Automated algorithms and quantitative electroencephalography for seizure detection in critically ill children

Man vs Machine

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Background

Non-convulsive seizures are reported in 7-46% of critically ill children and can only be identified on continuous EEG monitoring.

Most North American centers review their continuous EEG no more than 2-3 times a day.

Potential for long delays between seizure occurrence, recognition and treatment.

Quantitative EEG tools can be used by critical care providers to bridge these gaps in time between expert-review of raw EEG.

The only ‘truly continuous’ alternative is to use automated seizure detection algorithms that provide a real-time alert for non-convulsive seizures in critically ill patients.

**KEY QUESTION**

How do automated seizure detection algorithms perform in comparison to QEEG-based seizure identification by EEG experts?
Methods

19 cEEG recordings

- Wide spectrum of seizure types & EEG background patterns
- 347 hours of recordings
- 11 recordings contained 379 seizures

Automated Seizure Detectors
ICTA-S – Stellate Harmonie
NB – Newborn
P11 – Persyst 11
P13 – Persyst 13

Quantitative EEG display trends
aEEG – amplitude-integrated EEG
CDSA – Color Density Spectral Array

EEG experts
3 Neurophysiologists
3 EEG Technologists

Comparison
Standard

Detected Seizures

Seizures identified by a Neurophysiologist on raw EEG

Identified Seizures

Structured 2-hour training on QEEG use for seizure identification

Detected Seizures
Results

Ranking sensitivity across modalities:
1. NB
2. P11, P13, aEEG & CDSA
3. ICTA-S

Ranking false positive rates across modalities:
1. P11, aEEG, CDSA, ICTA-S
2. P13
3. NB
Results

Significant variability in performance across EEG recordings

P13 and P11 complementary to aEEG and CDSA
CONCLUSIONS

• Automated seizure detection algorithms (P11 and P13) have acceptable performance and are likely to have their greatest utility as an ‘early warning system’, with alarms prompting more timely review of the QEEG trends and raw EEG tracings

• The added benefit of seizure detection algorithms would likely be greatest in institutions where EEG review is currently infrequent

• With certain algorithms (NB), frequent false positive detections prompting frequent calls for confirmatory EEG review can become a nuisance that outweighs the benefits of more timely seizure detection
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