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Research Article

Predictive value of electroencephalography for developmental outcome at 6 month of age in full term neonates with seizures

Jyotsana Shrivastava, Akhil Singh*, Amit Agarwal

Department of Paediatrics, Gandhi Medical College, Bhopal, MP, India

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***Correspondence:**
Dr. Akhil Singh,
E-mail: dr_akhilsingh@yahoo.com

ABSTRACT

Background: Electroencephalography (EEG) is an important tool to evaluate infant with symptoms refer to central nervous system. The objective of the work was to study the predictive value of EEG for developmental outcome in full term neonates with seizures at 6 month of age.
Methods: This was prospective observational study at tertiary care centre, Gandhi Medical College, Bhopal. The participants were full term hospitalized neonates with documented seizures. Newborns admitted for complaints other than seizure, hypoxic-ischemic encephalopathy (HIE) stage I, preterm and neonates born to mother on anti-epileptic therapy were excluded from the study.
Results: Out of total 54 registered neonates 7 expired and 5 lost to follow up. In remaining 42 cases, 18 (42.9%) had generalized discharge, 8 (19%) had focal and 3 (7.1%) had multifocal discharge while 22 (52.3%) had normal EEG patterns. HIE being the most common cause and subtle seizure being the most common type of seizures. On follow up at 6 month, all neonates with normal EEG pattern (n=22) had normal developmental outcome. Out of 20 neonates with abnormal EEG discharges, 13(65%) had developmental delay while 7 (35%) had normal development for age.
Conclusions: EEG could be a simple and cost effective prognostic tool where neonates presenting with seizure. Newborn with abnormal discharge should be closely monitored on DDST for early identification and early intervention.

Keywords: Electroencephalography, Outcome, Seizures, DDST

INTRODUCTION

Neonatal seizures are the most common overt manifestation of neurological dysfunction in the newborn. It may be the first and only manifestation of neurological dysfunction in variety of insults. The reported prevalence is approximately 1.5% and incidence is approximately 0.95–3.5 per 1,000 live births.[1-3] A seizure may arise from varying foci at different times. Not all clinical seizures correlate with electroencephalography (EEG) changes and not all seizure activity shown on EEG recordings are clinically apparent.[4] Since long EEG is an important tool to evaluate infant with symptoms refer to central nervous system.[5] The present study was aimed to use EEG not only as a method of assessing neonatal seizures but also for formulating prognosis for long term developmental outcome.

METHODS

This was prospective observational study at tertiary care centre from April 2012 to March 2013 after taking ethical committee approval and parental consent, on full term neonates with documented seizure episode during neonatal period. Sample size was computed in

accordance to DePaulo method of sample size calculation for qualitative research.[6] Babies of mother on anti-epileptics, pre term neonates, full term neonates with undocumented seizures and HIE I cases were excluded from the study.

In present study, gestational age of the newborn was calculated by the New Ballard Scoring system.[7] Seizures were – "reported or observed repeated involuntary muscle contractions, abnormal tonic extensions or jerky movements of any part of the limb, face or mouth that was not stimulus sensitive or repetitive abnormal chewing, ocular fixation or cycled fluttering, pedalling movements, lip smacking".[8] Neonatal hypocalcaemia was – "total serum calcium concentration <7mg/dl and hypomagnesium at serum magnesium levels lower than 1.6 mg/dl".[9] Blood sugar less than 45mg/dl was considered as hypoglycaemia and WBC ≥32/mm^3 in CSF was considered as meningitis.[10,11]

All babies had an EEG recorded after stabilization within 7 days of seizure episode. EEG was recorded with 10 scalp electrodes, placed as per 10-20 international system of electrode placement.[12] EEG was reported by single neurologist who was blinded to the clinical status of the baby. Different patterns of EEG were classified as normal, focal, multi focal and generalized / burst suppression. Sedation for EEG was given with syrup Triclofos in a dose of 20-30 mg/kg orally only when essential. Neurodevelopment assessment was done by the Denver Developmental Screening Test II (Denver II Test). Denver II assess child development in four domains - gross motor, fine motor-adaptive, language and personal social by 105 items. Test application time was 15 to 20 minutes for performance by child and intervening parents. Each task on DDST II were graded as pass (P), fail (F) or refuse to co-operate (R). Interpretation of DDST II was made as follow:

1. ***Advance*** – If a child passes a task that falls completely to the right of child's age limit.
2. ***Normal*** – If a child passes, fail or refuse an item of the test which the age line falls on between 25th and 75th percentile.
3. ***Caution*** – When a child fails or refuses a task within the age line cut through between the 75th and 90th percentile.
4. ***Delayed*** – the child fails or refuses an item that falls completely to the left of the age line.

Follow up was done at 4th week, 12th week and 6th month of age and recorded on same development chart. - Statistical analysis was done using Fisher exact test to find the significance of various EEG patterns in predicting outcome.

RESULTS

54 neonates with seizure episode were enrolled during study period. Of these 54 cases, 29 (53.7%) were male and 25 (46.3%) were female. 38% were full term low birth weight (1500-2500 grams) and 16 (29.6%) of them had weight > 2500 grams. EEG was recorded in all included neonates, 25 (46%) EEG was normal. 18 (33.3%) had generalized discharge pattern, 8 (14.8%) had focal discharge while 3 (5.6%) had multifocal discharge. Of these 54 cases 7 expired and 5 lost to follow up. Remaining were 42 cases where follow up was done up to 6 month of age.

