

**A STUDY OF HEARING EVALUATION FOR NEONATES WITH HYPERBILIRUBINEMIA USING OTOACOUSTIC EMISSION AND BRAIN STEM AUDITORY EVOKED RESPONSE**Poornima Shankar<sup>1</sup>, Manjunath V. C<sup>2</sup>**HOW TO CITE THIS ARTICLE:**

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**ABSTRACT:** Jaundice is one of the most common problems occurring in newborns. Although most of jaundiced patients are normal; because of the bilirubin toxicity, high serum levels can lead to kernicterus. It is important to identify and evaluate the jaundice early to prevent complications like bilirubin encephalopathy leading to hearing loss. Such early detection is possible only if some form of routine screening is used, one of which is otoacoustic emission. By detecting the hearing loss in time with screening methods we can ensure normal language development by appropriate intervention like hearing aids and infant stimulation. In this study otoacoustic emission will be followed by brain stem auditory evoked response and the results will be analyzed to look for the effectiveness of using otoacoustic emission for mass screening. **METHODOLOGY:** after obtaining approval and clearance from the institutional ethics committee this study included 105 children which satisfied the inclusion criteria. A standard case record was maintained for each subject. The neonate was subjected to otoacoustic emission just before discharge from the hospital. Otoacoustic emission was followed by brain stem auditory evoked response and the results compiled. Result of brain stem auditory evoked response was taken as gold standard and the results were analyzed. **RESULTS:** Abnormal OAE changes were seen in 6 and abnormal BERA was seen in 9 babies out of a total of 105 babies tested with hyperbilirubinemia. **CONCLUSION:** use of otoacoustic emissions as initial screening test provides as easy, cost effective and quick method to detect infants with hearing loss. As it is less invasive and less time consuming than BERA, dpOAE can be used as initial screening method for hearing loss in infants with BERA being reserved for infants that fail dpOAE.

**KEYWORDS:** Hyperbilirubinemia – Hearing, Evaluation – OAE – BERA – Neonates.

**INTRODUCTION:** Hyperbilirubinemia is the most common clinical condition requiring evaluation and management in the newborn.

Jaundice is one of the most common problems occurring in newborns. Although most of the jaundiced babies are normal, because of the bilirubin toxicity; high serum bilirubin levels can lead to kernicterus<sup>1</sup> (bilirubin encephalopathy) and hearing. Speech and hearing are interrelated-i.e. a problem with one could mean a problem with the other as speech and language is acquired normally through auditory system.<sup>2</sup>

The prevalence of mild to profound hearing loss is reported to be between 1.1- 6 per 1, 000 live-births and with prevalence of hearing loss is estimated to be between 2.5%- 10% among high-risk infants<sup>3</sup> Hearing impairment in infants should be identified as early as possible to enable interventions to take full advantage of the plasticity of developing sensory system. Hearing integrity in the first 3-4 years of life, the 'critical period', is essential for acquisition of speech and language.

Otoacoustic Emissions (OAE) reflect the status of the cochlea (outer hair cells). A probe

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microphone similar to that used in acoustic immittance measures the inaudible sounds reflected by vibratory motion in cochlea. OAE's are a byproduct of sensory outer hair cell transduction and are reflected as echoes into the external auditory canal. OAE's are preneural in origin and directly dependent on outer hair cell integrity.

Brainstem Evoked Response Audiometry (BERA) is an objective test of audio logical function which measures activity from the auditory nerve up to the level of brainstem on stimulating with acoustic stimulus. It assesses the neural integrity of auditory pathway up to the brainstem. However it is an indirect measure of hearing acuity.

**MATERIALS AND METHODS:** This study which was approved by the ethical committee was conducted in the neonatal care unit of department of pediatrics, KIMS, BANGALORE.

A total of 105 neonates were selected for the above study. Informed consent was obtained from the parents for OAE followed by BERA. The study was conducted between January 2012 and June 2013. The Inclusion Criteria were preterm neonates with serum bilirubin of >14mg/dl, term neonates with serum bilirubin of >12mg/dl.

Mother and neonates on ototoxic drugs (Aminoglycosides), babies delivered with major congenital anomalies, dysmorphic features, syndromic cases and all cases with family history of Hearing loss were excluded. This was a blind study conducted on 105 babies who had neonatal hyperbilirubinemia. The babies were subjected to OAE followed by BERA.

105 neonates who had neonatal hyperbilirubinemia were evaluated by means of:

1. Proper history.
2. Clinical examination including anthropometry, general examination and serum bilirubin.
3. Distortion Product Otoacoustic Emissions (DPOAE) testing of infants was done at discharge and was immediately subjected to Brainstem Evoked Response testing (BERA) to confirm hearing loss.

