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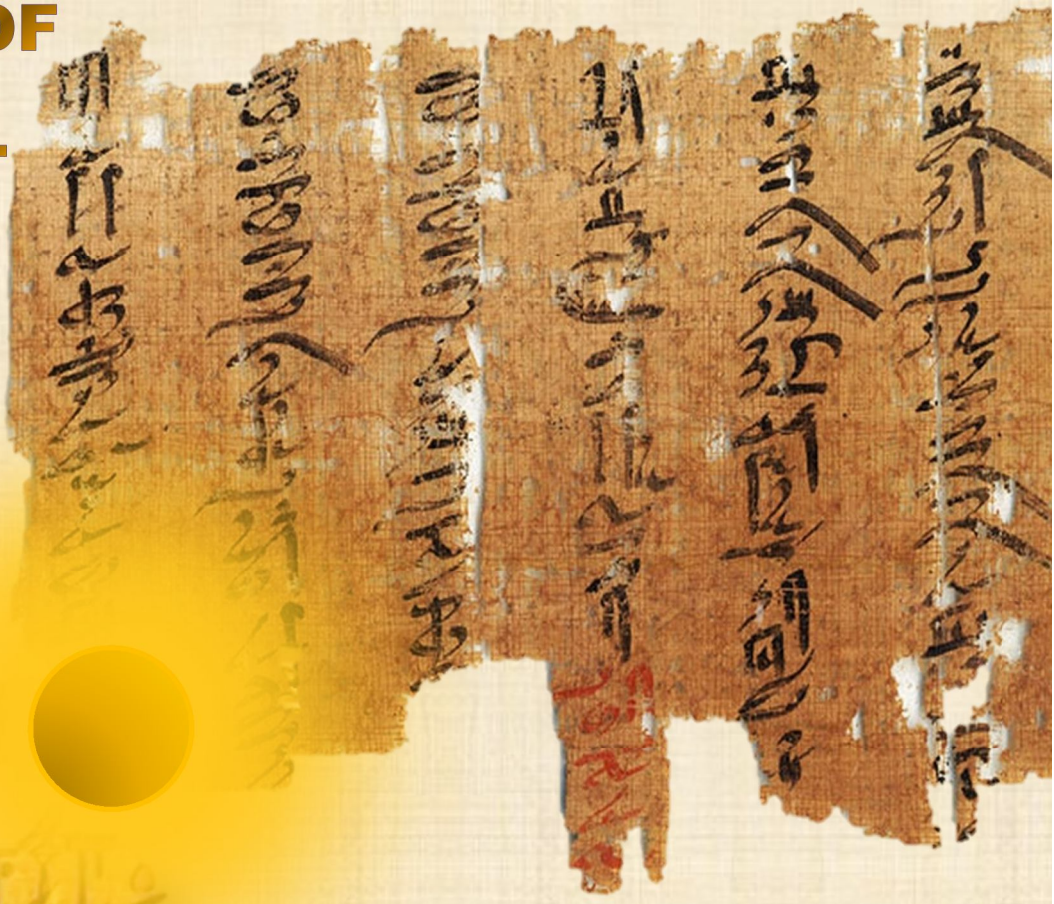

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Original article

Hearing Screening in Neonates of Pre-eclamptic Mother

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ABSTRACT

Background: The incidence of congenital sensorineural hearing loss in the new-born is higher than the combined incidence of all the metabolic conditions that we currently screen for with blood tests, the tool we are using, and the timing of screening are very important.

Aim of the work: To evaluate the possible effects of pre-eclampsia on the neonate's hearing and determine the best timing to perform the screening.

Patients and Methods: Seventy neonates were included, they were divided into two groups: control group included 40 neonates born to healthy mothers and study group included 30 neonates born to pre-eclamptic mothers. All neonates in this study subjected to the following: screening with handheld transient evoked otoacoustic emission [TEOAEs] within the first 48 hours after delivery. Infants who failed the first TEOAEs, were re-examined two weeks later. If failed, they were re-examined for the third time with TEOAEs two weeks later.

Results: There were statistically significant difference between the study and the control group as regards the TEOAES results [p-value = 0.001] in the first and second screening tests. In the control group, 73.8% passed from the first time, versus 41.7% of the study group. In the second TEOAEs, 17.5% control versus 41.7% of the study group.

