Some Risk Factors for Neonatal Sensorineural hearing Loss in a neonatal Intensive Care Unit

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Abstract

Background: The sensorineural hearing loss incidence ranges from 1 to 3 per 1.000 live births in term healthy neonates, and 2- 4 per 100 in high- risk infants, a 10- fold increase.

Objectives: To estimate the incidence of SNHL among newborns in NICU at Al Monira Hospital, Cairo, Egypt; and to describe the distribution of risk factors associated with SNHL and the effects of their interaction.

Patients and methods: This descriptive study was carried out on 710 neonates in Al Monira Hospital, Cairo, Egypt; The neonates in the study were 710 (401Males and 309 Females) and had birth weight ranging from 680 to 5500 gm and the mean gestational age was 35.8± 3 weeks. All the cases were screened for hearing loss using the transient evoked otoacoustic emission device, followed by a second stage screening for those who failed and cases given a Refer then undergo an Automated Auditory Brainstem Response test.

Results: In the studied cases, 76.7% had hyperbilirubinemia, 8.73% were of low birth weight (<1500 g), and 15.5% were on mechanical ventilation. In the first screening phase, 80% were given a Pass response and 20% were given a Refer response for the right ear. In the second screening phase, 91% were given a Pass, 9% were given a Refer.

Conclusion: A comprehensive intervention and management program must be an integral part of screening programs in the postnatal period. Awareness about the value of hearing screening is important. Further assessment of high prevalence of hyperbilirubinemia are needed.

Keywords: Hearing loss, High- risk, hyperbilirubinemia, low birth weight, mechanical ventilation, Neonatal hearing screening

بعض عوامل الخطورة لفقدان السمع الحسى العصبى للأطفال بوحدة رعاية مركزة للأطفال حديثى الولادة

المقدمة: يعد فقدان السمع الحسى البصرى من بين العيوب الخلقية التى تصيب الأطفال حديثى الولادة بنسبة من ١- ٢ لكل ١٠٠٠ طفل مولود ولكن لوحظ ارتفاع هذه المعدلات إلى عشرة أمثال هذه النسبة نتيجة وجود عوامل مساعدة لذلك منها على سبيل حجز الطفل بعد ولادته بوحدة رعاية مركزة للأطفال حديثى الولادة.

الهدف: هو تحديد بعض عوامل المسببة لفقد السمع الحسى العصبى بين الأطفال المحجوزين بوحدة الرعاية المركزة للأطفال حديثى الولادة بمستشفى المنيرة بمحافظة القاهرة– مصر.

المنهجية: شملت هذه الدراسة الوصفية على ٧١٠ طفل حديث الولادة بمستشفى المنيرة بالقاهرة– مصر وقد كان عدد الذكور والإناث فى الدراسة (٤٠١ ولد، ٣٠٩ بنت) وقد تراوحت أوزانهم من ٦٨٠ جرام الى ٥٥٠٠ جرام وكان متوسط العمر الرحمى لهم (٣± ٣٥,٨) وتم تقييم السمع لدى الطفل وذلك عن طريق قياس الانبعاث الصوتى وتم اختباره مرة أخرى لمن فشل فى المرحلة الأولى ثم أخيرا لمن فشل فى المرحلة الثانية يتم قياس الضغط داخل الأذن ومن ثم تقييم السمع عن طريق استجابة الدماغ الحسية.

النتائج: لوحظ ان من بين الأطفال الذين تم فحصهم أن ٧٦,٧% منهم كانوا يعانون من ارتفاع نسبة الصفراء بالدم وأن من بينهم ٨,٧٣% قليلى الوزن واحتاج من بينهم ١٥,٥% لوضعهم على جهاز تنفس صناعى نتيجة صعوبات التنفس. وأشارت نتائج تقييم السمع أن ٨٠% من الأطفال لا يعانون من أى خلل بالسمع واحتاج ٢٠% للتقييم مرة أخرى كمرحلة ثانية وصلت النتاج من خلالها إلى ٩١%.

الخلاصة: التشخيص المبكر يحمى الطفل من فقدان دائم للسمع بكل مخاطره لذلك كان التوجه لعمل مسح لاكتشاف هذه الحالات مبكرا وسرعة علاجها ولذلك نوصى بأن يكون اختبار السمع لدى الأطفال جزء من الفحص الروتينى بعد الولادة لتفادى مخاطر فقدان السمع.

