Section: Radiology

Research

THE ROLE OF NEUROSONOGRAPHY IN NEONATES WITH HYPOXIC ISCHEMIC ENCEPHALOPATHY WITH CLINICAL CORRELATION

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Abstract

Background: Neonatal hypoxic-ischemic encephalopathy (HIE) can leave children with serious neurologic abnormalities or even cause death. Neuroimaging with cranial ultrasound (US) is a valuable and non-invasive tool in the workup of patients with HIE. This prospective study aimed to evaluate the sensitivity of cranial ultrasound in detecting HIE in first 72 hours of life due to birth asphyxia. This has been correlated with clinical grading. **Materials and Methods:** Study population included 70 neonates, who had history of birth asphyxia. All the neonates were clinically graded using Sarnat & Sarnat grading system. After that all the neonates were subjected to ultrasound examination. Ultrasound imaging was done in both coronal and sagittal planes. **Result:** Of 32 Grade I case, the cranial ultrasound was found to be normal in about 27 cases and it was able to pick up the abnormality in about 5 cases. The most common finding in the Grade I cases was cerebral edema. Of the 28 cases of Grade II HIE, the USG were able to pick up the abnormality in all cases. The common findings were some forms of hemorrhage in all cases. Of the 10 cases of Grade III HIE, USG was able to pick up the abnormality in all. The most common finding was hemorrhage, and the most common site was SHE-IVH. Thus, the sensitivity of USG in Grade I HIE is about 9.3% and in Grade II & Grade III, is 100%. The overall sensitivity is about 57.1%. **Conclusion:** Cranial ultrasound is an effective modality in detecting HIE changes earlier and has very good correlation with clinical grading particularly in Grade II and Grade III cases. Hence, USG should be used as primary screening procedure in all neonates who had history of birth asphyxia, irrespective of clinical symptoms.

INTRODUCTION

Neonatal hypoxic-ischemic encephalopathy (HIE) is a critical contributor to infant mortality and long-term disabilities.[1,2,3,4] When a hypoxic-ischemic event occurs during the prenatal, intrapartum, or postnatal phase, it can result in HIE, a brain injury that stops the infant's brain from receiving appropriate blood flow. Clinical symptoms of HIE, a condition, point to brain dysfunction. Cord prolapse, uterine rupture, abruptio placenta, placenta previa, maternal hypotension, breech presentation, or shoulder dystonia might pre-exist in children with HIE, however the precise aetiology is mostly unknown.[4,5,6]

Different imaging modalities, such as magnetic resonance imaging (MRI) and ultrasound (USG), have been utilised to categorise brain damage patterns in the context of HIE-related injury. However, MRI is expensive, immobile, and time-consuming, which limits its applicability in non-academic settings, in underdeveloped nations, and with critically ill patients who are too unstable to be moved. Brain USG has become a potent, affordable supplement and MRI substitute. USG is readily available, can be carried out at the patient's bedside without sedation, can be done as often as necessary, has no side effects, and can reveal a plethora of anatomical and functional details when carried out by a skilled sonographer utilising top-of-the-line equipment.[7]

If the fontanelles are still open, neurosonography or cranial USG is still the favoured early brain imaging technique due to its affordability, portability, and safety.[8] In high-risk newborn's, it finds most haemorrhagic, ischemic, and cystic brain lesions as well as calcifications, cerebral infections, and

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significant anatomical abnormalities. Additionally, determining the severity of new-born encephalopathy and tracking the development of hypoxic-ischemic brain injury afterward are all very beneficial.[9,10]

This study aimed to evaluate the sensitivity of cranial ultrasound in detecting HIE in first 72hrs of life due to birth asphyxia and correlate with clinical grading.[11]

MATERIALS AND METHODS

This prospective study was carried out at the Institute of Child Health and Hospital for Children, Madras Medical College, during the period of September 2013 to September 2014. Ethical approval was obtained from the ethics committee.70 neonates were chosen for this study of which 38 were male and 32 were female.

Inclusion Criteria

All neonates less than 72hrs of birth, having a history of birth asphyxia were included in the study.

Exclusion Criteria

Neonates older than 72hrs, those with septic shock and cardiopulmonary anomalies were excluded from the study.

Patient consent was taken both verbally and in writing from the neonate's parents and guardians.

The ultrasound examination was carried out using MY LAB 40, ESOATE and performed through the anterior fontanelle in both coronal and sagittal planes. Coronal images were obtained by placing the transducer transversely across the anterior fontanelle and then, the plane of the beam was swept in the anterior to posterior direction to completely scan the brain. The sagittal images were obtained by placing the transducer longitudinally across the anterior fontanelle and angling it each side, so that the anterior portion of the sector is directed medially, and posterior portion of the sector is directed laterally to include the entire lateral ventricle in a single image plane.

