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Original Research Article

A study on prevalence and risk factors of hearing impairment among newborns

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ABSTRACT

Background: Hearing impairment in children constitutes a particularly serious obstacle to their optimal development. Early detection of hearing impairment is vital since early intervention including hearing aids and speech therapy can be initiated at the earliest and will help them to enjoy equal opportunities in society alongside all other children. The aim of the study was to determine the prevalence and risk factors associated with hearing impairment among newborns delivered in a tertiary care centre using a two staged OAE test.
Methods: This study was a prospective descriptive study done in Govt. T.D. medical college, Alappuzha over a period of 12 months. All newborns (4359) were included in the study. They were carefully evaluated for presence of risk factors and OAE was done before discharge from the hospital. If found abnormal OAE was repeated at 6 weeks, failing which BERA was performed.
Results: Out of 4268 newborns screened, 275 failed OAE (6.4%) and 44 failed second OAE (1.03%) also. BERA was done in 40 newborns out of whom 6 failed (prevalence of 1.3 per 1000 population). Risk factors studied were prematurity, perinatal asphyxia, hyperbilirubinemea requiring phototherapy, congenital infection, family history of deafness, NICU admission more than 5 days, culture positive sepsis and newborns receiving ototoxic medications.
Conclusions: Hearing impairment was more among those with risk factors. But hearing evaluation is important in all newborns irrespective of presence of risk factors to avoid missing hearing impairment in otherwise normal newborn.

Keywords: Hearing impairment, OAE, Risk factors, Screening

INTRODUCTION

Hearing impairment in children across the world constitutes a particularly serious obstacle to their optimal development and education, including language acquisition. Neonatal hearing loss has a prevalence that is more than twice that of other newborn disorders such as congenital hypothyroidism and phenylketonuria.[1,2] Congenital, bilateral hearing impairment occurs in approximately 1 to 5 per 1000 live births and when permanent unilateral hearing loss is included, the incidence increases to 8 per 1000 live births.[3-5] Studies done in India using different hearing screening protocols have estimated the prevalence of neonatal hearing loss to vary between 1 and 8 per 1000 babies screened.[6-9]

First year of life is the critical period for brain development, especially auditory pathway. Auditory experience during this period has good influence on the functional development of auditory system.[10]

American Academy of Pediatrics (AAP) in 1999 advocated Universal New Born Hearing Screening Programme (UNHSP) and remedial intervention which is being practiced in most of the developed countries. In a

developing country like India, the risk of infants to develop these difficulties is obviously more.[11,12] In India, newborn hearing screening is usually available only to newborns brought to tertiary referral hospitals.[13,14]

A two stage screening protocol with otoacoustic emission (OAE) as the first screen, followed by auditory brainstem response (ABR) for those who fail the first screen was introduced.[15]

The AAP Task Force on newborn and infant hearing recommends UNHS by 3 months of age with intervention by 6 months of age. The Joint Committee on Infant Hearing (JCIH) position statement provides guidelines that include Newborn Hearing Screening (NHS) soon after birth, before discharge from hospital, or before 1 month of age, diagnosis of hearing loss through audiological and medical evaluation before 3 months, and intervention through interdisciplinary programme for infants with confirmed hearing loss before 6 months of age.[16]

METHODS

This prospective descriptive study was done on all babies born during the study period of 12 months (July 2016 – June 2017) including those admitted in Inborn and Outborn Nursery as well as those babies who were kept at mother's side in obstetrics ward in Government T. D. Medical College Hospital.

Sample included all newborn babies born in labor ward of Govt. T.D Medical College Hospital, Alappuzha and babies in Outborn nursery during the period July 2016 to June 2017 which included a total of 4359 babies.

After getting ethical committee clearance, study was started in July 2016. All newborns born in labor rooms were included in study excluding those not given consent, died or referred. Newborns admitted in newborn ICU were carefully evaluated for presence of risk factors and OAE was done on all healthy newborns by a person trained in OAE before discharge from the hospital. Risk factors evaluated include preterm birth, perinatal depression, hyperbilirubinemea requiring phototherapy, congenital infections, family history of deafness, NICU admission for more than 5 days, culture positive sepsis, ototoxic medications

Babies were screened by portable handy equipment interacoustic "the titan".

Babies who failed the first OAE underwent a second OAE at 6 weeks when they were brought for immunization.

Babies who failed the second OAE also were referred to audiologist to perform BERA using ''Intelligent Hearing Systems" Evoked Potential machine.

Statistical analysis

Statistical analysis was done using computer software SPSS. Data was expressed in frequency and percentage. To elucidate the associations Chi square test and student's t test were used. For all statistical evaluations, a two tailed probability of value, <0.05 was considered significant.

RESULTS

Of 4359 newborns taken in study 946 (21.7%) newborns had one or more risk factors and 3413(78.3%) had no risk factors.

Table 1: Percentage distribution of the sample according to risk factor.

