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A STUDY OF NEUROSONOGRAPHY PATTERNS IN PRETERM NEONATES

Radiodiagnosis

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ABSTRACT

Annually, an expected rate of 15 million babies are born preterm (before 37 completed weeks of gestation), and this number is increasing. India is one among the top ten countries with the highest number of preterm births. The purpose of the study is describe the various patterns of cranial abnormalities on ultrasound in 130 preterm neonates within one week of birth and their prevalence in a hospital - based population which will become a baseline for further studies.

KEYWORDS

Neurosonography, neonate cranial USG, NSG.

INTRODUCTION:

Cranial ultrasound (CUS) has become a significant diagnostic tool in modern neonatology for depicting normal anatomy and pathological changes in the newborn brain parenchyma. Because in the neonates, sutures, and fontanels are still open and these can be used as acoustic windows to "look" into the neuroparenchyma1.

It can be performed efficiently & conveniently in the Neonatal intensive care unit (NICU) with a portable ultrasound machine at the bedside; it meets the definition of point-of-care testing (POCT). It is also cost-effective, radiation-free and its safety is well-established[2].

It can enumerate various pathological processes that occur in the brain parenchyma like

- Periventricular leucomalacia.
- Germinal matrix hemorrhage.
- Hydrocephalus.
- cerebral edema
- Congenital anomalies
- Other miscellaneous conditions like cepal hematoma, caput succedaneum, choroid plexus cysts, slit like lateral ventricles in association of agenesis of corpus callosum, hyperechogenicity in the cerebellum and to assess the possibility of meningitis.

MATERIALS AND METHODS:-

This prospective study was conducted in Dr. PINNAMANENI SIDDARTHA INSTITUTE OF MEDICAL SCIENCES AND RESEARCH FOUNDATION, CHINNAOUTPALLI. During the period of November 2016 to September 2018,130 preterm neonates, who fulfilled the inclusion criteria (neonates were born before 37 weeks period of gestational age) were studied out of which 66 were males, 64 were females.

They were again divided in to neonates who were born <32 weeks (24.06%), born between 32-34 weeks (26.09%) and between 35-37 weeks (48.05%) period of gestational age.

Time of examination between 0-3 days (51.5%) and 4-7 days (48.5%).

Radiographic instrumentation:

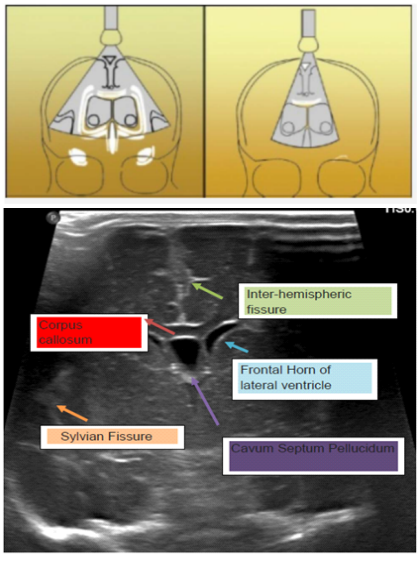
Philips affinity 50G ultrasound machine with probe frequency of 3-6MHz, 5-12MHz in department of radio diagnosis.

Technique:

High-frequency phased array transducer (5-8 MHz) along with a small footprint probe gives the best results. High-resolution images are obtained by using probe frequency of 7.5 MHz. A technical issue may occur in obtaining a good image in the case of a small anterior fontanelle(Fig below). The diagnostic quality of examination could be achieved by using phased array transducers of small footprint and wide insonation angle (up to 140°).

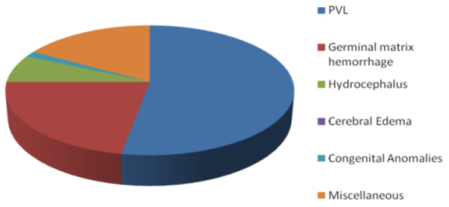
NSG begins with gray-scale imaging performed via the anterior fontanelle in both the coronal and sagittal planes 31,37-38. Generally, six to eight coronal images are taken, beginning at the anterior frontal lobes and proceeding up to the occipital lobes posterior to the trigones of lateral ventricles. Then rotate the transducer 90°, and five sagittal images are obtained, which includes a midline and two parasagittal views of the right hemisphere and left hemisphere including the peripheral cortex.

For the screening of vascular structures, color doppler images may be taken. The main role of Doppler is used in assessing the circle of Willis and the region of the vein of Galen. For the evaluating ischemia spectral tracing using doppler indices like resistive index (RI), peak systolic velocity (PSV), end diastolic velocity (EDV) need to be done. In suspected cases of vascular occlusions, infarction or ischemia power doppler imaging has also been preferred to look for areas of hyper- or hypovascularity.

