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Hyper-acute changes on γ frequency functional connectivity induced by STN-DBS in a patient with advanced Parkinson's disease

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Introduction: Subthalamic nucleus deep brain stimulation (STN-DBS) is a successful and widespread surgical treatment in patients with advanced Parkinson's disease (PD) [1]. STN-DBS, in addition to rapid improvement of PD motor symptoms, can exert fast local neuromodulator activity [2]. However, short-term effects of STN-DBS on cortical functional connectivity have been scarcely explored.

Objective: In this case study, we analysed the hyper-acute changes induced on EEG cortical functional connectivity by STN-DBS in a patient with advanced PD.

Methods: We describe a 68-year-old man with diagnosis of PD in 2008, whose onset symptoms were bradykinesia in the right upper-limb. Due to worsening of PD motor complications, patient underwent bilateral STN-DBS in October 2021. We recorded 64-channels EEG data in DBS-OFF and DBS-ON during resting state. Electrophysiological assessment was performed in February 2022. Power spectral density was computed in four frequency bands (θ-α-β-γ). Source reconstruction method was used to identify brain regions activity. Functional connectivity was calculated using imaginary part of coherency in four frequency bands (θ-α-β-γ). Power spectral density and functional connectivity were compared between DBS-OFF and DBS-ON states. Analysis were made using custom-written MATLAB script and Brainstorm toolbox [3].

Results: In DBS-OFF state, power spectral density revealed greater γ-frequency activity in left channels than in right ones. Consistently, functional connectivity showed greater values in γ-frequency over the left, more affected, hemisphere compared to the contralateral. After activating STN-DBS, we recorded a hyper-acute reduction in both power spectral density and functional connectivity in γ-frequency in left hemisphere, up to similar values to the right hemisphere. No differences were observed in θ-α-β frequencies.

Conclusion: We reported a case of hyper-acute effect of STN-DBS in modulating γ-frequency functional connectivity in a patient with advanced PD. Further studies are required to confirm this observation and investigate the potential role of γ cortical connectivity reduction in adaptive DBS.

References:

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