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A Comparison of Gray Matter Structural Networks of Patients with Migraine and Healthy Subjects: A Graph Theory-Based Study

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Abstract

Migraine is a common primary brain disorder which is characterized by recurrent pulsating and throbbing head pain. Magnetic Resonance Imaging (MRI) - based neuroimaging has been extensively used to detect structural brain changes in migraines. We hypothesize that the above- mentioned changes may alter structural brain network topology in the brain, resulting in poor information transfer. Therefore, we aimed to characterize the global network topology of patients with migraine and healthy subjects using gray matter structural networks. The study was performed using 3D T1-weighted MRI images of the brains of 45 migraine patients and 46 healthy controls. Then group-level structural connectivity matrices were developed using Pearson correlation and the matrices were binarized by applying a series of sparsity thresholds and global network topologies (small worldness, network efficiency, hierarchy, synchronization, and assortativity) were computed. Between-group differences of global topological metrics were tested using nonparametric statistics (permutation tests, n=1000). According to between-group results, patients with migraine showed increases in small-worldness, and global efficiency while local efficiency and synchronization did not differ significantly between patients and healthy subjects (p<0.05). Assortativity values were largely dispersed among their sparsities and were considerably higher in the healthy network than in the migraine network at sparsities of 0.4 and 0.5 (p<0.05). In addition, with the increasing network sparsity there was an increasing trend for hierarchy property of patients. Our findings imply that migraine could alter the topological properties of structural brain networks and graph theory-based approach provides valuable information about them.

Keywords: *Migraine, Gray matter, Structural networks, Graph theory, MRI*