Brain imaging genetics in ADHD and beyond – mapping pathways from gene to disorder at different levels of complexity

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Abstract

Attention-deficit/hyperactivity disorder (ADHD) is a common and often persistent neurodevelopmental disorder. Beyond gene-finding, neurobiological parameters, such as brain structure, connectivity, and function, have been used to link genetic variation to ADHD symptomatology. We performed a systematic review of brain imaging genetics studies involving 62 ADHD candidate genes in childhood and adult ADHD cohorts. Fifty-one eligible research articles described studies of 13 ADHD candidate genes. Almost exclusively, single genetic variants were studied, mostly focusing on dopamine-related genes. While promising results have been reported, imaging genetics studies are thus far hampered by methodological differences in study design and analysis methodology, as well as limited sample sizes. Beyond reviewing imaging genetics studies, we also discuss the need for complementary approaches at multiple levels of biological complexity and emphasise the importance of combining and integrating findings across levels for a better understanding of biological pathways from gene to disease. These may include multi-modal imaging genetics studies, bioinformatic analyses, and functional analyses of cell and animal models.