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ORIGINAL ARTICLE

Cranial ultrasonography findings and immediate outcome of neonates with seizure

Zahid Hossain[1], Farid Ahmed[2]

Abstract

Background: *Intracranial imaging of the neonate is a logistically challenging task. Ultrasonography is a non-invasive diagnostic technique, simultaneously efficient, effective, and safe modality for this application, and it is particularly appropriate for many common clinical scenarios in neonates. Cranial ultrasonography can be done to evaluate the neonatal brain, after seizure to identify its cause.*

Objective: *The objective of this study was to evaluate the cranial ultrasonographic findings and immediate outcome of neonates with seizures.*

Methods: *This was a prospective study conducted from July 2010 to June 2011 at Dhaka Shishu (Children) Hospital. Total 94 neonates with seizures were included in the study. Cranial USG was done in all the cases. Neurological assessment was done to evaluate the outcome at discharge.*

Results: *Among 94 neonates with seizure, 25(26.6%) came within 24 hours of birth, 85 (90.4%) were term and 20 (21.3%) were low birth weight. In 49 (52.1%) neonate time of onset of seizure was first 48 hours of life. Hypoxic ischemic encephalopathy (HIE) was found to be the commonest etiology of seizure (56.4%). Commonest abnormal cranial USG finding was intraventricular haemorrhage (IVH) 26 (27.6%); IVH Grade-I 13 (13.8%), IVH grade-II 10 (10.6%), IVH grade-III 3 (3.2%). The other sonographic abnormalities were cerebral oedema 11 (11.7%), subdural haematoma 6 (6.4%), sub-arachnoid haemorrhage 5 (5.3%), and agenesis of corpus callosum 1 (1.1%). Finding was normal in 45 (48.5%) neonates. It was found that immediate outcome was poor in neonates with seizure who had cerebral oedema, IVH grade-III and subdural haematoma.*

Conclusion: *This study found that cranial USG is a useful investigation to identify the pathology of neonatal seizure. The neonates with seizures who had cerebral oedema, IVH-III and subdural haematoma had poor outcome.*

Key wards: Neonate, seizure, cranial ultrasonography, outcome.

Introduction

Neonatal seizures represent one of the several clinical features of an evolving encephalopathic process.[1] Neonates with seizures have a higher risk of death or neurodevelopmental squelae. The incidence of seizures in term babies is reported to be 3-6 per l000 live birth.[2] In Bangladesh the prevalence of neonatal seizure is 8.4 per 1000 live birth.[3]

The incidence of seizure due to perinatal asphyxia is high in first two days of life. There is a second peak of incidence from 3 days onwards which is usually due to septicaemia, meningitis and metabolic causes.[4] Prolonged seizure results in extensive damage of neonatal brain that may lead to a very grave prognosis. In the individual case, outcome and prognosis is estimated by the level of brain maturity, underlying aetiology of the seizure and investigations

1. Associate Professor, Department of Radiology and Imaging, Bangladesh Institute of Child Health (BICH), Dhaka Shishu Hospital.
2. Associate Professor of Paediatrics, Bangladesh Institute of Child Health (BICH), Dhaka Shishu Hospital.

Correspondence to : Dr. Zahid Hossain, Associate Professor, Department of Radiology and Imaging, Bangladesh Institute of Child Health (BICH), Dhaka Shishu Hospital. E-mail: farid_shamim@live.com

like, electroencephalogram (EEG) and imaging studies of the brain. Ultrasonography (USG), magnetic resonance imaging (MRI) and computerized tomography (CT) scan[5-8] are the important methods of investigation by which one might have an idea of the condition of the neonatal brain. To ascertain the prognosis of hypoxic ischemic encephalopathy (HIE) and seizures due to other causes, imaging studies of the brain have been performed along with Sarnat staging.[9]

Though CT scan and MRI of brain are highly informative, but these techniques also have disadvantages. For these investigations a very ill neonate might required sedation for optimal studies, patient must be transported to the radiology department and finally the hazards associated with ionizing radiation are of major concern.[10]

