Abnormal Fear Circuitry in Attention Deficit Hyperactivity Disorder: A Controlled Magnetic Resonance Imaging Study

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Abstract

We examined whether non-traumatized subjects with Attention Deficit Hyperactivity Disorder (ADHD) have dysfunctional activation in brain structures mediating fear extinction, possibly explaining the statistical association between ADHD and other disorders characterised by aberrant fear processing such as PTSD. Medication naïve, non-traumatized young adult subjects with (N=27) and without (N=20) ADHD underwent a 2-day fear conditioning and extinction protocol in a 3 T functional magnetic resonance imaging (fMRI) scanner. Skin conductance response (SCR) was recorded as a measure of conditioned response. Compared to healthy controls, ADHD subjects had significantly greater insular cortex activation during early extinction, lesser dorsal anterior cingulate cortex (dACC) activation during late extinction, lesser ventromedial prefrontal cortex (vmPFC) activation during late extinction learning and extinction recall, and greater hippocampal activation during extinction recall. Hippocampal and vmPFC deficits were similar to those documented in PTSD subjects compared to traumatised controls without PTSD. Non-traumatized, medication-naïve adults with ADHD had abnormalities in fear circuits during extinction learning and extinction recall, and some findings were consistent with those previously documented in subjects with PTSD compared to traumatised controls without PTSD. These findings could explain the significant association between ADHD and PTSD as well as impaired emotion regulation in ADHD.