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Symptom differences in children with absence seizures versus inattention

Jane Williams,* Gregory B. Sharp, Emily DelosReyes, Stephen Bates, Tonya Phillips, Bernadette Lange, May L. Griebel, Mark Edwards, and Pippa Simpson

Department of Pediatrics, University of Arkansas for Medical Sciences, 800 Marshall Street, Little Rock, AR 72202, USA

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Abstract

Objective. Differentiation between the diagnoses of absence seizures and Attention Deficit Hyperactivity Disorder (ADHD), Predominantly Inattentive Type, is frequently confounded by similarities in symptom presentation. The purpose of the present study was to determine symptoms that would distinguish between the disorders.

Methods. Prior to diagnosis, parents of children with absence seizures ($n = 17$) or ADHD, Predominantly Inattentive Type ($n = 26$), were administered the Attention Deficit Disorder Evaluation Scale—Home Version (ADDES-HV). A statistical model was developed based on age, gender, race, and items from the Inattentive Scale of the ADDES-HV.

Results. Two items, "does not complete homework" and "does not remain on task," correctly classified 40 of 43 children. Children with absence seizures were rated by their parents as having a low rate of occurrence of these behaviors.

Conclusion. Lack of sustained attention distinguished between the groups and was much more prevalent in children with ADHD, Predominantly Inattentive Type.

1. Introduction

The diagnoses of epilepsy and attention deficit hyperactivity disorder (ADHD) are heavily dependent on behavioral descriptors. There is no laboratory test for ADHD, and the diagnosis is based on behavorial ratings in the home and school environments, behavioral history, and clinical observation. Although the diagnosis of epilepsy is greatly assisted by EEG recordings, description of behavior during clinical events is critical for diagnostic accuracy, particularly when the EEG is normal or clinical events are not recorded.

The differential diagnosis between epilepsy, especially absence seizures, and ADHD, Predominantly Inattentive Type, has been complicated by the overlap in symptoms associated with both conditions. Of the primary overlapping behaviors, staring is strongly associated with absence seizures and a hallmark of ADHD, Predominantly Inattentive Type [1]. In one video telemetry study, staring was the most common nonepileptic phenomenon and occurred in more than 50% of the children [2]. Another common symptom, inattention, is seen in children with absence seizures who are often described as having problems with attention and concentration, also classic symptoms of ADHD, Predominantly Inattentive Type. Differentiating between epilepsy and ADHD is critical, as the misdiagnosis of ADHD for epilepsy delays appropriate treatment with an anticonvulsant and places the child at risk for continuing and/or increased seizure occurrence.

The purpose of the present study was to examine behavioral differences between children with new-onset absence seizures and ADHD, Predominantly Inattentive Type, which might be helpful in making a differential diagnosis.

2. Methods

2.1. Subjects

Participants in the study were all children ($n = 201$) newly referred to either an outpatient neurology or a

* Corresponding author. Fax: +501-320-2840.
E-mail address: williamsjanep@uams.edu (J. Williams).

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developmental pediatric clinic at a university-affiliated children's hospital. At the time of the study, none of the children had been diagnosed or treated for epilepsy or ADHD. Following completion of the study questionnaire, children were seen for a diagnostic workup.

Eighty-two children were evaluated in the neurology clinic by one of seven pediatric neurologists. Of these children, 17 were diagnosed with absence seizures. Diagnosis of absence seizures was based on description of ictal behavioral changes and clinical findings. Twelve of the children had electroencephalograms with 3 cycles/second spike and wave activity, while 5 had fragmented but clearly generalized brief spike and wave bursts less than 1 s in duration. All of the children had behavioral changes consistent with clinical absence seizures.

One hundred nineteen children were seen in the developmental pediatric clinic and evaluated by a multidisciplinary team consisting of a developmental pediatrician, psychologist, and speech/language pathologist. Of these children, 26 were diagnosed with ADHD, Predominantly Inattentive Type. Diagnosis was based on ratings from both parents and teachers, the child's history, and exclusion of comorbid disorders as the primary cause of the ADHD symptoms. A cutoff *T* score of 65 on the rating scales was used for the diagnosis.

