

Role of Cranial Ultrasonography in Evaluation of Brain Injuries in Preterm Neonates

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ABSTRACT

Introduction: Preterm neonates have more likelihood of having neurological abnormalities due to intracranial hemorrhages, perinatal asphyxia and congenital anomalies. Early recognition of these conditions is important for proper management. Cranial ultrasonography can be used to diagnose such conditions at the bedside.

Aim: The present study was undertaken with objective of detecting and grading brain injuries using neurosonogram and to evaluate the possible use in determining the prognosis and outcome at the end of the study.

Materials and Methods: This was a prospective study conducted over a one year period in the pediatric Hospital, tertiary care Institute in North West part of Rajasthan (Bikaner). A total of 62 preterm babies with suspected neurological injuries were included in this study. Neurosonogram was carried out within 1 week of birth and at the end of 1

month follow-up scan was done.

Results: Incidence of CUS abnormalities in preterm neonates is 16.1% in the present study. There were 62.9% male and 37.1% female neonates. 11.2% of these had evidence of intracranial bleed, 1.6% periventricular echogenicity, 1.6% had ventriculomegaly and 1.6% had periventricular leukomalacia. Most common clinical presentation was seizures followed by absent suckling and lethargy. Brain injuries were found mostly in babies born before 32 weeks. The most common abnormality was grade I GMH (about 27.4%).

Conclusion: Neurosonogram is the best initial method of investigation for preterm babies with suspected neurological injuries. It is best to perform neurosonogram studies on preterm babies within 1st week of birth and follow-up scan at the end of 1st month. It is non-invasive, non-ionising, widely available, cheap and repeatable.

Keywords: Germinal matrix hemorrhage, Neurosonogram, NICU, Ventriculomegaly

INTRODUCTION

Preterm neonates, defined as childbirth occurring at less than 37 completed weeks of gestation. Children who are born prematurely have high rates of intraventricular hemorrhage, respiratory illness, patent ductus arteriosus, sepsis and visual abnormalities like retinopathy of prematurity compared with children born at term. These neonates are more prone to have neuro developmental delay. Cranial ultrasound can be used to diagnose brain abnormalities at the bedside and that too non-invasively. It detects most of the hemorrhagic, ischemic and cystic brain lesions as well as calcifications, cerebral infections and major structural abnormalities in preterm and full term infants [1]. In neonates surviving with cerebral injury, it may help to optimize treatment of the infant both during the neonatal period and thereafter [2]. Neonatal sonography of the brain is now an essential part of new born care, particularly in high risk and unstable premature infants. Current ultrasound technology allows for rapid evaluation of infants in intensive care nursery with virtually no risk [3].

Currently many imaging modalities are available like ultrasonography, computed tomography and Magnetic Resonance Imaging to detect the probable intracranial abnormalities in these neonates. However, advantages of Cranial Ultrasonography are easy availability, not expensive, easy to perform; quick can be done at bedside, repeatable and radiation free. Hence, this study is undertaken to evaluate the usefulness of cranial ultrasonography in preterm neonates, in the diagnosis of various brain lesions.

MATERIALS AND METHODS

This was a prospective study was conducted from September 2014- September 2015 over a period of one year in the Pediatric Hospital, tertiary care Institute in North West part of Rajasthan (Bikaner). The Institute Ethics Committee approved the study protocol. Sixty two preterm neonates admitted to neonatal intensive care unit were selected as per the inclusion criteria on non-randomized purposive sampling basis and were subjected to neurosonography on selected days. If

cranial ultrasonography revealed various findings, repeat neurosonogram were done to follow-up sequelae if any. This study criterion includes: preterm with abnormal neurological presentation seizures, lethargy, apnea, sudden onset pallor, increase in muscle tone, bulging anterior fontanel, all preterm born prior to 32 weeks of gestation, all preterm that weighs less than 1500g at birth and excludes all cases suspected to have congenital malformations, severe infections and failed resuscitation. Informed consent was obtained from the parents/guardian regarding inclusion of the neonate in the study. Assessment of factors placing the neonate in a high risk category was done taking detailed maternal history reviewing antenatal records. All perinatal details were recorded and detailed clinical examination was done including anthropometric measurements. Vital parameters were recorded within 24-48 hrs of admission and complete neurological examination was done during baby's stay in NICU. Gestational age was assessed as per modified Ballard's scoring method for all preterm neonates. Basic routine investigations like septic screening, random blood sugar, ionized calcium, chest X-ray for respiratory symptoms and lumbar puncture was done for suspected meningitis neonates. Cranial ultrasound was done for all study included preterm neonates. IVH grading was done by using Volpe staging method. Clinical correlation with USG finding was done. Neonates were followed till recovery and discharge from NICU. Statistical analysis was done by using SPSS software.

