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Jeffrey M. Chung

Cedars-Sinai Medical Center, USA

Which frequency comes first in intracranial EEG ictal onset: High or low?

High frequency oscillations (HFO)—100 – 150 Hz—are thought to be the earliest ictal onset frequencies which may be used to identify the epileptogenic zone for surgical resection. We analyzed EEG data sampled at 2 kHz from 10 patients with medically refractory partial epilepsy undergoing intracranial macroelectrode monitoring (5 depth electrodes, 5 subdural grids). Multiband frequency and power analysis were performed to characterize the predominating frequency during the interictal, pre-ictal, ictal, and postictal periods. Thirty-seven seizures—17 from subdural grid and 20 from depth electrodes—were analyzed. In eight patients, power spectrogram between 0 – 100 Hz demonstrated the ictal onset was localized to one contact and was characterized by a significant increase of 10 – 30 Hz frequencies preceding the increase of 30 – 100 Hz frequencies by 3 seconds before propagation. Focal surgical resections were performed in the areas correlated to the synchronization of these alpha-beta frequencies and HFO prior to and during the patients' clinical seizures. These eight patients have seizure-free outcomes confirming the localization. In contrast, the alpha-beta frequencies synchronization was not seen in two patients (13 seizures) who did not become seizure-free. Previous studies of HFO from intracranial EEG recordings consistently show the frequencies at ictal onset above gamma range. In contrast, we found that HFO were preceded by lower frequencies, and the presence of the lower frequency synchronization correlated with post-operative seizure freedom. HFO may not be the first ictal manifestation in some cases and lower frequency ictal frequencies should not be overlooked. Larger studies are underway.

Biography

Jeffrey M. Chung received his Doctor in Medicine from Northwestern University Medical School. He is currently the Director of Epilepsy and Neurophysiology Programs at Cedars-Sinai Medical Center and an Associate Clinical Professor of Neurology at UCLA. He has presented at multiple national and international conferences on the localization of the epileptogenic zone with neuronal signal processing analysis and on the prediction of surgical decisions and outcomes with multi-modal probabilistic mapping techniques. His awards include Falks Medical Scholar, CARE Outstanding Patient Care Award, and the Clinical Research Fellowship Training Award from the Epilepsy Foundation, and multiple teaching awards.