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Research Paper

Correlation between Cranial Ultrasonography Findings in Term Neonates with Perinatal Asphyxia and Severity of Hypoxic Ischaemic Encephalopathy

Authors
Bidyut Bhusan Nath[1], Anupama Deka[2], Arindam Ganguly[2*]
[1,2]Deptt. of Paediatrics, Silchar Medical College & Hospital, Assam, India
[*]Corresponding Author
Dr Arindam Ganguly

Abstract
Introduction: *Perinatal asphyxia leading to Hypoxic Ischemic Encephalopathy is a dreaded neurological disease of the newborn. The pattern of injury in brain imaging has crucial implications in therapies and predicted neurodevelopmental outcomes. Concurrent use of cranial ultrasound and clinical staging systems are evolving to predict the prognosis.*
Objective: *To study the cranial ultrasonographic finding in neonates with perinatal asphyxia and its clinical correlation.*
Method: *It is a prospective observational study of 100 term neonates with perinatal asphyxia admitted in the Neonatal ICU of Silchar Medical College & Hospital. Cranial Ultrasonography was done within 3-7 days of life.*
Result: *Correlation of initial cranial USG grading with mortality showed an increasing trend, as the USG grading increases, with 50 % and 80% mortality in cases presenting with Grade III & Grade IV intra-cranial hemorrhage respectively.*
Conclusion: *The cranial USG findings in asphyxiated neonates, when done within 3-7 days of life, reveal strong positive correlation with the severity of HIE. Ideally, MRI brain should be performed on all neonates with HIE but due to cost effectiveness and easy availability cranial USG can be used for initial assessment.*
Keywords: *HIE, Cranial USG, Intra-cranial hemorrhage, Perinatal asphyxia.*

Introduction

Hypoxic-ischemic injury (HII) of the neonatal brainand subsequent clinical hypoxic-ischemic encephalopathy (HIE) affects 1–3 per 1,000 live births in developed countries and is responsible for a significant burden of morbidity and mortality in the pediatric population[1].

Despite major advances in obstetric and neonatal care,neonatal asphyxia encephalopathy occurs in 1-2 per 1000 births in the high income countries,[2-4] in low-income countries, the incidence is much higher.[5,6]

Hypoxic-Ischemic Encephalopathy (HIE) in a full-term infant is a clinically defined syndrome of the disturbed neurologic function in the earliest days after birth in infancy, manifested by difficulty with initiating and maintaining respiration, the depression of the muscle tone and

reflexes, the subnormal level of consciousness and often seizures.[7] The Sarnat clinical stages are commonly used to estimate the severity of asphyxia insult to infants more than 36 weeks of gestation age.[8]

As survivors of severe HIE have profound long-term neurologic disability like cerebral palsy, mental retardation and epilepsy[9,10]and a large majority of infants with moderate HIE have cognitive problems, sequelae of hypoxic-ischemic brain injury require significant resources.[11] Assessment of severity of HIE would help proper parent counseling and early institution of stimulation therapy for better development of the infant.

Different imaging modalities, including ultrasound (USG) and magnetic resonance imaging (MRI) have been usedto classify patterns of cerebral injury within the realm of HIE-related injury. MRI is predictive of long-term outcomes in patients with HII/HIE in multiple studies.[12-15] However, MRI is costly, lacks portability, is time consuming, and, consequently, is limited in its utility in nonacademic centers, in low-income countries, and with critically ill patients who are too unstable to be moved. USG, on the other hand, is widely available, can be performed bedside without sedation, can be repeated as often as necessary, has no side effects, and thus, Concurrent use of sonographic grading with clinical staging systems are evolving to predict ultimate prognosis[16].

This current study was undertaken in view of the paucity of any such study in the resource-starved NE region of the country.

Method

The study was conducted at Silchar Medical College & Hospital. It was a prospective observational study. A total of 100 neonates, fulfilling the inclusion criteria, were studied. Written consent was taken from the parents prior to enrollment.

Inclusion Criteria

Term neonates with either one of the following:

- Documented APGAR score of 3 or less at 1 minute
- History of difficult labour with poor or no cry immediately after birth (in cases of babies referred to Out born NICU where APGAR Score is not available).

Exclusion Criteria

- Injury to brain caused by metabolic derangement, cerebral dysgenesis, infections, prematurity, hyperbilirubinemia.
- Neonates who left against medical advice.
- Neonates with congenital malformations.
- Death within half an hour of admission.
- Neonates, whose parents refused to give consent for the study

Baseline characteristics like sex, birth weight, maternal history with risk factors, and mode of delivery were noted. Detailed history was taken and detailed examination was done. The neonates were graded into HIE stages using Sarnat & Sarnat staging[7].

Cranial USG was done between days3-7 of life. Scans were performed through the anterior fontanelle in both sagittal and coronal planes. USG grading was done according to Papile[17].

