

Screening of Neonates with Hyperbilirubinemia for Sensorineural Deafness

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ABSTRACT

BACKGROUND AND OBJECTIVES: Hyperbilirubinemia is associated with hearing impairment. This study was aimed to evaluate the incidence of hearing impairment among the term neonates with hyperbilirubinemia by using otoacoustic emission (OAE) and auditory brainstem response (ABR).

METHODS: This one year hospital based prospective observational study was conducted from October 2019 to March 2021. A Total of 190 healthy term neonates with hyperbilirubinemia admitted under the department of pediatrics, Mahadevappa Rampure Medical College, Kalaburagi during the study period were studied.

RESULTS: Most of the neonates were boys (60.53%) and boy to girl ratio was 1.53:1. History of consanguineous marriage was noted in 6.32% of the parents. The mean age was 4.73 ± 2.65 days. Majority of the neonates (97.37%) weighed between 2.5 to 3.5 Kg. The mean birth weight was 2.84 ± 0.84 Kg. The mean direct bilirubin levels were 0.88 ± 29 mg/dL and mean total bilirubin levels were 17.3 ± 2.58 mg/dL. During OAE-I, 33.16% of the neonates were advised to refer for second OAE and during OAE-II, 2.63% of the neonates were advised to undergo BERA. The incidence of hearing impairment based on BERA findings was 2.63%. 60.53% of the babies were born by LSCS while 39.47% were born through vaginal route and all the babies with hearing impairment had vaginal delivery while none of the baby with LSCS had hearing impairment ($p=0.009$). No association was found between hearing impairment in neonate with sex, age at admission and history of consanguineous marriage in parents and total bilirubin levels ($p>0.050$). Also the mean direct bilirubin, total bilirubin, birth weight, duration of NICU stay and age admission ($p>0.050$) were similar in babies with and without hearing impairment.

CONCLUSION AND INTERPRETATION: The present study showed incidence of hearing impairment as 33.16% based on OAE examination and 2.63% based on BERA.

KEYWORDS: Auditory brainstem response; Hearing impairment; Hyperbilirubinemia.

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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 (bilirubin encephalopathy).¹

The incidence of indirect bilirubin levels greater

than 12.9mg/dl in term neonates is 6-7% and less than 3% have bilirubin levels greater than 15mg/dl. Therefore it is very important to identify and evaluate the jaundice early, to prevent the complications like bilirubin encephalopathy, leading to hearing loss. Such early detection is possible only if some form of routine screening is used. However, to screen all neonates would neither be cost-effective nor practical. Hence it becomes necessary to focus on those neonates who are at high risk for this. One of the high risks being Hyperbilirubinemia.²

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.²

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.⁴ In most countries, newborn hearing screening programmes that screen only high-risk infants have been in existence for more than 20 years. However, this group of infants with hearing loss comprises only 50% of newborn population with hearing loss. Therefore, hearing screening programs that screened only high-risk neonates missed out 50% of hearing-impaired newborns, who are from among infants without any risks factors. Also as hearing loss is an invisible disability it cannot be passively identified until the child fails to develop speech and language.³

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. Unfortunately, by the time hearing loss in infancy and early childhood is suspected, audio logically evaluated and appropriately managed two or more of these critical years have elapsed and the child has lost an enormous developmental advantage.⁴

Otoacoustic Emissions (OAE) reflect the status of the cochlea (outer hair cells). 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 dependant on outer hair cell integrity.⁵

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.⁵

AIMS AND OBJECTIVES

To evaluate the burden of hearing impairment among the term neonates with hyperbilirubinemia by using otoacoustic emission (OAE) and auditory brainstem response (ABR).

To find the incidence of hearing impairment among term neonates with hyperbilirubinemia

MATERIALS AND METHODS

The present study was conducted in the Department of Pediatrics, Mahadevappa Rampure Medical College, Kalaburagi. The study design was a hospital based prospective observational study. This was conducted for a period from October 2019 to March 2021.

Inborn or Outborn neonates with hyperbilirubinemia admitted under the Department of Pediatrics, Mahadevappa Rampure Medical College, Kalaburagi during the study period were enrolled. Consent was obtained from parents of all children included in study.

Selection criteria

Inclusion criteria

Term neonates with TSB that requires either phototherapy or exchange transfusion according to American Academy of Paediatrics (AAP) guidelines during the first two weeks of postnatal life.