Conclusion: Preeclampsia has some temporary effect on hearing in the newborns of pre-eclamptic mothers. So, it's better to postpone the first neonatal hearing screening of these babies, to be performed 2 weeks after delivery.

Keywords: Auditory Brainstem Response; Otoacoustic Emissions; Transient Evoked Otoacoustic Emission; Preeclampsia; New-born; Hearing screening.

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* Main subject and any subcategories have been classified according to research topic.

INTRODUCTION

Hearing loss is the most common cause of moderate and severe disability and a leading cause of disability in low- and middle-income countries[1].

Children with a disabling hearing loss are at risk of delayed speech and language development with consequent poor academic performance[2].

The congenital sensorineural hearing loss in the new-born is higher than the combined incidence of all the metabolic conditions that we currently testing for with blood tests. The prevalence of congenital bilateral permanent hearing loss is approximately 1 per 1000 live births[3].

The significant phase for speech and language development is around the time from birth to about 5 years old. Data from cohort studies indicate that the crucial time for diagnosis and intervention is earlier than 6 months of age since it provides opportunity for the improvement of language and speech.[4]

Auditory brainstem response [ABR], otoacoustic emissions [OAEs], and automated ABR [AABR] testing have all been used in new-born hearing-screening programs for 20 years .OAEs are consider to be fast objective screening test, it can be used to evaluate the cochlear function for the 500-6000 Hz frequency range. The presence of evoked OAE responses indicating normal or close to normal hearing sensitivity[5].

However, OAE is not an adequate screening tool in infants that at high risk for neuropathy. Infants were in the NICU or in the hospital for more than 5 days should undergo an ABR testing to insure that we don't miss the presence of neural hearing loss [5].

AABR is an electrophysiologic measurement that is used to assess auditory function from the eighth nerve through the auditory brainstem. The aABR test uses a series of click sounds at 35 dB hearing level and detects brainstem responses to these stimuli. AABR has also been found to be time and cost-effective, with a high sensitivity and a low failure rate[6].

In many developed economies new-born hearing screening with one of these two tests, is now mandatory prior to maternity hospital discharge. The mean age of hearing loss detection has fallen dramatically, after the universal neonatal hearing screening is practiced. The implementation of universal neonatal hearing screening in the under-developed and the developing nations is challenging. One option is to consider targeted rather than universal hearing screening. Targeted hearing screening, that only target new-borns with high risk factors can detect about 50% of hearing loss. Targeted screening can be a great starting step before resources become available for comprehensive and universal screening coverage[7].

Neonatal hearing screening is important because early intervention is associated with significantly better speech and language development than late intervention. The golden age to start intervention can be as early as six months[8-9].

Pregnancy-induced hypertension [PIH] or pre-eclampsia, occurs in about 6% of the general population; Pre-eclampsia may be associated with early delivery and foetal complications including acute and chronic uteroplacental insufficiency as a result of prematurity[10].

The association of PIH with congenital hearing loss still controversial. Also, the relation to the severity of the mother's PIH is not clear. At the time of designing this study the universal neonatal hearing screening was still not applicable in Egypt, so this study was done to determine the probable prevalence of hearing impairment in neonates who's their mothers suffered of preeclampsia, compared to those born to healthy mothers.

AIM OF THE WORK

To evaluate the possible effects of pre-eclampsia on the neonate's hearing and determine the best timing to perform the screening test.

PATIENTS AND METHODS

This was a cohort study, included 70 neonates matched on gestational age. All neonates were delivered in the Department of Gynaecology and Obstetrics [Kafrelheikh General Hospital, Ministry of Health, Egypt] from October 2018 through July 2019. They were divided into 2 groups: control group included 40 neonates born to healthy mothers and study group included 30 neonates born to pre-eclamptic mothers. Pre-eclampsia was diagnosed according to the criteria of Committee

on Obstetric Practice[11].

Neonates that enrolled in the study, whether born to healthy or preeclamptic women, should fulfilled the following inclusion criteria: 1] Gestational age of more than 32 weeks; 2] No risk factors, according to the modified high-risk criteria stated by American Academy of Pediatrics Joint Committee on Infant Hearing[12]

An approval from the ethical review board of Al-Azhar Faculty of Medicine [Girls] for this work was obtained in 2018.