Risk factor	Number	Percentage
present	946	21.7
absent	3413	78.3

Of the 946 newborns preterm 640 (67.6%), babies with perinatal asphyxia 66 (6.9%), hyperbilirubinemea requiring phototherapy 307 (32.4%), congenital infections 28 (2.95%), family history of hearing impairment 9 (0.95%), newborn ICU admission more than 5 days 203 (21.45%), culture positive sepsis 32 (3.38%) and those received ototoxic medication 107 (11.31%). Many had more than one risk factors.

Table 2: Percentage distribution of each risk factor.

Risk factor	Number	Percentage
Preterm	640	67.6
Perinatal depression	66	6.9
phototherapy	307	32.4
Congenital infections	28	2.95
Family H/O of deafness	9	0.95
NICU > 5 days	203	21.45
Culture positive sepsis	32	3.38
Ototoxic medication	107	11.31

Hearing impairment profile of newborn delivered in TDMCH.

Table 3: Percentage distribution of the sample according to first OAE.

First OAE	Count	Percent
Pass	3993	93.6
Fail	275	6.4

Table 4: Percentage distribution of the sample according to second OAE.

Second OAE	Count	Percent
Pass	214	82.9
Fail	44	17.1

First OAE was done for all newborns among whom 3993 (93.6) passed and 275 (6.5%) failed. In those newborns who had failed first OAE, repeat OAE was done around 45 days of age, among whom 17 were lost for follow up. In the remaining 258 infants second OAE was done at 45 days and 214 newborns passed (82.9%) and 44 newborns failed (17.1%).

Table 5: Percentage distribution of the sample according to BERA study.

BERA	Count	Percent
Pass	34	85.0
Fail	6	15.0

Table 6: Comparison of selected variables based on risk factors of first OAE.

		Pass		Refer		χ^2	p
		Count	Percent	Count	Percent		
Gestational age	Term	3452	94.7	195	5.3	49.99**	0.000
	Preterm	541	87.1	80	12.9		
Perinatal asphyxia	Absent	3953	94.0	254	6.0	80.39**	0.000
	Present	40	65.6	21	34.4		
Phototherapy	Absent	3736	94.1	234	5.9	28.44**	0.000
	Present	257	86.2	41	13.8		
Congenital infection	Absent	3969	93.6	271	6.4	2.88	0.090
	Present	24	85.7	4	14.3		
Family h/o	Absent	3991	93.7	268	6.3	76.13**	0.000
	Present	2	22.2	7	77.8		
NICU > 5 days	Absent	3869	95.0	205	5.0	296.18**	0.000
	Present	124	63.9	70	36.1		
Culture positive sepsis	Absent	3984	94.0	253	6.0	215.67**	0.000
	Present	9	29.0	22	71.0		
Ototoxic medication	Not given	3942	94.6	223	5.4	339.63**	0.000
	Given	51	49.5	52	50.5		
Risk factor	Absent	3198	95.3	158	4.7	78.46**	0.000
	Present	795	87.2	117	12.8		

**Significant at 0.01 level

Table 7: Comparison of selected variables based on risk factors at second OAE.

		Pass		Refer		χ^2	p
		Count	Percent	Count	Percent		
Gestational age	Term	168	91.8	15	8.2	34.91**	0.000
	Preterm	46	61.3	29	38.7		
Perinatal asphyxia	Absent	202	85.2	35	14.8	10.76**	0.001
	Present	12	57.1	9	42.9		
Phototherapy	Absent	193	88.5	25	11.5	31.02**	0.000
	Present	21	52.5	19	47.5		
Congenital infection	Absent	210	82.7	44	17.3	0.84	0.361
	Present	4	100.0	0	0.0		
Family h/o	Absent	211	84.1	40	15.9	8.17**	0.004
	Present	3	42.9	4	57.1		
NICU > 5 days	Absent	180	94.2	11	5.8	66.33**	0.000
	Present	34	50.7	33	49.3		
Culture positive sepsis	Absent	208	87.8	29	12.2	47.78**	0.000
	Present	6	28.6	15	71.4		
Ototoxic medication	Not given	195	93.8	13	6.3	88.57**	0.000
	Given	19	38.0	31	62.0		
Risk factor	Absent	142	96.6	5	3.4	45.02**	0.000
	Present	72	64.9	39	35.1		

**Significant at 0.01 level

BERA was done for all newborns who failed the second OAE of which only 6 failed. Risk factor for hearing impairment among the newborns.

Among risk factors, out of 621 preterm, 80 failed (12.9%); 61 with perinatal depression, 21 failed (34.4%); 298 who received phototherapy 41 failed (13.8%); 9 with family history of hearing impairment 7 failed (77.8); 194 with newborn ICU admission 70 failed (36.1%); 31 with culture positive sepsis 22 failed (71%); 103 who received ototoxic medication 52 failed. All these values are statistically significant [p<0.01].

Table 8: Comparison of selected variables based on risk factors of BERA.

