

Neonatal Seizures: Correlation between Clinico-Etiological Profile and EEG Findings

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Abstract:

Introduction: Seizures are quite common in newborn babies. Among other investigations, EEG is used to show the type and location of the activity in the brain during a seizure. Correlation between clinico-etiological profile of neonatal seizures and EEG findings, so far, has not been studied in Bangladesh.

Objective: The objective of the study was to correlate the clinical, etiological and EEG profile of neonatal seizures.

Methodology: It was a cross-sectional study done at NICU of BSMMU and Central Hospital Ltd. All the neonates admitted with seizures during the study period were included in the study. Their clinico-etiological profiles were carefully recorded and EEG were done in all the cases. Chi-square test was done to find out the statistical difference.

Results: Among total 51 cases of neonatal seizures, 29 (56.86%) cases had perinatal asphyxia, followed by septicemia in 8 (15.67%) and meningitis in 6 (11.76%). Hypoglycemia and hypocalcaemia was found in 10 (19.6%) & 8 (15.7%) cases respectively and 15 (29.4%) had acidosis. Thirty seven (72.5%) patients had seizure within 3rd day of life. Seizures were found tonic in nature in 23(45.1%) cases and subtle 18 (35.3%) cases. EEG findings were abnormal in 22 (43.1%) cases. EEG findings were analyzed with the etiology of seizures and it was found that there was a significant relationship between EEG changes and perinatal asphyxia ($p < .0001$), septicemia ($p < .05$), meningitis ($p < .01$) and neurometabolic disorder ($p < .0001$). However, no statistical significant relationship between type of discharges of EEG and type ($p > .05$) & pattern of seizures ($p > .05$) was found.

Conclusion: This study suggests that there is a significant statistical relationship between EEG findings with perinatal asphyxia, septicemia and meningitis, but no relationship with types and pattern of seizures.

Introduction:

Neonatal seizures are the most common neurological problems in the newborn.¹ Determining the underlying etiology for neonatal seizures is critical. Etiology determines prognosis and outcome and guides therapeutic strategies.²

Seizures in neonates are different from those seen in older children. The differences are perhaps due to

the neuro-anatomic and neurophysiologic developmental status of the newborn infant. In the neonatal brain glial proliferation, neuronal migration, establishment of axonal deposition, dendritic contacts and myelin deposition are incomplete. For these reasons, clinical presentation differs.³

Hypoxic-ischemic encephalopathy (HIE) is an important cause of neonatal seizures. A detailed pregnancy history, history of TORCH (toxoplasmosis, rubella, cytomegalovirus, herpes) infections, fetal distress, pre-eclampsia, or maternal infection also can provide etiologic clues. Neonatal seizures with an uneventful antenatal history and delivery may result from a postnatal cause. A history of tremulousness may suggest drug withdrawal or neonatal hypocalcaemia.⁴

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EEG is valuable in confirming the presence of seizures. The EEG findings, such as background abnormality, area of involvement of the discharges and the type of discharges were seen to categorize the neonatal seizures. In neonatal seizures, EEG amplitudes are usually low (bilateral cortical damage, wide spread cerebral damage, structural brain stem damage, mild metabolic disorders etc.) or very low (extensive cortical damage due to any cause). Slow waves in EEG in neonatal seizures signify any type of anoxic, metabolic, toxic encephalopathy etc. The clinical observation of the neonate with suspected seizures is often inadequate, if we are to characterize and understand the nature of the epileptic and non-epileptic events that are occurring.

The aim of the study was, therefore, to determine and correlate the etiological factors, clinical types and EEG profile of neonatal seizures.

Methodology:

This cross-sectional study was carried out in the Neonatology Department of Bangabandhu Sheikh Mujib Medical University (BSMMU) and Neonatal Intensive Care Unit of Central Hospital Limited. Total study period was six months commencing from 1st September 2010 to 28th February 2011.

Fifty one neonates with seizures admitted into the neonatology unit of BSMMU and Central Hospital during the study period were enrolled in the study.

Selection criteria of the study population

Inclusion criteria: All the neonates admitted in the hospital during the study period with clinically identified seizures.

Exclusion criteria:

1. Newborns with gross congenital anomalies.
2. Extreme prematures (Birth weight <1000 gms)
3. Babies on ventilators right from the begin of admission.

Extreme premature and babies on ventilators were excluded deliberately, because in all the cases, EEG was recorded in the EEG Lab. Transferring these critical babies to the EEG Lab was technically not possible in these cases.