Sonography overcomes these challenges and provides several advantages. While many neonatal organ systems are amenable to sonographic evaluation, brain imaging is a particularly attractive application. Not only is the neonatal head uniquely configured to facilitate ultrasound scanning through fontanelles, but the most common cranial pathology are readily evaluated. Further, the real-time nature, portability, and safety of this modality allow clinicians to perform rapid, frequent (serial), bedside exams as clinically indicated, even for haemodynamically unstable neonates.[11,12] B-Mode, gray scale and real time ultrasound provides a useful method for examining brain of preterm and term neonates with seizures.[13] Ultrasonography in HIE cases and LBW cases usually performed around 72 hours of age. Evolution of encephalopathic changes and intraventricular haemorrhage needs 48 to72 hours. McDonald et al[14], Sie et al[15] and Dolfin et al[16] had shown that cranial USG studies on 3rd, 4th or 5th day was more informative than on 2nd day. Pathological change in the brain indicates immediate as well as late complication of the neonates with seizure. Ultrasonographic findings indicating pathological damage of the brain help physicians to identify the babies at risk for abnormal neurological outcome. Neonates with grade III and IV intraventricular haemorrhages (IVHs) and increased echodensity had the worst prognosis.[5] This study was conducted to evaluate the cranial USG findings in neonates with seizures and their immediate outcome.

Materials and methods

This was a prospective study, conducted at Dhaka Shishu (Children) Hospital from July 2010 to June 2011. Ninety four neonates admitted with seizures were enrolled in this study. Following enrollment, age of starting of seizure, admission age, weight, length, OFC, gestational age, clinical diagnosis, neurological examination, complication during hospital stay, outcome were recorded. Hypoxic ischaemic encephalopathy cases were classified according to modified Sarnat and Sarnat staging.[17]

Cranial USG was performed with a real time B mode gray scale machine with a 5 MHz transducer by one of the investigators in all enrolled neonates. Different scans on sagital and coronal planes were taken.

Outcome was categorized into neurologically normal and abnormal at the time of discharge, LAMA (left against medical advice) and death. Data was analyzed with the SPSS version 10.

Results

Among 94 neonates with seizures 59 (62.8%) were male and 35 (37.2%) were female with male to female ratio (M:F) was 1.7:1. Mean age on admission was 5.5±5.3 days, and 25 (26.6%) of them were admitted within first 24 hours of age. Most of the neonates 85 (90.4%) were term. Low birth weight neonates (<2500 gm) were 20 (21.3%) (Table I). Mean length was 48.9±3.09 cm and mean occipito-frontal circumference was 34.6±1.6 cm. In 49 (52.1%) neonates time of onset of seizure was first 48 hours of life (Fig 1).

Table I
Characteristics of the study population (N=94)

Baseline characteristics	Number	%
Age on admission		
<24 hours	25	26.6
1-3 days	39	41.5
4-7 days	30	31.9
Mean age	5.5± 5.8 days	
Gestational age (weeks)		
34-36	7	7.5
37-42	85	90.4
>42	2	2.1
Mean Gestational age	39.2±1.6	
Weight (grams)		
<2500	20	21.3
>2500- 4000	74	78.7
Mean weight	2744 ± 521	