Introduction:

Hearing impairment is 20 times more prevalent in neonates than are other disorders that are routinely screened for, including hypothyroidism, sickle cell anemia, and phenylketonuria (Oghalai et.al., 2002).

A number of risk factors for SNHL were described, involving low gestational age and birth weight, intrauterine and postnatal infections, neonatal asphyxia, requirement for prolonged oxygen therapy and respiratory support, hyperbilirubinemia needing exchange transfusion, hyponatremia, surgery during the neonatal period, congenital malformations, family history of hearing impairment, genetic abnormalities, and exposure to ototoxic medications such as diuretics and antibiotics (Fuchs et.al., 2016).

Current recommendations are to conduct universal hearing screening in all infants. Techniques used primarily involved automated auditory brainstem responses and otoacoustic emissions that provide noninvasive recordings of physiologic auditory activity and are easily performed in neonates and infants (Wroblewska et al., 2017 b).

In contrast to the recommendations of the Joint Committee on Infant Hearing (JCIH), neonatal hearing screening programs are still not universally available, and many countries still implement elective screening in high- risk neonates (Korres et.al., 2005).

It was noted that early detection of hearing loss will improve the success of programs. Other studies supported by the National Institute of Health have concluded that children whose hearing loss is identified and who receive appropriate intervention before 6 months of age develop significantly better language ability than those who are identified later (Allen et.al., 1999).

Objective:

The goal of this study was To estimate the incidence of SNHL among newborns in NICU at Al- Monira Hospital, Cairo, Egypt; and to describe the distribution of risk factors associated with SNHL and the effects of their interaction.

Patients and Methods

This descriptive study was conducted on 710 neonates (1420 ears right& left), 401 were males and 309 were females, selected from a Hospital, between July 2016 and June 2017. The mean gestational age was 35.8± 3 weeks. Birth weight ranged from 680 to 5500 gm. All the newborns were examined by transient evoked otoacoustic emission (TEOAE) devices between the first and fourth day of life.

The screening was carried out over (2- 3) days in a week. These cases fulfilled the selection criteria of the HRR of the Joint Committee of Infant Hearing (1994). A portable TEOAE screener (Echo- Screen) was used for the first- stage screening, which gave a Pass or Refer response. A second-stage screening after (3- 4) weeks was carried out for cases given a Refer response, using the same equipment. Cases given a Refer response underwent an Automated Auditory Brainstem Response.

(AABR) test using the same portable Echo- Screen device at age 4th month. The newborns were tested with AABR after they failed the second- stage TEOAE tests, using three surface electrodes. The newborn was tested first at 35 and 55 dBnHL.

Both the TEOAE and AABR screening tests were conducted during natural sleep with no sedation.

Statistical Analysis:

All statistical calculations and analyses were carried out using the computer program SPSS version 12 (Statistical Package for Social Science; SPSS Inc., Chicago, Illinois, USA). The basic statistical analysis included arithmetic mean, SD, range, frequencies (number of cases), and relative frequencies (Percentages) of age and sex. All P- values are two- sided; P-value less than0.05 was considered significant.

Results:

In the initial screening of the 710 neonates in the NICU using TEOAE devices, 80% were given a Pass response and 20% were given a Refer for right ear as in Table (4) and 85.9% were given a Pass response and 14.9% were given a Refer for left ear as in Table (5). The mode of delivery was 38% by vaginal delivery and 62% by CS as shown in Table (1).

Table (1) Mode of Delivery among studied cases.

	No.	Percent
Vaginal	270	38
CS	440	62
Total	710	100

Table (2) Ventilation method among studied cases

	No.	Percent
NO	87	12.3
Nasal	14	2
CPAP	499	70.2
Mech Vent	110	15.5
Total	710	100

From Table (2), the number of neonates who were on Mechanical ventilation 110 (15.5%), 499 (70.2%) on NCPAP, 14 (2%) on nasal oxygen and 87 (12.3%) weren't need to oxygen.

Table (3) Hyperbilirubinemia among studied cases.

	No.	Percent
Negative	165	23.3
Positive	545	76.7
Total	710	100.0

From Table (3), the most frequent risk factor in the NICU is observed to be hyperbilirubinemia, the number of neonates with neonatal hyperbilirubinemia were 545 (76.7%).

