

The study of convergence insufficiency in children with attention deficit hyperactivity disorder

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Introduction

Attention deficit-hyperactivity disorder (ADHD) is characterized by low levels of attention and concentration and high levels of activity, distractibility, and impulsivity. Convergence insufficiency (CI) is a common condition that is characterized by a patient's inability to maintain proper binocular eye alignment on objects as they approach from distance to near. Several studies have been conducted to discover the relationship between ADHD and CI. Researchers reported that children with CI had a higher frequency of parent-reported ADHD and/or learning problems, but their studies were limited to patients with CI.

Aim of the work

The purpose of this study was to identify patients with CI in a cohort of patients diagnosed with ADHD.

Materials and methods

The study included 20 children diagnosed with ADHD. They were diagnosed on the basis of the clinical assessment and fulfilling the diagnostic criteria of the DSM-IV. Other assessments included mental age assessment using the Stanford–Binet scale and ADHD assessment using Conners' parents' rating scale. Participants underwent complete ophthalmologic examination: visual acuity test using an illiterate E chart; stereopsis using Lang card; cover tests; convergence amplitude; near point of convergence; slit-lamp examination for the anterior segment; cycloplegic refraction; and fundus examination. Written informed consent was taken from the parents of all children included in the study.

Results

CI was present in 35% of cases, with a near point of convergence more than 6.

Conclusion

CI appeared to be a comorbid disorder in patients with ADHD, and may cause misdiagnosis, or exacerbation of the symptoms of ADHD. Patients diagnosed with ADHD should be evaluated for CI. It is worthy of mention that CI is a disease that can be effectively managed with orthoptic exercises, or surgically.

Keywords:

attention deficit-hyperactivity disorder, convergence insufficiency, learning disabilities

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Introduction

Convergence insufficiency (CI) is a common vision disorder characterized by exophoria greater at near than at distance, a receded near point of convergence, and reduced positive fusional vergence at near, and it has a prevalence of ~5%. The adverse impact of CI occurs during near viewing; typical symptoms include double vision, blurred vision, eyestrain, difficulty concentrating, and slow reading [1–4].

Recent studies have suggested a possible association between CI and a prevalent behavioral disorder, attention deficit-hyperactivity disorder (ADHD) [5–7].

Attention deficit disorder (ADD) and ADHD are the most common neurobehavioral disorders during childhood, with a prevalence of up to 12% in the community settings. Children diagnosed

with ADHD show developmentally inappropriate levels of inattention, hyperactivity, and impulsivity characterized by onset during childhood and may impair school performance, intellectual functioning, social skills, and occupational functioning [8,9].

It is well noted that symptoms frequently reported in CI, such as loss of concentration when reading or reading slowly, are similar to behaviors associated with ADHD (inattentive type), such as, failure to complete assignments and trouble concentrating in class. This study aimed to detect CI in children diagnosed with ADHD.

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Materials and methods

The studied group included 20 children with newly diagnosed ADHD. Their ages ranged from 5 to 11 years, with a mean of 7.3 ± 1.7 years. Fourteen patients were male and six were female.

Patients included in the study were diagnosed with ADD/ADHD on the basis of clinical evaluation using the criteria from the *Diagnostic and Statistical Manual of Mental Disorders* (DSM IV-TR) criteria for ADD/ADHD in addition to assessment using Conners' scale [9,10].

The following ophthalmologic tests were performed by a pediatric ophthalmologist:

- (1) Determination of visual acuity: Visual acuity was tested monocularly at a distance of 3 m with an illiterate E chart. Values were noted in decimal format.
- (2) Investigation of strabismus and ocular motility: Heterotropia was investigated using a cover test. Heterophoria was detected using an alternate cover test and was defined as a latent deviation of exophoria more than 4 pD or esophoria more than 2 pD at near (0.33 m) and/or at distance (3 m) [11].
- (3) Near point of convergence: For near point of convergence evaluation in cm, the Royal Air Force (RAF) ruler was used. A mean value of three measurements was recorded.

To meet the criteria for the diagnosis of CI, all three of the following signs were required: (a) greater exophoria at near than distance by 4 pD; (b) failed Sheard's criteria or minimum normative positive fusional vergence at near (<15 pD for break); and (c) receded near point of convergence (>6 cm break point) [12].

Diagnoses of CI was based on near point of convergence (>6 cm), fusional amplitudes (≤ 15 pD at near), and symptoms (headaches, asthenopia, and difficulty in reading) [13].

- (4) Refraction under cycloplegia: This was performed with an autorefractometer (Topcon RM-A7000B, Japan) after instillation of cyclopentolate (1%).
- (5) Examination of the anterior segment, media, and ocular fundus: The anterior segment of the eye was examined using a slit lamp and the ocular fundus was examined by means of indirect ophthalmoscopy.

