



Original Article

Ultrasonographic Findings of Brain in Perinatal Asphyxiated Babies

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Abstract

Perinatal asphyxia is a major cause of morbidity and mortality among the newborns in developing countries like Bangladesh. The CNS lesions following perinatal asphyxia can be detected by ultrasonography before closure of fontanelles which is easier, cost-effective, and convenient than other methods like CT scan and MRI. This cross-sectional type of descriptive study was conducted on 99 perinatal asphyxiated babies in the Paediatric department of Rajshahi Medical College Hospital during the period of July 2008 to June 2010 to assess CNS lesions in different grades of HIE in term and preterm babies. A non-random purposive sampling method was adopted to select the sample unit. Ultrasonography of the brain of each patient was done at the Centre for Nuclear Medicine & Ultrasound, Rajshahi only once within first 28 days of life when the baby became clinically stable. Ultrasonographic findings showed that 13.1% term babies had abnormal findings of which cerebral edema occupied the major portions (54.54%). About 20.0% preterm babies had abnormal ultrasonographic findings of which ventriculomegaly without IVH (66.6%). The study also showed that the prevalence of intracranial abnormality was higher (78.6%) among the perinatal asphyxiated babies with HIE stage-2 in comparison to that of the HIE stage-3 (14.3%) and HIE stage-1 (7.1%). So, this study provided evidences in favour of role of ultrasonography of brain in the evaluation of perinatal asphyxiated babies and designing appropriate management.

Key words: Perinatal asphyxia, Brain lesions, HIE, Ultrasonography

TAJ 2016; 29 : No-2: 21-25

Introduction

Perinatal Asphyxia may be defined as an insult to the fetus or newborn due to lack of oxygen (hypoxia) and or a lack of perfusion (ischemia) to various organs, which will manifest as difficulty in establishing spontaneous respiration evident by

delayed cry after birth.^{1,2} It is a major cause of morbidity and mortality among the newborns in developing countries like Bangladesh where 5-10/1000 live births occur.^{3,4,5} World Health organization (WHO) estimates that globally 4 to 9 million newborns suffer from perinatal asphyxia

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each year. Of those, an estimated 1.2 million die (29.0% of all neonatal deaths) and almost the same numbers develop severe consequences.⁶ Hypoxic-Ischemic encephalopathy is an important cause of permanent damage to CNS tissues that may result in neonatal death or manifest later as cerebral palsy, epilepsy or developmental delay. Fifteen to 20% of infants with HIE die in the neonatal period and 25 to 30% of survivors are left with permanent neurodevelopmental abnormalities (cerebral palsy, mental retardation).⁷ Target organs of perinatal asphyxia are the brain, heart, lungs, kidneys, liver, bowel, and bone marrow. In a study of asphyxiated newborns 34% had no evidence of organ injury, 23% had an abnormality confined to one organ, 34% involved two organs, and 9% had three affected organs. The most frequent abnormalities involved the kidney (50%), followed by the CNS (28%), CVS (25%) and respiratory system (23%). Ultrasonic examination of the brain may reveal haemorrhage or periventricular changes (useful in preterm infants) and less well, the extent of cerebral edema (midline shift, ventricular compression).⁸ USG is of major value in identification of intraventricular hemorrhage (IVH), necrosis of basal ganglia and thalamus. It is superior to CT in identifying both the acute and subacute-chronic manifestations of periventricular white matter injury.⁹ Sensitivity in detecting IVH by ultrasound and CT scan is 83% and 39% respectively. So, before closure of fontanelle ultrasonography is easier, cost-effective and acceptable method to diagnose IVH in infant.¹⁰ This study has been undertaken to assess CNS lesions in different grades of HIE in term and preterm babies with prenatal asphyxia.

Material and Methods

The cross-sectional type of descriptive study was conducted at the Department of Pediatrics, Rajshahi Medical College Hospital with the collaboration of Centre for Nuclear Medicine and Ultrasound, Rajshahi from July 2008 to June 2010.

A total number of 99 asphyxiated newborn babies admitted in hospital constituted the sample size. Non-random purposive sampling procedure was adopted to select the sample unit. Clinically suspected cases of perinatal asphyxiated babies were selected from inpatient department according to selection criteria. After obtaining informed consent, proper history was taken from the mother or the person attending the baby. The obstetric history was also collected from the written information prepared by the attending physician conducting the labor. Thorough clinical examination was done in all the babies. Examination findings were documented in a preformed questionnaire. To obtain brain image for suspected anoxia/brain injury, High Resolution Ultrasonography (HRUS) was done by using 5.0 MHz/7.5 MHz linear or sectoral probes through anterior fontanel as an acoustic window. Increased echogenicity of brain parenchyma represents cerebral edema or evolving infarction. On the other hand focal area of increased echogenicity represents vasculitis, cerebritis or infarction. TOSHIBA JUST VISION 400 ultrasound machine was used in this study with 7.5 MHz probe in both sagittal and coronal planes. Suspected cases were confirmed by using 5-10 MHz linear transducer of SONOLINE ULTRASOUND SYSTEM, Simens Germany Machine.

