RESTING STATE EEG BEFORE AND AFTER HFS-INDUCED CENTRAL SENSITIZATION

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Background and aims

Animal studies have shown that high frequency electrical stimulation (HFS) of the sciatic nerve triggers long-term potentiation within spinal nociceptive circuits and long-lasting changes in thalamocortical networks, manifested as a slow-wave EEG pattern (0.5-8 Hz bandwidth), recorded from electrodes covering the parietal cortex (S1) (1). Here, we assess if HFS applied to human skin, which induces a long-lasting increase in pain sensitivity in both the area at which HFS was applied as well as the surrounding unstimulated skin, changes the ongoing EEG recorded over the left and right parietal region.

Methods

HFS (5 trains of 100 Hz electrical pulses lasting 1 sec each and delivered with a 10 s inter-train interval) was delivered to the left or right volar forearm of 21 healthy participants (6 males, aged 23 ± 3 years), using a multi-pin electrode designed to preferentially activate nociceptive afferents (2). Before HFS and thirty minutes after applying HFS, seventy seconds of ongoing EEG (32 channels, referenced to the mastoids) was recorded during eyes closed. The spectral content of the ongoing EEG was analyzed offline using a fast Fourier transform (FFT) on half-overlapping 2 seconds segments. Four different frequency bands were analyzed after averaging the signal from parietal electrodes C3 and C4 : δ (0–4 Hz), θ (4–8 Hz), α (8–12 Hz) and β (12–30 Hz). Paired-t tests were used to test for differences in power spectrum before versus after HFS within each bandwidth.

Results

After HFS, a significant decrease in δ power ($p = 0.046$) and an increase in α power ($p = 0.023$) was observed. The power of other frequency bands was not significantly changed after HFS.

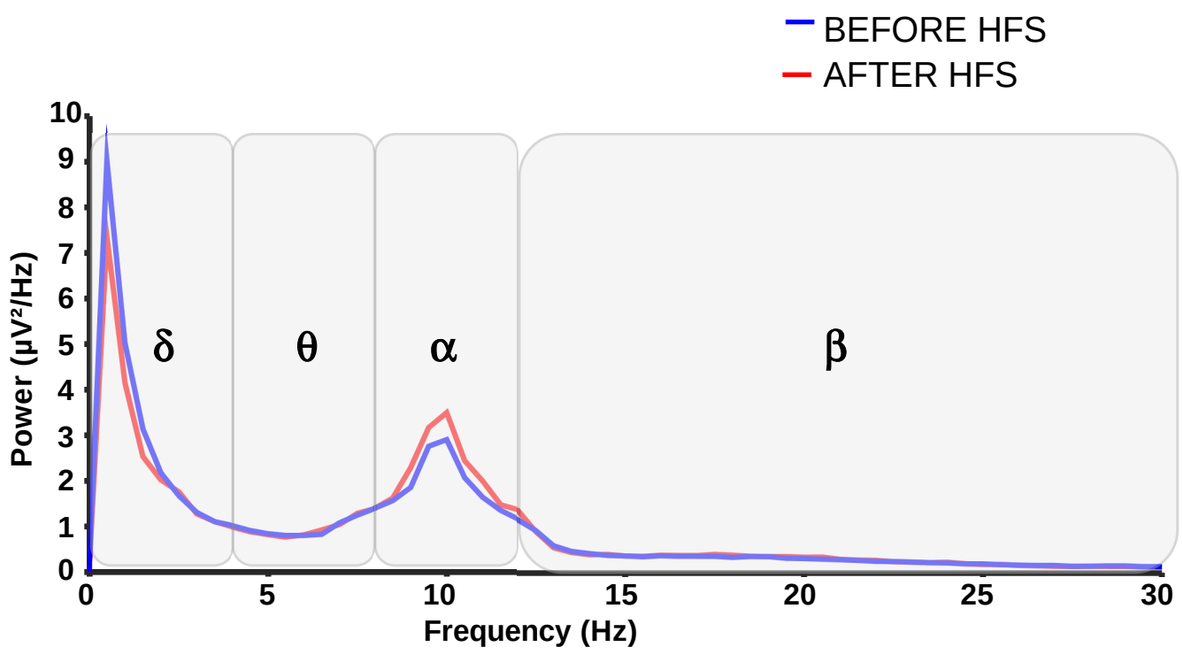

Fig 1. Spectral content of ongoing EEG recorded BEFORE and 30 minutes AFTER applying HFS to the volar forearm.

