ORIGINAL ARTICLE

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Newborn Hearing Screening Outcomes From Rize; Turkey

ABSTRACT

Objective: The aim of the present study was to evaluate the patients included into national newborn hearing program in Rize Province,Turkey, between 2010 and 2015 with literature outcomes.
Material and Method: Totally 25,373 newborns born within Rize province between January 2010 and December 2015 were enrolled into the study. Transient Evoked Otoacoustic Emission (TEOAE) and Auditory Brainstem Response (ARB) tests were used. The infants failed from TEOAE were subjected to ABR on the same day; infants who also failed from ABR were referred to a reference centre for clinical ABR.
Results: Among 25,373 infants enrolled into the study, 1,562 (6.15%) infants failed from first and second tests and were referred to a reference centre for clinical ABR. Unilateral hearing loss was detected in 1 infant whereas bilateral hearing loss was detected in 15 infants. A risk factor was determined in 7 of 16 infants with hearing loss.
Conclusion: Hearing loss affects the social, emotional and mental development of the newborns negatively. Newborn hearing screening allows early recognition of babies with hearing loss and may provide early treatment.

Keywords: Newborn hearing screening,Hearing loss,Tests in hearing screening

Yenidoğan İşitme Taraması Sonuçları Rize; Türkiye

ÖZET

Amaç: Çalışmamızda Rize ilindeki 2010 ile 2015 yılları arasındaki ulusal yenidoğan işitme programına alınan hastaların sonuçlarının literatürle karşılaştırılması amaçlanmıştır.
Materyal ve Metod: Çalışmaya Rize ilinde 2010 Ocak ayı ile 2015 Aralık ayı arsında doğmuş 25373 yenidoğan dahil edilmiştir. TEOAE (Transient Evoked Otoacoustic Emission) ve ABR (Auditory Brainstem Response) testleri kullanılmıştır. TEOAE den kalan bebeklere 15 gün sonra yeniden TEOAE uygulandı testten kalan bebeklere aynı gün ABR uygulanarak testi geçemeyen bebekler klinik ABR için referans merkeze yönlendirildi.
Bulgular: Test uygulanan 25373 bebekten 1562 si (6,15%) birinci ve ikinci testi geçemeyerek klinik ABR için referans merkeze yönlendirildi. Yönlendirilen bebeklerin 1 inde tektaraflı 15 inde çifttaraflı işitme kaybı saptandı.İşitme kaybı saptanan 16 bebekten 7 sinde risk faktörü tespit edildi.
Sonuç: İşitme kayıpları yenidoğanlarda sosyal, duygusal ve zihinsel gelişimi olumsuz yönde etkilemektedir. Yenidoğan işitme taraması işitme kayıplı bebeklerin erken tanınmasına ve erken tedavilerine olanak sağlamaktadır.

Anahtar kelimeler:
Yenidoğan işitme taraması,İşitme kaybı,İşitme tarama testleri

INTRODUCTION

Hearing loss is one of the most common congenital abnormalities of the newborn with an incidence of 0.1 to 0.6% (1,2).

Speaking and language development is affected in the children with congenital hearing loss who are deprived of auditory during the first year of life (3,4).Language and speaking development of such children are normal or almost normal if hearing loss is treated within first 6 to 9 months of the life and early intervention services are provided (5,6).

Previous studies showed that determination of the children with hearing loss who may have hearing aid through a successful screening program revealed normal results in expressive language tests performed at three years of age (7,8).

Two methods are used for newborn hearing screening: TEOAE (transient evoked otoacoustic emissions) and ABR (auditory brainstem response). TEOAE are acoustic signals generated by the cochlea as a response of auditory stimuli. This test shows physical status of the cochlea. It measures independent cochlear functions of central nervous system (9). ABR is measurement of electrical potential responses created by intermittent stimuli on auditory tracts and brainstem within first 10 to 20 ms through surface electrodes on the skull (10). These are used as screening tests becouse they are non-invasive, cost effective and easily applicable.

Performance of hearing screening of the newborns, differentiation of those with hearing loss and enabling a normal development by referring for an appropriate amplification or cochlear implantation therapies are crucial. The aim of the study was to report hearing screening outcomes of the infants borned in Rize between January 2010 and December 2015 and to compare our outcomes with the literature.

