Hemispheric brain asymmetry differences in youths with attention-deficit/hyperactivity disorder


Abstract

INTRODUCTION:
Attention-deficit hyperactive disorder (ADHD) is the most common neurodevelopmental disorder in children. Diagnosis is currently based on behavioral criteria, but magnetic resonance imaging (MRI) of the brain is increasingly used in ADHD research. To date however, MRI studies have provided mixed results in ADHD patients, particularly with respect to the laterality of findings.

METHODS:
We studied 849 children and adolescents (ages 6-21 y.o.) diagnosed with ADHD (n = 341) and age-matched typically developing (TD) controls with structural brain MRI. We calculated volumetric measures from 34 cortical and 14 non-cortical brain regions per hemisphere, and detailed shape morphometry of subcortical nuclei. Diffusion tensor imaging (DTI) data were collected for a subset of 104 subjects; from these, we calculated mean diffusivity and fractional anisotropy of white matter tracts. Group comparisons were made for within-hemisphere (right/left) and between hemisphere asymmetry indices (AI) for each measure.

RESULTS:
DTI mean diffusivity AI group differences were significant in cingulum, inferior and superior longitudinal fasciculus, and cortico-spinal tracts (p < 0.001) with the effect of stimulant treatment tending to reduce these patterns of asymmetry differences. Gray matter volumes were more asymmetric in medication free ADHD individuals compared to TD in twelve cortical regions and two non-cortical volumes studied (p < 0.05). Morphometric analyses revealed that caudate, hippocampus, thalamus, and amygdala were more asymmetric (p < 0.0001) in ADHD individuals compared to TD, and that asymmetry differences were more significant than lateralized comparisons.

CONCLUSIONS:
Brain asymmetry measures allow each individual to serve as their own control, diminishing variability between individuals and when pooling data across sites. Asymmetry group differences were more significant than lateralized comparisons between ADHD and TD subjects across morphometric, volumetric, and DTI comparisons.