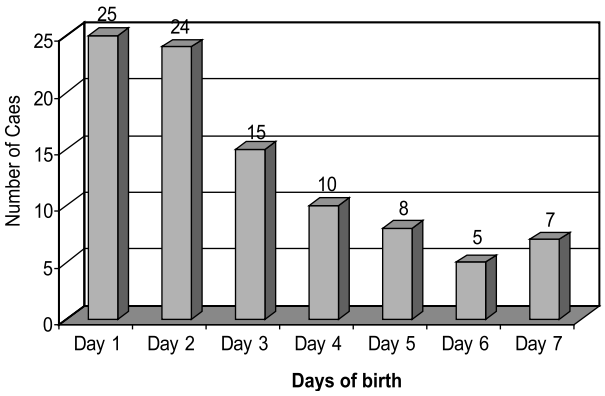

Fig 1 *Time of onset of neonatal seizure*

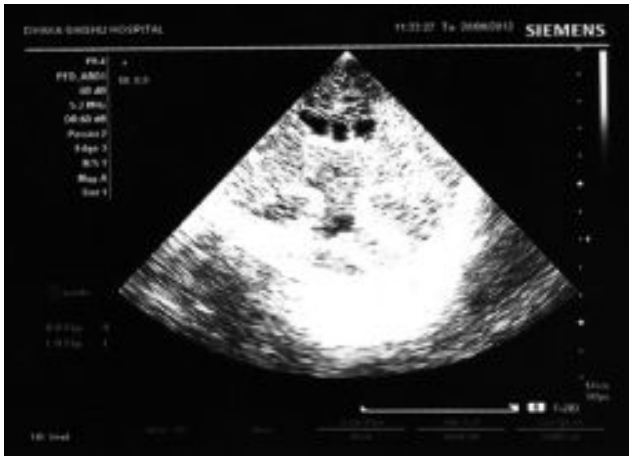

Fig 2 Coronal scans demonstrates dilated blood field lateral ventricles, the intra ventricular haemorrhage inseparable from the Subependymal haemorrhage were it originated (IVH-III).

Commonest abnormal cranial USG finding was intraventricular haemorrhage (IVH) 26 (27.6%); IVH Grade-I 13 (13.8%), IVH grade-II 10 (10.6%), IVH grade-III 3 (3.2%) (Fig 2). The other sonographic abnormalities were cerebral oedema 11 (11.7%) (Fig 3), subdural haematoma 6 (6.4%) (Fig 4), sub-arachnoid haemorrhage 5 (5.3%), and agenesis of corpus callosum 1 (1.1%) (Fig-5) respectively. In 45 (47.9%) neonates cranial USG findings were normal (Table II).

Hypoxic ischemic encephalopathy (HIE) (Fig 6a, 6b) was found to be the commonest aetiology of seizure (56.4%). Among the HIE cases, 30 (31.9%) were with Stage II and 3 (3.2%) were with Stage III. Fourteen (14.9%) were complicated with septicaemia and six (6.4%) preterm low birth babies had HIE. Cross tabulation between primary

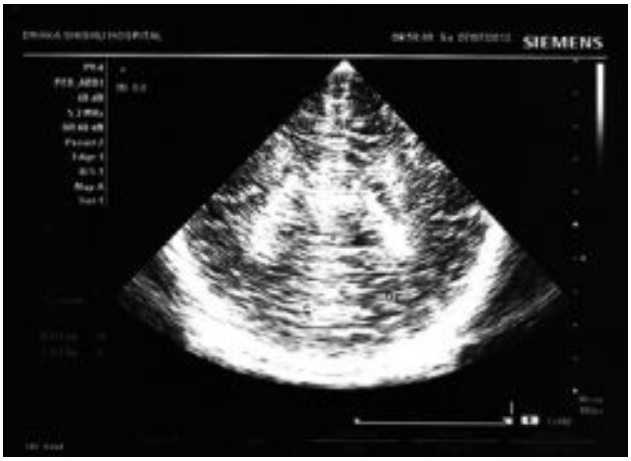

Fig 3 Coronal scanning shows echogenic echopattern of brain parenchyma with compressed of ventricular system (cerebral Odema)

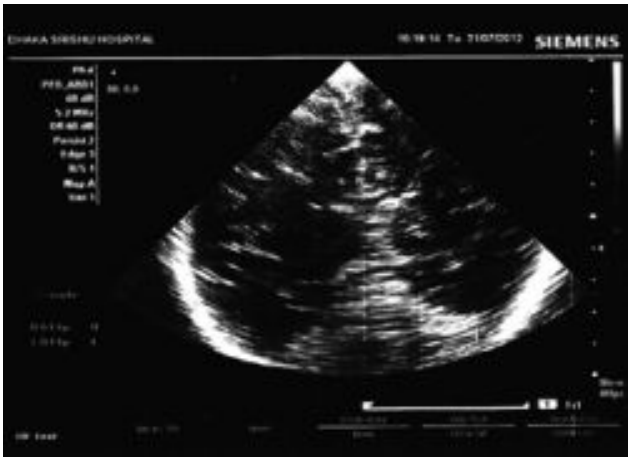

Fig 4 Coronal scan shows a Sonolucent fluid collection over cerebral hemispheres (Subdural hematoma)

