Objective measurement of hyperactivity, impulsivity, and inattention in children with hyperkinetic disorders before and after treatment with methylphenidate

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Abstract  Purpose The purpose of this study was to investigate whether values of the respective parameters of the OPTAx test dependently differ due to the medication with methylphenidate (MPH) in children with hyperkinetic disorders (HD) suffering from hyperactivity, impulsivity, and attention deficits. Methods The OPTAx test is an infrared motion analysis to record the movement pattern during a continuous performance test. We tested 25 children between 6 and 12 years with HD (ICD-10: F90.0 or F90.1) before and after treatment with MPH. The parameters under investigation were activity (microevents and spatial scaling), impulsivity (errors of commission), and attentiveness (accuracy and variability). For statistical analysis a one-tailed matched pairs test (adj. p = 0.01) was conducted to discriminate differences found from those occurred at random. A post hoc partial correlation of absolute differences in the respective parameters and the daily dose of MPH (adj. for BMI) was performed if p < 0.01. Results Statistically significant results were found for microevents, spatial scaling, errors of commission, accuracy, and variability. The partial correlation showed significant results for microevents and variability. Conclusion The mean pre–post changes found in all parameters investigated consistently correspond with benefits desired from medication with MPH in children with HD. Absolute differences in microevents and variability seem to depend on the daily dose of MPH after adjustment for BMI.

Key words hyperactivity – impulsivity – inattention – hyperkinetic disorder – methylphenidate

Introduction

The DSM-IV diagnosis (APA 1994) attention-deficit/hyperactive disorders (ADHD) as well as the ICD-10 diagnosis (WHO 1992) hyperkinetic disorders (HD) are among the most often diagnosed psychiatric disorders in school-age children (Barkley 1998). The prevalence for HD is between 2 and 6%. The large differences in prevalence are due to different study designs which differ in the investigated population and diagnostic criteria and instruments, respectively (Cantwell 1996). The kind and number of informants has also a large influence on the prevalence (Achenbach et al. 1987). ADHD is diagnosed in boys 4–9 times more often than in girls (APA 1994).

Some attempts have been made to develop objective measures to demonstrate the core symptoms of HD and ADHD in a single test situation, respectively. Halperin et al. [1992, 1993] and Reichenbach et al. (1992) used actigraphs combined with a continuous performance test (CPT). Reichenbach et al. (1992) found that actigraph measures correlated with both parent and teacher ratings of hyperactivity with a good test-retest reliability during the CPT. Halperin et al. (1992) tested ADHD patients, non-ADHD patients and normal controls with a CPT combined with a solid state actigraph. Both patient groups were inattentive relative to normals, but were indistinguishable from each other. However, the ADHD group was more active than both non-ADHD patients and normals, who did not differ from each other.
In another study Halperin et al. (1993) used the same method to investigate ADHD patients without any co-morbid diagnosis, patients with anxiety disorder, disruptive disorders other than ADHD and normal controls. The ADHD was found to be inattentive and impulsive relative to the other patient groups and controls. The activity distinguished the ADHD group from controls but not from the other patient groups. Matier et al. (1992) tested the response to a single 5 mg dose of MPH in aggressive and non-aggressive ADHD children using CPT and actigraph. After medication, both ADHD groups had a significant decrease in inattention, whereas impulsivity remained unchanged. Activity level decreased only in the non-aggressive group.

Marks et al. (1999) identified 4 subgroups of children with ADHD (hyperactive-inattentive, impulsive-inattentive, inattentive only, and hyperactive only) by CPT and solid state actigraphs. These groups were then also rated by parents and teachers and tests of intellectual functioning and academic achievement were performed. The hyperactive-inattentive group was impaired on measures of intellectual functioning and academic achievement relative to the other three groups. The impulsive-inattentive group was generally rated as more aggressive, although this difference was not significant for all measures.

However, “actigraphs simplify and reduce the complexity of activity” (Teicher et al. 1996). Teicher et al. (1996) used an infrared motion analysis to record the movement pattern during a CPT. They found that boys with ADHD moved their head 2.3 times more often than normal children, moved 3.4 times as far, covered a 3.8-fold greater area, and had a more linear and less complex movement pattern. On the CPT the children with ADHD responded more slowly and with greater variability on the CPT. The test discriminated 16 of 18 patients with ADHD from 11 of 11 controls. Complexity of head movement and variability in response latency significantly correlated with teacher ratings (r > 0.7).

The purpose of this study was to investigate whether values of the respective parameters of the OPTAx test dependently differ due to the medication with MPH in children with HD and if there is a partial correlation between these parameters and the daily dose of MPH adjusted for BMI.

**Methods**

**Sample description**

Twenty-five children (20: 5, males: females) aged 6 to 12 years (9.0 ± 1.6 y) with hyperkinetic disorders (HD) according to ICD-10 (F90.0 or F90.1) were tested. The required diagnostic criteria were independently evaluated by two experienced psychiatric clinicians. Furthermore inattentive and impulsive relative to the other patient groups and controls. The ADHD was found to be inattentive and impulsive relative to the other patient groups and controls. The activity distinguished the ADHD group from controls but not from the other patient groups.

**Statistical analysis**

Means and standard deviations (sd) are given. In order to discriminate pre-post intra-individual differences at random from those based on substantial effects we used the one-tailed T-test for matched pairs to evaluate observed changes of the respective parameters of the OPTAx-test. The a priori direction of the difference expected for each parameter was defined.

Due to the number of parameters tested [5] we ad-