The severity of HIE was classified into three groups: mild (Grade 1), moderate (Grade 2), and severe (Grade 3) as per the Sarnat & Sarnat grading system.[12]

RESULTS

All 70 cases with history of birth asphyxia were clinically graded and subjected to ultrasound examination. Of the 70 cases, 32 cases were Grade I, 28 cases were Grade II, and 10 cases were Grade III.

Table 1: Severity

Severity	Stage 1 (Mild)	Stage 2 (Moderate)	Stage 3 (Severe)
Level of consciousness	Hyperalert	Lethargic or obtunded	Stupor or coma
Activity	Normal	Decreased	Absent
Neuromuscular control			
Muscle tone	Normal	Mild hypotonia	Flaccid
Posture	Mild distal flexion	Strong distal flexion	Intermittent decerebration
Stretch reflexes	Overactive	Overactive	Decreased or Absent
Complex or primitive reflexes			
Suck	Weak	Weak or Absent	Absent
Moro (Startle)	Strong	Weak	Absent
Tonic neck	Slight	Strong	Absent
Autonomic function			
Pupils	Mydriasis	Miosis	Variable
Heart rate	Tachycardia	Bradycardia	Variable
Seizures	None	Common	Uncommon

Table 2: Clinical findings

Clinical findings	Mild (Grade 1)	Moderate (Grade 2)	Severe (Grade 3)
Conscious level	Irritable/hyper alert	Lethargic	Comatose, stuporous
Tone	Mildly abnormal (Hypo or hypertonic)	Moderately abnormal (Hypotonic or dissociated)	Severely abnormal: Flaccid (Hypotonic)
Seizures	Absent	Present	Present
Primitive reflexes	Exaggerated	Depressed	Absent

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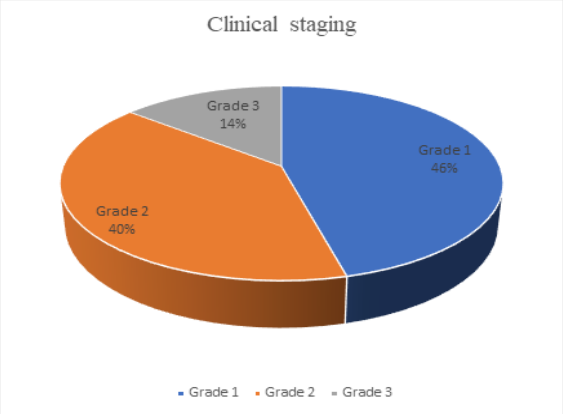

Figure 1: Clinical staging

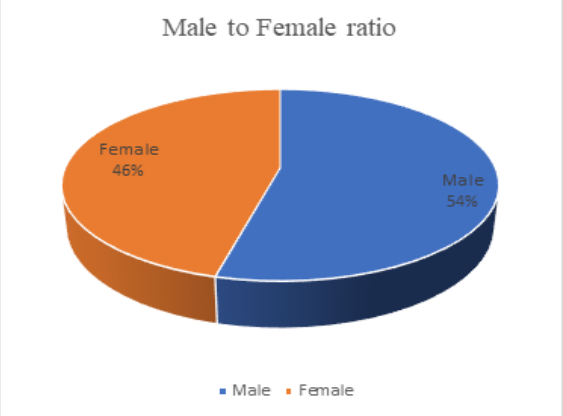

Figure 2: Male to Female ratio

Of the 70 cases, 38 cases were male while 32 were female.

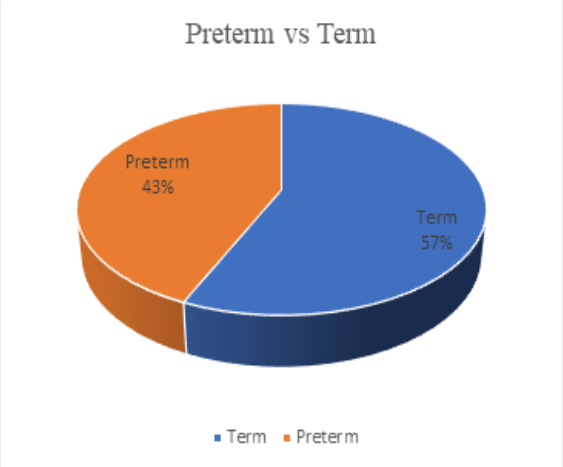

Figure 3: Preterm vs Term

42 cases were preterm babies & 28 babies were term babies.