Table (4) TEOAES stage 1 Right ear

	No.	Percent
Pass	475	80
Refer	120	20
Total	595	100
Died	115	
Total	710	

Table (5) TEOAES stage 1 Left ear

	No.	Percent
Pass	511	85.9
Refer	84	14.1
Total	595	100.0
Died	115	
Total	710	

A follow- up investigation was planned for all neonates who did not pass the initial screening by TEOAE. A second screening or rescreening was carried out in the follow- up clinic in Al- Monira Hospital, but out of the 131 cases (91%) that were given a Pass response and 13 cases (9%) were given a Refer response for right ear as shown in Table (6). And 135 cases (93.7%) that were given a Pass response and 9 cases (6.3%) were given a Refer response for right ear as shown in Table (7).

Table (6) TEOAES. STAGE. 2. RT ear

No.	Percent	
Pass	131	91
Refer	13	9
Total	144	100

Table (7) TEOAES. STAGE. 2. LT ear

Frequency	Percent	
Pass	135	93.7
Refer	9	6.3
Total	144	100.0

Table (8) Descriptive statistics among studied cases

	Mean	± Std. Deviation
Gestational Age/Week	35.8	3.0
Birth Weight/. Gm	2630.87	770.91
APGAR. SCORE. 1Min.	5.6	1.2
APGAR. SCORE. 5Min.	8.4	1.39
Hemoglobin Gm/Dl	14.8	2.3
Total Leukocytic Count	13718.78	6276.17
Platelets Count	237240.8	80267.9
Blood. P H	7.3	0.08
Paco2.	34.16	14.86
HCO3	17.12	5.7

Table (8) showed that the mean of Gestational age was 35.8 weeks, Mean of Birth Weight was 2630.87 grams, Mean of APGAR. score 1 Min. was 5.6 minutes. Mean of APGAR. score 5 Min. was 8.4 minutes, Mean of Hemoglobin was 14.8 gm/dl, Mean of Total Leukocytic Count was 13718.78/ cmm, Mean of Platelets count was 237240.8/ cmm, Mean of blood PH was 7.3, Mean of $PaCo_2$ was 34.16 and Mean of HCO_3 was 17.12.

Table (9) showed ANOVA One- way analysis with the outcome among studied cases.

Table (9) ANOVA One- way, With OUTCOME

		Sum Of Squares	Mean Square	F	P- Sig.
G Age	Between Groups	301.936	301.936	35.123	0.000
	Within Groups	5966.041	8.597		
	Total	6267.977			
Birth Wt	Between Groups	35587206.27	35587206.27	65.219	0.000
	Within Groups	385782140.647	545660.736		
	Total	421369346.92			
Apgar1	Between Groups	585.581	585.581	886.447	0.000
	Within Groups	466.379	0.661		
	Total	1051.960			
Apgar5	Between Groups	937.905	937.905	1477.499	0.000
	Within Groups	448.798	0.635		
	Total	1386.702			
Iv Fluids	Between Groups	1.033	1.033	10.442	0.001
	Within Groups	69.940	0.099		
	Total	70.973			
TPN	Between Groups	3.413	3.413	95.312	0.000
	Within Groups	25.318	0.036		
	Total	28.731			
STAY	Between Groups	900.251	900.251	10.149	0.002
	Within Groups	62712.386	88.702		
	Total	63612.638			
VENT	Between Groups	171250.096	171250.096	48.903	0.000
	Within Groups	2174635.563	3501.829		
	Total	2345885.660			

Discussion:

The current study was carried out on 710 neonates in a Hospital, Cairo, Egypt; The neonates in the study were 710 (401 Males and 309 Females) and had birth weight ranging from 680 to 5500 gm and the mean gestational age was 35.8± 3 weeks. All the cases were screened for hearing loss using the transient evoked otoacoustic emission device (Echo-Screen), followed by a second stage screening for those who failed the test with the transient evoked otoacoustic emission device. Those cases given a Refer were then made to undergo an Automated Auditory Brainstem Response test.