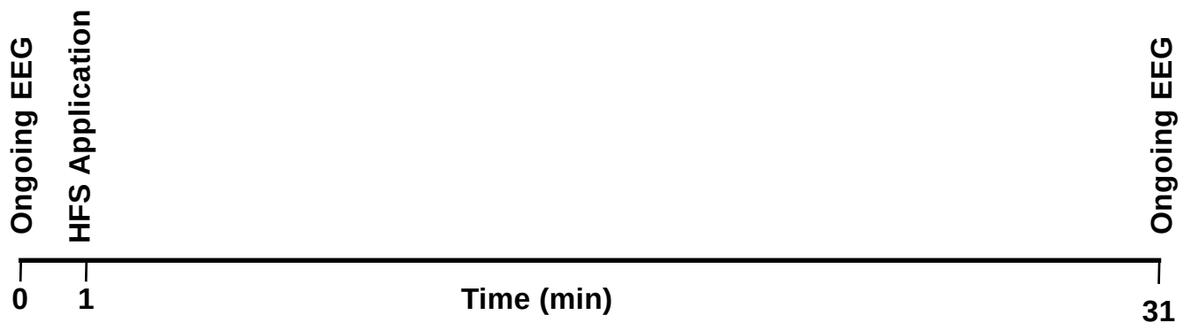

Fig 2. Timeline of the experiment

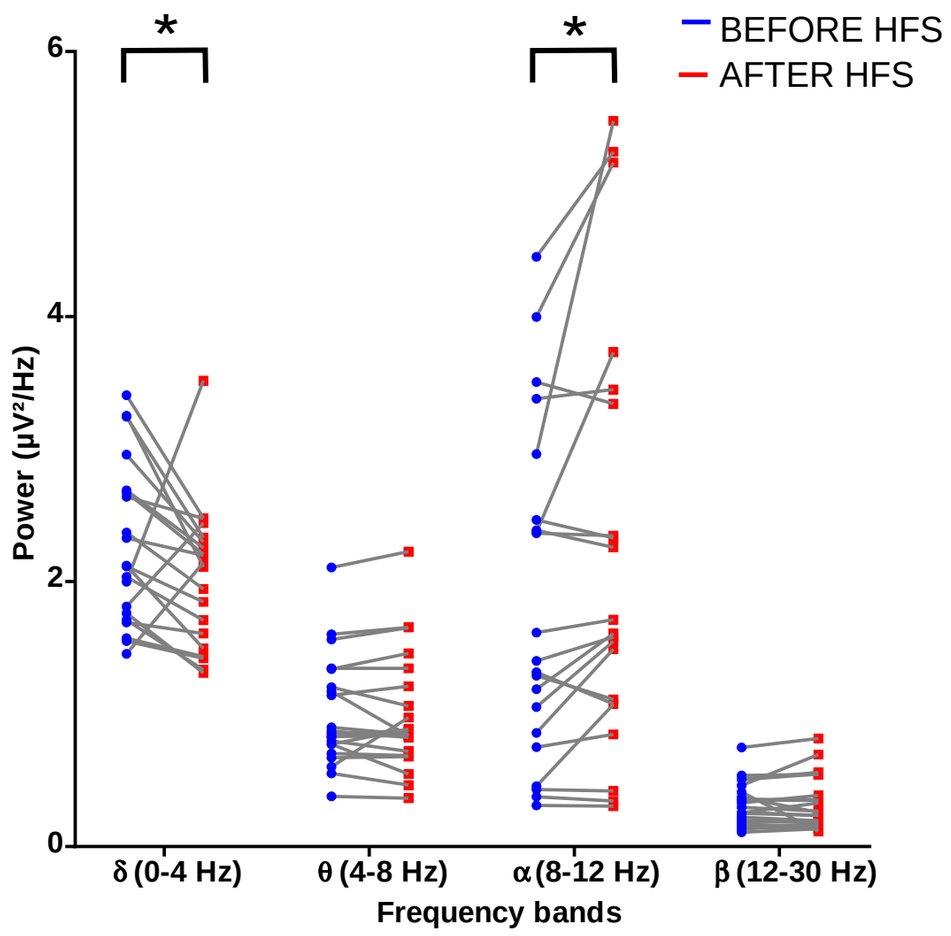

Fig 3. Power of the different frequency bands BEFORE HFS and AFTER HFS, mean +/- SD, each dot represents a single subject.
* indicates significant differences revealed by paired t-tests.

Conclusion

The spectral content of the ongoing EEG recorded 30 minutes after applying HFS differs from the spectral content of the ongoing EEG recorded before applying HFS. Future studies should investigate the functional significance of these changes and their relation to HFS-induced changes in pain sensitivity.

1. Sanoja et al., 2013 Enhanced excitability of thalamic sensory neurons and slow-wave EEG pattern after stimuli that induce spinal long-term potentiation *J Neurosci 33(38), 15109-15119.*
2. Klein et al., 2004 Perceptual correlates of nociceptive long-term potentiation and long-term depression in humans *J Neurosci 24(4), 964-971.*

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