Brain Oscillation in Patients with Parkinson's Disease Underwent Different Treatment Scenarios

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Abstract

Introduction: Parkinson's disease (PD) is a neurodegenerative disorder with a complex and not yet fully understood etiology. One approach for its understanding is brain oscillations analysis, by which delta (0,5-3 Hz), theta (4-7 Hz), alpha (8-12 Hz), beta (13-30 Hz) and gamma (>31 Hz) waves are evaluated by quantitative electroencephalography to comprehend brain function. This study aims to characterize the impact of each treatment on brain oscillatory activity.

Method: This is a prospective, observational on cross-sectional ongoing study. So far, 21 participants were randomly selected from University Hospital Antonio Pedro, among which 7 patients are treated with clinical therapy, 12 were submitted to DBS surgery and 2 patients to pallidotomy. Tests are conducted both On and Off medication, DBS On and Off and pre and post-pallidotomy. Variables include sex, age, disease course length, disease subtype and side of onset, as well as EEG outcomes.

Results: Preliminary results shows a predominance of male patients (76%), with age ranging from 65-70 years old, alongside with a disease course length from 3 up to 22 years. Most of the participants had a tremor-dominant onset (60%) with symptoms emerging from the left side (60%). We've analysed the qEEG in 4 patients (2 managed with DBS approach and 2 with conservative treatment). Regarding the clinical participants, the analysis revealed an important mean amplitude reduction in the delta wave band (μMedOFF = 4,256; μMedON = 2,898), as well as theta peek reductions with a lower standard deviation (μMedOFF 2,359 ± 2,152; μMedON 2,374 ± 1,848). Similar results were found on the surgical group, with a mean amplitude reduction in theta wave bands (μDBS-ONMed-ON 2,22 ± 1,319; μDBSOFFMedOFF 5,166 ± 6,167), but also a increase in beta and gamma mean amplitude (Beta: μDBSONMedON 1,447 ± 0,893; μDBSOFFMedOFF 1,034 ± 0,636 | Gamma: μDBSONMedON 0,539 ± 0,539; μDBSOFFMedOFF 0,220 ± 0,104).

Discussion: Preliminary results shows a predominance of male patients (76%), with age ranging from 65-70 years old, alongside with a disease course length from 3 up to 22 years. Most of the participants had a tremor-dominant onset (60%) with symptoms emerging from the left side (60%). We've analysed the qEEG in 4 patients (2 managed with DBS approach and 2 with conservative treatment). Regarding the clinical participants, the analysis revealed an important mean amplitude reduction in the delta wave band (μMedOFF = 4,256; μMedON = 2,898), as well as theta peek reductions with a lower standard deviation (μMedOFF 2,359 ± 2,152; μMedON 2,374 ± 1,848). Similar results were found on the surgical group, with a mean amplitude reduction in theta wave bands (μDBS-ONMed-ON 2,22 ± 1,319; μDBSOFF-MedOFF 5,166 ± 6,167), but also a increase in beta and gamma mean amplitude (Beta: μDBSONMedON 1,447 ± 0,893; μDBSOFFMedOFF 1,034 ± 0,636 | Gamma: μDBSONMedON 0,539 ± 0,539; μDBSOFFMedOFF 0,220 ± 0,104).

Conclusions: These undergoing study results suggest that dopaminergic therapy and DBS jointly suppress pathological slow activity while restoring higher-frequency oscillations, which highlight the clinical value of oscillatory biomarkers for guiding personalized neuromodulation. Through this approach, we hope to facilitate the identification of pathological neural patterns and uncover new therapeutic targets.

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