ORIGINAL ARTICLE

The Distribution of Risk Factors among High Risk Infants who Failed at Hearing Screening

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OBJECTIVES: Describe the incidence of risk factors for hearing loss among NICU babies who failed at hearing screening.

DESIGN: A total of 966 babies born at either university hospital or referred by the state maternity hospitals within near vicinity were screened during one year period. Madsen Accuscreen Pro Transient Evoked Otoacoustic Emission Measurement (TE-OAE) system was used for initial hearing screening. Year 2000 Position Statement: Principles and guidelines for early hearing detection and intervention programs prepared by Joint Committee on Infant Hearing were used for risk factors and to prepare hearing screening protocol. A total of 275 NICU babies were screened just before the baby discharge from the hospital and if the baby fails at first screen then follow up tests were done when the baby reach full term. Of 275 babies 151 (55%) were males and 124 (45%) were females.

RESULTS: Descriptive analyses were used to describe characteristics of this sample. A total of 227 (83%) out of 275 NICU babies passed and 48 (17%) failed initial hearing screening and among them, 5 babies (1.8%) were diagnosed as hearing impaired at various degrees and they all were aided by the end of the first year.

CONCLUSION:Bacterial meningitis, consanguinity and prolonged mechanical ventilation as well as prematurity and low birth weight are high risk factors of congenital hearing loss for babes in NICU.

The prevalence of severe congenital hearing loss is around 0.1-0.3% in live births, however the prevalence rates are significantly higher, about 2-4% among infants need a special care in neonatal intensive care units (NICU) [1]. Since the elimination of detrimental effects of hearing loss on speech, language and cognitive development is possible only through early intervention, implementation of universally new born hearing screening has been recommended by several institutions in Europe and the U.S.A. Intervention is believed to be most successful if started in the first few months of life [13]. Thus identification by screening at or shortly after birth has the potential to improve quality of life and opportunities for those affected [3].

Therefore a one year project was carried out to implement neonatal hearing screening program at the Ondokuz Mayıs University Audiology and Speech Pathology unit of ENT Department as a base and spread this program to the state maternity hospitals through out the Black Sea region of Turkey where a congenital hearing loss is quite high due to the consanguineous marriage. A total of 966 babies (511 males and 455 females) born at either university hospital or referred by the state maternity hospitals within near vicinity were screened during one year period. Six hundred ninety-one babies (71.5%) were from well baby clinic and 275 babies (28.5%) were screened at NICU clinic. Those babies who passed initial screening but had risk factors were tested at their 3 , 6 and 9 months and when they are one year old. However substantial number of drop outs makes it difficult to follow these babies throughout their development.

The distribution of risk factors among NICU babies were reported in this study. Risk factors were classified as follows: gestational age under 36 weeks, low birth weight (<1500gr), consanguinity, history of familial hearing loss, hyperbilirubinemia (biluribin > 10mg/dl), severe birth asphyxia, bacterial meningitis, administration of ototoxic drugs (>10 days), mechanical ventilation (>5 days) , and chromosome anomalies.

MATERIALS AND METHODS

Participants

A total of 275 babies were screened just before the baby discharge from the NICU and if the baby fails at first screen then follow up tests were done when the baby reach full term. Of 275 babies 151 (55%) were males and 124 (45%) were females.

Materials

Madsen Accuscreen Pro Transient Evoked Otoacoustic Emission Measurement (TE-OAE) system was used for initial hearing screening, Intelligent Hearing System (IHS) Smart Evoked Potential (EP) system was used for ABR test, and Beltone 2000 Clinical Audiometer was used for hearing evaluation. Hearing thresholds were determined by using Conditioned Auditory Visual Response Audiometry (CAVR) method. To rule out any possible middle ear problems immitancemetric evaluation was carried out by using Grason Steadler Industry (GSI) Tympstar immitancemeter. All of the audiological tests were done in sound proof rooms. Demographic data sheet was also used to record prenatal, natal and postnatal status of baby, and familial history for hearing loss. Informed consent was also obtained from the parents. Year 2000 Position Statement: Principles and guidelines for early hearing detection and intervention programs prepared by Joint Committee on Infant Hearing were used for risk factors and to prepare hearing screening protocol [6].

