
Responses to single-pulse electrical stimulation in freely moving rats

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Résumé

Direct electrical stimulation is a neurosurgical procedure used to investigate brain connectivity in drug-resistant epileptic patients implanted with intracranial electrodes. The responses to single pulses of injected current in the brain are called cortico-cortical evoked potentials (CCEP). CCEP provide a novel way to explore *in vivo* connectivity in the living human brain, however its use is currently limited to epileptic individuals with few possibilities to explore different configurations. This project aims to transfer this methodology in the small animal, and more particularly in freely moving rats, to be able to test the therapeutic potential of drug candidates *in vivo*. To do so, many parameters must be adapted to meet various material and technical constraints.

A first phase of tests was conducted on healthy rats to characterize the potential effects of electrical stimulation on brain oscillations. Rats were implanted bilaterally into the parietal cortex, known to be a very well interconnected structure, with electrodes at different depths. We managed to record CCEP on freely moving rats which were really similar in shape than those from previous studies on humans or anesthetized rats. Intracranial stimulation seems to transiently and briefly modify induced brain oscillations and the frequency content of the responses differs according to the cortical layer. These results are preliminary and should be compared to responses from other brain areas.

This approach based on cortical excitability could reveal connectivity defects present in multiple neurodegenerative pathologies. This is the case of Parkinson's disease, in which several structures of the cortico-basal ganglia-cortical loop see their connectivity altered due to nigrostriatal deficits of dopamine. The study of the responses from these various structures to electrical stimulation could highlight a specific EEG signature of the disease and link it with its progression. Such an application of the technique would then help to identify prodromal markers that could lead to an early diagnosis, and improve therapeutic intervention by helping the discovery of neuroprotective treatments.

Mots-Clés: cortical excitability, electrical stimulation, EEG, rodent, CCEP

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