Original Research Article

Neurosonogram for cranial abnormalities of neonates

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Abstract

Background: Neurosonography is an important test in the diagnosis of hemorrhage and other acquired and congenital brain pathologies of the newborn. Portability of the study, lack of need to transport baby to radiology services, and the wealth of diagnostic information available from a large open anterior fontanelle makes this study a highly challenging one. The aim of the study was to evaluate the role of neurosonogram in diagnosing intracranial pathologies and to analyze the results of our study with the studies in the present literature.

Materials and methods: Patients who were referred to Department of Radiology for neurosonogram in NRI Medical College in the period of December 2015 to October 2017. 62 neonates with age less than 28 days were included in the study. It was a descriptive observational study with no potential risk.

Results: The present study included 62 babies of which (32) 52% were male and (30) 48% were female babies, of which majority of them are of age less than 1 week (66%) and preterm 58% (36). Most common indication for the scan was as a part preterm care (25.8%) and rest of them had respiratory distress, convulsions and birth asphyxia, shock, sepsis and jaundice. 52% of the babies had abnormal findings of which most common pathology was intraventricular/ germinal matrix hemorrhage of different grades accounting to 13(21%) babies. Others cases include 8(12%) hydrocephalus, 5(8%) periventricular leucomalacia changes, 8(13%) congenital anomalies, 2 (3%) had signs of infection (TORCH) and 2 miscellaneous cases.

Conclusions: This study shows that neurosonogram is the best modality for non-invasive bedside imaging for cranial abnormalities in neonates. Despite the advances in multi-slice CT and MRI, NSG is the most commonly used first baseline modality, considering growing economic pressure, and low

invasiveness as well as easy availability of US that can easily be repeated at any time. It has good sensitivity for picking up most of the common pathologies in a neonate brain.

Key words

Neurosonogram, Cranial, Abnormalities, Neonates.

Introduction

Ultrasound of the Brain, Neurosonogram, has become an integral part of care in neonates in the past decade replacing CT in many instances. Portability of the study, lack of need to transport baby to radiology services, and the wealth of diagnostic information available from a large open anterior fontanelle makes this study a highly challenging one [1]. The advantages over CT and MRI include portability, lower cost, speed, lack of ionizing radiation and no need for sedation. CT and MRI provide complementary rather than competitive imaging techniques to investigate the infant brain more fully. Screening of premature infants for hemorrhage has proved highly sensitive and specific. It is also valuable in evaluation of other entities such as brain anomalies, the sequel of infection, masses, hydrocephalus, periventricular leukomalacia and hypoxic injury but is relatively insensitive in acute phase for the latter two conditions. High frequency linear array transducers are generally used to evaluate extra axial fluid space, superior sagittal sinus, dura meninges, conventional markings and certain portions of cerebral cortex. However sonography is limited to patients with open fontanelle or other acoustic window and is relatively dependent on skill of operator and quality of equipment.

Materials and methods

The present study was a descriptive study carried out in the Department of Radiodiagnosis, NRI Medical College, to analyze various cranial abnormalities in babies who underwent neurosonogram examination using Philips HD 6 and 11 XE ultrasound machine. The present study sample included 62 babies with age less than 28 days who were referred to the Department of Radiology, for neurosonogram examinations from December 2015 to October 2017. Using curvilinear and linear probes coronal, sagittal and transverse views of infant brain were viewed through fontenelles. Clinical diagnosis and imaging findings were noted. This data was analyzed statistically for incidence of various pathologies and their distribution.

Results

The present study included 62 babies of which (32) 52% are male and 48% are female babies. These babies were of neonatal age group i.e. 0-28 days, of which majority of the babies were of age less than 1 week (66%). Majority of babies in the present study were preterm babies accounting to 58% (36) and term babies are 42% (26).

Most of the babies included in the study were examined as a part preterm care (25.8%). Rest of the babies presented with respiratory distress, convulsions, birth asphyxia, shock, sepsis and jaundice etc. 32 babies had abnormal findings which account for 52% (**Figure – 1 to 4**). Normal findings are seen in 30 babies i.e. 48%.