Papile's grading of IVH:

Grading of IVH	Description
I	No IVH
II	IVH without ventricular dilatation
III	IVH with ventricular dilatation
IV	IVH with parenchymal hemorrhage

IVH= Intra Ventricular Hemorrhage

Results

Table 1: Baseline variables

Sl. No.	Variables	Number	Percentage
1	Males	61	61%
2	Females	39	39%
3	NVD	43	43%
4	LSCS	29	29%
5	Assisted Vaginal Delivery	28	28%

Among the 100 cases included in the study, 61 were males, 39 females. 43 of them were delivered by Normal Vaginal Delivery, 29 by LSCS and 28 by assisted vaginal delivery. (Table1)

Table 2: HIE Grading

Sl. No.	HIE grading	Number of cases	Percentage
1	I	39	39%
2	II	49	49%
3	III	12	12%

Clinically, neonates were grouped under 3 stages of HIE in accordance to Sarnat & Sarnat staging. 39 neonates were grouped under HIE-I, 49 under HIE-II and 12 under HIE-III (Table 2).

Table 3: USG Cranium findings

Sl. No.	USG Cranium Findings	Number	Percentage
1	Normal study	32	32%
2	Cerebral Oedema	14	14%
3	Grade I Intraventricular hemorrhage (IVH)	21	21%
4	Grade II IVH	18	18%
5	Grade III IVH	10	10%
6	Grade IV IVH	5	5%

Trans-fontanelle USG cranium findings revealed normal study in 32 neonates and cerebral oedema in 14 cases. Regarding intra-cranial hemorrhage, 21 cases had Grade I IVH; 18 cases had Grade II IVH; 10 cases had Grade III IVH and 5 cases had Grade IV IVH. (Table 3)

Table 4: Correlation of HIE Grading with USG Cranium findings

Sl. No.	HIE Grades	USG Cranium findings						
		Normal	Cerebral oedema	Grade I IVH	Grade II IVH	Grade III IVH	Grade IV IVH	p value
1	I (39)	32 (82.5%)	7 (17%)	-	-	-	-	p=0.0016
2	II (49)	-	7 (14.2%)	21 (42.8%)	18 (36.7%)	3 (6.1%)	-	
3	III (12)	-	-	-	-	7 (58.3%)	5 (41.6%)	

Cranial USG revealed that neonates with HIE I mostly had normal scans (82%), while only 17% cases had cerebral oedema. Amongst the neonates with HIE II, 14.2 % had cerebral oedema, 42.8% had Grade I IVH, 36.7% had Grade II IVH and 6.1% had Grade III IVH. Neonates with HIE III had Grade III IVH (58.3%) and Grade IV IVH (41.6%). Chi square test has revealed that clinical grading of HIE and USG cranium findings are strongly related. (r_s=0.867, p =0.0016) (Table 4)

Table 5: Correlation of Cranial USG with mortality

Sl. No.	USG Cranium findings	Number	Mortality	Correlation
1	Normal	32	-	
2	Cerebral Oedema	14	-	
3	Grade I IVH	21	-	r_s=0.8670
4	Grade II IVH	18	-	
5	Grade III IVH	10	5 (50%)	
6	Grade IV IVH	5	4 (80%)	

There is a strong positive correlation between increasing Grades of intra-ventricular hemorrhage and mortality (r_s=0.8670). (Table 5)

Discussion

This study attempted to correlate the clinical staging of HIE with USG Cranium findings. In this study USG Cranium showed normal study in 32% cases, cerebral oedema in 14% cases and varying degrees of intra-cranial hemorrhage in the rest 46 % cases. Zhu L et al[18] had reported 10.4 % of cerebral oedema and 18.5% of intra-cranial hemorrhage. Prithviraj et al[19] has found 46% normal study and 38 % of cerebral oedema in cranial USG of neonates with HIE. A study by Anand N K et al[20] in New Delhi revealed 86% normal scans and 14% cerebral oedema.

In the present study, HIE I cases had 82.5% normal scans and 17% of cerebral oedema; HIE II cases had 14.2 % of cerebral oedema, 42.8% of Grade I ICH, 36.7% Grade II ICH, 6.1% Grade III ICH; HIE III cases had 58.3% of Grade III ICH and 41.6% Grade IV ICH. Bijay et al[21]in a study conducted in Odisha found cranial USG abnormality in 10.8% of HIE I; 45% of HIE II and 30.8% of HIE III cases.Indira Raghupathy[22] in a study of HIE cases in Child trust hospital from May 1986 to August 1990 observed grade-I ultrasound abnormality in 46.5% cases, 34.8% in grade-II, 18.6% in grade –III HIE cases which is much different from the present study.

In the present study 9 cases have expired within the first week of life. All these cases were clinically staged as HIE III (75% mortality). Out of these 9 cases, 5 cases had Grade III ICH and rest 4 had Grade IV ICH thus pointing towards a strong positive correlation between increasing grades of ICH with the severity of HIE. In a similar study conducted by Khan RH et al[23] in 2014 in Bangladesh out of 178 neonates, 28 % had developed intra-ventricular hemorrhage and all 7 cases of Grade IV hemorrhage had expired.

Limitations of the study are small sample size, neurodevelopmental follow up not being included in the study. There is no blinding done with respect to pediatrician who is examining the baby or radiologist who has reported the USG cranium.

Conclusion

Imaging studies are usually done in all neonates with HIE. Ideally, MRI brain is the most sensitive and specific modality for assessment of severity of HIE but MRI is difficult to perform during the acute stage, since it is time consuming and needs deep sedation which is risky in asphyxiated babies. USG is easier to perform and helps in practical management by detecting intracranial hemorrhage. Moreover due to easy availability and reproducibility added with the strong correlation with clinical staging, cranial USG can be used for initial assessment.

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