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Newborn Hearing Screening at Qena University Hospital

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ABSTRACT
Background: Permanent hearing loss is one of the most common congenital disorders, with an estimated incidence of one to three per thousand live births far exceeding the combined incidence of conditions for which newborns are routinely screened. **Objective:** The aim of this study was to estimate the incidence of hearing loss in newborn at Qena University Hospital, for early diagnosis, early intervention and good prognosis.
Patients and Methods: This cross-sectional study was conducted at Qena University Hospital and 100 neonates were examined. The study was conducted in a duration of 6 months.
Results: There was statistically significant relationship between the presence of risk factors such as prematurity, hyperbilirubinemia, hydrocephalus, respiratory distress syndrome, and amplitude of frequencies in both ears, there was no correlation between amplitudes of frequencies in both ears and age, heart rate, respiratory rate, incubation period or temperature. **Conclusion:** It could be concluded that otoacoustic Emission (OAE) is a reliable test for newborn hearing screening. Although all the 200 ears passed the screening test at Qena University Hospital, this does not guarantee a low prevalence of hearing loss but due to the limited number of cases and short duration of the study.
Keywords: Newborn, Hearing Screening

INTRODUCTION

Newborn hearing screening (NHS) is a strategy that enables us to identify congenital deafness and hearing loss. Over the past two decades, screening neonates for hearing deficit has become the standard of care in many countries all over the world. The major objective of NHS is to identify children with all kinds and degrees of hearing impairment, both bilateral and unilateral and to lower the age at the time of diagnosis for early hearing amplification, to maximize their linguistic competence and literacy development [(1)].

Hearing loss in infancy has been shown in numerous studies to be permanent, affecting not only the development of speech and language but also the cognitive, intellectual, cultural, and social development of children [(2)]. The international statistic is reported two to six per 1000 live birth suffering from hearing loss. In the United States, three per 1000 live birth are born with permanent hearing loss [(3)]. Due to the negative impact of hearing loss on child development, the World Health Organization recommends the Newborn Hearing Screening (NHS) programs [(4)].

The objective of the NHS is the early detection of hearing loss in those individuals who are very likely to be affected, referring them to rehabilitation [(5)].

Hearing screening at a young age is critical for a child's future development. Newborn hearing screening can detect infants with mild to moderate bilateral or unilateral hearing loss. These youngsters have previously been identified as having speech or educational issues later in childhood. In addition, children with hearing loss who are discovered early have a better chance of gaining language skills than children who are diagnosed later. Only children diagnosed with hearing loss early in life and fitted with hearing aids before the age of six months have a better chance of growing properly [(6)]. The aim of this study was to estimate the incidence of hearing loss in newborn at Qena University Hospital, for early diagnosis, early intervention and good prognosis.

PATIENTS AND METHODS

This cross-sectional study included a total of 100 neonates, attending at Qena University Hospital. This study was conducted for 6 months.

Inclusion criteria: Neonates at Qena university hospital.
Exclusion criteria: All Patients > 1 month of age.

All neonates were subjected to:
History: Personal history (age, sex, residency and socio-economic state of the parents), present history (Fever, tachypnea, dyspnea, yellowish discoloration, convulsion), past history (previous admission in NICU), prenatal history (Full term, preterm, type of delivery, type of medication, History of maternal disease, anoxia, convulsion, jaundice), nutritional history (breast feeding, artificial formula), developmental history, vaccination and family history (family history of hearing loss, Consanguinity)

Physical examination: General examination: Skin: Color: pink, jaundice, pallor, and plethora, head and neck: Assessment of head and neck, extremities: abnormal palmar creases, and talipes and back and spine: spinal defect, Scoliosis.
Vital signs: Hyperthermia>38 or hypothermia <36° rectal, tachycardia (infant heart rate >160 beats per minute and tachypnea (infants' respiratory rate >60 breaths per minute.

