Stimulus amplitude effect in time and frequency on responses to single pulse electrical stimulation in stereoelectroencephalographic studies.

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Purpose: Intracranial Direct Electrical Stimulation (iDES) is a powerful method for exploring excitability of relevant structures in patients with refractory epilepsy. Stereoelectroencephalography (SEEG), in particular, allows a 3D exploration of the epileptogenic network based on a working hypothesis. We studied responses to single pulse (SPES) to assess excitability of seizure onset zones (SOZ) versus non-SOZ.

Methods: We recorded responses to iDES in 4 subjects undergoing presurgical evaluation for temporal lobe epilepsy using SEEG. We compared the responses not only to different stimulation protocols currently used in clinical practice, but systematically explored the role of various pulse parameters in evoking responses. Effects of monophasic versus biphasic pulses of 1-3ms as well as intensity-response curves in the interval 0 to 5 mA (0.25 mA step) were studied. Trains of pseudo-random amplitude pulses having a 15 second inter-pulse interval were applied by using a programmable stimulator (Guideline LP+, FHC Inc).

Results: SPES showed stimulus-response curves having a quasi-linear appearance, but also exhibiting saturation at various thresholds that are correlated with the localization within SOZ or outside SOZ. Post-stimulus oscillations in various frequency bands, including HFO and fast-ripples, were observed and their dependence on the stimulus intensity exhibited both a positive and a negative correlation.

Conclusions: Evaluation of thresholds from stimulus-response curves as well as oscillations in various frequency bands triggered by SPES can provide valuable complementary information to recording spontaneous activity and responses to standard stimulation protocols for better defining the epileptogenic network, reducing the duration of the invasive monitoring phase.