Statistical analysis

Statistical analysis was carried out using Statistical Package for Social Sciences (SPSS/version 15) software, and mean (\bar{X}), SD, and percentages were calculated.

Results

The studied group included 20 children with newly diagnosed ADHD. Their ages ranged from 5 to 11 years, with a mean of 7.3 ± 1.7 years. Fourteen patients were male and six were female (Table 1).

The spherical equivalent refractive error ranged from -0.25 to 3.75 , with a mean of 1.0 ± 1.1 (Table 2).

CI was present in 35% of cases, with a near point of convergence more than 6 (Table 3).

Visual acuity was 1.0 in 75% of right eyes and in 85% of left eyes without glasses. Glasses were prescribed for 25% of cases, with attaining of a visual acuity of 1.0 in all eyes thereafter (Table 4).

Discussion

Impact of ADHD on the global functioning of the patient is at many instances of great magnitude [14]. The diagnosis of ADHD remains essentially clinical and is based on certain behavioral criteria [9]. This diagnosis often depends largely on the inputs provided by means

Table 1 Personal characteristics of children with attention deficit-hyperactivity disorder

Personal characteristics	Children with ADHD ($n = 18$) [n (%)]
Sex	
Male	14 (70)
Female	6 (30)
Age (years)	
Minimum–maximum	5.0–11.0
Mean \pm SD	7.3 ± 1.7

ADHD, attention deficit-hyperactivity disorder.

Table 2 Spherical equivalent results among children with attention deficit-hyperactivity disorder

Spherical equivalent	Children with ADHD ($n = 20$)
Minimum–maximum	-0.25 to 3.75
Mean \pm SD	1.0 ± 1.1
Median (Q1–Q3)	0.75 (0.0 – 1.7)

ADHD, attention deficit-hyperactivity disorder.

Table 3 Convergence results among children with attention deficit-hyperactivity disorder

Convergence	Children with ADHD ($n=18$) [n (%)]
Convergence insufficiency	
Absent	15 (75)
Present	5 (25)
Near point of convergence	
Normal (6 cm or less)	15 (65)
Abnormal (more than 6 cm)	5 (35)
Minimum–maximum	3–15
Mean \pm SD	6.2 ± 3.1

ADHD, attention deficit-hyperactivity disorder.

Table 4 Visual acuity of children with attention deficit-hyperactivity disorder

Visual acuity	Children with ADHD (n = 20) [n (%)]
Visual acuity of the right eye	
0.5	2 (10)
0.8	1 (5)
0.9	2 (10)
1	15 (75)
Visual acuity of the left eye	
0.5	1 (5)
0.8	1 (5)
0.9	1 (5)
1	17 (85)
Use of glasses	
No	15 (75)
Yes	5 (25)
Fundus examination	
Free	20 (100.0)

ADHD, attention deficit-hyperactivity disorder.

of questionnaires that both parents and teachers fill and also by the patients themselves. The clinician needs to correlate the results of these surveys with his own clinical findings. A comprehensive examination is needed to rule out any comorbid disorders with overlapping symptoms, including an eye exam.

The studied group included 20 children with newly diagnosed ADHD. None of the participants was on medications for the management of ADHD. Their ages ranged from 5 to 11 years, with a mean of 7.3 ± 1.7 years. Fourteen patients were male and six were female.

In the present study CI was found in 25% of patients (five out of 20 patients). This surprisingly high incidence in children with newly diagnosed ADD/ADHD compared with those reported in other studies reinforces the importance of screening this population for CI. Computer search review showed the prevalence of CI in elementary school students to be 2.25–4.2% during the year 1988 [15].

A study by Granet *et al.* [6] reported an apparent three-fold greater incidence of ADHD among patients with CI compared with the incidence of ADHD in the general US population using strict criteria (1.8–3.3%), the incidence seen in subspecialty mental health settings (estimated at 3–5% of school-aged children), and in some cases the incidence in community settings (4–12% of children) [16]. The same study by Granet and colleagues suggested that there is a greater incidence of CI in ADHD patients. The review of computer records showed a 15.9% incidence of CI in ADHD patients.

It was suggested that the medications used to treat ADHD aggravate CI. For some of these drugs, difficulties with accommodation and blurring have

been reported [17]. Another point to add is that, of those diagnosed with CI in ADHD patients discovered by Granet and colleagues, 76.9% were on medication. Our series included all newly diagnosed children with no history of medication administration for the management of ADHD. This indicates that medication administration by itself is not the only cause for the high incidence of CI in ADHD patients.

CI appears to be a comorbid disorder in patients with ADHD, and may cause misdiagnosis, or exacerbation of the symptoms of ADHD. Patients diagnosed with ADHD should be evaluated for CI. It is worthy of mention that CI is a disease that can be effectively managed by means of orthoptic exercises, or surgically [18].

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Conflicts of interest

There are no conflicts of interest.

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