Intraventricular hemorrhage: 13 babies in the present study showed intraventricular/ germinal matrix hemorrhage which accounts for 21% of the cases examined. Of these 38% of the cases had grade I hemorrhage i.e. germinal matrix hemorrhage. 23% of these babies had grade II intraventricular hehmorrhage, 30% babies had grade III hemorrhage and 9% babies had grade IV intraventricular hemorrhage (**Table – 1, 2**).

Table - 1: Intraventricular hemorrhage/ germinal matrix hemorrhage.

IVH/GMH	No. of babies	Percentage
PRESENT	13	21%
ABSENT	49	79%

Table – 2: IVH grade.

IVH GRADE	No. of babies
GRADE I	5
GRADE II	3
GRADE III	4
GRADE IV	1

Table - 3: No. of hydrocephalus cases.

Hydrocephalus	No. of babies
Present	8
Absent	54

Table - 4: Cause of hydrocephalus.

Cause of hydrocephalus	No. of babies
Congenital causes	3
Post hemorrhagic	5
Post meningitis	0
Secondary to mass lesion	0

Figure - 1: 5 day old preterm neonate (34weeks) with birth asphyxia showed hyperechoic foci in bilateral caudothalamic grooves – s/o germinal matrix.

Hydrocephalus: A total of 8 hydrocephalus cases were observed (12%). Most of the cases of hydrocephalus were secondary to hemorrhage (62%) and rest was due to congenital causes like aqueductal stenosis, holoprosencephaly and assoscited with dandy walker variant anomaly (**Table – 3, 4**).

Figure - 2: One day old preterm infant with seizures showed hydrocephalus with cerebellar vermis hypolplasia – dandy walker variant.

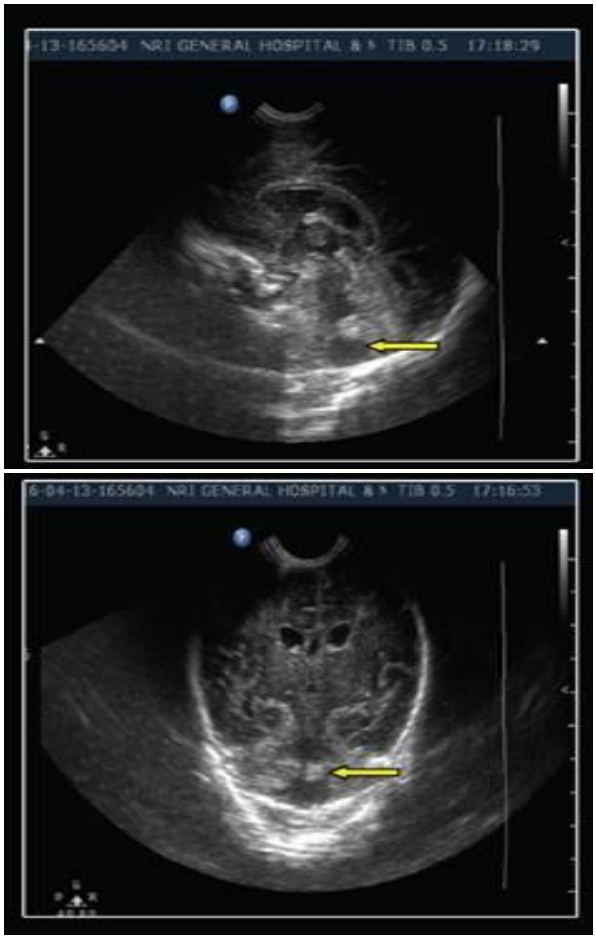


Figure - 3: Preterm infant with birth asphyxia showing small cysts in bilateral periventricular regions – s/o periventricular leucomalacia changes.