RESULTS

Total 62 preterm neonates were enrolled in the study. Incidence of CUS abnormalities in Preterm neonates is 16.1% in the present study. There were 62.9%% male and 37.1%% female neonates, There was no significant correlation of incidence of abnormal cranial ultrasound findings in male and female. Correlation of gestational age with cranial ultrasound findings was statistically significant. 11.2% of these had evidence of intracranial bleed, 1.6% periventricular echogenicity, 1.6% had ventriculomegaly and 1.6% had periventricular leukomalacia. Of the high risk neonates with preterm gestation, 83.9% had normal and 17.7% had abnormal CUS. Correlation between CUS findings of neonates with prematurity was statistically significant

Cranial ultrasound	Number of neonates (n=62)	%
Normal	52	83.9
Abnormal	10	16.1
• GMH	7	11.2%
• periventricular echogenicity	1	1.6%
• Ventriculomegaly	1	1.6%
• leukomalacia	1	1.6%

[Table/Fig-1]: Incidence of different cus abnormalities in neonates.

Cranial ultrasound	Number of neonates (n=62)	Day of life of CUS		
		<24 hrs (n=5)	24-72 hrs (n=32)	>72 hrs (n=25)
Normal	52 (83.8%)	5 (100%)	23 (71.8%)	24 (96%)
Abnormal	10 (16.2%)	0 (0%)	9 (28.1%)	1 (4%)
• GMH	7 (11.2%)	0 (0%)	7 (21.8%)	0 (0%)
• Periventricular echogenicity	1 (1.6%)	0 (0%)	1 (3.1%)	0 (0%)
• Ventriculomegaly	1 (1.6%)	0 (0%)	1 (3.1%)	0 (0%)
• Leukomalacia	1 (1.6%)	0 (0%)	0 (0)	1 (4%)

[Table/Fig-2]: Cranial ultrasound findings correlating with and days of life.

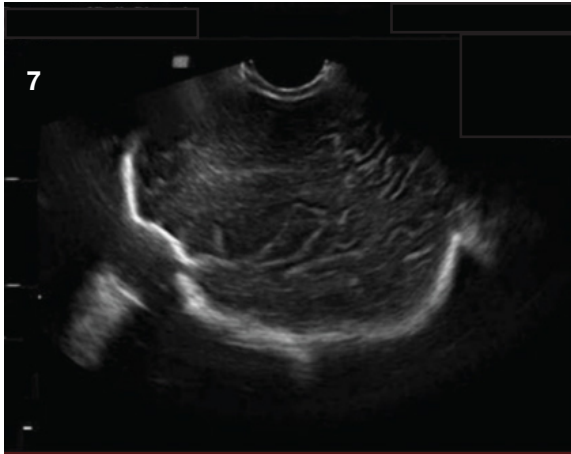
Outcome	Number of neonates (n=62)	%
Relieved	11	17.7
Cured	38	61.2
Death	8	12.9
Dama	5	8.06

[Table/Fig-3]: Clinical outcome of high risk neonates enrolled in the study.

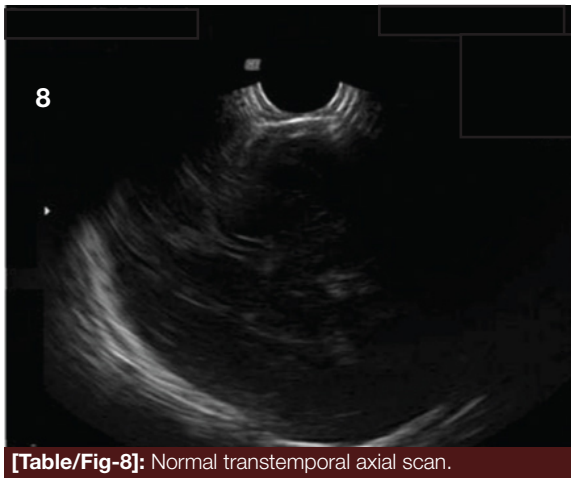
($p=0.015$). There was no significant correlation with abnormal findings on CUS and day of life it was done ($p=0.752$). There was statistically significant correlation between gestational age of high risk neonate and day of life cranial ultrasonography was done ($p=0.001$). Of the neonates with gestational age less than 32 weeks having abnormal findings on CUS, 11.2% had GMH. 61.2% of neonates enrolled had cured at the time of NICU discharge, 12.9% died and 16.1% neonates were relieved at the time of NICU discharge, 8.06% discharged from NICU for various reasons before clinical recovery (DAMA) [Table/Fig-1-8].