After parental informed verbal consent, all neonates in this study subjected to the following: complete history, complete prenatal, perinatal and postnatal history; cleaning of neonatal ear. Examination by otoscope. Screening with handheld transient evoked otoacoustic emission **[EchoLab OAE-ABR screening]** within first 48 hours after delivery. Infants who initially failed the first TEOAEs, were re-examined two weeks later. If failed in the second test, they were re-examined for the third time with TEOAEs two weeks later. If the third TEOAEs were still abnormal, final confirmation with ABR **[Bio-logic Model Navigator PRO]** within first three months had been conducted.

Statistical Analysis: Data were collected, revised, coded and entered to the Statistical Package for Social Science [IBM SPSS] version 23. The quantitative data were presented as mean, standard deviations and ranges when their distribution found parametric and median within inter-quartile range [IQR] when their distribution found non-parametric. Also qualitative data were presented as number and percentages. The comparison between two independent groups with qualitative data was done by using Chi-square test and/or Fisher exact test only when the expected count in any cell found less than 5. The comparison between two independent groups with quantitative data and parametric distribution was done by using Independent t-test while non parametric distribution was done by using Mann-Whitney test.

RESULTS

This study included 40 neonates born to healthy mothers [The control group] and 30 neonates born to pre-eclamptic mothers [Study group]. The study group were 18 males [60%] and 12 females [40%]. Age ranged from 1 to 2 days [mean 1.67 ± 0.48].

Birth weight ranged from 2.2 to 4.1 kg [mean: 2.81± 0.53]. APGAR score ranged from 7 to 10 [median= 9]. Gestational age ranged from 34 to 40 weeks [mean = 36.97± 1.75].

According to the type of pre-eclampsia, the study group has been subdivided according to the severity of the preeclampsia into two subgroups: mild 20 [66.7%] and severe10 [33.3%].

There was no statistically significant difference found between the control group and the study group regarding gender, age and birth weight, while there was statistically significant difference found between the two groups regarding APGAR score [P value = 0.019] and gestational age [P value = 0.019] [Table1].

Table [2] shows that 59 out of 80 ears of the control group [73.8%] passed their TEOAE test from the first time, but only 25/60 [41.7%] of the pre-eclamptic study group had passed. Also 14/80 [17.5%] control ear passed from second time vs. 25/60 [41.7%] of the pre-eclamptic study group which was highly statistically significant difference between them with p-value = 0.001; which indicated that, there was high failure rate in first TEOAEs test in pre-eclamptic study group when compared to control group, while there was no statistically significant difference found between them in remaining results.

Two neonates failed their third TEOAEs test from the control group and four from the study group. They underwent diagnostic ABR, where normal results were recorded in the two of neonates of the control group and in one out of 4 from study group where wave V of ABR were traced down to 30 dBnHL.

The other 3 neonates from the study group were found to have various degrees of hearing loss ranging from severe to mild as shown in table [3], where one neonate had absent wave V at 90 dBnHL in both ears, another neonate had identifiable and repeatable wave V at 40 dBnHL in both ears, and one neonate had identifiable and repeatable wave V at 50dBnHL in right ear, and at 70 dBnHL in left ear.

So, when Chi-square test was done for comparison between control group and study group regarding ABR results, there was no statistically significant difference found between the two studied groups [P value > 0.05] [Table 3].

Table [1]: Comparison between control group and study group regarding demographic data.

		Control group	Study group	Test value	P-value	Sig.
		No. = 40	No. = 30			
Gender	Male	20 [50.0%]	18 [60.0%]	0.691*	0.406	NS
	Female	20 [50.0%]	12 [40.0%]			
Age in test [days]	Mean ± SD	1.70 ± 0.46	1.67 ± 0.48	0.293•	0.770	NS
	Range	1 – 2	1 – 2			
Birth weight [kg]	Mean ± SD	2.98 ± 0.39	2.81 ± 0.53	1.539•	0.129	NS
	Range	2 – 3.8	2.2 – 4.1			
APGAR score	Median [IQR]	9 [8.5 – 10]	9 [8 – 9]	-2.348≠	0.019	S
	Range	7 – 10	7 – 10			
Gestational age [weeks]	Mean ± SD	37.80 ± 1.02	36.97 ± 1.75	2.502•	0.015	S
	Range	34 – 40	34 – 40			

P-value > 0.05: Non significant [NS]; P-value < 0.05: Significant [S]; P-value < 0.01: Highly significant [HS]; *: Chi-square test; •: Independent t-test; ≠: Mann-Whitney test

Table [2]: Comparison between control group and study group regarding TEOAEs [total right and left].

