Analysis of circadian changes in high-frequency oscillations properties using automated detection algorithm

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Rational: High-frequency oscillations (HFOs) represent biomarker of epileptogenic tissue. It is well established that spatiotemporal profile of HFOs can be modified by level of GABAergic inhibition, antiepileptic drugs etc. One of the main modulators of HFO properties is sleep. In this study we aimed to examine detailed circadian changes in HFOs dynamics using automatic HFO detecting algorithm.

Methods: The HFO detection was based on the dynamical thresholding of short-time energy changes, followed by calculation of the number of cycles within the detected HFO event and identification of peak frequency within HFO frequency bands. The detector was applied to continuous long-term recordings from six patients with implanted intracranial electrodes.

Results: The automated algorithms analysed 17.9 ± 5.7 hours of intracranial data from 114 ± 22 channels. It revealed the presence of fluctuations in HFO incidence related to sleep and wakefulness with significant increase in HFO rates during NREM sleep. Quantitative analysis of HFO events recorded during NREM sleep demonstrated that regions generating high-rate HFOs spatially overlapped with the seizure onset zone (SOZ). During REM sleep and wakefulness HFO rates failed to provide any localizing information about SOZ.

Discussion: This study demonstrates that automatic HFO detection can be reliably used in the analysis of long-term intracranial recordings. Obtained results point to limited information yield of HFOs recorded during wakefulness or REM sleep. Circadian changes in HFO properties must be always considered in the analysis of intracranial recordings that aims to delineate SOZ.

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