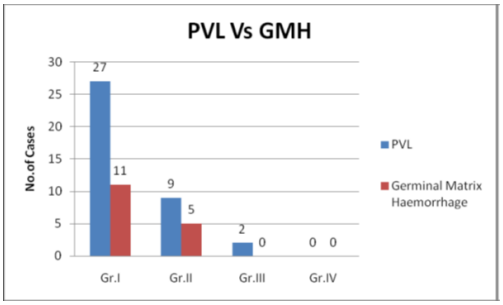


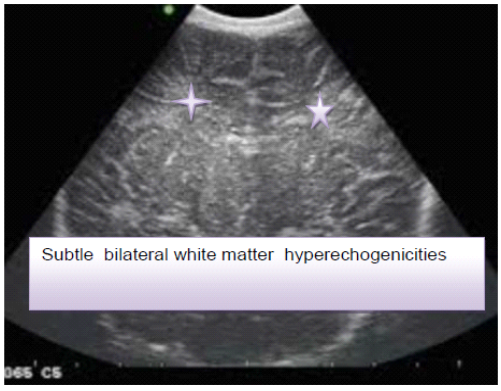
RESULTS:

PVL (29.2%) is the most commonly identified abnormality in the study group followed by GMH (12.3%). Rest of the abnormalities identified were hydrocephalus (3.8%), cerebral edema, congenital anomalies (0.8%) and neonates included in the miscellaneous group (9.2%).

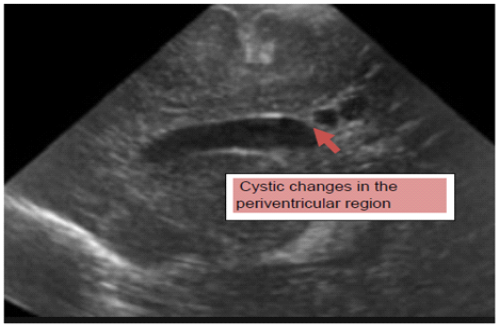


The number of neonates with PVL and GMH were identified along with their stages of presentation. Majority of the neonates were identified before 32 weeks period of gestation and grade I type of PVL was most commonly seen.