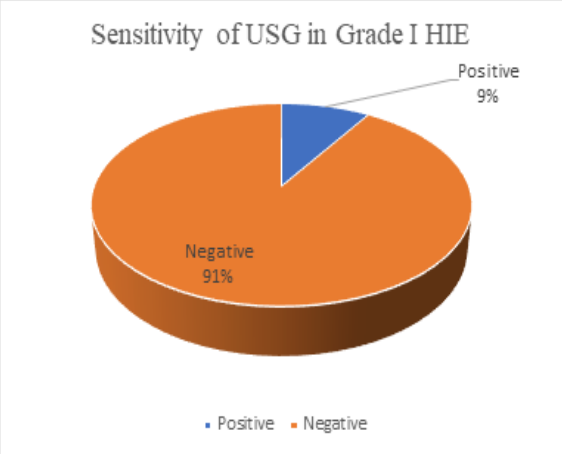

Figure 4: Sensitivity of USG in Grade I HIE

Of 32 Grade I case, the cranial ultrasound was found to be normal in about 27 cases and it was able to pick up the abnormality in about 5 cases.

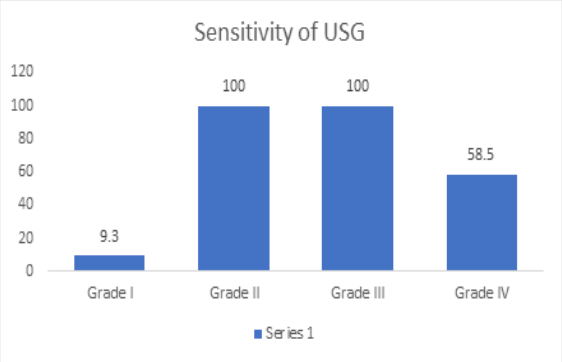

Figure 5. Sensitivity of USG

Sensitivity of cranial USG was maximum for Grade II and Grade III neonates while it was the lowest for Grade I cases.

DISCUSSION

Due to its low cost, portability, and lack of radiation exposure, cranial ultrasound (US) is the first test of choice in suspected infant HIE patients.[9] Based on this we evaluated the sensitivity of cranial ultrasound in detecting HIE in first 72hrs of life due to birth asphyxia. This was correlated using Sarnat & Sarnat grading system.

There were 54% of male and 46% of female neonates enrolled in this study. The difference between a number of males and females was not found to be statistically significant. The frequency of abnormal cranial ultrasonography results did not significantly differ between males and females. This finding was in agreement with that of Nagaraj et al.[10]

60% were preterm neonates while 40% were term neonates in the present study. In a study by Lakhkar et al,[11] amongst a total of 215 babies with HIE ,80 (32%) were term and the rest were preterm.

In the present study, 32 of the 70 cases were Grade I, 28 were Grades II, and 10 were Grade III

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instances. According to a study by Malick et al, cranial USG revealed 1.8% were in grade -I. 30.8% were in grade –III and majority were in grade –II (45%) among 120 infants.[13,14]

Our study comprised of 38 male infants while 32 were female. In a study by Mangaraj et al, signifying the importance of neurosonography in neonates with HIE, among the 80 neonates admitted with HIE, the male: female ratio was 4:1.[15]

42 cases were preterm babies & 28 babies were term babies. Premature born Infants have a high incidence of neonatal brain injury accompanied with adverse effects on motor, cognitive, behavioral, social, attentional, and sensory functional outcomes.[16]

Of 32 Grade I case, the cranial ultrasound was normal in 27 cases while abnormality was detected in about 5 cases. This indicated a lower sensitivity of cranial ultrasound in detecting Grade I HIE. Thakkar et al found that on comparing the ultrasound findings with clinical diagnosis for diagnosing intracranial bleed in preterm neonates, the sensitivity was 88.89% and specificity was 95.83%. The diagnostic accuracy of the test was 93.94%.[17]

Bundi et al observed that abnormal US findings were more likely to be detected in Sarnat Stage III when compared to Sarnat Stages I and II.[18] Our study showed maximum sensitivity of CUS in detecting grade II and grade III cases.

CONCLUSION

HIE is an important cause of mortality and morbidity in the neonatal period. Cranial US identifies the specific pattern of brain injury and helps rule out alternative causes of encephalopathy. For an early diagnosis and prompt therapy to minimise the severity of neonatal brain injury, imaging is essential.

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