		Pass		Fail		χ^2	p
		Count	Percent	Count	Percent		
Gestational age	Term	12	85.7	2	14.3	0.01	0.926
	Preterm	22	84.6	4	15.4		
Perinatal asphyxia	Absent	27	87.1	4	12.9	0.48	0.491
	Present	7	77.8	2	22.2		
Phototherapy	Absent	21	91.3	2	8.7	1.69	0.194
	Present	13	76.5	4	23.5		
Congenital infection	Absent	34	85.0	6	15.0	-	-
	Present	0	0.0	0	0.0		
Family h/o	Absent	30	83.3	6	16.7	0.78	0.376
	Present	4	100.0	0	0.0		
NICU > 5 days	Absent	9	90.0	1	10.0	0.26	0.609
	Present	25	83.3	5	16.7		
Culture positive sepsis	Absent	24	88.9	3	11.1	0.99	0.321
	Present	10	76.9	3	23.1		
Ototoxic medication	Not given	10	83.3	2	16.7	0.04	0.847
	Given	24	85.7	4	14.3		
Risk factor	Absent	3	75.0	1	25.0	0.35	0.555
	Present	31	86.1	5	13.9		

Among 111 newborns with one or more risk factors who underwent second OAE, 39 failed (35.1%); 29 out of 75 preterm (38.7%); 9 out of 21 newborns with perinatal depression (42.9%); 19 out of 40 who received phototherapy (47.5%); 4 out of 7 with family history of hearing impairment (57.1%); 33 out of 77 newborns admitted in newborn ICU (49.3%); 15 out of 21 with culture positive sepsis (71.4%); 31 out of 50 who received ototoxic medication (62.0%) failed second OAE.

DISCUSSION

Early detection of hearing impairment by screening at or shortly after birth helps in appropriate intervention that are critical for speech, language and cognitive development. Universal Neonatal Hearing Screening (UNHS) is done for all child irrespective of presence or absence of risk factor to identify hearing impairment as early as possible to provide interventions.

In our study 6 babies out of 4359 failed in BERA which means a prevalence of 1.3 per 1000 population which is similar to those in literature (1 per 1000) and prevalence among high risk newborn is 0.63 per 100 which is similar to those of study by Abraham K Paul et al (0.7 per 100 high risk newborn) and by Van Straaten HL et al, Finitzo et al (1-2 case per 200 high risk newborn).[17,18]

Prevalence of individual risk factor as in JCIH include preterm birth (14.7%), perinatal asphyxia (1.5%), hyperbilirubinemia requiring phototherapy (7%), congenital infection (0.6%), family history of hearing impairment (0.2%), NICU admission more than 5 days (4.7%), culture positive sepsis (0.7%), babies who received ototoxic medicine (2.5%).

Thus, prevalence of all risk factors combined is 21.7% which is similar to those from study by Paul AK et al, (16.63%).

Among newborn tested for first OAE 6.3% failed, whose value are usually variable and depends on risk factor distribution in each population, this is similar to the study done by De Oliveire JS et al (7.2%).[19] But failure rate can be as high as 12% as in Paul AK et al, and may be an acceptable figure because of early screening on Day 2 or 3 of delivery in view of the early discharge practice.

Abdullah et al, found that 11.8% of the screened high risk neonate failed in OAE test which is similar in this study (12.8%).[20] Among study group 44 newborn failed in both

OAE screening which constitute around 1.00% which is similar to those found in study by Watkin PM et al.

In this study conducted from July, 2016 till June 2017 for a period of one year include all newborn delivered in labor room which includes a total of 4359 excluding babies those died during the stay in hospital which includes a total of 33.

This study was conducted for a period of one year and included 4359 newborns. First OAE was not done for 119 newborns out of 4359 (2.72%) which is less than 4% cutoff given by Universal Neonatal Hearing Screening (UNHS) guidelines. 17 newborns were missed in second OAE out of 275 who failed in first OAE. 4 newborns were missed during BERA study out of 44 newborns who failed in second OAE which is quite high. If all these newborn were screened, then chance of missing babies with hearing impairment could have been minimised. This high value may be partly because of shortage of trained technicians. Only single technician was allotted for screening the whole population.

CONCLUSION

Hearing impairment is more among those with risk factor such as preterm birth, hyperbilirubinemea requiring phototherapy, NICU admission more than 5 days, culture positive sepsis and ototoxic medicines. But, hearing evaluation is important in all newborn irrespective of presence of risk factor for hearing impairment. Two step hearing evaluation using OAE is done. BERA is done for those who failed the second OAE but those who failed OAE and passed BERA may also have mild degree of hearing impairment and must be followed up.

Limitations of the study were, since the study was done in tertiary centre it doesn't project the hearing impairment of whole population. Genetic testing for hearing impairment was not done. Tests to rule out CMV infection was not done for all babies delivered. Since single technician performed OAE for all newborn, many newborns were lost for follow up.

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