Methodology

All the neonates admitted with seizures during the study period were included in the study. Detailed history regarding age, sex, gestational age, maternal history of pregnancy, perinatal and history of birth asphyxia, time of occurrence and types of seizure, history of fever, lethargy or reluctance to feed etc. were taken and carefully recorded by the study physician. EEG was done in all the cases when stable,

but not later than 7 days of occurrence of seizure. EEG was done using standard methods and standard number of leads as is done in all cases of neonatal seizures in our settings. Serum calcium and glucose levels were measured using standard methods in a compatible biochemical laboratory. For data analysis, SPSS version 16.0 for windows was used. Ethical clearance was obtained according to the rules of BCPS.

Results:

A total of 51 neonates having various types of seizures were studied during the study period. The mean age of the neonates was 8.84 ± 7.17 days (Range 1-12 days). 76.5 (39/51) were male and 23.5 % (12/51) were female. Fifty two point nine four percent (27/51) were delivered at term and 56.86 % (29/51) had perinatal asphyxia, followed by septicemia 15.67 % (8/51), meningitis 11.76 % (6/51), neonatal jaundice 3.92%(2/51), neurometabolic disorder 3.92%(2/51), and TORCH (Rubella) infection 1.96%(1/51). Seizures were found tonic in nature 45.1% (23/51) cases followed by subtle 35.3%(18/51), clonic 15.7%(8/51) and mixed 3.9%(2/51) cases (Table 1). Hypoglycemia and hypocalcaemia was found in 19.6% (10/51) and 15.65 % (8/51) cases respectively and 29.4 % (15/51) had acidosis. Majority i.e., 72.5 % (37/51) patients had seizure within 3rd day of life. There was 1.96% (1/51) neonate where definite diagnosis could not be established. Electroencephalography (EEG) was done in all cases within 7 days of occurrence of seizure, but when stable. Among these, 43.1 % (22/51) cases were found and in majority of the cases i.e., 56.9% (29/51) had normal EEG findings (Table 6). EEG findings were analyzed with the etiology of seizures and it was found that there was a significant relationship between EEG changes and perinatal asphyxia (p<.0001), septicemia (p<.05), meningitis (p<.01) and neurometabolic disorder (p<.0001)(Table-III-IV). However, no statistical significant relationship between type of discharges of EEG and type (p>.05) & pattern of seizures (p>.05) was found (Table-V).

Table-I

Showing type of seizure among the study neonates. (n=51)

Type of seizure	Frequency	Percent
Tonic	23	45.1
Subtle	18	35.3
Clonic	8	15.7
Mixed	2	3.9
Total	51	100.0

Table-II
Showing the EEG findings among the study neonates. (n=51)

	Background abnormality		Area of involvement of discharges		Type of discharges			
	Frequency	Percent	Frequency	Percent	Frequency	Percent		
Low voltage	12	23.5	Generalized	4	7.8	Spikes	6	11.8
Very low voltage	4	7.8	Multifocal	2	3.9	Sharp spikes	8	15.7
Slow waves	6	11.8	Focal	16	31.4	Both	2	3.9
Total	22	43.1	Total	22	43.1	Total	16	31.4

Table shows the EEG findings of the neonate, including background abnormality, area of involvement of the discharges and the type of discharges. In background abnormality 23.5% had low voltage. In area of involvement of the discharges, it was mostly focal (31.4%). In type discharges, sharp spikes (15.7%) were predominant, followed by spikes (11.8%).

Table-III
Association of the EEG findings and the perinatal asphyxia of the neonate.

EEG findings	H/O perinatal asphyxia		χ^2	P value
	No	Yes		
Normal	14	10		
Abnormal	8	19	15.013	<.0001
Total	22	29		

Table shows that there was a statistically significant relationship between EEG findings and the perinatal asphyxia ($\chi^2=15.013$, $df=1$, $p<.0001$). The other abnormal EEG findings in different groups were statistically not significant (not shown in the table).

Table – IV
Association between background abnormality of EEG and meningitis of the neonate.

Background abnormality	Meningitis		Total	χ^2	P value
	No	Yes			
Low voltage	0	12	12		
Very low voltage	2	2	04	10.236	.006
slow waves	4	2	06		
Total	06	16	22		

Table shows that majority i.e. 72.7% (16 out of 22) with abnormal EEG findings were suffering from meningitis and this relationship was statistically significant ($\chi^2=5.346$, $df=2$, $p<.01$).

Table-V
Association between type of discharges of EEG and of seizure of the neonate.

Type of discharges	Type of seizure			Total	P value
	Subtle	Mixed	Clonic		
Spikes	2	2	2	6	
Sharp spikes	4	4	0	8	.216
Both	2	0	0	2	
Total	8	6	2	16	

Table shows there was no statistically significant relationship between type of discharges of EEG and type of seizures ($\chi^2=5.778$, $df=4$, $p>.05$).