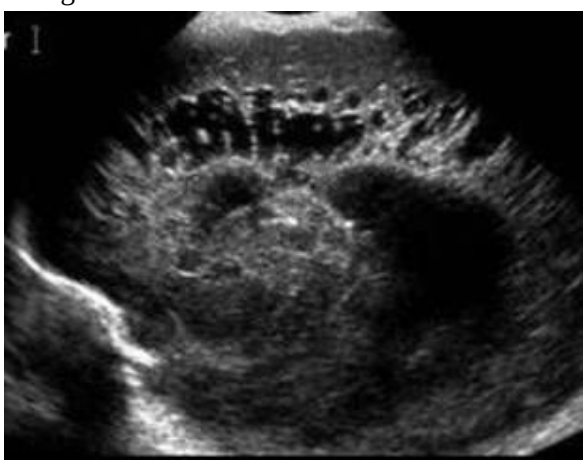
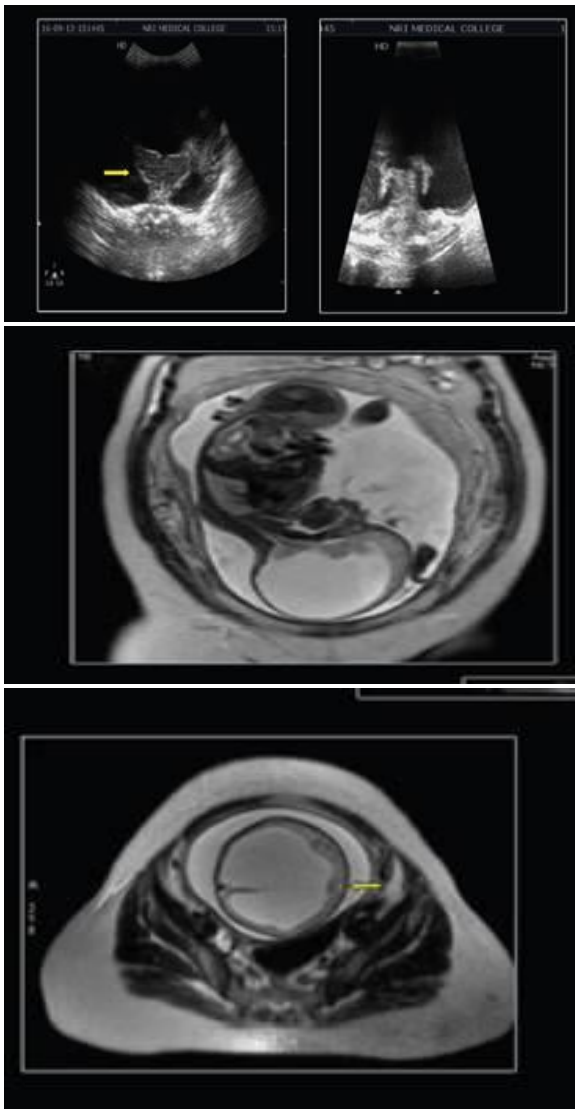


Figure - 4: Preterm infant with maternal polyhydramnios was antenatally diagnosed with fetal hydrocephalus and further investigated wuth fetal MRI which revealed enlarged head gross hydrocephalus with absent inter hemispheric fissure and corpus callosum and fused thalami. Same findings were seen on neurosonogram.



Periventricular leucomalacia changes: Out 62 babies examined 5 babies had changes of periventricular leucomalacia accounting to 8% of the cases. Few of them had periventricular hyperechogenecity and other cases showed small cystic changes in bilateral periventricular regions.

Congenital anomalies: 13% of total cases examined showed congenital anomalies which account for 8 cases which include holoprosencephaly, dandy walker variant, aqueductal stenosis, corpus callosal agenesis, dorsal dermal sinus and others include choroid plexus cysts and sub ependymal cysts.

Miscellaneous: 2 cases (3%) had signs of infection like parenchymal calcification and microcephaly. These findings are sequelae to the TORCH infections in utero.

