



TRANSCRANIAL ULTRASOUND IN PRETERM NEONATES WITH SUSPECTED INTRACRANIAL PATHOLOGIES

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ABSTRACT

Most of the neonatal centers in India nowadays have advanced medical care even at tertiary as well as community levels. Preterm neonates (defined as <37 weeks gestation) are a major predisposing factors for neonatal mortality and morbidity, since neonates who are born prematurely are prone for sensory deficits, learning disabilities, respiratory symptoms and cerebral palsy as compared to children born at term. Early diagnosis is important for prognostication, optimal treatment and predicting the neurological outcome. Since neurosonography is easily available, it has become an ideal investigation tool for screening intracranial pathologies of the preterm neonates. **Objectives:** This study is to estimate diagnostic accuracy of neurosonography and enumerate various neurosonographic features of intracranial pathologies in preterm neonates suspected to have intracranial pathologies. **Methods:** The present study was performed at a tertiary care centre in Northern part of Karnataka state, India from June 2021 to January 2022 (8 months). 75 preterm neonates with suspected intracranial pathologies were taken into the study, transcranial US was performed bedside. Detailed birth history was taken and evaluated. This is an observational study due to rules and regulations of PNDT and hence the study was conducted by competent authorities. The findings were reviewed and analyzed by principal investigator to arrive at a conclusion. **Results:** In this hospital based observational prospective study of 75 neonates, 45 neonates showed normal appearance while the remaining 30 neonates showed some abnormality on the sonography. Among the abnormal sonograms, most common finding was Periventricular Leukomalacia (PVL) followed by Subependymal Hemorrhage / Intraventricular Hemorrhage and less common finding came out to be Cerebral Edema. One neonate had obstructive hydrocephalus secondary to aqueductal stenosis. **Conclusion:** Transcranial ultrasound is a reliable investigation of choice in preterm neonates suspected to have intracranial pathologies owing to its easy availability, radiation free, cost effectiveness, no transportation of baby and fair diagnostic accuracy.

KEYWORDS : Neurosonography, Preterm Neonates, Periventricular Leukomalacia, Germinal Matrix Hemorrhage, Cerebral Edema

INTRODUCTION:

Since the late 1970s to modern day neonatology, transcranial sonography has become the most often utilised neuroimaging method in premature newborns, providing information on displaying normal architecture, prenatal brain injuries and predicting long-term prognosis. [2] Cranial sonography is extremely sensitive for detection of various intracranial pathologies such as hemorrhage, periventricular leukomalacia & hydrocephalus in preterm neonates. [3]

Early diagnosis is essential for prognosis of the pathology, optimal treatment and prediction of the neurological outcome in preterm neonates. [1] Currently, various imaging modalities such as Transcranial Ultrasonography, Computed Tomography and Magnetic Resonance Imaging are being used to diagnose various intracranial pathologies. Neurosonogram has various advantages over Computed Tomography in being non-invasive, free from radiation, inexpensive, faster and safer imaging modalities for evaluation of intracranial pathologies. [13]

MATERIAL AND METHODS:

Study design:

This prospective observational study includes preterm neonates with clinically suspected intracranial pathologies admitted a tertiary care centre in Northern part of Karnataka

state, India from June 2021 to January 2022. Detailed birth history was taken and informed consent was obtained from the parents before the study.

Equipment:

Neurosonogram was done using GE Versana Active ultrasound machine.

Ultrasound evaluation:

All transcranial sonography were performed by a single experienced radiologist to prevent errors occurring due to variation in observations. Transcranial US was done bedside by co- investigator and was reviewed by the principal investigator. Maria et al [11] concluded that for detection of periventricular abnormalities, sonography becomes an important bedside investigation of choice.

Many sutures and fontanelles are open in the neonates, which can be used as acoustic window to visualize the brain anatomy [4]. Coronal and sagittal sections were obtained by keeping the transducer in coronal and sagittal sections over anterior fontanelle of the neonate. Gel was used as transducing media. Imaging through posterior fontanelle and lambdoid opening were done whenever required.

