Measuring the Effect of CPT-3 Administration on Regional Cerebral Blood Flow with Single-Photon Emission Computed Tomography (SPECT) in ADHD

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Objective

The aim of this study is to investigate the effect of the administration of the Conners Continuous Performance Test (CPT-3) on cerebral blood flow (CBF) in children with ADHD.

Methods

The data for this study was derived from a large de-identified single-photon emission computed tomography (SPECT) database. Participants in the ADHD group (n=1853, M_{age}=12.01) included individuals under the age of 18 given a formal ADHD diagnosis. Participants in the control group (n=38, M_{age}=11.70) were healthy individuals with no prior mental health diagnoses. All participants were assessed for cerebral blood flow levels before and after CPT-3 administration. Participants with co-morbid diagnoses were included. Race, gender, and age were considered covariates.

Results

-Multiple 2-by-2 ANOVAs with repeated measures were conducted with sphericity assumed. The interaction between CPT-3 administration and ADHD diagnosis was not significant in any brain region assessed (all p-values>0.05).

-The overall effect of ADHD diagnosis on CBF levels was not significant in any brain region assessed (all p-values>0.05).

-The overall effect of CPT-3 administration on CBF levels was significant in the right cingulate [$F(1,1809)=4.057$, $p=0.044$, $\eta_p^2= 0.002$], left and right sides (respectively) of the frontal lobe [$F(1,1809)= 5.401$, $p=0.020$, $\eta_p^2= 0.003$]; [$F(1,1809)=3.873$, $p=0.049$, $\eta_p^2=0.002$], left and right sides of the occipital lobe [$F(1,1809)=12.919$, $p<0.001$, $\eta_p^2= 0.007$]; [$F(1,1809)=11.364$, $p<0.001$, $\eta_p^2=0.006$], left and right sides of the parietal lobe [$F(1,1809)= 6.629$, $p=0.010$, $\eta_p^2= 0.004$]; [$F(1,1809)=5.035$, $p=0.025$, $\eta_p^2=0.003$], left and right sides of the subcortical region [$F(1,1809)= 5.042$, $p=0.025$, $\eta_p^2= 0.003$]; [$F(1,1809)= 4.756$, $p<0.029$, $\eta_p^2=0.003$].

-Post hoc analysis with a Bonferroni adjustment revealed that CBF levels were statistically significantly increased from baseline to following CPT-3 administration in both the ADHD and control groups (respectively) significantly increased from baseline to following CPT-3 administration in the left side of the occipital lobe [2.069(95%CI, 1.168 to 2.970)]; [2.724(95%CI, 0.941 to 4.507)], right side of the occipital lobe [1.662(95%CI, 0.816 to 2.508)]; [2.174(95%CI, 0.498 to 3.849)], left side of the parietal lobe [1.124(95%CI, 0.856 to 1.393)]; [2.181(95%CI, 0.321 to 4.041)], and right side of the parietal lobe [0.941(95%CI, 0.679 to 1.202)]; [1.907(95%CI, 0.095 to 3.720)].

-Significant increases were found in the ADHD group in the right side of the cingulate [0.357(95%CI, 0.587 to 0.128)], left side of the frontal lobe[0.880(95%CI, 0.016 to 1.744], right side of the frontal lobe [0.394(95%CI, 0.113 to 0.617)], left subcortical regions [0.603(95%CI, 0.368 to 0.838] and right subcortical regions [0.617(95%CI, 0.383 to 0.851].

Discussion

While the interaction between administration of CPT-3 and ADHD was not significant in the brain regions assessed, the main effect of CPT-3 on CBF levels was found to be significant such that following the administration of CPT-3, individuals had higher levels of CBF than before the administration of CPT-3. Without an interaction, we can infer that ADHD diagnosis does not change the effect of CPT-3 administration on CBF levels. This is counterintuitive considering that CPT-3 is a test of sustained attention, a common challenge for children with ADHD.

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