MATERIAL AND METHOD

Study design:

The present descriptive study included retrospective review of UNHS test results of the babies born in Rize, Turkey between May, 2016 and February, 2010.Turkey between January 2010 and December 2015 through National Newborn Hearing Screening (NNHS) program.

Population:

The present study included 25.373 newborns born in Rize. The results were obtained from two hospitals in the centre.

NNHS protocol:

TEOAE test was applied to both ears of the infants during first examination. Infants who responded on both ears were accepted as "passed from the screening". Infants who failed from the screening on a single ear or both ears were referred to an autoscopic examination and tympanometric evaluation. Treatments required were prescribed in case of debris or effusion and they were invited to a secondary control after 15 days. TEOAE test was applied again during control visit. Infants who failed the test were exposed to ABR test. Infants failed from ABR test were referred to a superior centre(11).

Devices:

The tests were applied in a special room allocated for the test when the infants were on their mother's lap or on a flat surface. Appropriate probes were selected according to the external ear tract of the infants. Hearing screening tests, TEOAE and ABR were performed by MADSEN Accu-Screen PRO device; tympanometric examinations were applied by Interacoustics AT 235 device.

Data collection:

Use of computerized data collection based on the internet has gradually increased since 2010: screening results are transferred directly from devices to the central database,and results of the audiological assessments are directly typed in the database by the Ear, Nose and Throat (ENT) doctors.

Table I. National Newborn Hearing Screening Programme Results.

	Applied tests							
	Passed		*Failed*		*Defaults*		*Total*	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
1st A-TEOAE	1844	72.67	6933	27.33	0	0.00	25373	100.00
2nd A-TEOAE	492ô	19.39	1965	7.74	48	0.02	6933	27.32
A-TEOAE+ A-	1432	0.05	497	5.12	36	0.01	1965	0.71
Clinical ABR	1542	0.06	16	0.06	4	0.00	1562	0.61

RESULTS

The present screening program was applied to 25,373 (99.1%) of 26,603 infants born in Rize(Turkey)between January 2010 and December 2015. Among the babies who had a hearing screening test, 94% passed the test at first or second screening. 1562 babies who failed the test were referred to a reference centre (Table 1). Annual distribution of these infants was shown in (Table 2).

Table 2. Hearing screening tests and clinical ABR referrals in 2010-2015.

Years	*Screened by A-TEOAE; or A-TEOAE+A-ABR*	*Number of Newborns Referred for clinical ABR*	*Default*
2010	4180	167	1
2011	4153	319	2
2012	4273	361	1
2013	4363	390	5
2014	4204	164	3
2015	4200	161	4
Total	***25373***	***1562***	***16***

Bilateral hearing loss was detected in 15 infants including 7 boys and 8 girls whereas unilateral hearing loss was detected in 1 girl in the reference centre (Table 3).

Table 3. Hearing loss detected by clinical ABR

	N	*%*
Bilateral SNHL	15	93.75
Unilateral SNHL	1	6.25
Total	***16***	***100.00***

When we contacted to parents of these 16 babies with hearing loss and learned the detailed history, a risk factor was detected in 7 infants (three with a family history, two with a long term(longer than five days) intensive care unit hospitalization, two with a family history of parental consanguinity) (Table 4).

Table 4. Risk factors for hearing loss

Risk factors	*Newborns with risk factors*		*Diagnosed as SNHL (n=16)*
	Passed screening tests by A-TEOAE or A-TEOAE+A-ABR (n=25373)	*Failed at hearing screening tests and referred for diagnostic ABR (n=1562)*	
Family history of hearing loss	798	325	3
Parental consanguinity	421	115	2
Low birth weight (low 1500	356	96	0
RDS	24	23	0
Long term intensive care unit hospitalization	16	7	2
Hyperbiluribinemia	236	46	0
Head and face anomalies	12	6	0
Congenital genetic disorders	10	4	0
Total number of risk factors	***1973***	***442***	***7***

SNHL: Sensorineural hearing loss, RDS: Respiratory Distress Syndrome

DISCUSSION

Newborn hearing screening aims to identify the infants with hearing loss as soon as possible cost-effectively and definitely and to plan the required intervention earlier.