Results

During the two years period a total number of 99 perinatal asphyxiated babies were undergone ultrasonographic examination of brain. The results are shown on the following figures and tables.

The gestational age of the majority of the babies [84 (84.8%)] were 37 weeks and above (Term) and 15.2% were below 37 weeks (preterm). (Figure-I).

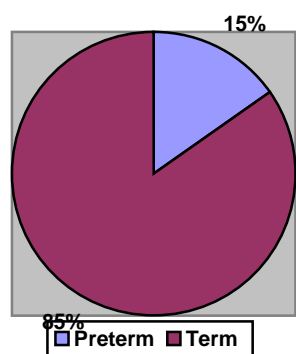


Figure I: Gestational age of the babies

Table-I: Ultrasonographic findings and gestational age (Term and Preterm).

USG findings	Preterm N (%)	Term N (%)	Total N (%)
Cerebral edema	1(6.7)	6(7.1)	7(7.07)
Ventriculo megaly	2(13.3)	2(2.4)	4(4.04)
Normal	12(80.0)	73(86.9)	85(85.85)
Subdural haematoma	-	1(1.2)	1(1.01)
Cerebral infarct	-	1(1.2)	1(1.01)
IPH	-	1(1.2)	1(1.01)
Total	15(15.15)	84(84.84)	99(100.0)

About 6.7% preterm baby and 7.1% term babies had cerebral edema. Equal number of both term and preterm babies had ventriculomegaly. In case of term babies 1.2% had subdural hematoma, cerebral infarct and intraparenchymal haemorrhage

Table-II. Abnormal ultrasonographic findings in asphyxiated babies.

USG findings	Preterm N (%)	Term N (%)	Total N (%)
Cerebral edema	1(33.3)	6(54.54)	7(50.0)
Ventriculomegaly	2(66.66)	2(18.18)	4(28.57)
Subdural haematoma	-	1(9.09)	1(7.14)
Cerebral infarct	-	1(9.09)	1(7.14)
IPH	-	1(9.09)	1(7.14)
Total	3(21.42)	11 (78.57)	14(100.0)

Among the 3 preterm babies having abnormal ultrasonographic findings, majority (66.66%) of them had ventriculomegaly and 33.3% had cerebral edema. In case of term babies, 11 were detected as ultrasonographically abnormal of which 54.54% had cerebral edema, 18.18% ventriculomegaly, 9.09%

subdural haematoma and equal percentage of cerebral infarct and IPH respectively (Table-II)

Table-III. USG findings and Clinical staging of hypoxic-ischemic encephalopathy (HIE)

USG findings	Clinical diagnosis			Total N(%)
	PNA with HIE- 1 N (%)	PNA with HIE - 2 N(%)	PNA with HIE - 3 N(%)	
Cerebral edema	0(.0%)	6(85.7%)	1(14.3%)	7(7.07%)
Ventriculomegaly	1(25.0%)	2(50.0%)	1(25.0%)	4(4.04%)
Sub dural haematoma	0 (.0%)	1(100.0%)	0(0.0%)	1(1.01%)
Normal	24(28.2%)	55(64.7%)	6(7.1%)	85(85.85%)
Cerebral infarct	0(.0%)	1(100.0%)	0(0.0%)	1(1.01)
IPH	0(0%)	1(100.0%)	0(0%)	1(1.01)
Total	25(25.3%)	66(66.7%)	8(8.1%)	99(100.0%)

Cerebral edema was present in 7.0% babies. Among them majority (85.7%) babies were in HIE stage -2 and 14.3% babies were in HIE stage-3 respectively. There was 4 babies who had ventriculomegaly, among them 50.0% babies were in HIE stage-2 and 25.0% babies were in HIE stage-1 and HIE stage -3. (Table-III)

Table-IV: Distribution of babies by the stages of HIE and USG findings

USG Finding	Clinical diagnosis			Total
	PNA with HIE-1	PNA with HIE-2	PNA with HIE-3	
Normal finding	24 (28.2%)	55 (64.7%)	6 (7.1%)	85 (85.85%)
Abnormal finding	1 (7.1%)	11 (78.6%)	2 (14.3%)	14 (14.14%)
Total	25 (25.3%)	66 (66.7%)	8 (8.1%)	99 (100.0%)

Majority of the babies (85.85%) had normal and 14.14% babies had abnormal ultrasonography findings (Table-IV).

Table-V. Sites of brain lesions found on USG.