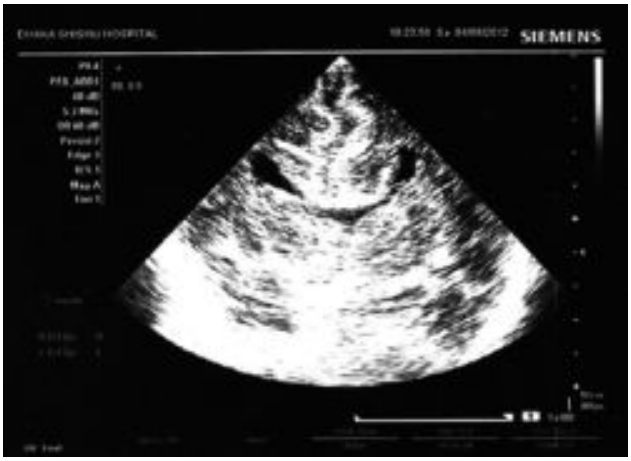

Fig 5 Coronal sonogram shows wide separation and sharp angulation of frontal horns with concave medial borders (Agenesis of corpus callosum)

etiology of seizure and sonographic findings showed that intraventricular haemorrhage was common in preterm babies (12 out of 26). Rest 14 cases of IVH were due to HIE stage II and III and HIE complicated with septicaemia. Cerebral oedema was common in babies with septicaemia or HIE complicated with septicaemia. Subdural haematoma and subarachnoid haemorrhage were found mostly in full term babies with HIE (Table III).

On evaluation of outcome of the enrolled neonates, it was found that babies with cerebral oedema had the worst outcome, 3 (27.3%) died and 5 (45.4%) were neurologically abnormal. Half of the neonates with subdural haematoma were labeled as neurologically abnormal at discharge. Only 1 (7.7%) cases of IVH grade I and 2 (20%) cases of IVH grade II were found neurologically abnormal at discharge. Among 3 neonates of IVH grade III, 2 (66.7%) unfortunate neonates died and 1 (33.3%) found neurologically abnormal. Among 45 neonates with normal sonographic findings, 6 were abnormal and 2 died. These neonates had septicaemia and some other diagnosis (Table IV).

Table II

Cranial Ultrasonography findings		Number	%
Abnormal	IVH grade 1	13	13.8
	IVH grade II	10	10.6
	IVH grade III	3	3.2
	cerebral oedema	11	11.7
	Subdural haematoma	6	6.4
	Sub arachnoid haemorrhage	5	5.3
	Malformation	1	1.1
Normal		45	47.9

Table III
Cranial Ultrasonography and primary aetiology of seizure (N=94)

USG findings	Primary etiology					
	Stage II & III HIE	Septicaemia	HIE complicated with septicaemia	PTLBW with complications	Others	Total
IVH grade I	3	0	3	7	0	13
Cerebral oedema	2	4	3	1	1	11
IVH grade II	5	0	2	3	0	10
Subdural Haematoma	5	1	0	0	0	6
Sub- arachnoid haemorrhage	3	1	0	1	0	5
IVH grade III	0	0	1	2	0	3
IVH grade IV	0	0	0	0	0	0
Normal	15	18	5	0	7	45
Malformation	0	0	0	0	1	1
Total	33	24	14	14	9	94

Table IV
Cranial USG findings and outcome (N=94):

USG findings	Outcome				
	Neurologically Normal	Neurologically Abnormal	Death	LAMA	Total
Cerebral oedema	3	5	3		11
Subdural haematoma	3	3			6
Sub arachnoid hemorrhage	3	1		1	5
IVH grade I	12	1			13
IVH Grade II	8	2			10
IVH Grade III	0	1	2		3
IVH Grade IV	0	0 0			
Normal	35	6	2	2	45
Malformation	1				1
Total	65	19	7	3	94

