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Neuroimaging correlates of tremor and bradykinesia in patients with essential tremor

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Introduction: Essential tremor (ET) is a neurological condition characterized by postural and kinetic tremor of the upper limbs. Moreover, it has been recently pointed out that bradykinesia may be a relatively common motor feature in ET. Despite the well-known role of the cerebellum in ET pathophysiology, the possible involvement of other brain areas remains unclear.

Aims: To investigate structural damage and resting-state functional alteration of the cerebral cortex, basal ganglia, and the cerebellum in ET. Moreover, we aimed to assess possible correlations between magnetic resonance imaging (MRI) findings and bradykinesia.

Methods: Twenty patients with ET and 17 healthy subjects (HS) underwent multimodal 3T-MRI, including 3D-T1 and blood oxygen-level dependent (BOLD) sequences at rest. MRI structural analysis was performed on 3D-T1 images. A seed-based analysis was performed to study resting-state functional connectivity (rsFC) of the dentate nucleus and globus pallidus. Postural and kinetic tremor and bradykinesia during repetitive finger tapping were kinematically recorded via an optoelectronic system. We then analysed: tremor amplitude (GRMS^2) and frequency (Hz) and various movement parameters, e.g., movement velocity and amplitude and sequence effect. Finally, we assessed possible correlations between neuroimaging, clinical scores and kinematic parameters.

Results: Compared to HS, ET patients showed a higher dentate FC with cerebellum, and a lower FC with precentral and frontal areas. Furthermore, ET patients showed a higher pallidal FC with cerebellum and sensorimotor areas, and a lower FC with crus II and superior frontal gyrus. Confirming previous findings, ET patients showed lower movement velocity of finger tapping, compared to HS. Pallidal and dentate rsFC negatively correlated with tremor severity, however, they both positively correlated with movement velocity during finger tapping.

Conclusion: We here provided novel pathophysiological information in ET. The data suggest a role of both basal ganglia and cerebellar nuclei in generating either postural tremor or bradykinesia in ET.