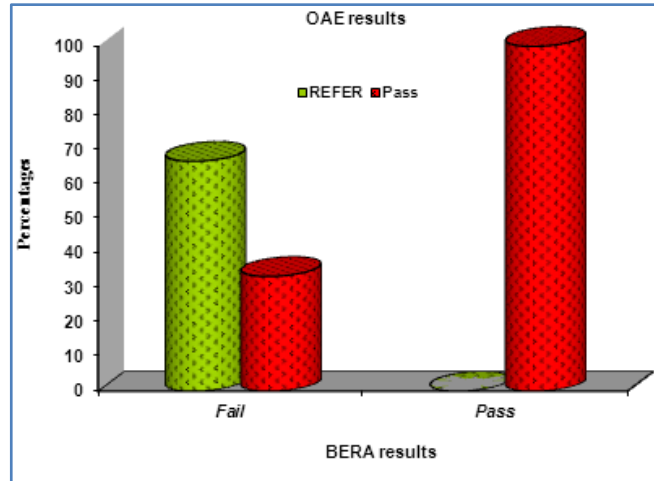
### RESULTS:

OAE results	No of Babies	BERA results	
		Fail	Pass
REFER	6(5.7%)	6(66.7%)	0
Pass	99(94.3%)	3(33.3%)	96(100.0%)
<b>Total</b>	<b>105(100.0%)</b>	<b>9(100.0%)</b>	<b>96(100.0%)</b>

**Table 1: Correlation of BERA results with OAE results**

OAE findings are significantly associated with BERA findings with  $P < 0.001^{***}$

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**Fig. 1: Correlation of OAE results with BERA results**

	Sensitivity	Specificity	PPV	NPV	Accuracy	Kappa
<b>OAE vs. BERA</b>	<b>66.67</b>	<b>100.00</b>	<b>100.00</b>	<b>96.97</b>	<b>97.14</b>	<b>0.785</b>

**Table 2: Correlation of OAE as Screening tool in relation to BERA results for hearing abnormalities**

**STATISTICAL METHODS:** Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean  $\pm$  SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance. Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups. 95% Confidence Interval has been computed to find the significant features. Confidence Interval with lower limit more than 50% is associated with statistical significance.

**DISCUSSION:** Hearing loss is referred to as the silent, overlooked epidemic of developing countries because of its invisible nature which prevents detection through routine clinical procedures.

Hearing loss in infants should be done with a screening test that is simple, cost effective, quick, sensitive, efficient, reliable and effective. In the absence of such objective screening test, hearing loss may not be detected until the child is 2-6 years of age, when intervention outcomes may be suboptimal.

Many centers in developed countries have programs for hearing screening both in the neonatal period and infancy<sup>4</sup> and such programs have helped to detect the infants with hearing loss in time.

Independent studies in Sheffield and Southampton compared OAEs with ABR in a total of over one thousand infants. They calculated that the two tier screen would have a specificity of over 99%.<sup>5</sup>

Screening for sensorineural hearing loss is reported to identify 260 infants per 1, 00, 000 infants screened in comparison to 50 infants per 1,00,000 infants screened for congenital hypothyroidism.<sup>6</sup>

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Because of this reason, this study was undertaken to document the importance of using Distortion Product Otoacoustic Emissions (DPOAE) as a screening tool for evaluating hearing loss and cochlear function and to screen for hearing loss in infants especially in high risk infants like hyperbilirubinemia.

### SUMMARY:

- Incidence of hearing loss of 8.6% was detected which is on the higher side as per published literature, but can be explained by the fact that the effects of hyperbilirubinemia is a transient phenomenon.
- ABO incompatibility was the commonest cause of hyperbilirubinemia in our study.
- As per the correlation of OAE and BERA it was found that OAE had a specificity of 100% but had a sensitivity of 66.67%.

As per the correlation of OAE as a screening test though it had a sensitivity of 66.67% it can still be used as a screening test considering the cost factor and also the ease of conducting OAE.

**CONCLUSION:** With the development of BERA a new era in hearing screening was introduced. But its invasive nature, need for infant cooperation, cost and need for trained audiologist to conduct the test proves as limitations for the test to be used on large number of infants as a screening tool.

Otoacoustic Emissions on the other hand is an easy, cost effective and reliable method of testing of large number of infants for hearing loss. OAE's a screening test does hold as a good promise in hearing screening. Also more studies are required to standardize the protocol required and to normalize data. This study was an attempt to show the importance of developing a hearing screen with DPOAE that when repeated appropriately and when required, combined with BERA for cases that fail serves as effective screening test.

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