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Original Research Article

Cranial ultrasound findings in asphyxiated term neonates and their correlation clinically with hypoxic ischemic encephalopathy staging

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ABSTRACT

Background: The survival of asphyxiated neonates has significantly increased in recent years because of numerous advancements in contemporary neonatal intensive care. The most popular and easily repeatable imaging method for the neonatal brain, the neurosonogram can demonstrate the most common types of cerebral injury in preterms and term infants. This study aims to analyse the value of cranial ultrasonography as an investigative tool for birth asphyxia babies (>34 weeks) will be evaluated to learn the morphology of various cerebral lesions and to compare clinical findings with neurosonogram results.
Methods: An observational study was conducted in 75 neonates (>34 weeks) admitted in Government Cuddalore medical college with birth asphyxia. A detailed history and clinical examination was carried out according to the designed proforma. All the babies in the study group were subjected to cranial ultrasound and the morphology of findings studied. CUS findings were correlated clinically.
Results: Among babies with HIE stage I, 89.7% had normal Cranial Ultrasound Findings, and 10.3% had abnormal findings. 43.3% babies had abnormal Cranial ultrasound findings in HIE stage II, and 70% had abnormal findings in HIE stage 3.
Conclusions: Cerebral oedema was the commonest neurosonogram finding in Asphyxiated babies and HIE 3 had the maximum abnormal findings in our study. Since there is a positive correlation between the severity of hypoxic ischemic encephalopathy and cranial ultrasound findings, USG cranium can be performed as a screening tool in all neonates with birth asphyxia in whom additional investigations could not be performed.

Keywords: Neurosonogram, Hypoxic ischemic encephalopathy, Cerebral oedema, Birth asphyxia

INTRODUCTION

Perinatal asphyxia is the failure of a newborn to initiate and sustain normal respiration after birth is another definition of perinatal asphyxia.[1,3] Perinatal asphyxia is a condition that causes multi-organ failure as well as hypoxemia, hypercapnia, and metabolic acidosis that worsen with time.[1,2] According to the American college of obstetricians and gynecologists, and the American academy of pediatrics, a neonate is labelled to be asphyxiated if; umbilical cord arterial pH <7; APGAR score of 0-3 for longer than 5 min; neonatal neurological manifestations (seizures, coma or hypotonia); and multisystem organ dysfunction (cardiovascular, gastrointestinal, hematological, pulmonary or renal system).[1,4] The term "hypoxic-ischemic encephalopathy" (HIE) refers to encephalopathy with objective data supporting a hypoxic-ischemic (HI) mechanism as the underlying cause. The incidence of birth asphyxia in India is around 6.6 percent and the mortality was 17.8% percent.

Male to female ratio was 1.4: 1 according to Indian studies.[5] The report of the World health organization (WHO) indicated that 4 million neonatal deaths occur yearly due to birth asphyxia.[6]The incidence of birth asphyxia in most developed countries accounts less than 0.1% of newborn deaths. But, in developing countries, it ranged from 4.6/1000 to 7-26/1000 live births.[7] Cranial ultrasonography enables at-the-bedside imaging of the developing brain. Nowadays, cranial ultrasonography is used more frequently to identify congenital and acquired abnormalities of the prenatal brain as well as patterns of brain injury in all asphyxiated neonates. It can identify the majority of brain lesions, infections, and structural defects in preterm and full-term neonates.[8] The objective of this study was to identify the cranial ultrasound findings in neonates with birth asphyxia and to correlate the cranial ultrasound findings with clinical findings of birth asphyxia.

METHODS

Current cross-sectional observational study was conducted in Government Cuddalore medical college hospital, Chidambaram. The study period was 2 years (December 2020 to December 2022). 75 asphyxiated neonates (>34 weeks) with features of hypoxic ischemic encephalopathy were enrolled in the study after getting consent from parents or guardian. The study was analysed by SPSS software and was approved by Institutional Ethical committee.

Inclusion criteria

Inclusion criteria for current study were; neonates >34 weeks with features suggestive of birth asphyxia, H/o birth asphyxia defined by: APGAR score of <7 at 5min and/or need for positive pressure ventilation >1 min after birth, presence of features of hypoxic ischemic encephalopathy: altered consciousness, abnormal tone & reflexes and seizures.

Exclusion criteria

Exclusion criteria for current study were; preterm babies <34 weeks, neonates with congenital anomalies, babies with sepsis/meningitis.