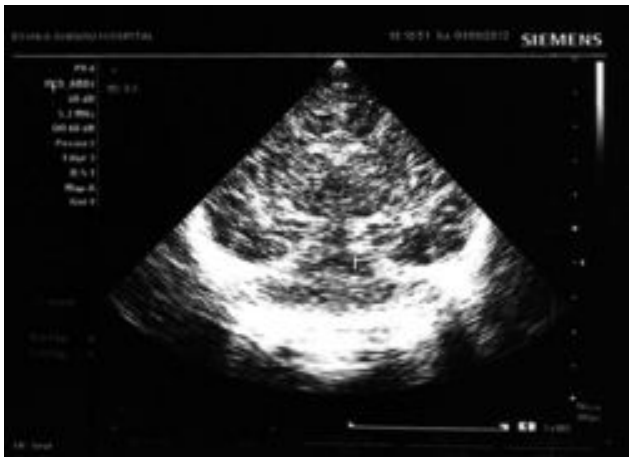

Fig 6a Coronal image

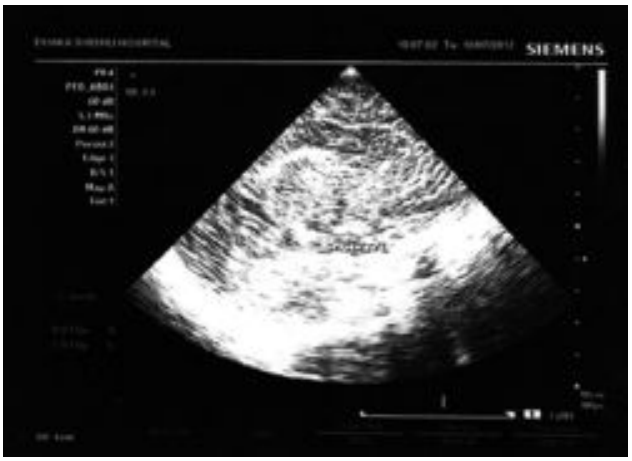

Fig 6b Sagital image

Fig 6 Coronal and sagital images showed symmetric echogenicity around lateral ventricle (HIE)

Discussion

Outcome and prognosis of neonatal seizures depend on the level of brain maturity, underlying etiology of the seizure, EEG and neuro-imaging findings. The imaging studies of the brain such as ultrasound, CT scan and MRI could help us to see the pathology of brain in case of neonatal seizure.

Demographic features of our study group like age and weight on admission, gestational age were similar with other studies of neonatal seizure.[6,18] Starting age of convulsion has strong correlation with aetiology. Seizure at first 24 to 48 hours of life is usually due to perinatal insult of the brain and seizures on 3 to 5 days are caused by metabolic and Barnes[22] had also found cerebral oedema in encephalopathy cases. Subdural haemorrhage and subaracnoidal haemorrhage were the findings observed in term neonates with prolonged and difficult labour.[22] We got 6 (6.4%) term babies with subdural haematoma and 5 (5.3%) term babies with subarachnoid haemorrhage. Volpe JJ[1] got similar findings.

IVH is the usual USG finding in preterm babies.[21,23] The germinal matrix in sub-ependymal area of

ventricles in preterm babies is composed of cells that develop into neurons and glia of cerebral cortex and basal ganglia. These cells are loosely organized, contain a rich vascular supply and for this reason IVH is common in preterm babies. In our study, 11 PTLBW babies and 15 term babies with HIE and septicaemia had different grades of IVH. Volpe JJ[1] in his study had found IVH in cases of severe HIE.

Ultrasonography may remain normal in many of the cases of neonatal seizure. In our study near about half (47.9%) of the neonates had normal sonographic findings and etiology of seizure of those cases were septicaemia with or without meningitis and metabolic abnormalities. Friedland et al[24] in his study had found that in central nervous infection neuroimaging findings might not be suggestive of pathological changes.

Outcome and prognosis of neonatal seizure depends on various factors. A single factor can not determine the neurodevelopmental outcome. Again, as development is a continuous maturational process, varies from brain to brain[9], it is difficult to detect a point that a baby would be able to achieve the goal. Even then various studies have been performed to see the outcome of neonatal seizure. Curtis et al[6], Patricia et al[7], Bernes et al[8] and Thompson et al[9], all had found USG findings as an important indicator of immediate outcome. In this study, we found all grade-III IVH and 20% of grade-II IVH had poor outcome. Neonates with seizure who developed cerebral oedema and subdural haematoma also had poor outcome. These findings were similar to that of Donat et al[25], Shankaran et al[26] and Chadha et al[27].

Conclusions

This study found that cranial USG is a useful investigation to identify the pathology of neonatal seizure. The neonates with seizures who had cerebral oedema, IVH-III and subdural haematoma by USG had poor outcome. So, each and every neonate with seizure should have a cranial USG during hospital stay.

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