[Table/Fig-4]: coronal through sylvian fissure: Normal, **[Table/Fig-5]:** coronal through foramen Munro: Normal, **[Table/Fig-6]:** Periventricular leucomalacia



[Table/Fig-7]: Right parasagittal: Normal.



[Table/Fig-8]: Normal transtemporal axial scan.

DISCUSSION

CUS is an ideal tool for primary screening of the neonatal brain. Ultrasound is cheap, radiation free and useful in diagnosing brain abnormalities in bedside, when the baby is unstable for transport. Hence, this study is undertaken to evaluate the usefulness of Neurosonogram in diagnosis of various lesion in preterm neonates.

Incidence of CUS abnormalities in high risk neonates is 16.1% in the present study. There were 62.9% male and 37.1% female neonates; there was no significant correlation of incidence of abnormal cranial ultrasound findings in male and female. Choudhary V et al., [4] in their study on 50 preterm neonates of which 58% were males and 42% females, detected intracranial pathology in 12% of preterms and 6% of these had intracranial haemorrhage. In the present study 16.1% had intracranial pathology of which 11.2% had GMH. Soni JP et al., [5] in their study suggested that CUS is sensitive and specific for the detection of various types of ICH (SAH, IVH, PVL). One hundred and eleven high risk neonates were subjected to CUS, one quarter of these neonates developed intracranial hemorrhage (ICH) within 120 hours of birth. In the present study 11.2% preterm neonates have evidence of intracranial bleed (GMH, IVH) all of which were picked up between 24 to 72 hours of life. In the present study, 16.1%

preterms had abnormal findings on cranial ultrasound of which 11.2% had GMH. The maximum incidence of GMH 41.2% was found in preterms less than 32 weeks. Rehan N, et al., [6] concluded that frequency of IVH was found in 47.5% preterm neonates. Arti Maria et al., [7] concluded CUS remains an important bedside diagnostic tool for PVL. In the present study, one preterm neonate on regular follow up CUS developed findings suggestive of cystic PVL. In the present study, 1.6% high risk neonates had periventricular echogenicity findings by a neurosonogram. Hannah C et al., [8] in their study reported that 3.8% preterm neonates had clinical seizures. CUS was abnormal in all these infants and was accurate for detecting IVH and PVH. In this study, of all high risk neonates presenting with seizures 47.6% had normal and 52.4% had abnormal CUS. Of the 16.1%, neonates which had abnormal CUS, 5.2% had positive CRP which was statistically significant correlation. In the present study, there was statistically significant correlation with neonates having positive CRP, low platelet with abnormal CUS findings. There was no correlation of Hb, PCV, TLC, reticulocyte count and positive culture, serum electrolytes, serum bilirubin and CSF analysis with abnormal CUS findings. 61.2% of neonates enrolled had cured at the time of NICU discharge, 12.9% died and 17.7% neonates were relieved at the time of NICU discharge, 8.06% discharged from NICU for various reasons before clinical recovery (DAMA).

LIMITATIONS

In our study sample size is normal as compared to other studies. Cranial ultrasound findings were totally depending on radiologist opinion. There may be the chance of bias in interpreting USG findings. In our study Neurodevelopmental follow-up was not done in abnormal CUS preterm. It is necessary to follow-up such neonates.

CONCLUSION

Neurosonogram remains the accurate, rapid imaging modality of choice for detecting brain injuries in preterm neonate. This technique is both sensitive and specific for detecting germinal matrix hemorrhage and periventricular leucomalacia. Neurosonogram is the best initial method of investigation for preterm babies with suspected neurological injuries. It is best to perform neurosonogram studies on preterm babies within 1st week of birth and follow-up scan at the end of 1 month. It is non-invasive, non-ionising, widely available, cheap and repeatable.

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