A detailed antenatal history is taken and asphyxiated neonates were identified. Perinatal events and detailed clinical assessment were done including anthropometric measurements. Vitals were monitored continuously and neonate selected was made to undergo complete neurological examination. Neurosonogram was performed within first week of life. Neurosonogram findings recorded were correlated with various clinical findings.

Clinical neurological examination

Complete neurological examination of babies was done. The neonates were graded based on Sarnat and Sarnat Staging. Special emphasis was given on; presence of cranial nerve palsies, strabismus, examination for hypertonia/hypotonia by scarf sign, adductor angle and passive movements of limbs, examination for weakness of muscle groups and deep tendon reflexes were elicited for presence of hyperreflexia.

Neonatal reflexes

Special emphasis was given to elicitation of; moro reflex, grasp reflex and asymmetric tonic neck reflex. Children were observed for the persistence or asymmetry of these reflexes. Necessary investigation and appropriate treatment were given to these babies.

RESULTS

Among the 75 subjects, 39 (52%) were male and 36 (48%) were female (Figure 1). Neurosonogram was done between 2-7 days in our subjects (Figure 2).

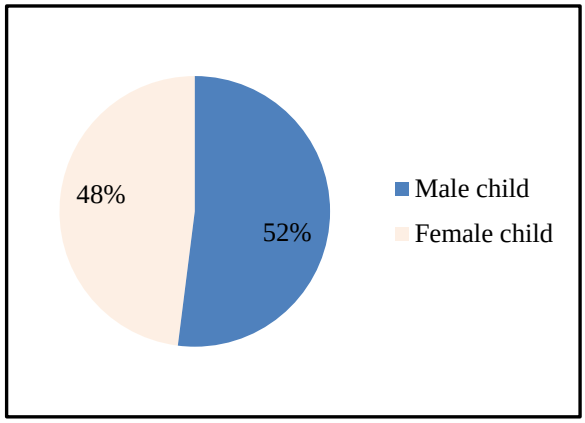

Figure 1: Pie diagram shows neonatal sex distribution.

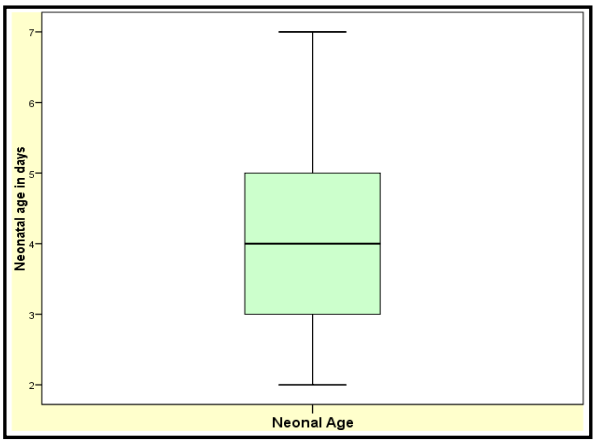

Figure 2: Box whisker diagram shows neonatal age distribution.

Regarding delivery details, 9 (12%) had late term gestation and 66 (88%) had term gestation. In mode of delivery, 29 (38.7 %) had LSCS and 46 (61.3 %) had normal vaginal delivery. 37 (49.3%) were Inborn and 38 (50.7%) were

Outborn. Out of 75 participants, 39 (52%) were in HIE stage I, 26 (34.7%) were in HIE stage II and 10 (13.3%) were in HIE stage III. Majority of the patients belongs to HIE stage I followed by HIE stage II and Stage III (Figure 3). Comparing HIE stage with APGAR score at 10 minutes, HIE III stage significantly higher number of neonates had APGAR score less than three when compared to HIE I and HIE II stages with the p value of less than 0.05 (Figure 4).

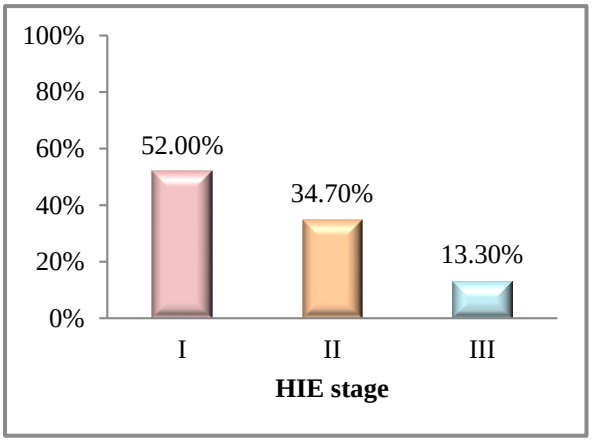

Figure 3: Cluster bar diagram shows break up of cases according to HIE stage.

