Testing Functional Brain Activation and Connectivity for Visual Attention Processing between Young Adults with Primary Attention-Deficit/Hyperactivity Disorder (ADHD) and Traumatic Brain Injury (TBI) using Functional Near-Infrared Spectroscopy (fNIRS)

Jerry Shih-Ming Wang

Objective— The neurobiological mechanisms of inattention in people with primary attention-deficit/hyperactivity disorder (ADHD) and people post traumatic brain injury (TBI) are not yet well understood. Altered functional brain activations in the prefrontal, frontal, and parietal cortices have been reported in primary ADHD; secondary ADHD has been reported for people with different regional damages post TBI in some longitudinal studies. The objective of this study was to test the hypothesis that young adults with ADHD have significant differences in their functional brain regions of interest (ROI) activations and between-ROI connectivity patterns as compared to those with TBI, and that these functional alterations would be related to their respective inattentive symptoms of the disorders.

Method— Visual attention processing task-based functional near-infrared spectroscopy data from three demographically matched groups were analyzed: 20 subjects with predominantly inattention and/or combined symptoms on Conners' Adult ADHD Rating Scales (CAARS) for ADHD, 20 subjects with mild or moderate scale on Glasgow coma scale (GCS) for TBI, and 19 normal control subjects. Cortical activation maps for ROIs and between-ROI connectivity patterns were created for individual participants. Significant differences among the three groups of brain activation and connectivity were determined using one-way analysis of variance (one-way ANOVA) and one-way analysis of covariance (one-way ANCOVA), and significant between-group differences were determined using Tukey's honest significance difference test (Tukey's HSD).

Results— Compared to controls, subjects with TBI have significantly increased activation in the right calcarine gyrus (CG), significantly decreased connectivity between left middle frontal gyrus (MFG) and right CG, and significantly increased connectivity between right CG and right inferior occipital cortex (IOC). Compared to controls, subjects with primary