



The clinical value of amplitude-integrated EEG for neonatal seizures: comparison of short-term (6-12 hours) and long-term (24-48 hours) monitoring

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INTRODUCTION

Amplitude-integrated electroencephalography (aEEG) monitoring:

- has a critical importance for the definition of neonatal seizures (electro-clinic / electro-graphic)
- is not as sensitive or specific as routine conventional EEG (rc-EEG) monitoring for the detection of neonatal seizures

Prolonged aEEG monitoring is suggested to increase the diagnostic yield of this modality

OBJECTIVES

- To investigate the predictive value of aEEG monitoring time for seizure detection in neonates with encephalopathy

MATERIAL & METHODS

- 88 neonates (preterm: 42, term: 46) with neonatal encephalopathy (NE)
- EEG monitoring:
 - aEEG monitoring was performed within the first 24 hours of NE
 - aEEG and a one-hour rc-EEG recording were performed simultaneously
- Based on the monitoring duration:
 - Group I (n=36): short-term monitoring (6-12 hours)
 - Group 2 (n=52): long-term monitoring (24-48 hours)

RESULTS

- Seizure detection rate for aEEG monitoring in whole cohort was 36.3% (32/88)
- Abnormal background patterns were identified in 27 of 36 (75%) NE in group I and 36 of 52 (69%) NE in group II
- A reduced aEEG score was found in neonates with seizures compared to neonates without seizures during long-term EEG monitoring 4.26 ± 3.17 versus 6.29 ± 2.6 , respectively ($p=0.015$)

Table I. Comparison of the groups that performed long-term and short-term aEEG monitoring (n=88)

| | n (%) | Group I (Short-term monitoring, 6-12 hours) 36 (41%) | Group II (Long-term monitoring, 24-48 hours) n:52 (59%) | p |
|---------------------------------------|--|--|---|-------|
| Type of delivery | Spontaneous | 8 (22.2) | 10 (19.2) | 0.046 |
| | Cesarian delivery | 28 (77.8) | 42 (80.8) | |
| Gestational age | Preterm | 17 (47.2) | 25 (48) | 0.555 |
| | Term | 19 (52.8) | 27 (52) | |
| MRI findings | Normal | 9 (25) | 27 (51.9) | 0.008 |
| | IVH grades 1-2 | 13 (36.1) | 6 (11.5) | |
| | Parenchymal damage, brain malformation | 14 (38.8) | 19 (36.5) | |
| Clinical seizure | Present | 26 (72.2) | 31 (59.6) | 0.224 |
| | Absent | 10 (27.8) | 21 (40.4) | |
| Volpe's seizure classification | Subtle | 8 (26.6) | 6 (19.4) | 0.122 |
| | Tonic | 5 (18.5) | 6 (19.4) | |
| | Myoclonic | 5 (18.5) | 1 (3.2) | |
| | Clonic | 9 (33.5) | 18 (58.1) | |
| aEEG seizure detection | Electro-clinical | 11(30.5) | 11 (21.2) | |
| | Electro-graphic | 6 (16.7) | 4 (7.8) | |
| | Total | 17 (47.2) | 15 (28.8) | 0.078 |
| EEG background grades | Grade 0-1 | 21 (80.7) | 44 (84.6) | 0.751 |
| | Grade 2-3 | 5 (19.3) | 8 (15.4) | |
| Mortality | | 9 (25) | 7 (13.5) | 0.168 |

Table IIa. The predictive values of aEEG monitoring for neonatal seizure detection

| | Group I (Short-term monitoring, 6-12 hours) n (%) | | |
|---------------|--|-----------|-----------|
| | Seizure + | Seizure - | Total |
| Clinic | | | |
| | Seizure + 11 (electro-clinic) | 15 | 26 (72.2) |
| | Seizure - 6 (electro-graphic) | 4 | 10 (28.8) |
| | Total 17 (47.2) | 19 (52.8) | 36 |
| | Group II (Long-term monitoring, 24-48 hours) n (%) | | |
| | Seizure + | Seizure - | Total |
| Clinic | | | |
| | Seizure + 11 (electro-clinic) | 20 | 31 (59) |
| | Seizure - 4 (electro-graphic) | 17 | 21 (40.3) |
| | Total 15 (28.8) | 37 (71.2) | 52 |

- The magnitude of brain injury with MRI is correlated with aEEG background scoring ($p=0.031$, $r:-0.230$)
- The aEEG background score of neonates who died in the NICU was 3 ± 1.8 , while those who survived were 5.3 ± 3.3 ($p=0.004$)
- There was consistency between aEEG and the rc-EEG with respect to background characteristics in both cohorts ($r=-0.452$)

Table III. EEG findings according to presence of clinical seizure

| | | Clinical seizure + | Clinical seizure - | p |
|--|------------|--------------------|--------------------|-------|
| Duration of aEEG monitorization, n(%) | Short-term | 26 (45.6) | 10 (32.3) | 0.224 |
| | Long-term | 31 (54.4) | 21 (67.7) | |
| aEEG seizure capture, n (%) | | 22 (38.6) | 10 (32.8) | 0.555 |
| aEEG score, mean±SD | Preterm | 3.71 ± 2.4 | 3.3 ± 2.2 | 0.667 |
| | Term | 5.3 ± 3.4 | 6.9 ± 3.3 | 0.131 |
| | Total | 4.47 ± 3.03 | 5.6 ± 3.4 | 0.108 |
| EEG background grades, n (%) | Grade 0-1 | 21 (80.7) | 44 (84.6) | 0.751 |
| | Grade 2-3 | 5 (19.3) | 8 (15.4) | |

Table IIb. The predictive values of aEEG monitoring for neonatal seizure detection

| | Group I (Short-term monitoring, 6-12 hours) | Group II (Long-term monitoring, 24-48 hours) |
|----------------------|---|--|
| Sensitivity % | 64.7 (38.3-85.7) | 73.3 (44.9-99.2) |
| Specificity % | 21.05 (6.05-45.57) | 45.9 (29.49-63.08) |
| PPV % | 42.31 (32.50-52.77) | 35.48 (26.4-45.7) |
| NPV % | 40 (18.4-66.31) | 80.9 (63.1-91.3) |
| Accuracy rate | 41.67 (25.51-59.24) | 53.8 (39.4-67.7) |

CONCLUSIONS

- The long-term aEEG monitoring of up to 48 hours in preterm and term neonates improves the diagnostic yield of aEEG for seizure detection
- aEEG background scoring is a valuable parameter for adverse outcomes in NICU

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