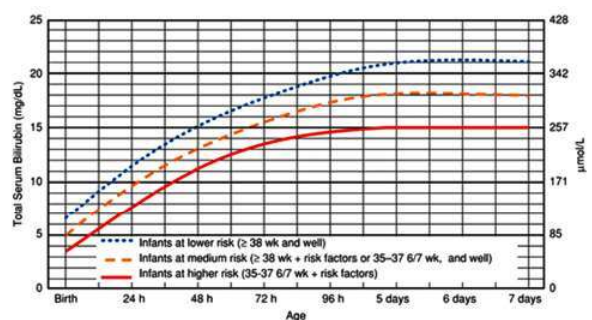


Fig. 1: Guidelines for phototherapy in hospitalized infants of 35 or more weeks gestation⁵

Exclusion criteria

Neonates with congenital anomalies, ototoxic drugs consumption, dysmorphic features, syndromic features, chromosomal disorders, family history of

hearing loss or congenital deafness, Torch infection, septicemia, pyogenic meningitis, mechanically ventilated, Birth asphyxia.

STATISTICAL METHODS

The data obtained was tabulated on Microsoft Excel spreadsheet. The data was analyzed by SPSS version 20.0 statistical software. The categorical data was expressed as ratios and percentages and continuous data was expressed in terms of mean±standard deviation (SD). The incidence of hearing impairment among term neonates with hyperbilirubinemia was expressed in terms percentages. The association of hearing impairment with risk factors was determined by Chi-square test or Fisher's exact test. Independent sample t test was used to compare means. At 95% confidence interval (CI), a probability value ('p' value) of less than or equal to 0.05 was considered to be statistically significant.

RESULTS

This one year hospital based prospective observational study was conducted from October

2019 to March 2021. A Total of 190 term healthy neonates with hyperbilirubinemia were studied. The data was analysed and the final results were tabulated and interpreted as below. Table 1 depicts the Distribution of babies according to the gender. 60.53% of the babies were boys and 39.47% of the babies were girls. The boy to girl ratio was 1.53:1.

Table 1: Distribution of babies according to the gender

Gender	Distribution (n=190)	
	Number	Percentage
Male	115	60.53
Female	75	39.47
Total	190	100.00

Table 2: Distribution of babies according to the age at phototherapy.

Age group (Days)	Distribution (n=190)	
	Number	Percentage
< 24 hours	0	0.00
>24 hours to 5 days	156	82.11
6 to 10	29	15.26
11 to 15	5	2.63
Total	190	100.00

Table 3: Distribution of babies according to the first OAE examination.

OAE findings	Right ear (n=190)		Left ear (n=190)	
	Number	Percentage	Number	Percentage
Pass	135	71.05	127	66.84
Refer	55	28.95	63	33.16
Total	190	100.00	190	100.00

Table 4: Distribution of babies according to the second OAE examination

OAE findings	Right ear (n=190)		Left ear (n=190)	
	Number	Percentage	Number	Percentage
Pass	186	97.89	185	97.37
Refer	4	2.11	5	2.63
Total	190	100.00	190	100.00

Table 5: Incidence of hearing impairment based on BERA.

Hearing impairment	Distribution (n=190)	
	Number	Percentage
Yes	5	2.63
No	185	97.37
Total	190	100.00

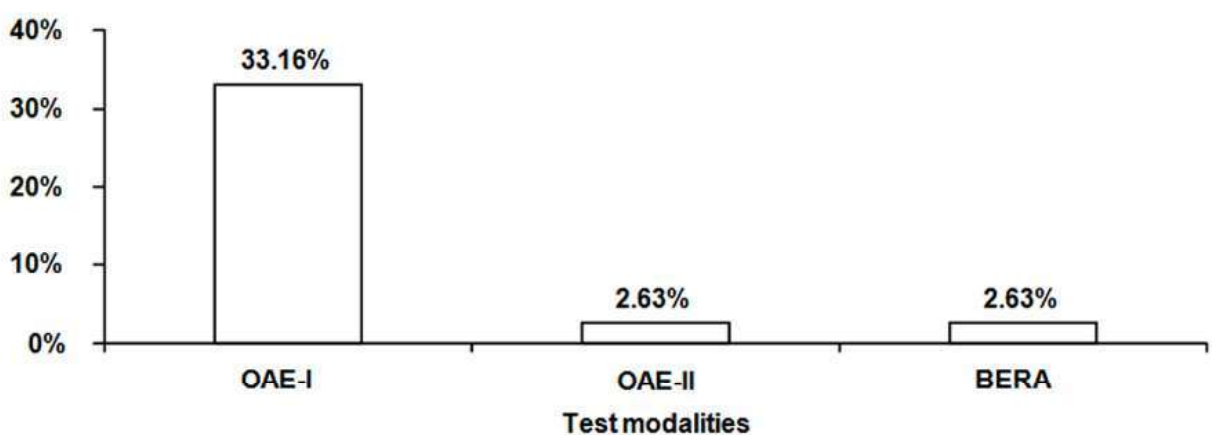
Table 6: Incidence of hearing impairment based on OAE-I, II and BERA.

