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Interrogating cortical excitability with TMS-EEG to explain motor impairment in patients with Parkinson disease

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Introduction: In recent years, a novel brain-stimulation technique which combines MRI-navigated TMS with high-density EEG (TMS-EEG) has emerged as a powerful tool to non-invasively probe brain circuits, allowing for the assessment of several cortical properties such as excitability and connectivity and adding a new dimension to the functional study of the human brain. Indeed, a previous TMS-EEG study unveiled the change of excitability induced by an acute dopamine intake in the premotor cortex of Parkinson's disease (PD) patients [1].

Objective: To investigate the TMS-evoked potentials (TEP) obtained by targeting occipital and premotor cortex in PD patients without dementia and to evaluate their association with motor impairment and cognitive performance.

Methods: 12 subjects with a diagnosis of PD according to the MDS Clinical Diagnostic Criteria were enrolled. We measured the EEG responses to TMS obtained by targeting the supplementary motor area and occipital cortex. We also recorded resting high-density EEG both in the eyes open and closed conditions. In addition to the MDS-UPDRS Part III, a comprehensive neuropsychological assessment were performed. TEP were analyzed to compute latency, area and slope of statistically significant peaks with respect to the baseline. We also detected alpha peak and power of resting EEG. A correlation analysis of neurophysiological measures, neuropsychological scores and MDS-UPDRS Part III was performed.

Results: We found that the MDS-UPDRS Part III is significantly positively associated with the latency of occipital TEP and negatively associated with the latency of premotor TEP. Furthermore, the performance at Rey-Osterrieth complex figure is negatively associated with eyes-closed alpha peak in resting EEG.

Conclusions: Our findings support the use of TMS-EEG as a non-invasive tool to probe the role of different cortical regions in the pathophysiology of PD and further disclose the functional impairment of premotor and occipital cortical areas with potential implications for rehabilitation targets.

References:

[1] S. Casarotto. Brain Stimul. Jan-Feb 2019;12(1):152-160