Procedure

For hearing screening of NICU babies following steps were carried out;

1. Initial screening was done when the baby ready to discharge from the hospital. Bilateral “Pass” results required to pass the test.
2. When the baby fails the initial screening in one or both ears second screening was scheduled within 7 days, and third screening within 5 weeks and/or when baby reaches full term.

3. All screening tests were done in sound proof rooms while the baby in her/his natural sleep
4. If the baby fails in third screening then immitancemetric tests followed by ENT examination, were done.
5. If the baby has no middle ear problem then ABR test was done when baby in his/her natural sleeps.
6. If the click and tone ABR tests indicate any hearing loss, then these thresholds were cross checked by CAVR results.
7. The baby was diagnosed as having hearing loss if s/he fails all tests and then hearing aid adaptation was done.
8. When the NICU babies pass the initial hearing screening, they all followed up for the possible progressive hearing loss. Follow up tests were scheduled for their 3rd, 6th, and 12th months.

RESULTS

The objective of this study was to describe the incidence of risk factors for hearing loss among NICU babies. Descriptive analyses were used to describe characteristics of this sample. A total of 227 (83%) out of 275 NICU babies passed and 48 (17%) failed initial hearing screening and among them, 5 babies (1.8%) were diagnosed as hearing impaired at various degrees and they all were aided by the end of the first year. One baby lost her life right after the initial screening. Two babies who failed at initial screening have already received ABR tests which they failed at, and diagnostic behavioral tests were scheduled. One baby failed in one ear and will be followed for further evaluation. Unfortunately, 39 babies (who failed at initial screening bilaterally or unilaterally) did not return for follow up screens and/or diagnostic tests.

The distributions of risk factors for babies both who passed and failed initial screening were presented in the Table 1, and the distribution of risk factors for each baby who diagnosed as having hearing loss was shown in Table 2.

The independent-t test was conducted to see whether gestation age and weight differ significantly between two groups of babies. Significant differences were found both for weight [t (5.6)=6.74, p=.001] and gestational age [t (4.8)=5.82, p=.002]. NICU babies who failed at in both ears had a lower birth weight (X=1614grm, SD=285.4) than babies who passed in both ears (X=2583grm, SD=852.9). Also babies who passed the screening had a longer gestation age (X=35.9 wks, SD=4.1) than babies who failed (X=30.6 wks, SD=1.9).

The range for birth weight was 600-4680grm for pass group and was 1160-1940grm for refer group. Gestation age for pass group ranged between 24 to 40 weeks and for refer group between 28 to 33 weeks.

DISCUSSION

Since the first months and years of life are accepted as critical for normal language development[3], the early detection of hearing loss in neonates became an important objective in child care. Moving from the fact that only through neonatal hearing screening, early diagnosis, intervention and rehabilitation followed by a proper amplification are possible for congenitally hearing impaired; a one year project was carried out to implement neonatal hearing screening in our university as a base. Hearing screening was carried out by using TE-OAE and if baby had three refer results in one or both ears then conventional ABR test were administered since conventional ABR has been reported as a more reliable test for hearing screening [9,11] and because of much of the automated ABR equipment can only identify infants with moderate hearing loss [5]. The descriptive results of the first year for the distribution of risk factors among NICU babies were presented in this paper.

Table-1: Distribution of risk factors among NICU babies.