Instruments: - In this study we used one type of newborn hearing screening methods: Evoked Otoacoustic Emissions (EOAEs). (Interacoustics Titan). This method is safe and comfortable.
Trans evoked otoacoustic emission (TEOAE440): - From .5KHZ to 5.5 KHZ. measuring the amplitude of the frequencies, As well as the wave reproducibility offering

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complete and reliable TEOAE screening in a small, handheld device coupled with the TEOAE440 module, the Interacoustics Titan ensures precise stimulus intensity using real-ear detection methods, and can be configured to reject measurements in noisy environments.

Babies who do not pass on the first OAE test should be given a second screening, using ABR. A miniature earphone and microphone are placed in the ear; sounds are played and a response is measured.

***Ethical Consideration*:**

The study was approved by the Ethical Committee, the Faculty of Medicine, Qena University. Informed written consent was obtained from parents of all children participants before recruitment in the study, after explaining the objectives of the work. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Data were tested for normal distribution using the Shapiro Walk test. Qualitative data were represented as frequencies and relative percentages. Chi square test ($\chi 2$) to calculate difference between two or more groups of qualitative variables. Quantitative data were expressed as mean ± SD (Standard deviation). Independent samples t-test was used to compare between two independent groups of normally distributed variables (parametric data). P value < 0.05 was considered significant.

RESULTS

Table (1) shows that more than half of the screened neonates (53%) were males with mean age in hours 150.69±234.6 hrs. The mean incubation period was 3.47±7.5 days. 55% of them delivered cesarean and 45% were with vaginal delivery.

Table (1): Demographic distribution of the study group.

Variable	No. (n=100)
Gender	
Male	53
Female	47
Age (hours)	
Range (Min - Max)	719(1-720)
Mean±SD	150.69±234.6

Table (2) shows that there was statistical significant relationship between the presence of preterm as a risk factor and amplitude of frequency 5KHZ in the Rt ear where p vale =0.05, at the same time there was statistical significant relationship between the presence of RD Syndrome and hyperbilirubinemia as risk factor and amplitude of frequency 1KHZ in the Rt ear where p vale =0.03 and 0.01 respectively (figure 2), also there was statistical significant relationship between the presence of hydrocephalus as a risk factor and amplitude of frequency 2KHZ in the Rt ear where p vale =0.03 and there was statistical significant relationship between twins as a risk factor and amplitude of frequency 3KHZ in the right ear where p value=0.03.

Table (2): Distribution of risk factors according to amplitude of frequency among the study group in the right ear.

Variable		1KHZ	2KHZ	3KHZ	4KHZ	5KHZ
Sex	Male	8.1±6.1	8.8±6.6	8.5±6.8	6.5±4.8	4.1±4.01
	Female	8.3±6.2	9.8±6.7	9.1±6.1	6.3±4.6	4.5±3.5
P value		0.9	0.7	0.2	0.7	0.2
Low BW	Yes	8.1±6.1	8.1±6.1	8.1±6.1	8.1±6.1	8.1±6.1
	No	8.1±6.1	8.1±6.1	8.1±6.1	8.1±6.1	8.1±6.1
P value		0.1	0.7	0.2	0.5	0.6
Preterm	Yes	7.2±4	9.7±5.9	8.5±6.2	8.1±6.1	7.5±5.8
	No	8.4±6.1	9.3±6.7	8.1±6.1	8.8±6.4	4.5±3.6
P value		0.1	0.8	0.8	0.06	0.05**
RD Syndrome	Yes	8.1±6.1	10.1±6.4	10.3±7.4	7.6±4.3	4.5±3.7
	No	8.4±6.5	9.2±6.7	8.4±6.2	6.1±4.8	5.3±3.5
P value		0.03**	0.4	0.3	0.8	0.9
Hydro-cephalus	Yes	13±9.1	9.1±6.5	17±7	13.5±3.5	8 ±4.1
	No	8.1±6.1	22	8.6±6.3	6.2±4.6	4.6±3.7
P value		0.4	0.03**	0.9	0.4	0.9
Twins	Yes	9.3±6.7	13.6±8.01	9.6±12.5	5.3±4.5	3±1.7
	No	8.1±6.1	8.1±6.1	8.7±6.2	6.3±4.7	4.7±3.7
P value		0.7	1	0.03**	0.6	0.2
Hyper-bilirubinemia	Yes	6.8±2.8	12.7±6.9	12.6±6.1	8.1±6.1	8.1±6.1
	No	8.4±6.1	8.9±6.5	8.3±6.3	6.2±4.8	8.1±6.1
P value		0.01**	0.8	0.9	0.2	0.2

MANOVA test, *means (p < 0.05).

