Rotational and Collic Vestibular-Evoked Myogenic Potential Testing in Normal Developing Children and Children with Combined Attention Deficit/Hyperactivity Disorder.


Abstract

OBJECTIVES:
Vestibular dysfunction in childhood can have a major effect on a child’s developmental process. Balance function has been reported to be poorer in children with attention deficit and hyperactivity disorder (ADHD) than in their typically developing peers. Due to contradictory available evidence and the paucity of research on vestibular function specifically in children with combined ADHD (cADHD), we designed this aged-matched study to assess vestibular function in children with cADHD.

DESIGN:
We enrolled 30 typically developing children (15 boys and 15 girls; mean age, 9 years 6 months; range, 7 to 12 years) and 33 children (19 boys and 14 girls; mean age, 9 years 0 months; range, 7 to 12 years) with cADHD diagnosed by our research psychiatrist. Typically developing controls were used to obtain normative data on vestibular testing and to examine the impact of age on the vestibular response parameters, and these results were compared with those of the cADHD group. All children underwent the sinusoidal harmonic acceleration subtype of the rotary chair test (0.01, 0.02, 0.08, 0.16, and 0.32 Hz) and the cervical vestibular-evoked myogenic potential (cVEMP) test.

RESULTS:
At all five frequencies in the sinusoidal harmonic acceleration test, there was no significant correlation between age and any of the following rotary chair response parameters in typically developing children: vestibulo-ocular reflex (VOR) gain, phase, asymmetry, and fixation index. Furthermore, there was no significant correlation between age and any of the following cVEMP parameters for the right and left ears of control group: p1 and n1 latency, amplitude, threshold, and amplitude ratio. Significantly higher VOR gains were observed for children with cADHD at frequencies of 0.01 (p = 0.001), 0.08 (p < 0.001), 0.16 (p = 0.001), and 0.32 (p = 0.003) Hz, when compared with the control group. Furthermore, fixation abilities were significantly lower in the cADHD group than in the control group at 0.16 (p < 0.001) and 0.32 (p < 0.001) Hz. cVEMP parameters showed no significant differences between the two groups.

CONCLUSIONS:
Our results showed higher VOR gains and poorer fixation abilities in children with cADHD compared with typically developing children. Cerebellar dysfunction in patients with ADHD has been well documented in the literature, and our findings of cVEMP and rotary chair tests for these children showed impaired vestibular function in these children, based on increased VOR gain values and decreased fixation capabilities. Because VOR gain is mediated through the inferior olive and controlled by the cerebellum, our results suggest that central inhibition of vestibular function may be deficient in children with cADHD, resulting in higher VOR gains. Also, there is general agreement that failure of fixation suppression indicates a central lesion. The lesion can originate from the parietal-occipital cortex, the pons, or the cerebellum. However, failure of fixation suppression is most prominent in lesions involving the midline cerebellum that could be counted for children with cADHD. We believe that this contribution is theoretically and practically relevant as high VOR gains and decreased suppression capabilities may result in symptoms of reading and writing difficulties, learning disabilities, vertigo, and motion sickness in these children. Therefore, assessment of vestibular function in children with cADHD at a young age must be considered when developing rehabilitation protocols for these children.