Table-VI
Distribution of the child by the EEG findings.

EEG Findings	Frequency	Percent
Normal	29	56.9
Abnormal	22	43.1
Total	51	100

Discussion

Seizures in neonatal life are quite common. EEG is not done in all cases, and if done, the relationship between EEG findings and neonatal seizures is usually not analyzed with due importance. In this study, we have observed 51 neonates with seizures over a period of 6 months, and the EEG findings in these cases were analyzed.

In the present study, 39 cases (76.5%) were male and the rest 12 (23.5%) were female with a male to female ratio of 3.25:1. These findings were consistent with previous studies, where male predominant was found.^{5,6} Our study, 37(72.5%) neonates had H/O onset of seizure within 3 days of life. In a study of neonatal seizures by Ronen et al, onset of seizures

on first day of life was 36%; 64% had onset of seizures within first 48 hours, and 83% within first week of life, which is similar to our study. In the study of Volpe¹, however, seizures most commonly occurred prior to 24 hours of age and approximately 50% occurred within initial 12 hours⁸, which is consistent with this study.

In this study four fifth of the baby were delivered at term (80.4%), only one fifth were preterm birth (19.6%) and average birth weight of the neonate was 2591.84 ± 536.27 gm. Similar observations were documented by Sandhu et al,⁹ where term AGA neonate were 81.2% followed by preterm neonate in 18.8%. In our study, half of the neonate had perinatal asphyxia (56.86%), followed by septicemia (15.67%), meningitis (11.76%), neonatal jaundice (kernicterus) (3.92%), neurometabolic disorder (3.92%), TORCH (Rubella infection 1.96%). There were 1.96% neonates whom diagnosis could not be identified. Thirty five neonates had biochemical abnormalities and most of them had hypoglycemia (19.5%) and hypocalcaemia (15.7%). About 29.4% suffered from acidosis. There were no hypernatremia or hyperglycemia. Birth asphyxia was also the commonest cause of neonatal seizures reported by Soni et al¹⁰ and Ronen et al.⁷ In a study of neonatal seizures by Arthur L et al,¹¹ majority of neonates with perinatal asphyxia 50%, hypoglycemia 71%, CNS infection 69%, and hypocalcaemia during first and second day of life (6/28) and again during late first week and second week (19/28). Our findings were consistent with these studies.

We found majority of seizures was tonic (45.1%) in nature, followed by subtle seizure (35.3%), clonic (15.35) and mixed type (3.9%). In most of the cases seizures was generalized (62.7%) followed by focal (17.65%) and mixed (19.61%) type respectively. In a study of neonatal seizures by Brunquell J et al¹² subtle seizures were the commonest occurring in 51% (27 of 53), followed by focal clonic (42%), multifocal clonic (30%) and GTS (23%). Lakra et al⁵ also reported that subtle seizures were the commonest type. But in the study of Soni et al,¹⁰ generalized tonic seizure was commonest type of seizure, followed by subtle seizures.

In our study, about half (43.1%) of the EEG findings were abnormal. In background abnormality, 23.5% had low voltage; very low voltage was in 11.8%. In area of involvement of the discharges, it was mostly focal (31.4%). In the type of discharges, sharp spikes

(15.7%) and spikes (11.8%) were predominant. There was a statistically significant relationship between EEG findings and the perinatal asphyxia of the neonates ($\chi^2= 15.013$, $df=1$, $p<.000$). Rose and Lombroso¹² and Mizrahi and Kellaway¹³ reported abnormalities in standard EEG in HIE in 70% and 46.3% cases respectively.

In this study, there was a statistically significant relationship of meningitis with background abnormality of EEG (low voltage recorded in 12 cases, very low voltage recorded & slow wave voltage recorded in 2 cases each), area of involvement of discharges of EEG (focal in 14 cases, generalized in 2 cases), and type of discharges (spike in 6 cases, sharp spike in 2 cases). There was also a statistically significant relationship of septicemia with background abnormality of EEG (very low voltage in 2 cases, low voltage and slow wave 6 cases in each), area of involvement of discharges of EEG (focal in 12 cases and multifocal in 2 cases). Abnormal standard EEGs in meningitis with or without other sepsis (not separated by authors) has also been reported in 33.3% cases by Rose and Lombroso¹² and 17% by Mizrahi and Kellaway¹⁴ which were consistent with our study.

Conclusion

Most common cause of neonatal seizure is perinatal asphyxia. Acidosis is most common biochemical change associated with neonatal seizure. Tonic and subtle seizure was found as common seizure type in neonatal seizure. Significant relationship was found EEG recording with perinatal asphyxia, septicemia and meningitis. EEG findings were found normal in majority of cases of neonatal seizure.

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