Graph theoretical analysis of resting-state functional magnetic resonance imaging in essential tremor

J. Benito-Leon[1], E. Sanz-Morales[2], H. Melero[2], E. Louis[5], J. Pablo Romero[3], E. Rocon[4], N. Malpica[2]

[1]*Neurology, University Hospital "12 de Octubre", Spain*
[2]*Laboratorio de Análisis de Imagen Médica y Biometría (LAIMBIO), Rey Juan Carlos University, Spain*
[3]*Faculty of Biosanitary Sciences, Francisco de Vitoria University, Spain*
[4]*Neural and Cognitive Engineering group, Center for Automation and Robotics (CAR) CSIC-UPM, Spain*
[5]*Neurology, Yale School of Medicine, USA*

Essential tremor (ET) is a neurological disease with both motor and non-motor manifestations, including cognitive dysfunction; however, little is known about its underlying brain basis. Furthermore, the overall organization of the brain network in ET remains largely unexplored. Using a novel method, we investigated the topological properties of brain functional network, derived from resting-state functional MRI data, in 23 ET patients vs. 23 healthy controls. Graph theory analysis was used to assess the functional network organization at the global and regional levels. We found that at the global level, the functional network of ET patients was characterized by lower small-world values than healthy controls. At the regional level, compared with the healthy controls, ET patients showed significantly higher values of global efficiency, cost and degree, and a shorter average path length in the left inferior frontal gyrus (pars opercularis), right inferior temporal gyrus, right inferior lateral occipital cortex, left paracingulate, bilateral precuneus, left lingual gyrus, right hippocampus, left amygdala, and bilateral nucleus accumbens. In addition, ET patients showed significant higher local efficiency and clustering coefficient values in the bilateral frontal medial cortex, subcallosal cortex, posterior cingulate, bilateral parahippocampal gyrus, right lingual gyrus, and right cerebellar flocculus. Interpreting these data is challenging; nonetheless, each of the observed changes in connectivity patterns can be linked to one of the several non-motor features previously described in ET, such as cognitive dysfunction, depression, personality style, and impaired visual-motor integration. In conclusion, the efficiency of the overall brain functional network in ET is disrupted. At the regional level, we found the existence of multiple connectivity differences between ET patients and healthy controls in motor and extra-motor related areas. These data support the concept that ET is a disorder that disrupts widespread brain regions, including those outside of the brain regions responsible for tremor.