RISK FACTORS	Bilateral Pass (N=227)		Bilateral Refer (N=5)	
	N	%	N	%
Low Birth Weight (<1500grm)	33	15	1	20
Gestation Age (<36wks)	105	46	5	100
Consanguinity	28	12	2	40
History of Familial Hearing Loss	1	0.4	0	0
Hyperbilirubinemia (>10 mg/dl)	89	39	2	40
Asphyxia	12	5	0	0
Meningitis	21	9	3	60
Ototoxicity (>10 days)	11	5	0	0
Mechanical Ventilation (> 5days)	10	4	2	40
Chromosomal abnormality	2	0.9	0	0

Table-2: Distribution of risk factors among 5 NICU babies who diagnosed as hearing impaired.

RISK FACTORS	Baby 1 Male	Baby 2 Female	Baby 3 Male	Baby 4 Female	Baby 5 Male
Weight (grm)	1160	1570	1940	1600	1800
Gestation Age (weeks)	28	30	33	30	32
Consanguinity	none	none	3rd degree	1st degree	none
History of Familial Hearing Loss	none	none	none	none	none
Hyperbilirubinemia (mg/dl)	10-20	10-20	<10	<10	<10
Asphyxia	none	none	none	none	none
Meningitis	yes	none	yes	yes	none
Ototoxicity (days)	none	none	none	< 10	none
Mechanical Ventilation (days)	>5	none	>5	< 5	none
Chromosome abnormality	none	none	none	none	none

It has been reported that 2-4% of NICU babies have a significant bilateral congenital hearing loss[1]. In the present study a slightly lower rate, 1.8% was found for NICU babies. Suppiejet al. (2007) were reported the prevalence rate of hearing loss is about 2.9% for NICU babies, and Hille et al. (2007) suggested the rate of 3.2% in their study [11].

Although Yoshikawa et al. (2004) did not found any significant differences between pass and refer groups in NICU population in birth weight [12], the most important risk factors for hearing impairment in NICU babies were reported as low birth weight and prematurity [7]. Similarly, in the present study, NICU babies who diagnosed as having hearing loss was found to have a shorter gestation age and lower birth weight than those who passed the screening. Birth weight ranged between 600 to 4680 grams with the mean weight of 2583 grams in pass group, while the range was between 1160 to 1940 grams with the mean weight of 1614 grams in refer group. This difference was found statistically significant. The mean gestation age for pass group was 36 weeks (ranging from 24 to 42 weeks) whereas for refer group was 31 weeks (ranging from 28 to 33 weeks). This difference was statistically significant as well. In a study done with 2186 NICU babies mean gestation age was found 28.5 weeks and mean birth weight was found 1039 grams [4]. In another study with 777 NICU babies, 33.8 weeks mean gestation age and 2141 grams mean birth weight were reported [8].

The NICU babies of present study who diagnosed as hearing impaired also distinguished from babies who passed the screening on some other risk factors such as duration of mechanical ventilation (40% in refer group; 4% in pass group) and bacterial meningitis (60% in refer group and 9% in pass group) as reported in other studies in the literature[4,7,10]. The rate of consanguinity was 40% for refer and 12 % for pass groups of NICU babies. Consanguineous marriage is very common in Black Sea part of Turkey and apparently is one of high risk factors for hearing impairment for NICU babies as it was shown in the study of Bener et al [2]. Other risk factors almost equally distributed between two groups of NICU babies.

The major draw back of this one year project was dropouts. Total of 39 (1.1%) out of 275 NICU babies did not return for the follow up tests. This may be partially due to the fact that 15 babies' failed initial screen only in one ear; and most probably their parents did not believed that their baby will have a hearing loss since s/he responds to the sound. Thus neonatal hearing screening should not only done for every newborn but also include appropriate approach for the families to make sure that they understand what is the hearing loss and what would be the consequences if it is not diagnosed early and intervened properly.

As a conclusion, when then distribution of risk factors were examined descriptively, it may be suggested that bacterial meningitis, consanguinity and prolonged mechanical ventilation as well as prematurity and low birth weight are high risk factors of congenital hearing loss for babes in NICU.

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