Prediction Comatose Patient Outcomes Using Deep learning -based Analysis of 72-Hour EEG Power Spectral Density

Kyungmin Choi [1], Gi-Won Yoon[1], Sanghoon Choi[1] and Hyeon-Hwa Choi[1], Segyeong Joo[1]

[1]Department of Biomedical engineering, Asan Medical Institute of Convergence Science and Technology, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Republic of Korea.

ABSTRACT

Background and Objective: The EEG signal is capable of detecting changes in brain activity with millisecond-level precision. However, due to the high dimensionality and non-stationarity of EEG signals, various features, such as Power Spectral Density (PSD), are extracted instead of using EEG signals directly in deep learning models. One potential advantage of analyzing PSD in EEG analysis is that it provides information about the frequency components of the signal, which can help identify patterns and abnormalities in brain activity. Therefore, our team extracted PSD values from all time intervals within 72 hours of comatose patients to predict their neurological outcomes.

Methods: Since the number of recorded data varies for each patient, we extracted available records throughout 72 hours. The EEG feature selected was the PSD in major frequencies, including delta (0.5-4 Hz), theta (4-8 Hz), alpha (8-15 Hz), and beta (15-30 Hz). Therefore, we calculated the PSD and combined the values for each of the four frequency ranges. Each PSD value was classified using a ResNet model, and the average predicted values were used for binary classification in the Outcome model and for multi classification in the CPC model.

Results: Our team, EEG pz lmn sqz, achieved a score of 0.24 for 12 hours, 0.3 for 24 hours, 0.6 for 48 hours, and 0.58 for 72 hours, according to the challenge leaderboard.

Conclusion: Our team's approach has a significant novelty in that we utilized all available records within 72 hours for each patient to predict their prognosis during model evaluation. In the official phase, we plan to improve our results by incorporating other methods, such as the Discrete Wavelet Transform, into a more advanced deep learning model. We believe that this approach will enhance the accuracy and robustness of our predictions for comatose patients.

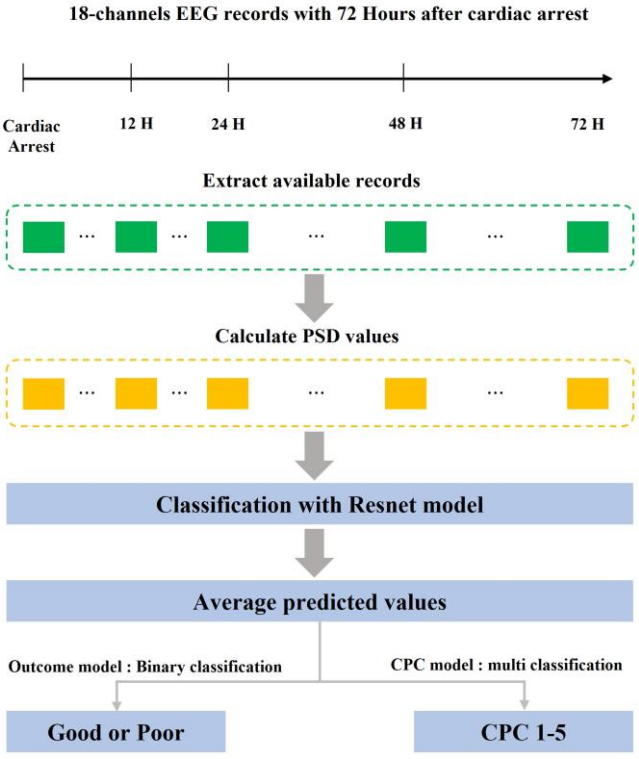

Figure 1. Model overview of proposed method.

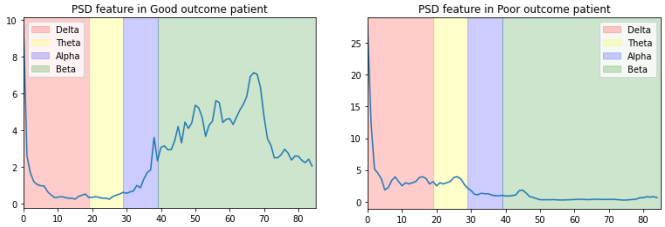

Figure 2. Example for PSD value of single channel extracted from the first EEG signal after cardiac arrest for each label.