

Analysis of HFOs during microseizures in humans with epilepsy

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Rational:

Both HFO and microseizures are epileptic patterns reported at submillimeter scales(1,2). Whereas HFO display a sinusoidal pattern with fixed frequency with spectral power above 80Hz(3), microseizures show temporal and spectral evolution(4). We here study interactions between HFO and microseizures using microwire recordings.

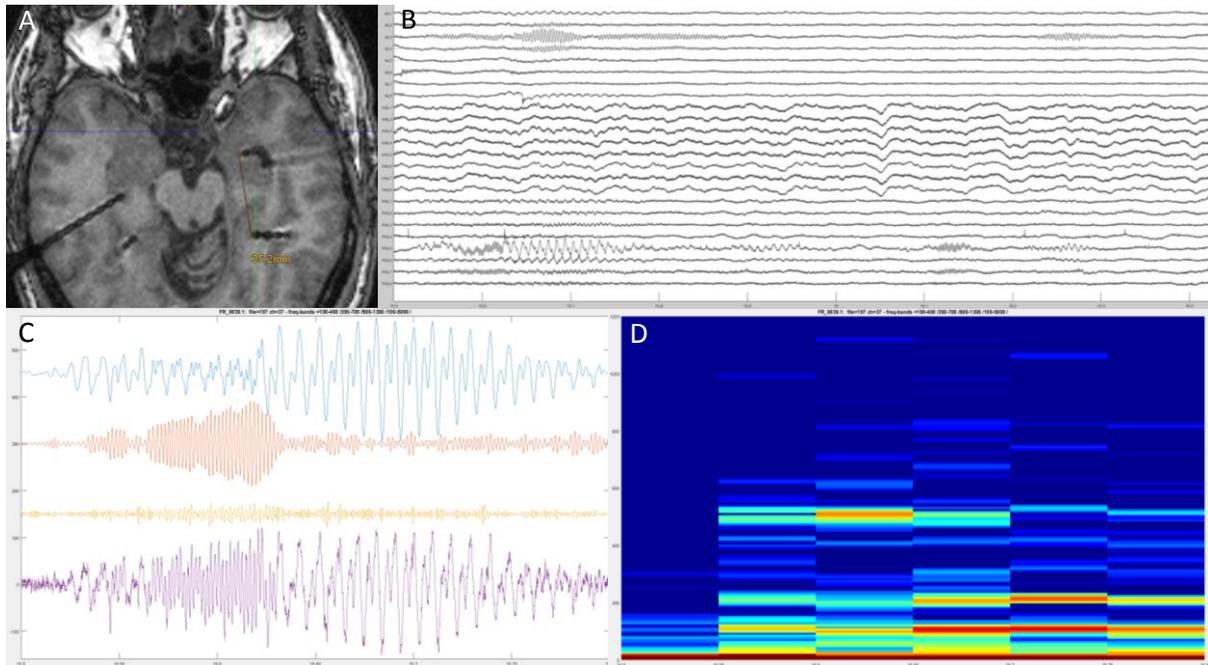
Methods:

One patient with suspected FCD and possible seizure generation in hippocampi underwent stereotactic implantation of Behnke-Fried electrodes into medialtemporal structures. Each contained 8microwires. Signals were recorded with 30.000Hz sampling-rate. Data were analyzed in the time/frequency domain.

Results:

Ripple, fast-ripple and sigma oscillations were detected in amygdala and hippocampus. There was a typical pattern of evolution with fast ripples in the amygdala, evolving to ripples in neighboring wires, and triggering microseizures in the hippocampus showing rhythmic bursts posteriorly and time-locked rhythmic activity in the anterior parts.

Oscillatory activity overlapped and evolved in and between different frequency bands, and in different brain areas (FigA), forming microseizures. FigB shows concurrent oscillations in the left amygdala (AL) and microseizures in the left posterior hippocampus (PHL). FigC displays the signal recorded in PHL5 with different filters (first row 100-400, second 350-700, third 600-1300, fourth 100-5000). FigD illustrates the spectrogram. Two different frequencies (510 Hz and 215 Hz) prevail at different time points (15.6 and 15.7 seconds) and also sigma oscillations (1100 Hz) are present.



Discussion:

This example illustrates the complexity behind microseizure generation. In the anatomical dimension, these events affect simultaneously two distant regions in mesiotemporal structures, connected as part of a network. In the temporal dimension, frequency changes within a HFO episode occurred locally, and different patterns with frequency, amplitude and morphology evolution were triggered in the hippocampus. This observation needs further corroboration in larger patient samples.

References:

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