The examination included searching for various intracranial

pathologies like IVH/SHE, PVL and congenital abnormalities.

Statistical Analysis:

In our study, descriptive statistical analysis was done. Results on continuous measurements were presented on Mean ± SD (Min to Max) and results on categorical measurements were presented in Number (%). Significance was assessed at 5% level. Chi-square/Fisher Exact test was used to identify the significance of study parameters on categorical scale between two or more groups.

RESULTS:

This study includes high risk preterm neonates suspected to have intracranial pathologies.

Of these preterm neonates 52% were males and 48% were female neonates.

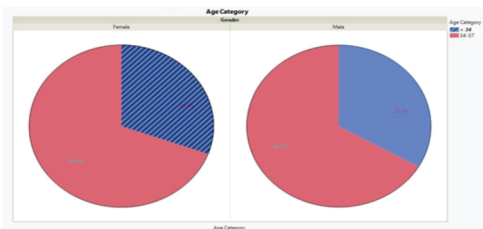


Fig 1: Pie chart showing distribution of males and females with respect to age (weeks) in the study

The mean weight of the neonates were 2.25 +/- 0.28 Kg.

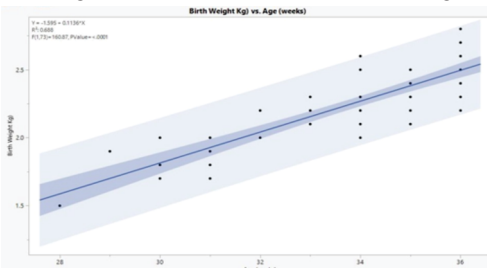


Fig 2: This image represents a simple linear regression line with birth weight (kg) taken as dependant variable and age (weeks) taken as independent variable. There is a positive correlation between Age (weeks) and birth weight (Kg) in the study.

Regression equation is $y = -1.595 + 0.1136 \times X$, $r^2 = 0.688$ $r = 0.808$, P value = 0.0032% of the study population was less than 34 weeks gestation and 68% were between 34 to 37 weeks of gestation. 42% neonates had normal vaginal delivery while the remaining 58% were delivered by LSCS.

Of the preterm neonates with less than 34 weeks gestation, 55% had normal findings while 45% had abnormal findings. Of the preterm neonates with 34 to 37 weeks gestation, 70% had normal findings while 30% had abnormal findings. Overall 35% of the preterm babies had abnormal sonographic findings. These findings were consistent with a study done by Badrawy et al. [9]

Table 1: Correlation of gestational age with various cranial ultrasound findings

Cranial Ultrasound	Number of neonates (n=75)	Gestational age (weeks)		P Value	Chi Squar value
		<34 (n=24)	34-37 (n=51)		
Normal	49 (65%)	13	36	0.163	1.943
Periventricular Leukomalacia	11 (14.6%)	4	7	0.145	2.127

SEH/IVH	8 (10.6%)	4	4	0.248	1.333
Cerebral Edema	6 (8%)	2	4	0.324	0.971
Other findings	1 (1.3%)	1	0	0.142	2.154

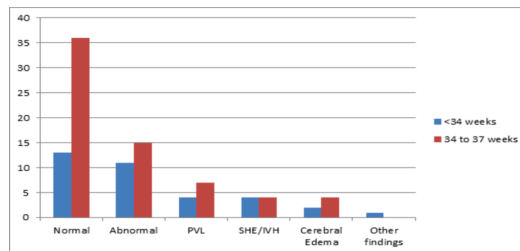


Fig 3: Bar chart showing distribution of high risk Neonates based on gestational age

Sonographic Images:

