Neurological Outcome Prediction in Comatose Cardiac Arrest Patients Using EEG Expert Features

Morteza Zabihi[1], Alireza Chaman Zar[1,2], Pulkit Grover[2], Eric. S. Rosenthal[1]

[1]Massachusetts General Hospital, Boston, MA, USA; [2]Carnegie Mellon University, Pittsburgh, PA, USA.

Aims: This study aims to investigate the capacity of scalp EEG recordings to predict recovery of cardiac arrest patients from coma, measured 3-6 months after the return of spontaneous circulation (ROSC) using the Cerebral Performance Category scale.

Methods: The utilized EEG dataset in this study was collected from seven hospitals and involved 608 adult cardiac arrest patients who regained heart function and remained comatose. The data provided include only the cleanest 5 minutes of EEG data per hour and collected up to 72hrs from ROSC, available with a sampling frequency of 100 Hz in a longitudinal bipolar montage. We extracted 44 features from each channel within 5-minute segments, including fractal dimensions, entropy-based features, frequency bands, short-time Fourier transform, and wavelet domain features. Additionally, an adjacency matrix was constructed based on the pairwise Euclidean distance between the extracted feature vectors in all EEG channels. Subsequently, we calculated graph parameters for the obtained adjacency matrix, such as clustering coefficient and network density, to model cross-channel information. To analyze the EEG data, we used an XGBoost classifier. Specifically, we averaged each feature vector with its preceding 6 hours window before inputting it into the classifier. The final prediction is obtained by averaging the generated probabilities of the aggregated time windows.

Results: Our model obtained an average challenge score mechanism of 0.457 ± 0.070 standard deviation using conventional 5-fold cross-validation. We further evaluated our model's performance using subgroup analysis by incorporating the given eight clinical admission variables. The cluster-based and propensity score-based subgroup analysis yielded average scores of 0.650 ± 0.152 and 0.436 ± 0.021, respectively. Our score provided by the Challenge submission system is 0.597.

Conclusion: We aim to improve our model's accuracy and robustness by extracting more features for cross-channel information and utilizing LSTM or attention-based models to incorporate temporal information.