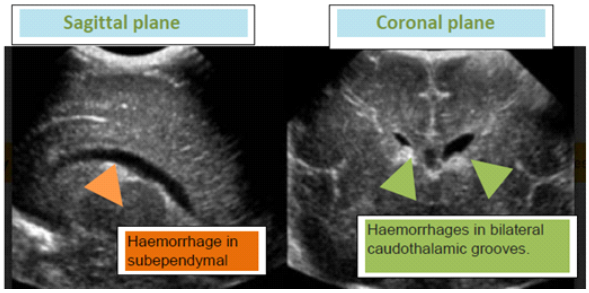




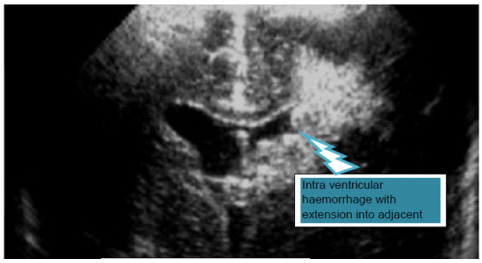
Grade 1 PVL



Grade II PVL

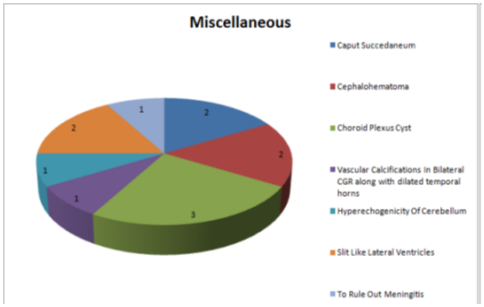


GMH in bilateral caudothalamic groove

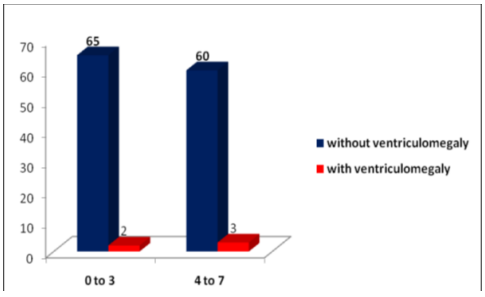


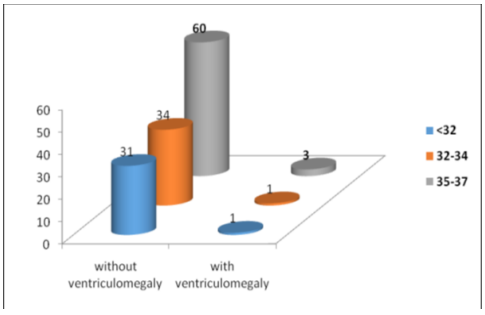
Grade IV GMH

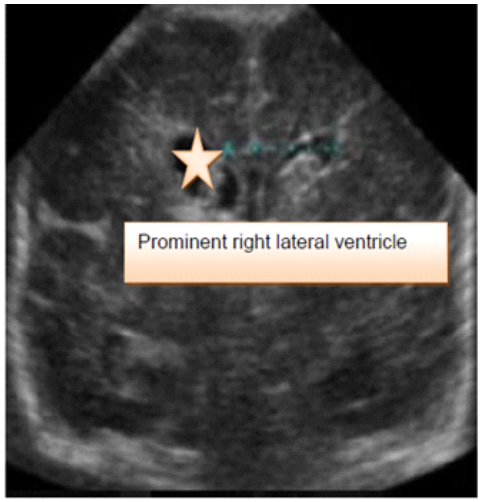
Various miscellaneous conditions involved are Caput Succedaneum, cephal hematoma, choroid plexus cyst, dilated temporal horns with vascular calcifications in bilateral CGR.

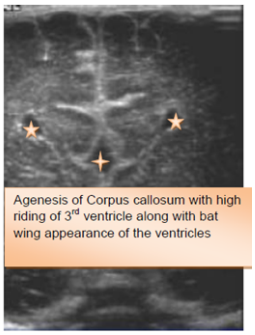


Correlation of the neonates with hydrocephalus with respect to time of examination and gestational age.









Agenesis of Corpus callosum with high riding of 3rd ventricle along with bat wing appearance of the ventricles

DISCUSSION:

This study highlights the usefulness and diagnostic efficiency of cranial ultrasound in high-risk neonates in NICU.

Gestational age is one of the chief independent factor contributing to the majority of parenchymal abnormalities.

Most commonly seen abnormalities are PVL followed by GMH in neonates who are born before 32 weeks period of gestation, in concordance with the study done by Mauricio Barría et al89.

In the study done by Kunal P Ahya et al.[3] PVL is identified as the most common white matter injury seen in premature infants than in, term infants, and the 56 incidence increases with decreasing gestation age. This disease affects the immature white matter of the cerebral hemispheres and peaks at 24–32 gestational weeks, which shows a correlation with our present study.

Time of examination is another criteria that is taken into consideration. The incidence of the cranial US in the identification of abnormalities was found to be 38 % which included both term and preterms, out of which majority (62%) was contributed by preterm neonates. The study done by R.Kalayani[4] examination of neonates was done between 3 - 5 days showed 18 cases of PVL and 11 cases of GMH. Follow up scan was done on 6th and 36th weeks after the birth.

In a study of Tsiantos A et al.[5] Found that 60% of the hemorrhages in preterm neonates took place between 15 to 48 hours of age with a mean age of 38 hours.

Twenty neonates in the study done by Carol M Rumack, MD et al.[6] found that 64% of the hemorrhages took place within 24 hours. The study was done by Leven MI et al. proved that most hemorrhages occurred during the first two days of life.

Whereas Tzipora Dolfin et al. study shows, 25% hemorrhages were diagnosed on the first scan within first 6 hours. These studies showed accordance with our study in which the majority of the GMH were documented in preterm before 32 weeks period of gestation and were diagnosed within the first 4 days of life.

Miscellaneous conditions:

In our study slit-like lateral ventricles are noted in 2 neonates (1.5%).

Neonates with a suspension of meningitis are seen in 1(0.8%) neonates.

In our study choroid plexus cysts were seen in 3 (2.3%) neonates. 69 Intracranial infections In our study, 1(0.8%) of the neonate presented with suspicion of meningitis in view of given imaging characteristics, it is also associated with the prominent ventricular system.

Evaluation of cerebellum

Cerebellar lesions with subtle injury are difficult to identify on CUS, so proper assessment of the posterior fossa is required by using additional acoustic windows.

In our study one case of cerebellar hyperechogenicity was identified.

LIMITATIONS:

In recent years attention has been raised that CUS is not able to detect a subtle abnormality in the preterm infants and it is not accurate in detection of focal infarction and lesions in the term infant with hypoxic-ischemic encephalopathy (HIE).

The arrival of MRI with its ability to identify very subtle parenchymal changes are better elicited in comparison with CUS.

The limitation of study is that the group did not undergo MRI evaluation to confirm the accuracy of ultrasound. Stroke in preterm infants, often affects the central grey matter, and may only be identified by careful sequential scanning.

CONCLUSION:

Neurosonogram is an easy and affordable non-invasive procedure and treatment is initiated at a very early stage and can be repeated if required and thereby enables the visualization of ongoing brain maturation and the evolution of brain lesions.

It can also be used to assess the timing of brain damage. Current evidence is that using the modern US machines, probes, a variety of acoustic windows and sequential scanning of preterm, high risk and suspicious cases of term infants at optimal times gives high-quality images that are diagnostically accurate.

NSG is used as a routine in NICUs was found to be an excellent and non invasive tool for brain imaging during the neonatal period.

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