

# PEDIATRIC NEUROLOGY BRIEFS

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J. GORDON MILLICHAP, M.D., F.R.C.P., EDITOR

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### ATTENTION DEFICIT DISORDERS

#### CORTICAL ABNORMALITIES IN ADHD

Grey-matter abnormalities at the cortical surface and regional brain size were mapped by high-resolution MRI and surface-based, computational image analytical techniques in a group of 27 children and adolescents with attention deficit hyperactivity disorder (ADHD) and 46 controls, matched by age and sex, at the University of California at Los Angeles. Fifteen patients were taking stimulant drugs. Significant structural cortical abnormalities were noted in patients with ADHD. These included bilateral reduction in the size of inferior portions of the dorsal prefrontal and the lateral aspects of anterior and midtemporal cortices. Also, the density of grey matter was increased in posterior aspects of the temporal lobes and inferior aspects of the parietal lobes bilaterally. These dorsolateral, prefrontal, lateral temporal, and parietal regions serve as association areas for integration of information from lower order sensory systems into higher order percepts and functions. These cortical regions and connections are important in the maintenance of attentional focus and the inhibitory control of distracting behavioral impulses, functions that are disrupted in children with ADHD. (Sowell ER, Thompson PM, Welcome SE, et al. Cortical abnormalities in children and adolescents with attention-deficit hyperactivity disorder. *Lancet* November 22, 2003;362:1699-1707). (Respond: Dr Elizabeth R Sowell, PhD, University of California at Los Angeles, Laboratory of Neuroimaging, Department of Neurology, 710 Westwood Plaza, Room 4-238, Los Angeles, CA 90095).

COMMENT. The identification of region-specific structural abnormalities in the brain cortices of children with ADHD corroborates previous studies and provides a more detailed analysis and further evidence of a neurobiological basis for ADHD. Variations with sex, age, and IQ in brain volumetric MRI studies, and the need for controls

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were demonstrated in reports from Johns Hopkins Hospital (Reiss AL et al, 1996). A lack of normal asymmetry of regional brain structures, and decreased volume of the prefrontal cortex, caudate nucleus, and globus pallidus on the right side were demonstrated in MRI studies of 57 boys with ADHD at the National Institutes of Health, Bethesda, MD (Castellanos FX et al, 1996). Underdevelopment of the splenium of the corpus callosum was found in an MRI study of 15 children with ADHD at the Massachusetts General Hospital, Boston (Semrud-Clikeman M et al, 1994). Further studies should include attempts to distinguish patients with subtypes of ADHD. (see Progress in Pediatric Neurology III, PNB Publishers, 1997;pp212 and 294).

## ABNORMALITIES OF RHYTHMIC FINGER-TAPPING IN ADHD

A finger-tapping test requiring rhythmic responses to frequencies from 1 to 6Hz was performed in 27 children (21 males, 6 females; aged 6 to 14 years, mean 11 years) diagnosed with ADHD, and in 33 controls at the Shaare Zedeck Medical Center, Jerusalem, Israel. Patients treated with methylphenidate (n=22) received no medication on the day of the test. Simultaneous computer-generated visual and auditory stimuli were presented at different frequencies over a 7-minute session. Children with ADHD responded at a faster rate than the stimulus, unlike control subjects who tapped in tandem with the stimulus. Fifteen of 27 children with ADHD demonstrated the "hastening" phenomenon (a tendency to exceed the stimulus frequency at the higher frequencies), compared to only 2 of the 33 controls ( $p<0.05$ ). Children demonstrating the hastening response made recurrent errors in tapping, their responses were faster than controls, and the response frequency was constant (mean 3.8Hz, range 2.8-4.7Hz) regardless of the stimulus. Age and fast tapping responses for ADHD children were correlated inversely ( $p<0.05$ ). The hastening phenomenon was not correlated with sex or handedness. (Ben-Pazi H, Gross-Tsur V, Bergman H, Shalev RS. Abnormal rhythmic motor response in children with attention-deficit-hyperactivity disorder. Dev Med Child Neurol Nov 2003;45:743-745). (Respond: Hilla Ben-Pazi MD, Neuropediatric Unit, Shaare Zedeck Medical Center, PO 3235, Jerusalem 91031, Israel).

COMMENT. This hastened voluntary response, termed *hastening phenomenon*, is also characteristic of patients with Parkinsonism. It may reflect an abnormal oscillatory mechanism mediated by dopaminergic frontal-striatal circuits that is released by cortical inhibitory frontal lobe deficits peculiar to ADHD. The authors propose that children with ADHD can follow slow rhythmic stimuli but at higher frequencies, their voluntary motor response is deranged by a disturbed central oscillatory mechanism. Impairments of handwriting and typing skills, both rhythmic voluntary movements, are often affected in ADHD and may be amenable to therapeutic intervention. Dysgraphia is frequently responsive to methylphenidate (MPH) as an adjunct to coordination exercises. (Millichap, 1973). The effect of MPH on the hastening phenomenon would be of interest.

A **dose-response study of OROS-MPH** showed that increasing doses (36-54 mg) were associated with a clear dose-response relationship, with improvements in 66-75% of ADHD-CT children. Parent ratings were more sensitive than teacher ratings. In children with ADHD-PI, improvements in attention occurred at lower doses, and less benefit was derived from higher doses. In both ADHD subtypes, higher doses were associated with