Table (3) shows that there was statistical significant relationship between the presence of preterm and hyperbilirubinemia as risk factors and amplitude of frequency 1KHZ in the Lt ear where p vale =0.05 and 0.01respectively, at the same time there was statistical significant relationship between the presence of RD Syndrome as a risk factor and amplitude of frequency 3KHZ,4KHZ,5KHZ in the Lt ear where p vale =0.01,0.02,0.03 respectively, also there was statistical significant relationship between the presence of hydrocephalus as a risk factor and amplitude of frequency 2KHZ ,3KHZ and 4KHZ in the Lt ear where p value =0.005,0.006 and 0.034respectively.

Table (3): Distribution of risk factors according to amplitude of frequency among the study group in the left ear.

Variable		1KHZ	2KHZ	3KHZ	4KHZ	5KHZ
Sex	Male	9.1±6.5	9.4±6.5	7.9±6.1	5.7±4.7	4.2±3.2
	Female	8.5±7.2	9.8±6.7	7.8±6.1	6.2±5.01	4.4±3.3
P value		0.7	0.8	0.9	0.7	0.7
Low BW	Yes	4±5.1	5.3±0.5	6.1±3.6	10.3±4.1	5.1±3.4
	No	9.1±6.9	9.8±6.8	8.1±6.1	5.7±4.7	4.3±3.2
P value		0.2	0.2	0.5	0.1	0.7
Preterm	Yes	2.5±3.7	4.00±1.8	8.1±6.1	7.5±5.4	3.7±3.7
	No	9.1±6.8	9.9±6.7	4.2±3.5	5.7±4.8	4.3±3.2
P value		0.05**	0.08	0.2	0.4	0.7
RD Syndrome	Yes	8.05±6.2	10.4±7.2	10.8±8.2	8.00±7.2	5.7±4.1
	No	9.1±7.01	9.4±6.7	7.2±5.2	5.3±3.8	3.9±2.9
P value		0.5	0.5	0.01	0.02	0.03**
Hydro-cephalus	Yes	15±12.1	23.1±1.5	7.7±5.7	13.5±7.5	7.5 ±3.5
	No	8.8±6.8	9.3.1±6.6	19.6±13.3	5.7±4.7	4.2±3.2
P value		0.2	0.005**	0.006	0.034	0.2
Twins	Yes	9.3±11.3	8.3±10.2	7.9±6.1	3.3±4.3	2.6±2.5
	No	8.9±6.8	9.7±6.7	8.6±4.6	5.9±4.8	4.3±3.2
P value		0.9	0.7	0.8	0.2	0.3
Hyper-bilirubinemia	Yes	6.8±2.8	12.7±6.9	12.6±6.1	8.1±6.1	8.1±6.1
	No	8.4±6.1	8.9±6.5	8.3±6.3	6.2±4.8	8.1±6.1
P value		0.01**	0.8	0.9	0.2	0.2

DISCUSSION

More than half of the screened neonates (53%) were males with mean age 150.69±234.6 hrs. The mean incubation period was 3.47±7.5 days. 55% of them delivered cesarean and 45% were with vaginal delivery.

1368 neonates (96.8%) passed the first OAE (otoacoustic emissions) in both ears in **Al-Balas *et al.*** [7] research, whereas 45 babies (30 females and 15 males) failed the first OAE in one or both ears at a rate of 3.2 percent. The lack of failed OAE in this study is attributed to the limited number of cases and short duration of the study.