TEOAEs	Control group Total [80 ears]		study group total [60 ears]		Test value*	P-value	Sig.
	No.	%	No.	%			
First Test	59	73.8%	25	41.7%	14.705	<0.001	HS
Second test	14	17.5%	25	41.7%	9.964	<0.001	HS
Third test	3	3.8%	2	3.3%	0.017	0.896	NS
Failed test	4	5.0%	8	13.3%	3.038	0.081	NS

P-value > 0.05: Non significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant *: Chi-square test

Table [3]: Comparison between control group and study group regarding ABR [total right and left].

ABR	Control group		study group		Test value*	P-value	Sig.
	No.	%	No.	%			
Normal	4	100.0%	2	25.0%	6.000	0.199	NS
>30-40dB	0	0.0%	2	25.0%			
41-55dB	0	0.0%	1	12.5%			
56-70dB	0	0.0%	1	12.5%			
Absent	0	0.0%	2	25.0%			

P-value > 0.05: Non significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant *: Chi-square test

DISUCSSION

Preeclampsia is responsible for a large proportion of maternal and perinatal mortality and morbidity, particularly when it occurs early in the second half of pregnancy [13]. PIH can cause pre-term birth or may necessitate premature induction of labour, leading to the problems of prematurity like hypoxia and intracranial haemorrhage which can lead to neural hearing loss [14].

In this study, there was statistically significant difference found between two studied groups regarding Apgar score [p-value =0.019] and gestational age [p-value =0.015]. This significant difference in the gestational age can be explained by that pre-eclampsia is one of the causes of premature labor[14], so gestational age decreased in study group when compared with control group.

This result is comparable to the study from Norway reveals that women with pre-eclampsia have a four times higher risk of having an infant small for gestational age [SGA] compared to normal pregnancies. If the disorder occurs in early pregnancy 53% of the infants are SGA[15].

The statistically significant difference in the APGAR score median value between study group and control group [p-value =0.019]. The low APGAR score can be due to the prematurity and significant difference in gestational age. This findings are in agreement with Sulaeman et al. [16], they performed a study on 450 preeclamptic women to correlate preeclampsia with Apgar score found that pre-eclampsia lead to low Apgar score in neonates.

As regard third TEOAEs screening there was no

statistically significant difference between both groups [p-value > 0.05] as regard pass or fail in the test. In other words , 3/80 [3.8%] ears of control group passed from third time and 2/60 [3.3%] ears of study group had passed, finally 4 ears of control group [5%] failed and 8 ears of study group [13.3%] failed [for ABR]. Therefore, it seems that pre-eclampsia might have some transient effect on hearing, which is recovered soon after separating most of the neonates from the probable toxic environment in the uterus of the affected mothers due to delivery. The current study is in agreement with, Bakhshaee, et al. [17], who found a significant difference in TEOAE of the neonates who were born to preeclamptic mothers in comparison to the controls in the first exam, which was performed immediately after delivery. In the follow-up tests with TEOAE and ABR two and four weeks later, the results in both groups did not show any significant difference. Another study confirmed the result of the current study done by Wells[14] in a clinical examination of 512 mothers with PIH, showed sensorineural hearing loss in only one child, which could be due to prematurity, foetal distress, and birth asphyxia, so he concluded that the incidence of direct association must be very low.

The present study is one of the first few studies which address the relation between the pre-eclampsia and hearing loss and the best time to conduct the neonatal hearing screening in this specific group to save the resources and to avoid the unnecessary stress on the families. However, the present study has a number of limitations. The sample size of the present study was not pre-planned and the statistical power of our findings is not clear. The sample was from a single-centre and the sampling technique was based on a non-probability consecutive sampling method, which may affect the generalizability of our findings, so we strongly recommend to repeat the study with bigger sample size and multi-centre based

In conclusions: Preeclampsia has some temporary effect on hearing in the new-borns of pre-eclamptic mothers. So, it's better to postpone the first neonatal hearing screening of these babies, to be 2 weeks after delivery. And to conduct further studies on a larger number of neonates of pre-eclamptic mothers to provide greater clarification of the probable association between PIH and neonatal hearing loss.

Financial and Non-Financial Relationships and Activities of Interest

Authors declare that, there was no competing interest

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