Children ranged in age from 5 to 16 years. At the time of diagnosis, the mean age of children with absence seizures ($n = 17$) was 10 years, 2 months (SD = 37 months), while the mean age of children with ADHD, Predominantly Inattentive Type ($n = 26$), was 9 years, 3 months (SD = 18 months). There were 12 females and 5 males in the absence group, with 7 females and 19 males in the ADHD, Predominantly Inattentive Type group. Ethnicity in the absence group included 14 Caucasian children and 3 African-American children, while the ADHD Inattentive group comprised 22 Caucasian children and 4 African-American children. Payment source indicated that 11 children with absence seizures were covered by insurance, while 6 were covered by Medicaid, self-pay, or a state-sponsored insurance program. Of the children with ADHD, Predominantly Inattentive Type, 14 were covered by insurance, while 12 were covered by Medicaid, self-pay, or a state program.

2.2. Procedure

The study was approved by the institutional review board, and written permission was obtained from parents for participation. Prior to a child being seen and diagnosed by a pediatric neurologist or developmental pediatrician, the parent was given the Attention Deficit Disorders Evaluation Scale—Home Version (ADDES-HV) [3] to complete. Results from this scale were not part of the diagnostic process. In addition, each parent was asked whether his or her child was noted to stare off during a typical event.

2.3. Instrument

The ADDES-HV is a 46-item rating scale concerning symptoms of inattention, hyperactivity, and impulsivity within the home environment for children between the ages of 3 and 18 years. The parent rates the child's behavior for each item on the ADDES-HV from 0 (absence of the behavior) to 4 (behavior occurs several times per hour). The first 22 items are focused on inattentive behavior and constitute the Inattentive Scale, while the next 24 items are focused on hyperactive–impulsive behaviors and constitute the Hyperactive–Impulsive Scale. Each scale contains all items used in the *Diagnostic and Statistical Manual of Mental Disorders—IV* [4] for diagnosis of the Predominantly Inattentive Type and Predominantly Hyperactive–Impulsive Type. Standard scores are derived for each of the scales and range from 0 to 20 with a mean of 10 and a standard deviation of 3. Scale scores below 4 are considered to be clinically significant. Reliability (α) was found to be 0.96 for each of the scales, while test–retest reliability of the ADDES-HV following 1-month interval ranged from 0.88 to 0.93. The ADDES-HV is heavily used in clinical and educational settings.

2.4. Analysis

Comparisons between the groups were completed using a *t* test for continuous variables and a Pearson χ^2 or Fisher exact test for categorical variables. Due to the comparatively large number of variables to cases, a tree analysis [5] was used to explore the interrelated effect of variables on classification into groups. All 22 items on the Inattentive Scale of the ADDES-HV, gender, race, and age were included in the analysis. Classification trees are a useful nonparametric exploratory technique when the outcome may depend on several interrelated variables of different kinds, such as continuous, nominal, and ordinal data. At each branch of the tree, all variables and all values of the variable are considered. Two branches are possible, and the variable chosen has values on one side or the other. SPlus [6] was used for this analysis. Results from the tree analysis were confirmed using forward likelihood ratio test logistic regression. The Hosmer Lemeshow statistic was used to confirm fit. SPSS [7] was employed for this analysis.

3. Results

Differences in demographics were not found between the groups based on age ($P > 0.22$), ethnicity ($P > 0.73$), or payment source ($P > 0.31$). There was a significant difference ($P < 0.005$) based on gender between the groups, with more males in the ADHD, Predominantly Inattentive Type group.

Table 1
Comparison of standard scores on the ADDES-HV based on group[a]

Scale	Group	
	Absence	ADHD-Inattentive
Inattentive	8.3 (SD = 4.4)	4.4 (SD = 2.0)
Hyperactive–Impulsive	8.6 (SD = 4.4)	8.5 (SD = 2.8)

[a] Mean standard score = 10 ± 3.

Staring behavior was endorsed by 94% of the parents of children with absence seizures, whereas 80% of the parents of children with ADHD, Predominantly Inattentive Type, endorsed this symptom. Comparison of staring behavior did not indicate significant differences in occurrence between the groups ($P > 0.19$).

Mean standard scores on the ADDES-HV for the group with absence seizures was within the normal range for both the Inattentive and Hyperactive–Impulsive scales (Table 1). Mean standard scores on the ADDES-HV for the group with ADHD, Predominantly Inattentive Type, were within the moderate to severe range for the Inattentive Scale and within the normal range for the Hyperactive–Impulsive Scale (Table 1). There was a significant difference between the groups on the Inattentive Scale ($P < 0.0003$), while no differences were noted on the Hyperactive–Impulsive Scale ($P > 0.96$).