Brain Lesions	Location/Site	Number
Ventricular dilatation	Lateral/third ventricle	4 (28.57%)
Sub dural haematoma	Subdural	1(7.14%)
Cerebral Infarct	Rt.Parietal lobe	1(7.14%)
Cerebral edema		
Diffuse	Both cerebral hemisphere	3(21.42%)

Mild	Both cerebral hemisphere	2(14.28%)
Focal	Frontal lobe	1(7.14%)
	Frontal & Parietal lobe	1(7.14%)
Cerebral edema, IPH and Ventricular dilatation	Both cerebral hemisphere, frontal lobe and all parts of ventricle	1(7.14%)
Total		14(100.0%)

28.57% brain lesions were ventricular dilatation and all of them were located in the lateral and/or third ventricle. About 21.42% diffuse and 14.28% mild cerebral edema were noted in the both cerebral hemispheres (Table-V)

Discussion

Perinatal asphyxia affects many organs of body. The most severe and fatal outcomes are the results of the lesion of the brain. The majority (84.84%) babies were term and 15.15% babies were preterm (Figure-I). Among the term babies 85.9% had normal ultrasonographic findings and 14.1% babies had abnormal ultrasonographic findings (Table-I). Among the abnormal ultrasonographic findings cerebral edema was noted in 54.54%, ventriculomegaly 18.18%, subdural haematoma 9.09%, cerebral infarct 9.09% and intraparenchymal hemorrhage 9.09% of term babies (Table-II). On the other hand 15.15% babies of the present study were preterm by gestational age. Among them majority (80.0%) babies had normal ultrasonographic findings and 66.66% babies had ventriculomegaly and 33.33% babies had cerebral edema (Table-II). Noman F showed 80.0% of the term babies had normal and 20.0% had abnormal ultrasonographic findings that included cerebral edema 4.0% and ventriculomegaly 16% cases¹¹. The author also found normal ultrasonographic finding in 90.0% cases and cerebral edema 4.0%, ventriculomegaly 4.0% and PVL 2.0% in case of preterm babies.¹¹ .Regarding ultrasonographic findings and clinical staging, it was found that 7.07% babies had cerebral edema. Among them majority (85.7%) babies were in HIE stage-2 and 14.3% babies were in HIE stage-3 respectively (Table-III). There were 4 babies who had ventriculomegaly, among

them 50.0% babies were in HIE stage-2 and 25.0% babies were in HIE stage-1 and HIE stage-3 respectively (Table-III). Noman F detected normal ultrasonographic findings in 85% cases and abnormal ultrasonographic findings in 15.0% cases as a whole¹¹. We found 85.85% babies had normal and 14.14% babies had abnormal ultrasonography findings as a whole (Table-IV). So, ultrasonographic finding of the present study coincides with that of Noman F¹¹ Miah MSR et al. found IVH in 32.4% of low birth weight babies with perinatal asphyxia.¹⁰ But we have not found no IVH probably may be due to the fewer number of low birth weight babies had been included in this study. Haider B A et al. found as many as 50.0% of the neurosonograms in neonates with HIE are normal.¹² Anand N K et al. found sonographic abnormalities, presumably indicating cerebral edema and or ischemia in 86.0% cases¹³. Ong L C et al. showed 57.9% babies had abnormal ultrasonographic findings. The abnormalities ranged from ventricular compression to focal or diffuse hyperechogenicity¹⁴. Soni J P et al. found 21.4% ventriculomegaly in his study.¹⁵ Studies undertaken by above three authors showed ultrasonographic abnormalities in 86.0%, 57.9% and 21.4% cases respectively.^{13,14,15} Whereas, we found ultrasonographic abnormalities in 14.14% cases. The previous studies failed to show consistent findings undertaken by different workers which are a bit difficult to explain. But it could be due to the recruitment of sample by purposive method in addition to variation in expertise of the sonologist. The study showed that 4 (28.57%) brain lesions were ventricular dilatation and all of them were located in the lateral and/or third ventricle. It was found that 21.42% diffuse cerebral edema noted in the both cerebral hemispheres in ultrasonography. There was 14.28% mild cerebral edema involving both cerebral hemispheres. It was observed that equal percentage (7.14%) of focal cerebral edema was present in frontal and parietal lobe. About 7.14% patient had cerebral infarction and similar percentage had subdural haematoma; the lesions

were located in the right parietal lobe and under the dura matter respectively. There was one patient who had multiple lesions like cerebral edema, IPH and Ventricular dilatation located in the both cerebral hemispheres, frontal lobe and all parts of ventricular system respectively (Table-V).

Conclusion

The study provided evidences in favour of the role of ultrasonography of brain in the evaluation of perinatal asphyxiated babies with hypoxic-ischemic encephalopathy (HIE). Thereby, ultrasonography may help early recognition of intracranial lesions in newborns with asphyxia. So, prognosis may be assessed, complication can be anticipated and appropriate management plan may be designed.

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