Since it was detected that early detection of hearing loss in newborns and implementation of required therapies enables normal cognitive and language development in such infants, "Newborn Hearing Committee" stressed necessity of identification of all babies with hearing loss and providing support to those through the methods such as implementation of a hearing aid, auditory training, language and speaking therapy (12).

When we review the literature, incidence for bilateral hearing loss was reported as 0.13-0.60% whereas incidence for unilateral hearing loss was reported as 0.17-0.38% (13,14,15). The incidence for present study was 0.08% for bilateral hearing loss and 0.04% for unilateral hearing loss. Approximately 1,300,000 infants are born in

our country every year. This counts for 1,500 to 2,000 newborns with hearing loss per year. Increase in in vitro fertilization, hospitalization of the infants with lower gestational age and birth weight considerably increased this rate (16). When compared with the literature this lower rates detected in the present study may be explained with that newborn intensive care unit in Rize has become operational since 2014 and risky pregnancies prior to 2014 were directed to nearby cities.

Severity of the exposure is proportional to degree of the hearing loss. The first three years of life is crucial for development of language skills. If the children with hearing loss who were not detected are not treated, further therapies and rehabilitation procedures are not as effective as the first three years (17).

Risk factors for sensorineural hearing loss

Hearing losses may appear within three different periods of life: Prenatal, perinatal and postnatal. Prenatal period covers the risk factors for hearing loss during pregnancy. These are; genetic causes (30-50%), ototoxic drug use, radiation exposure, congenital infections (TORCH), trauma and some systemic diseases. Risk factors during perinatal period includes, babies with low birth weight (less than 1,500 g), blood incompatibility, hospitalization in intensive care unit, asphyxia, head trauma during delivery (vacuum, forceps etc.), blood exchange and infections. Postnatal risk factors are; infections, convulsions, ototoxic drugs, head traumas, genetic disorders, craniofacial abnormalities, exposure to high sounds and idiopathic causes (18). Newborn hearing screening programs (NBHCP) were started for early diagnosis and rehabilitation in many countries to resolve this important biological, psychological and social problem.

American Academy of Paediatrics suggests that at least 95% of the target population should be included into the screening program for an effective outcome (19). With this screening program, 25,373 (99.1%) of 25,603 infants were examined. Bilateral hearing loss was detected in 15 infants whereas unilateral hearing loss was detected in one baby including 7infants with risk factors (3 with a family history, 2 with a long term intensive care unit hospitalization longer than 5 days, 2 with a family history of parental consanguinity, 1 with tragus abnormality) and 9 infants without risk factors.

Literature data suggests that sensironeural hearing loss may be higher in high risk groups (20). The risk factors include family history of hearing loss and parental consanguinity. The rate of kinship marriage for the present study was detected as 16.2%. The most common subtype of hereditary hearing loss is autosomal recessive form (77%); and association of parental consanguinity with hearing loss may be considered as a risk factor (21). Parental consanguinity was detected in 2 of 16 infants diagnosed with hearing loss in our screening program.

In the study, we found that 72.67% of the newborns passed first screening step with A-TEOAE. This result is quite similar with outcomes detected in the studies conducted by Ahmad et al (22) and Kucur et al (23); with rates of 74.5% and 76.9%, respectively. Although NHSS recommends the screening test for the infants within next week following discharge from the hospital, many infants may participate in the program late and false positive results may be obtained due to increase in activity and sensitivity to the sound over time.

The benefits of NNHS is quite clear; however, there are some limitations. Less severe congenital hearing loss (less than 30 dB or 40 dB) is not detected in most of NNHS programs. Some progressive or late-onset hearing impairment is also not detected by a newborn screening program. AJCIH in the 2007 Position Statement has identified the problem of late onset hearing loss and the risk factors which requires monitoring during the first years life (24). In recent years, there has been an increased focus on late onset hearing loss (25).

American Academy of Paediatrics deems a screening program reproductive if at least 95% of the infants failed from a newborn hearing screening have an advanced audiological evaluation. The rate of the infants who passes the first test and referred for a second test in national studies varies between 40% and 90% (26,27,28,29). This rate was found as 74.6% in the our study. This indicates the necessity of raising the awareness of Ear, Nose and Throat (ENT) specialists, gynaecologists, paediatricians, family practitioners as well as the families. Perhaps most of the patients who fail from the first test can be taken to a control examination and thus diagnosis may be established timely.

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