design: The Screening program employed a two stage hearing screening protocol using transient evoked otoacoustic emissions (TEOAE) screening with referral for diagnostic auditory brainstem response assessment. The infants who failed the first test were tested as many times as possible before discharge (stage I) to reduce the number of outpatient screening and to limit the stress for families. During the implementation, audiologists were free to choose the most appropriate time for the first test before discharge. All at risk were tested with TEOAE before discharge. Both the first test and the repeated first test formed the first stage of this screening program. Healthy and no pathologicalrisk newborns who failed at discharge were re-screened with TEOAE between 15 and 30 days old (stage II) and then tested with ABR.

Implementation Programme: Hearing screening during admission was performed on maternity by a team of two of three audiologists in each hospital. Before the study period, implementation of neonatal hearing screening started with a 3hr central training of these teams. This training not only consisted of the manual skills but also included a theoretical background of the method, the psychosocial impact of the screening for both the parents and the child, and the need for central program monitoring.

In each hospital the study coordinator (an audiologist) informed the medical and nursing staff and guided performance and solved problems during the program.

Monitoring of the Project: This implementation study was designed as part of a future wider hearing screening programme. This program consists of hearing screening in all newborns in the healthy baby clinic settings of several hospitals.

The monitoring of the program was done by an Audiologist in the research center. A reminder was sent (i) if no test result was obtained within 3days after birth (ii) if no result of a second screening was obtained 20days after referral on the first test; (iii) if within 40days no result of diagnostic ABR was obtained after a referral on the second test.

A child was considered lost to follow up when the parents refused further investigations.

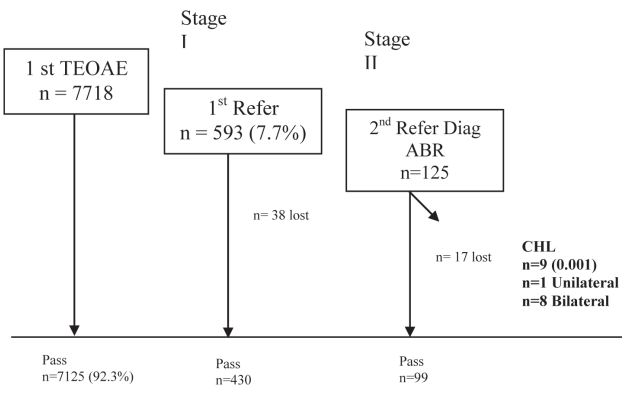

Fig1. Program design and results of the two stage neonatal hearing screening using TEOAE and ABR. CHL: congenital hearing loss

Statistical analysis:
Data were collected in a central database and analyzed with SPSS. This Statistical software program was used to obtain descriptive data for success rate screening, first stage pass/ referral rates, rescreening compliance, diagnostic referral rates and to establish the prevalence of congenital hearing loss (CHL). Differences in mean age at diagnostic ABR during implementation were tested using one-way ANOVA. A Pvalue of <0.05 was considered to be statically significant.

Results:
During the 18 months of our study period 7718 newborns were admitted in the hearing screening program.
3871 neonates in Hedayat hospital and 3847 one in Milad hospital. %51 (3911) of the newborns were male and %49 (3807) were female. Thus 7718 newborns fulfilled one or more of the JCIH criteria.
In the first Stage of the study, first TEOAE testing, 7125 (92.3%) passed (3738 from Hedayat and 3387 from milad hospital.
Fifty-five children (0.71%) were lost during the study period. 38/55 after one failed test and 17/55 after two failed tests.
The average age of the subjects at the initial screening test was 24h. After the first test a repeated first test was performed in 600 out of 7718 (7.77%) of the children before discharge from hospital. The combined results of the first test and repeated first test are hence forth presented as the first stage results. Figure 1 shows the program structure and the results of the 7718 children screened at the first stage.
The pass rate after the first stage was 92.3% (7125/7718), resulting in a first stage program referral rate of 7.7%. At the second stage 430/593 (72.5%) of the tested newborns passed . The referral rate diagnostic ABR for the whole program was 1.67% (125/7718). Ninty nine out of 125 (79.2%) had no hearing loss at diagnostic evaluation, 17 (13.6%) were lost and 9 (7.2%) had CHL.
One out of the nine hearing impaired children has Unilateral and eight one has bilateral hearing loss. Therefore the prevalence of hearing loss was 0.1% (9/7718).
According to the hearing level detected at the diagnostic ABR, 4/9 newborns had moderate to severe sensory neural hearing loss (40-80dB) and 5 out of 9 newborns had profound sensory neural hearing loss (80dB). [Table 1].
Four out of nine newborns with hearing loss had high risk criteria and five did not.
The false – positive rate after the first stage (the number of positive test results when there was no hearing loss) was 6.9% (529/529+7125).