Two cases showed subgaleal hematoma, one case showed collection in the subdural space along the cerebral convexity with internal echoes which was proved to be subdural hemorrhage in correlation CT imaging. One case was proved to be thalamic infarct which was correlated with MR imaging.

Discussion

De Vries and Cowan, et al. have suggested that neurosonogram and MRI are complementary modalities, with ultrasound as an especially useful tool in the early days, when the infant is unstable for transport and ultrasound findings may be sufficient for major clinical decisions. Current study aims at proving the same [2].

In the present study, preterm infants were 36 neonates (58%) and in neonates with abnormal findings 68.7% were preterm infants and 31.2% were term infants. In a study done by Dinakara Prithviraj, et al., majority of the cases were also preterm infants. According to the study done by Niranjan Nagaraj, et al., they proved that correlation between CUS findings of neonates with prematurity (p=0.015) and between gestational age of high risk neonate and day of life cranial ultrasound (p=0.001) was statistically significant. This was also true with the present study. Most NICU centres perform serial cranial ultrasound evaluations early in the course of hospitalization for premature infants and often, a follow-up examination is done at a later age. These evaluations are done to document the presence of intracranial hemorrhage, to guide choice of therapies that may exacerbate the risk

of further hemorrhage, and to counsel families about neurodevelopment outcomes [3, 4].

Four studies of De Vries, et al., Mack LA, et al., Pape KE, et al. and Levene MI et al reported results of a total of 87 autopsies performed on preterm infants, neurosonogram was 76% to 100% accurate in detecting Grade 1 lesions of >5 mm, Grade 3 and Grade 4 hemorrhages. Detection of Grade 2 hemorrhages was much less accurate. Literature reviews and published studies correlated the degree of prematurity and the increased ICH risk [5-7]. It is generally accepted that the incidence and severity of the ICH are related to both gestational age and birth weight, occurring in 25-30% of patients born at <32 weeks gestation, with <1500 g. The present study shows intraventricular hemorrhage in 13 cases of which 77% of these cases are preterm neonates and 70% were of gestational age less than 34 weeks. These findings were in accordance to the study done by Humsene, et al., Choudhary V, et al. and Niranjan Nagaraj, et al.

Similar to study done by Humsene, et al., the cases in the present study examined within 1 week of age showed increased periventricular echogenecity which persisted even after 1 week of age and few of them went on to develop small cystic lesions in the periventricular regions.

In the present study, 13% cases had hydrocephalus and the most common cause of hydrocephalus was post hemorrhagic and rest of the cases were due to congenital anomalies like aqueductal stenosis, holoprosencephaly and associated dandy walker variant anomaly. These results were not in accordance to the Humsene, et al., where most common cause for hydrocephalus was congenital.

Conclusion

This study shows that neurosonogram is the best modality for non-invasive bedside imaging for cranial abnormalities in neonates. Despite the advances in multi-slice computed tomography and MRI, NSG is the most commonly used first baseline modality for examining the newborn brain, considering growing economic pressure, and the low invasiveness as well as the easy availability of US that can easily be repeated at any time. Common causes for referral for neurosonogram examination were preterm care, birth asphyxia and convulsions. Of the total cases examined majority of the abnormal cases were preterm infants who have significant risk for various pathologies and majority of them were of gestational age 33-36 weeks, this could be due to improved obstetric care resulting in prolongation of pregnancy in high risk cases. Intraventricular/ germinal matrix hemorrhage was the commonest abnormality observed in the present study, in which majority of the cases are preterm infants. Hydrocephalus was the next most common pathology observed, of which most common cause was secondary to hemorrhage. Birth asphyxia was most common cause for pathologies like periventricular leucomalacia and intraventricular hemorrhage. Congenital anomalies and infection were noted in a few cases. The present study had limitations like few areas of the brain which could not be imaged on neurosonogram, further evaluation with imaging like CT or MRI was not done. Abnormal cases could not be followed up for the sequelae of the findings.

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