Tree analysis indicated that two variables from the ADDES-HV differentiated between the groups (Fig. 1). These two items (i.e., ADDES-HV Nos. 15 and 13) were "does not remain on task" and "starts but does not complete homework." Of the 19 parents who endorsed a low frequency (i.e., less than once per month) of their child not remaining on task, 15 were correctly diagnosed with a seizure disorder if they also endorsed a low frequency (i.e., once or less per week) of not completing homework. Three of these children were correctly diagnosed with ADHD if the parent endorsed a low frequency of not remaining on task, but a high frequency of not completing homework. One child was misdiagnosed based on these decision points.

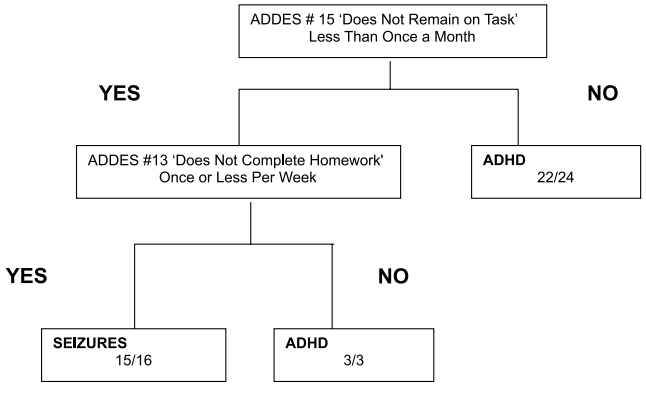

Fig. 1. Results from tree analysis specifying correct classification of diagnostic categories.

Of the 24 parents who indicated a high frequency (i.e., more than once a month) of their child not remaining on task, 22 were correctly diagnosed with ADHD. Two children were misdiagnosed based on this decision point.

With this model, 40 of 43 children were correctly classified. A logistic regression was used to verify the model using cut points and choice of variables from the tree. The analysis indicated that 15 of 17 children with absence seizures and 25 of 26 children with ADHD, Predominantly Inattentive Type, were correctly classified. The Hosmer Lemeshow goodness of fit test ($P > 0.99$) confirmed the appropriateness of the model.

4. Discussion

In the present study, staring was found to be a common behavior for children diagnosed with absence seizures and with ADHD, Predominantly Inattentive Type. Although it occurred slightly more frequently in children with absence seizures, this symptom did not appear to be useful in making a differential diagnosis. Further questions concerning staring episodes, such as whether there is preserved responsiveness to touch or a lack of interruption of activity, have been suggested as helpful in distinguishing nonepileptic events [8].

While inattention was a reported symptom for children with absence seizures and ADHD, Predominantly Inattentive Type, the level of intensity of these behaviors was significantly greater in children with ADHD. The Inattentive Scale of the ADDES-HV was assistive in distinguishing between the diagnoses. In contrast to hyperactive and impulsive behaviors, which were equivalent in the two groups, inattentive behaviors were significantly more frequent in children with ADHD, Predominantly Inattentive Type.

Two behaviors from the ADDES-HV effectively differentiated between the two diagnostic categories. Children with absence seizures were rated by their parents as having a low occurrence of not completing their homework and not remaining on task, while children with ADHD, Predominantly Inattentive Type, were rated as having a high frequency of these behaviors. These variables suggest a lack of sustained attention in children with ADHD, Predominantly Inattentive Type, compared to children with absence seizures. However, these findings need to be validated based on further data.

Results suggest that the use of a parent-completed structured instrument that measures the intensity of inattentive symptoms, along with exploration of the child's sustained attention, may be helpful in the diagnostic process. Asking questions during the clinical history concerning the child's task persistence and off-task behavior may aid in establishing a diagnosis, especially when clinical evidence is not confirmatory or inconclusive.

There are several limitations to this study. First, children diagnosed with ADHD did not undergo an EEG study and children with absence seizures did not have a workup for ADHD. Therefore, the possible coexistence of absence seizures and ADHD was not ruled out. A more definitive study would include video EEG monitoring of staring spells for both groups or routine EEG with hyperventilation for the ADHD group, as well as a multidisciplinary evaluation for the children with absence seizures. A second limitation is that the study focused only on differentiating between absence seizures and ADHD, Predominantly Inattentive Type. Children referred for a neurological workup may have other etiologies for nonepileptic staring behavior besides ADHD. In these cases, scores on the ADDES-HV Inattentive Scale would be less elevated, resulting in less differentiation from children with absence seizures.

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