Moreover, **Chen *et al.*** [8] demonstrated that the subjects screened included 10,665 (92.2%) normal newborns and 903 (7.8%) newborns with high-risk of hearing loss. While 8190 (70.8%) newborns passed the initial screening, 135 newborns failed in the re-screening, and 90 (66.7%) of these 135 newborns received diagnostic assessment. Finally, 58 infants were diagnosed as hearing loss, and the prevalence of congenital hearing loss among newborns in rural areas was 0.5% (58/11,568).

Several factors can influence the test and are linked to rising baby screening failure. Familial hearing inhibition, small for gestational age (SGA) status, male gender, the CD itself, vaginal delivery (VD), emergency CD, birth weight less than 2500 g, Apgar score less than 5 at 5 min, need for critical care, significant hyperbilirubinemia, and early-1st OAE before 24 hours of age are among these factors [9].

Regarding risk factors in our study group only 5 had Low BW, 4 were preterm, 3 were Twins, 20 had RD syndrome, 30 had consanguinity, 18 had hyperbilirubinemia but only 1 had Convulsions, no one of our cases had malnutrition, intra uterine infection or family history. 69 of the study group had no risk factors but 18 of them had one risk factor, 11had tow risk factor, 2 had three risk factors.

Our results showed that there was mild statistical significant relationship between the presence of preterm as a risk factor and amplitude of frequency 5KHZ in the Rt ear , at the same time there was strong statistical significant relationship between the presence of RD Syndrome and hyperbilirubinemia as risk factor and amplitude of frequency 1KHZ in the Rt ear , also there was strong statistical significant relationship between the presence of hydrocephalus as a risk factor and amplitude of frequency 2KHZ in the Rt ear. There was no statistically significant relationship between the total risk factors and any of the amplitude of frequency in the Rt ear. There were mild, strong and strong statistically significant relationship between wave reproduction and

the presence of preterm, twins and hyperbilirubinemia as risk factors respectively in the Rt ear.

There was strong statistically significant relationship between the total risk factors and amplitude of frequency 4KHZ were the mean of having 3 risk factors were 11±9.8 but that of having no risk factors were 5.01±3.3 in the Lt ear. There were very strong and strong statistically significant relationship between wave reproduction and the presence of twins and hyperbilirubinemia as risk factors respectively in the Lt ear.

There was no correlation between wave reproduction in both ears and age, heart rate, respiratory rate nor degree of temperature. There was no Correlation between amplitudes of frequencies in the both ears and age, heart rate, respiratory rate, incubation period or temperature.

The findings of this study were consistent with those of **Liu and Liu [10],** who reported that an analysis of information about risk factors in 57 cases diagnosed with hearing loss revealed that multiple risk factors coexisted in the majority of cases, with the primary diagnosis including: jaundice in 14 cases (14/57, 24.56 percent); neonatal asphyxia in 11 cases (11/57, 19.30 percent); premature birth and low birth weight in 10 cases (10/57, 17.54 and hypoglycemia in one case (1/57, 1.75%).

Furthermore, **Raquel *et al.* [11]** and other research found that the hearing screening referral rate was about 1.7 percent and the incidence of hearing loss was around 0.5 percent among low-birth-weight newborns. **Foulon *et al.* [12]** studied the incidence of sensorineural hearing loss caused by cytomegalovirus (CMV) infection in 14021 neonates and discovered that 0.53 percent of newborns had congenital CMV infection, with 22 percent suffering sensorineural hearing loss. These risk factors' impact on newborn hearing has been studied.

The definite diagnosis of permanent hearing loss is a combination of otolaryngological, audiological, and expanded audiological investigation, as well as diagnostic ABR, and behavioral assessment at 3 months to confirm electrophysiological diagnosis. The recommended test for all infants was OAE and ABR by the expert team (otologists, pediatricians, audiologists, audiological technicians, and nurses). Interpretation of otologic and audiologic results should be performed by an otolaryngologist [13].

CONCLUSION

It could be concluded that otoacoustic emmissio (OAE) is a reliable test for newborn hearing screening. Although all the 200 ears passed the screening test at Qena University Hospital, this does not guarantee a low prevalence of hearing loss but due to the limited number of cases and short duration of the study.

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