Dysfunction of the Fronto-Striatal-Insular Network in Drug-Naive Adolescents with Attention Deficit Hyperactivity Disorder: A Resting-State fMRI Study

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Introduction:

Many studies of attention deficit hyperactivity disorder (ADHD) have implicated the abnormalities in fronto-striatal structures including the lateral prefrontal cortex, dorsal anterior cingulate cortex and striatum. Recently, functional magnetic resonance imaging (fMRI) has been adapted to examine connectivity within some specific resting-state neural networks [1]. The goal of this study was to examine the resting-state functional connectivity within the fronto-striatal-insular network in subjects with ADHD and in healthy controls.

Methods:

Twenty-five drug-naive boys with ADHD and 27 healthy controls engaged in resting-state fMRI scanning. Four patients and two controls were excluded from further analysis due to excessive head motion. Probabilistic Independent component analysis [2] was used to extract the fronto-striatal-insular network in each subject. The differences between the two groups in spatial patterns of the fronto-striatal-insular network and power distributions of their time-courses were calculated using the two-sample t-tests, respectively.

Results:

The reduced functional connectivity was mainly distributed among the right fronto-striatal-insular network (middle frontal gyrus, medial frontal gyrus, paracentral lobule and superior frontal gyrus) (See Figure 1). Patients with ADHD had significantly less power in low-frequency oscillations (0.01 Hz ~ 0.1 Hz) in relation to healthy controls (See Figure 2).

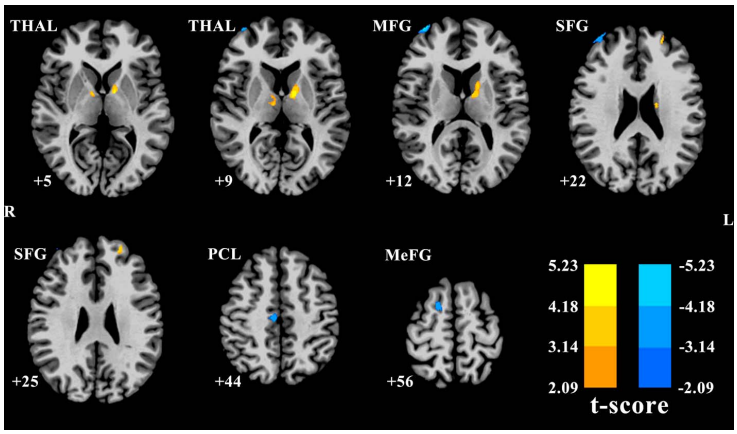

Figure 1. Dysfunctional fronto-striatal-insular network in ADHD. THAL, thalamus; SFG, superior frontal gyrus; PCL, paracentral lobule; MeFG, medial frontal gyrus; MFG, middle frontal gyrus; L, left; R, right.

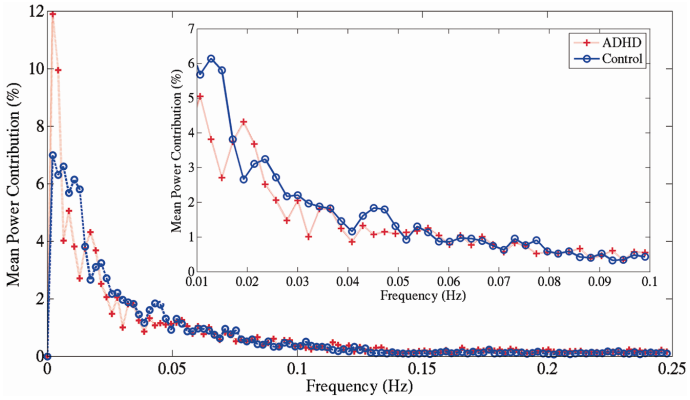

Figure 2. Power contribution to the mean fronto-striatal-insular time courses at the frequency domain. The averaged power contributions (0.01 ~ 0.1 Hz) showed significantly difference in a two-sample t-test (p = 0.0384) across two groups.

Conclusions:

The decreased functional connectivity or temporal synchronicity within the fronto-striatal-insular network fit the hypotheses that the pathophysiology of ADHD involves a dysfunctional connectivity or interaction among the components of fronto-striatal-insular circuitry [3]. Further, increased functional connectivity within the left hemispheres may suggest a compensatory attentional control in ADHD.

References:

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