Accuracy of Automated Machine Learning Software in Identifying EEGs with Prolonged Seizures

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Objective:

To demonstrate that combining automatic processing of EEG data using high performance machine learning algorithms with manual review by expert annotators can quickly identify subjects with prolonged seizures.

Background:

Prolonged seizures are markers of seizure severity, risk of transformation into status epilepticus, and medical morbidity. Early recognition of prolonged seizures permits intervention and reduces morbidity.

Design/Methods:

We triaged the TUH EEG Corpus, an open source database of EEGs, by running a state-of-the-art hybrid LSTM-based deep learning system. Then, we postprocessed the output to identify high confidence hypotheses for seizures that were greater than three minutes in duration.

Results:

The triaging method selected 25 subjects for further review. 17 subjects had seizures; only 5 met criteria for seizures greater than 3 minutes. 11 subjects did not have a prior diagnosis of epilepsy. Among these, 63% had acute respiratory failure and 36% had cardiac arrest leading to seizures secondary to anoxic brain injury. 18 (72%) EEGs were obtained in long-term monitoring (LTM), 1 (4%) in the epilepsy monitoring unit (EMU), and 6 (24%) as a routine EEG (rEEG). 72.2% of seizures in LTM were identified correctly versus 66.7% in rEEGs. Of the 9 subjects who were deceased, 7 (78%) had been on LTM. The seizure detection algorithm misidentified seizures in 7 subjects (28%). A total of 22 (88%) subjects had some ictal pattern. Patterns mistaken for seizure activity included muscle artifact, generalized periodic discharges, generalized spike-and-wave, triphasic waves, and interestingly, an EEG recording captured during CPR.

Conclusions:

This hybrid approach, which combines state-of-the-art machine learning seizure detection software with human annotation, successfully identified prolonged seizures in 72% of subjects; 88% had ictal patterns. Prolonged seizures were more common in LTM subjects than the EMU and were associated with acute cardiac or pulmonary insult.

Submitted:

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