Test modalities	Hearing impairment (n=190)	
	Number	Percentage
OAE- I	63	33.16
OAE-II	5	2.63
BERA	5	2.63

Table 7: Association between total serum bilirubin levels and hearing impairment.

Total bilirubin levels (mg/dL)	Hearing impairment				Total	
	No		Yes			
	No.	%	No.	%	No.	%
< 15.0	39	97.50	1	2.50	40	40.00
15.00 to 19.99	117	97.50	3	2.50	120	120.00
20.00 to 25.00	29	96.67	1	3.33	30	30.00
Total	185	97.37	5	2.63	190	100.00

p=0.966

**Fig. 2:** Incidence of hearing impairment based on OAE-I, II and BERA

In the present study incidence of hearing impairment was slightly high in neonates with total bilirubin levels of 20.00 to 25.00 mg/dL (3.33%) compared to those with 15.00 to 19.99 mg/dL (2.5%) and < 15.00 mg/dL (2.5%). But this difference was statistically not significant (p=0.966).

DISCUSSION

Hearing loss is thus referred to as the silent, overlooked epidemic of developing countries because of its invisible nature which prevents detection through routine clinical procedures. It is referred to as an epidemic because of its high prevalence, being the most frequently occurring birth defect, and even though it is not a life-threatening condition, failure to intervene in time renders it a severe threat to critical quality of life indicators. WHO estimates that globally the number of people with hearing loss, has more than doubled from 120 million in 2005 to at least 278 million in 2015, thus making this condition the most prevalent sensory deficit in the population. In India, it is estimated that 18.49 million persons have disability that equivalents to 1.8 percent of the

total population of the country where 10 percent of this figure are likely to have hearing disability of moderate to profound degree. Moreover, this number is likely to go up if we add lower degree of hearing disability.⁶

The adverse affects of hearing loss on language and cognitive development, as well as on psychosocial behavior are widely reported against the established benefits of early intervention. The definition of early identification and intervention has evolved over the years. In the past, early identification was defined as intervention before the age of 18 months. However now early identification is defined as diagnosis as early as 3 months with intervention by 6 months.⁸

Though a battery of tests are available today to detect hearing loss. Screening for 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 suboptima. 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. 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.⁷ Many centers in developed countries have programs for hearing screening both in the neonatal period and infancy and such programs have helped to detect the infants with hearing loss in time to ensure normal language development by appropriate intervention like hearing aids and infant stimulation. Of all the screening programmes for neonates it is screening for deafness which gives the maximum yield and is most cost effective. However unfortunately neonatal screening in india is a neglected field.¹⁰

With increasing emphasis on neonatal care and the improving survival of high risk neonates the chances of hearing impairments in survivors are likely to be quite high. Hence in this study emphasis was given studying hearing abnormalities in hyperbilirubinemia with OAE and BERA. A feasible system would be one where a hospital like ours would offer facilities like OAE and BERA to neonates referred from peripheries. A high risk register is supposed to be maintained for those children with suspect hearing or proven hearing loss so that follow up and periodic monitoring would be facilitated. This hospital based prospective observational study was conducted from October 2019 to march 2021. A Total of 190 term healthy neonates with hyperbilirubinemia admitted under the Department of Pediatrics, Mahadevappa Rampure Medical College, Kalaburagi during the study period were studied. Neonates were subjected to OAE twice and the neonates who had impaired hearing during OAE-II were evaluated for BERA.