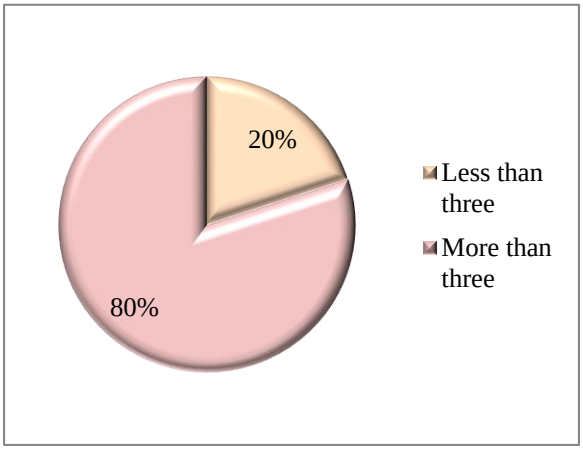

Figure 4: Pie diagram shows APGAR score distribution at 10 minutes.

Regarding cranial ultrasound findings among 39 participants in HIE stage I, 35 (89.7%) babies had normal cranial ultrasound findings, 1 (2.6%) had cerebral oedema, 2 (5.1%) had hydrocephalus and 1 (2.6%) had intra ventricular haemorrhage. Cranial ultrasound findings among 26 babies in HIE stage II, 15 (57.7%) participants cranial ultrasound findings were normal, 4 (15.4%) had cerebral oedema, 4 (15.4%) had hyper intensities and 3 (11.5%) had intra cerebral haemorrhage. Cranial ultrasound findings among 10 participants in HIE stage III, 3 (30.0%) participants cranial ultrasound findings were normal, 3 (30.0%) had hyper intensities and 4 (40.0%) had cerebral oedema (Figure 5). Regarding neonatal outcome, 84% were discharged 14.7% neonates died, and 1.3% referred.

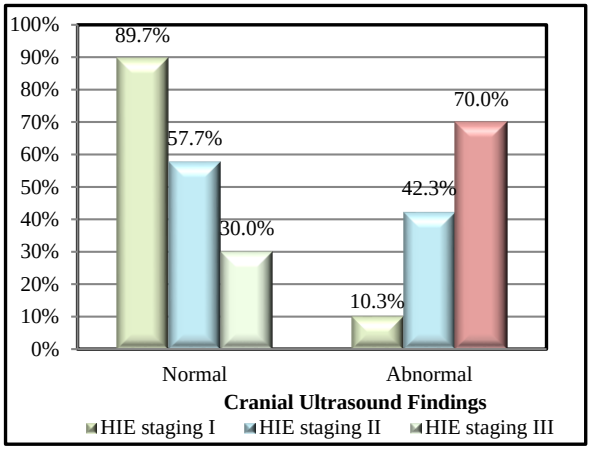

Figure 5: Cluster bar diagram shows comparison between HIE staging with cranial ultrasound findings.

DISCUSSION

In modern day neonatology cranial sonogram is used as newer diagnostic tool to know anatomical and pathological changes in neonatal brain. Generally all newborns have many sutures and fontanelles which will be open, and can be used as acoustic windows for imaging brain.[9] Neurosonogram plays an important role in assessing neurological outcome of neonates with birth asphyxia. In our study, 70% babies with birth asphyxia had normal Cranial Ultrasound findings, 12% babies had Cerebral edema, 9.3% had hyperintensities in white matter, 4% had intracerebral hemorrhage,and 2.6% had hydrocephalus. A study conducted Anand NK et al[10] in New Delhi revealed 86% normal scans and 14% cerebral edema. Prithviraj et al[11] has found 46% normal study and 38% cerebral edema in neonates with HIE.

