

Characteristics of inter-ictal and ictal gamma (30-70Hz) and ripples (80-200Hz) in human absence epilepsy

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Rationale: To identify, evaluate and compare the occurrence and distribution of gamma oscillations and ripples during inter-ictal and ictal discharges.

Methods: Twenty patients (M:F=10:10; age:10.25 ±3.39 years; duration of illness: 2.55±1.56 years), with drug naive childhood (n=12) and juvenile absence (n=8) epilepsies underwent MEG-EEG (2kHz sampling-rate) recording. Preprocessed data was filtered at 1-45Hz, for manual marking of segments consisting of sporadic or generalized spike and wave discharges (GSWD) lasting for <5 seconds(s) as ‘inter-ictal’ spikes and >5s as ‘ictal’ spikes. Subsequently, data was filtered with finite impulse response filter at 30-70Hz for manual marking of ‘spikes co-occurring gamma oscillations’ and at 80-200Hz for ‘spikes co-occurring ripples’. The temporo-spatial distribution of spikes, co-occurring gamma and ripples were evaluated. The number of gamma/ripples (mean±SE) co-occurring with the inter-ictal/ictal spikes was calculated. The differences in the characteristics between spikes with and without HFOs were evaluated using Mann Whitney U test.

Results: A total of 119 (5.95±1.2) seizures were analyzed. We manually marked 5135 (232.37±49.82) ictal and 3988 (209.84 ± 41.57) inter-ictal individual spike segments. A total of 95.7% (n=4918) gamma & 39.4% (n=2022) ripples co-occurred with the ictal spikes, while 95.18% (n=3796) gamma & 31% (n=1243) ripples co-occurred with the inter-ictal spikes. There was significant difference between occurrences of ripples compared to inter-ictal or ictal gamma (p<0.03) or spikes (p<0.001). Ictal ripples co-occurred with spikes at higher ratio compared to inter-ictal ripples. Their spatial distributions were much focal and predominantly fronto-central/fronto-temporal (n=14) and parieto-occipital (n=6) hemisphere dominance.

Conclusions: This is the first MEG study that visually analyzed & characterized co-occurring gamma and ripples during both ictal and inter-ictal epileptiform

discharges in absence epilepsy. It certainly further improves understanding in theory of focal origin in generalized epilepsies.

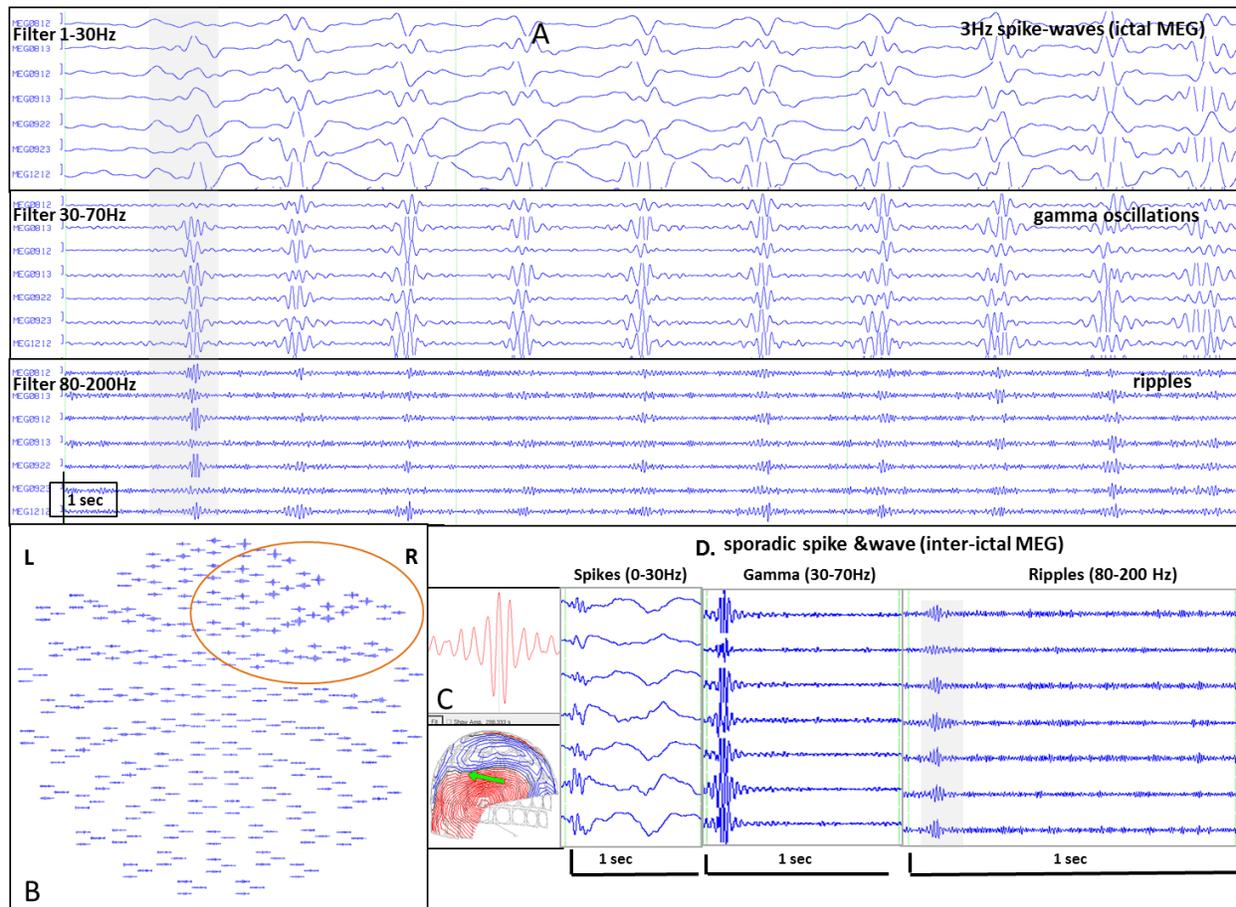


Figure legend: In the figure 1 sub-sections

(A) The ictal MEG recording from patient 3 demonstrated in 5 MEG channels filtered at 1-30 Hz, 30-70 Hz (Gamma) and 80-200 Hz (ripples). Occurrence of co-occurring gamma and ripples were seen in almost all ictal spikes;

(B) Two dimensional whole-plot of MEG sensors (first ictal ripple) clearly demonstrates the unilateral ictal ripples in right-frontal region.

(C) Demonstrates a single ripple (>4 oscillations from the background activity) and its right frontal spatial field topography

(D) Demonstrates a single polyspike filtered at 3 bandwidth and occurrence of co-occurring gamma and ripples with spikes.