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Noninvasive connectivity analysis: a novel methodology for functional cortical mapping

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

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: Nortshore-LIJ HS Dept. of Neurosurgery, New Hyde Park, NY, USA

The current gold standard for localizing language and motor networks in humans is electrical stimulation mapping. However, alternative non-invasive methods are being evaluated including task related fMRI, resting state functional connectivity (RSFC) analysis of the BOLD signal and cortical evoked potentials (CEP). We sought to compare these methods in patients undergoing intracranial monitoring for intractable epilepsy. fMRI was recorded at rest and while performing language tasks in a 3T scanner in three patients with medically intractable epilepsy prior to implantation of subdural electrodes. Extra-operative functional electrical stimulation mapping (ESM) and single pulse stimulation for the analysis of CEP was performed using subdural implanted electrodes. Electrode coordinates were localized in MRI space in order to perform correlations between methods. RSFC analysis tended to be more sensitive in detecting ESM defined language areas than task-based fMRI. Similar networks were revealed using language-positive ESM electrodes as stimulation site for CEP and as a seed for RSFC analysis. However, they only partially overlaid with functional electrodes identified with ESM. RSFC analysis is a promising tool to localize functional language areas. The combined application of RSFC, task-based fMRI, and CEP in addition to high frequency stimulation mapping might increase the sensitivity of delineating crucial language areas.