World Academy of Science, Engineering and Technology
International Journal of Biomedical and Biological Engineering
Vol:18, No:12, 2024

Spatiotemporal Propagation and Pattern of Epileptic Spike Predict Seizure Onset Zone

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Abstract : Interictal spikes provide valuable information on electrocorticography (ECoG), which aids in surgical planning for patients who suffer from refractory epilepsy. However, the shape and temporal dynamics of these spikes remain unclear. The purpose of this work was to analyze the shape of interictal spikes and measure their distance to the seizure onset zone (SOZ) to use in epilepsy surgery. Thirteen patients' data from the iEEG portal were retrospectively studied. For analysis, half an hour of ECoG data was used from each patient, with the data being truncated before the onset of a seizure. Spikes were first detected and grouped in a sequence, then clustered into interictal epileptiform discharges (IEDs) and non-IED groups using two-step clustering. The distance of the spikes from IED and non-IED groups to SOZ was quantified and compared using the Wilcoxon rank-sum test. Spikes in the IED group tended to be in SOZ or close to it, while spikes in the non-IED group were in distance of SOZ or non-SOZ area. At the group level, the distribution for sharp wave, positive baseline shift, slow wave, and slow wave to sharp wave ratio was significantly different for IED and non-IED groups. The distance of the IED cluster was 10.00mm and significantly closer to the SOZ than the 17.65mm for non-IEDs. These findings provide insights into the shape and spatiotemporal dynamics of spikes that could influence the network mechanisms underlying refractory epilepsy.

Keywords : spike propagation, spike pattern, clustering, SOZ
Conference Title : ICNBMT 2024 : International Conference on Neuroscience, Brain Mapping and Therapeutics
Conference Location : Tokyo, Japan
Conference Dates : December 02-03, 2024