ABNORMALITIES OF THE BRAIN FUNCTIONAL CONNECTOME IN PEDIATRIC PATIENTS WITH MULTIPLE SCLEROSIS

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Target Audience. Neurologists and Neuroradiologists.

Purpose. To investigate the functional organization of large-scale brain networks (connectome) in pediatric patients with multiple sclerosis (MS) using resting state (RS) fMRI and graph theory.[1]

Methods. Fifty-two pediatric MS patients and 16 age- and sex-matched healthy controls were studied. Whole-brain networks were constructed using graph theory. The overall topology of functional brain connectivity was examined by computing the average network degree (D), clustering coefficient (C), characteristic path length (L), global and local efficiencies (Eg and El) and assortativity. Between-group differences of global and local network connectivity metrics were investigated with a two-sample t-test. Brain regions were ranked according to their importance in explaining between-group differences by using the positive false-discovery rate method.[2]

Results. Significant abnormalities of global network metrics in pediatric MS patients compared with controls were found only for the assortativity (p ranging from 0.008 to 0.04). There were trends (p ranging from 0.07 to 0.09 for all metrics) towards a decrease of D and Eg, and an increase of L in pediatric MS patients vs controls (*Figure 1*). The bilateral middle cingulate cortex and middle temporal gyrus, right inferior temporal gyrus and bilateral cerebellum were hubs in both controls and pediatric MS patients. The right anterior cingulate cortex, bilateral thalamus and some occipital regions were hubs in controls only (*Figure 2*). Compared with controls, pediatric MS patients had a decreased nodal degree of several regions of the occipital and temporal lobes, basal ganglia and cerebellum. The bilateral thalamus, right cuneus, bilateral lingual gyrus, left middle and superior occipital gyrus, and bilateral cerebellum were ranked as the most important regions in explaining between-group differences. No correlation was found between graph measures and disease duration or T2 lesion volume.

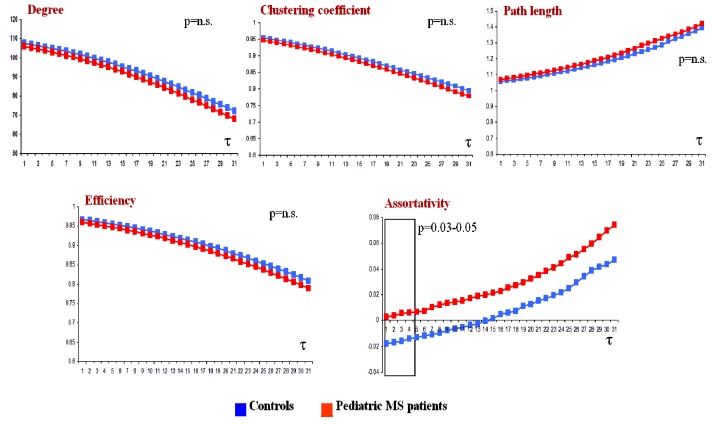

Figure 1. Global network properties in healthy controls (blue) and MS patients (red) over the selected range of correlations thresholds τ.

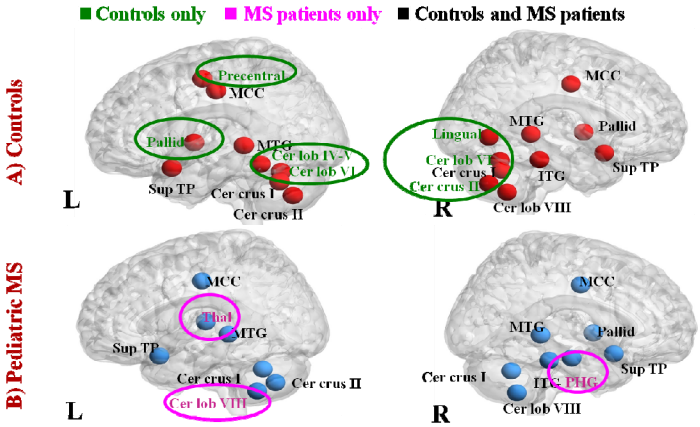

Figure 2. Brain Hubs detected in healthy controls (A) and in pediatric MS patients (B).

Discussion. We applied advanced methods of analysis of RS fMRI data to investigate the global topology of functional network organization in pediatric MS patients. Global topology of functional network organization is relatively preserved in this population. The local reorganization of functional network in pediatric MS patients involve only a few infratentorial and supratentorial brain regions including the cerebellum, basal ganglia and paritetal/occipital areas.

Conclusion. The limited modifications of brain topology found in pediatric MS patients might contribute to explain their better clinical outcome at short-medium term.

References.

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2. Storey JD. The positive false discovery rate: a Bayesian interpretation and the q-value. The Annals of Statistics 2003;31:2013-2035.

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