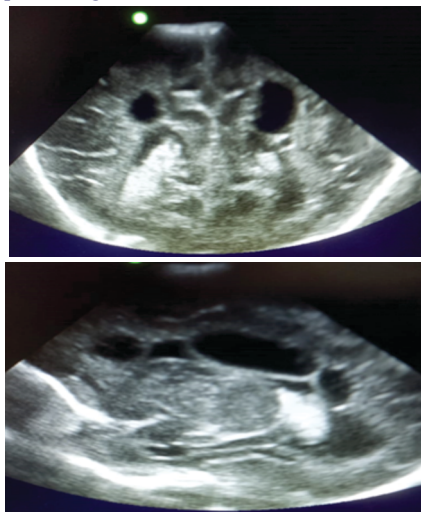


Fig 4: Coronal and sagittal images of neurosonogram depict multiple variable sized cystic areas predominantly in anterior periventricular regions (Grade-III Periventricular Leukomalacia), also note the increased periventricular echogenicity (Grade-I Periventricular Leukomalacia)



Fig 5: Sagittal images of the neurosonogram depict hyperechoic content in germinal matrix on the right side- S/o Germinal Matrix Hemorrhage

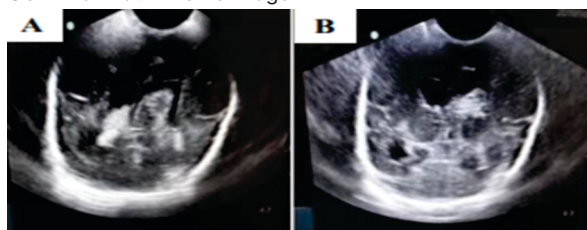


Fig 6: Coronal sections of the neurosonogram at different levels depict hyperechoic content within bilateral lateral ventricles causing its dilatation

DISCUSSION:

Transcranial ultrasound has its advantages of being cheap, readily available, non-invasive and requires minimal

transportation of the baby. It can be done as many times as required by the physician to look for the progression of the disease. It also helps in staging of various pathologies which is required for further clinical management of the baby.

De Vries and Cowan et al [7] suggested that transcranial ultrasound and magnetic resonance imaging work together as complementary modalities. When the neonate is not stable for transportation, transcranial ultrasound becomes a useful tool in initial days, and most of the times findings of the transcranial ultrasound become a decision making examination for major clinical decisions. The aim of our present study is to assess the reliability of the same.

The incidence of abnormal findings by transcranial ultrasound in preterm neonates in our study is 35%. Among the neonates which showed abnormal scans, the most common finding was Periventricular Leukomalacia (50%), followed by Subependymal Hemorrhage / Intraventricular Hemorrhage (34.6%) and less common finding came out to be Cerebral Edema (11.5%). One neonate had obstructive hydrocephalus secondary to aqueductal stenosis.

In a study done by Vergani P et al [8] found the prevalence of periventricular leukomalacia in preterm infants to be around 19% which correlates well with our study.

6 cases of intracranial hemorrhage in our study were detected on the first day itself. In a similar study done by Chowdhury et al [10] 50 preterm neonates were undertaken, out of these 58% were males while 42% of females. Out of the intracranial pathologies detected, 6% of preterm neonates had intracranial bleed.

In a similar study done by Tsiantos A et al [5] showed that 60% of the hemorrhages that took place happened between 15-48 hours of age with mean age of 38 hours.

In another similar study done by Carol M Rumack MD et al [6] showed that almost about 65% of the cases of hemorrhage that took place occurred within first 24 hours of life. Glass et al [12] in their study reported that 3.8% of the preterm neonates had clinically been diagnosed with seizures. The transcranial ultrasound showed abnormal findings in all of these infants and was accurate in diagnosing intraventricular hemorrhage.

CONCLUSION:

The results of the present study confirms that transcranial ultrasound is a reliable investigation of choice in preterm neonates suspected to have intracranial pathologies owing to its easy availability, radiation free, cost effectiveness, no transportation of the baby and fair diagnostic accuracy.

The present study also confirms the ability of neurosonogram to accurately diagnose and enumerate various sonographic features of intracranial pathologies in preterm neonates in suspected cases of intracranial pathologies.

Despite the limitation of neurosonography, the non-invasive and benign nature of this test makes it as an essential initial test for diagnosing pathologies in clinically suspected preterm neonates.

Fundings: Nil

Conflict of Interest: None

Ethical Clearance: Not yet

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