It is universally accepted that screening for hearing loss in neonates is crucial. Recognition and treating hearing loss in its early phase by screening is of critical value.⁹ In this study on first OAE, 28.95% of the neonates were advised to refer for second OAE based on right ear examination and 33.16% of the neonates based on left ear examination. But, during second OAE, only 2.11% of the neonates were advised to undergo BERA after second OAE based on right ear examination and 2.63% of the neonates based on left ear examination. Baradaranfar MH, et al.⁹ (2011) performed OAE on thirty-five neonates with hyperbilirubinemia, thirty cases (85.7%)

passed whereas the remaining (14.3%) seemed to be failures. The result of our study showed much high hearing impairment based on OAE. In the present study mean duration of NICU stay in neonates with and without hearing loss was almost similar statistically (4.40 ± 0.89 vs 4.27 ± 1.05 days; $p=0.774$). Overall the present study showed decrease in incidence of hearing impairment from 33.16% based on first OAE-I examination to 2.63% based on OAE-II examination and confirmed by BERA at three months interval in term neonates with hyperbilirubinemia. Furthermore, the risk of hearing impairment is high in neonates who were delivered through vaginal route and develop hyperbilirubinemia. However, these findings require careful interpretation due to potential limitations of this study that is, single centre study, relatively smaller sample size, smaller subset of neonates with hearing impairment which limited us to evaluate the other risk factors. Also none of the neonate in our study had family history of deafness.

Among the 5 children with hearing impairment, 2 babies were referred for cochlear implant to higher centre. Remaining 3 babies could not be followed up.

CONCLUSION

The incidence of hearing impairment based on OAE-I was 33.16%. The incidence of hearing impairment based on OAE-II was 2.63% which was confirmed on BERA at three months interval in term neonates with hyperbilirubinemia.

Hence the incidence of hearing impairment in term neonates with hyperbilirubinemia was 2.63%. The risk of hearing impairment is high in neonates who were delivered through vaginal route and develop hyperbilirubinemia.

Hearing impairment in neonates with hyperbilirubinemia was independent of sex, age at admission, history of consanguineous marriage in parents. Strict monitoring, timely diagnosis and treatment of hyperbilirubinemia help not only in the prevention of hyperbilirubinemia but also in prevention of hearing impairment.

REFERENCES

1. Jaundice and hyperbilirubinemia in the newborn. In: Behrman RE, Kliegman RM, Jenson HB, eds. Nelson Textbook of Pediatrics 21st ed. Philadelphia: Saunders, 2020:511-528.
2. Osuorah CDI, Ekwochi U, Asinobi IN.

- Clinical evaluation of severe neonatal Hyperbilirubinaemia in a resource-limited setting: a 4-year longitudinal study in south-East Nigeria. *BMC Pediatr*. 2018;18(1):202.
3. Vinodh M, Ambikapathy P, Aravind MA, Ganesh J. Reversibility of Brainstem Evoked Response Audiometry Abnormalities at 3 Months in Term Newborns with Hyperbilirubinemia. *Indian Pediatr* 2014;51:134-135.
 4. Martínez -Cruz CF, Alonso-Themann PG, Poblano A, Cedillo-Rodríguez IA. Hearing and Neurological Impairment in Children with History of Exchange Transfusion for Neonatal Hyperbilirubinemia. *International J Pediatr* 2014;Article ID 605828:7 pages.
 5. American Academy of Pediatrics, Joint Committee on Infant Hearing. Year 2007 position statement: principles and guidelines for early hearing detection and intervention programs. *Pediatrics* 2007;120(4):898-921.
 6. Mirajkar S, Rajadhyaksha S. Hearing Evaluation of Neonates with Hyperbilirubinemia by Otoacoustic Emissions and Brain Stem Evoked Response Audiometry. *J. Nepal Paediatr Soc* 2016;36(3):310-3.
 7. American Academy of Pediatrics Subcommittee on Hyperbilirubinemia;. Management of hyperbilirubinemia in the newborn infant 35 or more weeks of gestation. *Pediatrics* 2004;114(1):297-316.
 8. Hulzebos CV, van Dommelen P, Verkerk PH, Dijk PH, Van Straaten HLM. Evaluation of treatment thresholds for unconjugated hyperbilirubinemia in preterm infants: effects on serum bilirubin and on hearing loss? *PLoS One* 2013;8:e62858.
 9. Paulraj MP, Subramaniam K, Yaccob SB, Adom AH, Hema CR. Auditory evoked potential response and hearing loss: a review. *Open Biomed Eng J* 2015;9:17-24.
 10. Shankar P, Manjunath V. Study of hearing evaluation for neonates with hyperbilirubinemia using otoacoustic emissions and brain stem auditory evoked response. *J of Evolution of Med and Dent Sci* 2014;3(10):2403-7.