Regarding cranial ultrasound findings HIE stage I, 89.7% had normal cranial ultrasound findings were normal, and 10.3% had abnormal findings, among which 2.6% had Cerebral oedema, 5.1% had hydrocephalus and 2.6% had intra ventricular haemorrhage which was similar to the study conducted by Tarana Yasmin et al[12] which showed 82% of babies with stage 1 HIE had normal neurosonogram findings. In our study, 43.3% babies had abnormal Cranial ultrasound findings in HIE stage II, and 70% had abnormal findings in HIE stage 3. A study conducted by Bijay et al in Odisha concluded that 45% of HIE 2 and 30.8% of HIE 3 babies had abnormal cranial USG findings.[13] A study by Nagraj et al from India showed 24.6% neonates who had abnormal APGAR scores, 50% with moderate asphyxia, and 80% with severe asphyxia had abnormal findings on cranial ultrasound.[14] Among babies with HIE II ,15.4% had cerebral edema, 15.4% had hyper intensities and 11.5% had intra cerebral hemorrhage. Cranial ultrasound findings in HIE stage III, showed 40% participants had cerebral edema and 30% had hyperintensities in deep white matter which correlated

with the Study conducted by Yasmin et al which showed the common cranial ultrasound finding in term asphyxiated neonates to be cerebral edema (43%).[12]

Limitations

The limitations of the study are its small sample size, and the proportion of babies included in HIE stage 3 was significantly lower compared to HIE stage 2 and 3. Follow up was not done, hence neurodevelopmental outcome could not be assessed.

CONCLUSION

Since there is a positive correlation between the severity of hypoxic ischemic encephalopathy and cranial ultrasound findings, USG cranium can be performed as a screening tool in all neonates with birth asphyxia. The patterns of injury may be used for prognostication of disease severity and neurological outcome. Though MRI remains the gold standard for diagnosis it is difficult to perform in acute setting since its time consuming and requires deep sedation which may be risky for babies with asphyxia. Cranial USG may be used for initial assessment and its utility can be optimized particularly in those patients in whom additional imaging is not feasible. It is now increasingly used at determining the pattern, timing and extent of injury in HIE as well as differentiating it from a host of diagnosis that can result in a similar appearing clinical picture.

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REFERENCES

1. Workineh Y, Semachew A, Ayalew E, Animaw W, Tirfie M, Birhanu M. Prevalence of perinatal asphyxia in East and Central Africa: systematic review and meta-analysis. Heliyon. 2020;6(4):e03793.
2. Lawn JE, Cousens S, Zupan J; Lancet Neonatal Survival Steering Team. 4 million neonatal deaths: when? Where? Why? Lancet. 2005;365(9462):891-900.
3. Liu L, Oza S, Hogan D, Perin J, Rudan I, Lawn JE, et al. Global, regional, and national causes of child mortality in 2000-13, with projections to inform post-2015 priorities: an updated systematic analysis. Lancet. 2015;385(9966):430-40.
4. Kriebs JM. Guidelines for perinatal care: by the American academy of pediatrics and the American college of obstetricians and gynecologists. J Midwifery Wom Health. 2010;55(2):e37.
5. Babu BVA, Devi SS, Kumar BK. Birth asphyxia-incidence and immediate outcome in relation to risk factors and complications. Int J Res Health Sci. 2014;2(4):1064-71.
6. Majeed R, Memon Y, Majeed F, Shaikh NP, Rajar UD. Risk factors of birth asphyxia. J Ayub Med Coll Abbottabad. 2007;19(3):67-71.
7. Bhutta ZA. Paediatrics in the Tropics. In: Manson's Tropical Infectious Diseases. USA: Elsevier; 2014:1197-214.
8. Wezel-Meijler G. Cranial ultrasonography: advantages and aims. In: neonatal cranial ultrasonography, 1st ed. Berlin: Springer; 2007: 3-4.
9. Prithviraj D, Reddy B, Reddy R, Shruthi B. Neurosonogram in critically ill neonates in neonatal intensive care unit. Int J Sci Stud. 2016;4(1):124-8.
10. Anand NK, Gupta A. Neurosonographic neonates with hypoxic ischemic encephalopathy. Indian Pediatr. 1994;31(7):767-74.
11. TaranaY, Akther S, Sultana S, Amin MB. Assessment of cranial sonographic findings of hypoxic ischemic brain injury in perinatal asphyxia. J Med. 2018;17(1):12-6.
12. Malick BL, Murmu MC, Mohanty AK. Study of cranial ultrasound finding in hypoxic ischaemic encephalopathy in term infants and its clinical correlation. Int J Res Granthaalayah, 2018;6(4):157-65.
13. Nagaraj N, Berwal PK, Srinivas A, Sehra R, Swami S, Jeevaji P, et al. A study of neurosonogram abnormalities, clinical correlation with neurosonogram findings, and immediate outcome of high-risk neonates in Neonatal Intensive Care Unit. J Pediatr Neurosci. 2016;11(3):200-5.

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