Out of 42 cases, 22 (52.4%) cases had normal EEG pattern and all of them had normal neurodevelopment on follow up. 20 cases (6 = focal, 2 = multifocal & 12 = generalized) had abnormal patterns in EEG and of which 13 had abnormal neurodevelopmental outcome while 7 had normal outcome. Present study showed that early EEG has sensitivity of 100%, specificity of 75.86%, PPV of 65% and NPV of 100% in predicting developmental outcome in neonatal seizures.

Table 1: Electroencephalography patterns.

No	EEG Patterns	N	OUTCOME	
			Normal	Abnormal
1	Normal	22	100 % (22)	0 % (0)
2	Focal discharge	6	66.7 % (4)	33.3 % (2)
3	Multifocal discharge	2	50 % (1)	50 % (1)
4	Generalized discharge	12	16.7 % (2)	83.3 % (10)
TOTAL		42*	69.1% (29)	30.9% (13)

*7 expired and 5 lost to follow up p value < 0.0001.

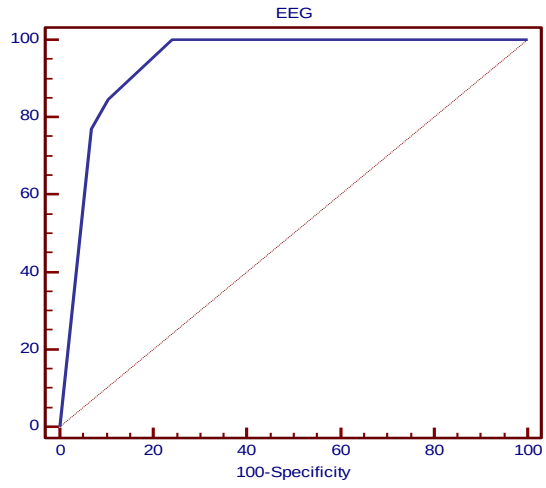

Figure 1: ROC Curve.

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DISCUSSION

Seizures in neonate are relatively common morbidity associated with various aetiology. They are powerful predictor of long term cognitive and developmental impairment. In present study EEG patterns was correlated with developmental outcome at 6 month of age in neonates with seizures.

Out of 42 cases – 22 (52.4%) cases had normal EEG and all of them had normal development at 6 month of age (p value <0.0001). 20 cases had various abnormal EEG patterns (6 focal, 2 multi focal and 12 generalized) of which 13 cases (65%) had abnormal development and 7 cases (35%) had normal development at 6 month of age.

Commonest abnormal outcome was observed in generalized / burst suppression EEG pattern where out of 12 cases 10 (83%) had developmental delay (p value < 0.0001). This observation is in accordance with that of many workers who had shown that a grossly abnormal EEG is associated with poor outcome.

Merchant et al concluded in their study that a detailed clinical evaluation, CT scan and EEG studies are significant in predicting immediate prognosis of HIE[13]. Similarly, Rowe JC et al in 1985 evaluated background rhythms and epileptiform activity of EEG for poor outcome in 74 term and preterm neonates after 33 month of follow up and concluded that EEG is highly sensitive tool for predicting outcome.[14]

Sinclair et al compared the patterns of burst suppression on EEG with long term neurological outcome in term infants with HIE and suggested a better outcome for infants with neonatal HIE and modified burst suppression compared to burst suppression.[15] Douglass et al and Holmes et al., studied burst suppression pattern on EEG among neonates with seizures in two separate studies and found that it is highly predictive for severe deficit on follow up Toso et al. also concluded that EEG is a useful tool at the neonatal intensive care unit for predicting poor short-term neurological outcomes for all sick newborn.[16-18]

In a recent study (2013) on 42 cases with seizure Annu Jose et al tried to co-relate electroencephalogram (EEG), computed tomography (CT), and magnetic resonance imaging (MRI) brain with neurological outcome at 12 months in term neonates. They concluded that a normal EEG and CT brain in a term newborn with hypoxic ischemic encephalopathy (HIE) is associated with good neurological outcome. Burst suppression pattern in EEG, bleeds, or hypodensities in the CT and involvement of basal ganglia/thalamus in the MRI are predictors of abnormal outcome. In predicting an abnormal outcome, EEG has a sensitivity of 100%, specificity of 40%, Positive Predictive Value (PPV) of 59.09%, Negative Predictive Value (NPV) of 100%, accuracy of 67.86, and *P* value of 0.010.[19] These results were similar to findings of present study were Sensitivity of 100%, Specificity of 75.86%, PPV of 65% and NPV of 100% was reported. 100% NPV for a normal EEG suggest that in spite of documented seizures there is very high probability of normal development in future among these babies. 0.940 of area under the ROC curve is also suggestive of that EEG is an excellent tool for predicting developmental outcome in neonates with seizures at a same instance we also realize that a larger sample size is required to comment on more accurate co-relation between EEG patterns and developmental outcome.

CONCLUSION

EEG could be an important prognostic tool specially in resource limited health settings where neonates with abnormal EEG patterns should be followed up regularly and at short intervals for their developmental examination. Accurate co-relation between different EEG patterns and developmental outcome if established would be of great assistance to clinician for planning further management and hence minimizing future disabilities.

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