Table1: Newborn Infants Tested by Two–stage TEOAE

Result	n	%
Normal TEOAE (2-stage)	7555	97.888
Normal ABR (referred from TEOAE)	99	1.282
Severe to profound CHL		
Unilateral	1	0.012
Bilateral	3	0.038
Profound CHL		
Unilateral		0.000
Bilateral	5	0.064
Missed from Study	55	0.712
Total Screened Infants	7718	100

True – positive rate (Sensitivity) of the program is unknown.

Discussion
This Study is one of the first studies – if not the first in Iran to present the results of an NHS program supported by the USWRS and one of the first steps towards a nationwide neonatal hearing screening program.
For hearing screening in general, two methods are available based on different principles. Recording of otoacoustic emissions is based on a physiological phenomenon from the inner ear (Kemp, 1991). An ABR is a simplified and statically modified recording based on conventional ABR. Both techniques are widely used for universal hearing screening (Norton, et al 2000 a,b).
The Present results show that it is possible to incorporate a two-stage TEOAE hearing screening program in Iran.
Audiologists could easily perform TEOAE hearing Screening in maternity hospitals. To avoid false-positive screening results newborns should be tested as late as possible before being discharged from nursery. On the other hand, infants should be tested as early as possible to avoid the situation where they had already been discharged. The prevalence of congenital bilateral loss in 0.1% the early age at which the neonates were tested resulted in a number of repeated first tests. (7.77%) Written parental information was given well in advance of the screening program. Written information was also given to parents whose

infant had to be referred to an audiological center. The goal of this information supply was to inform parents about each stage of the Screening process and thus to reduce the levels of anxiety caused by the process. The average age of the subjects at the initial screening test was one day old.

Further main results were a referral rate of 7.7% after the first stage.

A prevalence of 0.1% of CHL was established at the diagnostic audiological evaluation. After the first stage, a false – positive rate of 6.9% resulted.

The rescreening compliance after the first screening was 93.5% in this population. Although this is fairly good, increased knowledge among both professionals and the general public, as well as the introduction of neonatal hearing screening in all hospital is likely to increase the participation rate.

Further follow-up data are necessary to assess the sensitivity of this neonatal hearing screening.

Tracking of referred newborns and the need for appropriate auditory intervention in those infants identified with CHL is of importance and necessary, but widespread experience in this part of the audiological field cannot be available at the start of mass screening. (van straaten et al , 2003; Bamford and Davis, 1998; JCIH, 2000). All infants identified with CHL referred to SABA Clinic, Hearing Rehabilitation Center of the USWRS, and a completed diagnostic work up at 1.5 to 3 months ages could be reached.

There was a tracking function in the research center of the USWRS until the age at which a first diagnostic ABR establishes the hearing status in referred newborns.

An important goal for all hearing screening programs is the habilitation of the hearing-impaired child.

Infants as young as 5 weeks old were successfully fitted with hearing instrument and enrolled in the family center early intervention program at the SABA and Newsha , a private parent-infant hearing rehabilitation center.

Successful newborn hearing screening, diagnosis and intervention programs representing well integrated care systems, are rapidly being developed in IRAN. In order to ensure optimal outcomes all stakeholders, including parents, physicians , audiologists, speech pathologists , deaf and hard of hearing individuals, educators hospital and public health care representatives participate in development of nationwide systems. (Hayes, 2001).

By using the JCIH year 2000 position statement, EHDI systems incorporate well-defined benchmarks and quality monitoring protocols in to program design.

This study has shown that two–stage TEOAE hearing screening can be successfully implemented on a large scale in hospital to achieve the high quality standard of screening programs. We recommend a two-stage universal newborn screening protocols, amplification before age 6 months and regular Attendance of infants at aural habilitation sessions.

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