Results of the current study showed that 76.7% of cases had hyperbilirubinemia, 8.73% were of low birth weight (<1500 gm), and 15.5% were on mechanical ventilation. In the first screening phase, 80% were given a Pass response and 20% were given a Refer response for the right ear. In the second screening phase, 91% were given a Pass, 9% were given a Refer. The highest referral rates were in neonates with multiple risk factors.

Ahmed Sameh Farid (2012) studied 130 newborns, 30 had no risk factors for hearing loss (60 ears). In screening, 26 (86.7%) neonates passed the test and 4 (13.3%) had a Refer result. The failure was higher than cited by many authors (Bonfils et.al., 1988, Bener et.al., 2005); they found prevalence rates of hearing loss ranging from (0 to 5)%. However, all the previous authors had screened their cases after the second day of life, whereas in our study the cases were screened in the first 48 h of life, as reported by Levi et.al. (1997), who screened in the first 10- 48 h of life and reported a 22% referral rate. When the test was repeated after 108 h of life, the failure rate dropped to about 1%. This could be explained by the presence of vernix caseosa in the external canal or effusion in the middle ear, which could have been residual amniotic fluid.

The most frequent risk factor encountered in the NICU was ototoxicity (100%), followed by hyperbilirubinemia (55%), low birth weight (14.5%), mechanical ventilation for more than 5 days (11.5%), and finally craniofacial anomalies (1%). Vohr et.al. (2000) found that the four most frequent risk factors in the NICU were ototoxic drugs, low birth weight, mechanical ventilation for more than 5 days, and a low Apgar score.

Korres et.al. (2005) found that toxic levels of ototoxic drugs, mechanical ventilation for more than 24 h, prematurity, and low birth weight were the four frequent risk factors. Although there is a slight difference between the two studies, ototoxic drugs, mechanical ventilation,

and low birth weight were still the three most frequent risk factors in both studies. In contrast, hyperbilirubinemia was the most frequent factor encountered in our study and in other studies carried out in Egypt (Eldanasoury et.al., 2003), (El Gamal et.al., 2001).

This is a point that needs further research in coordination with pediatricians to assess its magnitude and effect, as neonatal jaundice is more likely to cause central rather than peripheral hearing loss. This necessitates the combination of TEOAE and ABR in cases with neonatal jaundice (Jakub et.al., 2003).

Most of the studied neonates were delivered by means of caesarian section (55%) with a mean weight of 3.19± 0.46 kg. All (100%) neonates attended the first- stage hearing screening, and only 27.8% of neonates attended the second stage. The most frequent risk factor was prematurity (54.6%). The percentage of high risk babies was 19.1% from the total neonates for the 3 years recorded for high risk. 10.3% attended the second stage and only one- fourth underwent diagnostic ABR. A percentage of 0.001- 0.003 hearing disorder was recorded. (Elsanadiky& Afifi, 2017).

Elsanadiky& Afifi (2017) showed that the highest risk factor was prematurity (54.6%), followed by sepsis (12.6%), hyperbilirubinemia (12.5%), hypoxia (2.8%), family history of hearing loss (2.4%), and congenital hearing loss (1.3%). The other 12.8% were admitted to the NICU for different causes (e.g., intrauterine growth retardation, respiratory distress syndrome, uncontrolled diabetes mellitus, and tachypnea).

TEOAEs test revealed failed response in some neonates, including high risk. Korres et.al. (2005), who examined hearing in well- nursery babies with TEOAEs in Greece, found a failure rate of 2.3%.

El- Gamal et.al. (2001), in Egypt, reported a failure rate of 54% in multiple risk factor neonates and 20% in the single risk factor neonates. However, Abdullah et.al. (2006) found that 11.8% of the screened high-risk neonates n Malaysia failed TEOAEs test. Imam et.al. (2013) recorded failed response in 28%.

Conclusion:

TEOAEs is sensitive, rapid, and simple test in newborn hearing screening. Universal two- stage NHS protocol should include AABR for all babies, not only the high- risk group. It is the key components of what constitutes "early intervention", and in particular what marks that intervention as being of high quality and leading to improved outcomes.

Recommendations:

A comprehensive intervention and management program must be an integral part of the screening program in the postnatal period. Public awareness about the value of hearing screening is important for follow- up to be more effective. Monitoring of ototoxic drug administration and further assessment of the high prevalence of hyperbilirubinemia are needed.

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