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Identifying functional networks in the human brain using single pulse electrical stimulation

Tóth, E.[3]; Entz, L.[1, 2, 4]; Bickel, S.[4]; Erőss, L.[1]; Ulbert, I.[2, 3*]; Mehta, A. D.[4]

1: National Institute of Neuroscience, Budapest, Hungary
2: Institute for Psychology, Hungarian Academy of Sciences, Budapest, Hungary
3: Pázmány Péter Catholic University, Faculty of Information Technology, Budapest, Hungary
4: Long Island Jewish Epilepsy Center, New Hyde Park, NY, USA

Mapping of functional areas in the human brain is crucial in epilepsy and tumor surgery. There are several methods to identify eloquent cortices, such as stimulation mapping, fMRI or PET. In this study we used single pulse electrical stimulation evoked late responses to map language and motor networks in epilepsy surgical candidates. We performed systematic bipolar stimulation of subdurally implanted electrodes by administering single pulse electrical currents (10 mA, 0.5 Hz, 0.2 msec) on 8 patients undergoing intracranial monitoring as part of the presurgical evaluation. Electrodes were localized using post-operative CT and MRI. Brodmann areas were identified using a semi-automated imaging technique. Evoked significant cortical late responses marked functional connections and a graph model was used to display them. Stimulating electrodes over Broca's area showed significant responses in electrodes part of the language network as defined with functional stimulation mapping. Responses to stimulation of the primary motor cortex revealed connections to major hubs involved in motor processing. Our results suggest that single pulse electrical stimulation evoked potentials correlate well with clinically defined functional networks. We conclude that single pulse electrical stimulation is a promising technique in delineating eloquent cortex and might be a useful tool to identify pathological networks.