Neurobiological correlates of cognitive flexibility in ADHD - A systematic review of the literature

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Abstract

INTRODUCTION:
Attention deficit hyperactivity disorder (ADHD) is one of the most commonly diagnosed childhood psychiatric disorders, which persists to adulthood in 30-50% of the cases. Previous studies have shown that cognitive flexibility, which means to switch between two different rules, that can be tested with task switching paradigms, is affected. Although poor performance in cognitive flexibility tests has been demonstrated, the neurobiological background is only partly known.

OBJECTIVE:
The aim of our review was to examine the neurobiological background of impairment of cognitive flexibility in ADHD, with a specific focus on functional MRI (fMRI) and electrophysiological (electroencephalography, EEG) studies.

METHODS:
We searched MEDLINE, PubMed, and PsychInfo using the following keywords: 'ADHD', 'cognitive flexibility', 'set shifting', 'task switching', 'EEG', 'fMRI'.

RESULTS:
Compared to healthy controls, ADHD patients showed reduced activation in regions of the prefrontal and parietal lobe and in the basal ganglia. However in two studies, increased activation was also observed in specific regions of temporal lobe and in anterior cingulate cortex. Magnetoencephalographic results indicated that instead of an increased activity in medio-temporal lobe, ADHD patients showed an enhanced activation in the superior temporal gyrus and in the left inferior parietal lobe.

CONCLUSIONS:
Based on our review, patients with ADHD, as compared to healthy controls, showed reduced activation in brain regions associated with cognitive flexibility. Based on the differences in the spatial and temporal patterns of activation in the temporal lobe we conclude that ADHD patient engage different brain regions to resolve the conflicts caused by task switching. However, further studies are required to corroborate this conclusion.