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Original Article

Common and Distinctive Patterns of Cognitive Dysfunction in Children With Benign Epilepsy Syndromes

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ABSTRACT

BACKGROUND: Childhood absence epilepsy and benign childhood epilepsy with centrotemporal spikes are the most common forms of benign epilepsy syndromes. Although cognitive dysfunctions occur in children with both childhood absence epilepsy and benign childhood epilepsy with centrotemporal spikes, the similarity between their patterns of underlying cognitive impairments is not well understood. To describe these patterns, we examined multiple cognitive functions in children with childhood absence epilepsy and benign childhood epilepsy with centrotemporal spikes. **METHODS:** In this study, 43 children with childhood absence epilepsy, 47 children with benign childhood epilepsy with centrotemporal spikes, and 64 control subjects were recruited; all received a standardized assessment (i.e., computerized test battery) assessing processing speed, spatial skills, calculation, language ability, intelligence, visual attention, and executive function. Groups were compared in these cognitive domains. Simple regression analysis was used to analyze the effects of epilepsy-related clinical variables on cognitive test scores. **RESULTS:** Compared with control subjects, children with childhood absence epilepsy and benign childhood epilepsy with centrotemporal spikes showed cognitive deficits in intelligence and executive function, but performed normally in language processing. Impairment in visual attention was specific to patients with childhood absence epilepsy, whereas impaired spatial ability was specific to the children with benign childhood epilepsy with centrotemporal spikes. Simple regression analysis showed syndrome-related clinical variables did not affect cognitive functions. **CONCLUSIONS:** This study provides evidence of both common and distinctive cognitive features underlying the relative cognitive difficulties in children with childhood absence epilepsy and benign childhood epilepsy with centrotemporal spikes. Our data suggest that clinicians should pay particular attention to the specific cognitive deficits in children with childhood absence epilepsy and benign childhood epilepsy with centrotemporal spikes, to allow for more discriminative and potentially more effective interventions.

Keywords: childhood absence epilepsy, benign epilepsy with centrotemporal spikes, neuropsychological assessment, cognitive dysfunction

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Introduction

Childhood absence epilepsy (CAE) and benign childhood epilepsy with centrotemporal spikes (BECTs) are the most common forms of benign epilepsy syndromes. Although they have differentiated pathophysiologies, these epileptic syndromes share many features, such as similar age of onset, overall good prognosis, and a hereditary nature. Because CAE and BECTs mostly emerge during childhood, educational underachievement is more likely in children

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with CAE or BECTs.[1] The relatively poorer academic performance in these children may be influenced by the pattern of cognitive deficits present in each syndrome.

There is evidence that CAE and BECTs have specific cognitive dysfunctions. CAE is known to affect multiple cognitive functions related to academic and functional difficulties,[2] such that CAE shows impairments in visual spatial skills,[3] verbal memory,[4] and presents with comorbid psychiatric conditions.[5] More recent articles suggest that CAE also impairs attention and executive function,[6] even when the seizures are well controlled.[7] Although BECTs is frequently associated with a good prognosis and remission of seizures before adulthood, it is still associated with deficits in cognitive abilities such as language, memory, and attention.[8] Therefore there are cognitive dysfunctions in both disorders, but how they compare is unclear, because they have only been assessed separately.

No empirical studies directly compare the particular patterns of cognitive deficits in children with CAE and BECTs. Whether they have common or distinctive patterns of cognitive dysfunction is unclear. The goal of the present study was to analyze these patterns and identify common versus distinctive cognitive deficits in children with CAE and BECTs. We hypothesized that children with CAE and BECTs would have significantly lower cognitive scores in attention and executive function than the healthy control group, and that each syndrome would have at least one distinctive cognitive trait that would allow for differentiation of the syndromes. We also considered the influence of comorbidities related to epilepsy by analyzing clinical variables including type of epilepsy, age at epilepsy onset, epileptic seizure, and treatment.[9]

Methods

Participants

In this case-control study, participants included 43 children with CAE, 47 children with BECTs, and 64 control subjects. Patients were enrolled with a history of typical CAE or BECTs from the Department of Pediatric Neurology in the Capital Institute of Pediatrics. The control group included 64 healthy participants who were recruited from primary school and junior middle school in Beijing.

A board-certified pediatric neurologist made the diagnosis of epilepsy (CAE or BECTs) according to the criteria of the International League Against Epilepsy, and all children with epilepsy must have experienced at least one seizure in the past year for inclusion. The diagnosis of CAE was based on clinical evidence of absence seizures induced by hyperventilation and an electroencephalogram (EEG) showing the typical 2.5 to 3.5 Hz generalized spike and wave discharges. For children with CAE, we excluded children with any other types of epilepsy (i.e., tonic-clonic, myoclonic, and partial seizures), prior epilepsy surgery, neurological illnesses other than epilepsy, and the inability to complete the neuropsychological tasks independently. BECTs patients were excluded with abnormal magnetic resonance imaging and a non-rapid eye movement sleep interictal epileptiform discharge frequency $\geq$50%. Approval for this project was granted by the Human Research Ethics Committee of Capital Institute of Pediatrics. Written informed consent was obtained from the parents of each of the individuals participating in the research.

The CAE group comprised 22 male and 21 female participants, age range six to 16 years. The BECTs group comprised 19 male and 28 female participants, age range six to 16 years. The control subjects were 31 male and 33 female participants, age range six to 15 years. There were no significant differences among three groups in age, sex ratio, and socioeconomic status (Table 1).

Neuropsychological assessment

The neuropsychological assessment battery included eight cognitive tests, described individually subsequently. The tests within the battery assessed multiple cognitive abilities: processing speed, spatial skills, calculation, language ability (including semantic comprehension; phonological processing ability), intelligence, visual attention, and executive function.

All tests were programmed using web-based applications in the Online Experimental Psychological System (www.dweipsy.com/lattice).[10] For all except two tests, the children indicated their responses by pressing one of two keys ("P" or "Q") on a computer keyboard; for visual tracing and the Wisconsin Card Sorting Test (WCST), participants clicked the mouse to choose the correct answers.

TABLE 1.
Demographic and Neurological Characteristics for the Participants

Variables	CAE (N = 43)	BECTs (N = 47)	Control Subjects (N = 64)	*P* Value
Age (years), mean (SD)	9.5 (2.6)	9.6 (2.1)	9.7 (2.8)	0.921
Gender (male/female)				
Boys	51% (N = 22)	40% (N = 19)	48% (N = 31)	0.559
Girls	49% (N = 21)	60% (N = 28)	52% (N = 33)	
Age at onset (years)				
≤5	33% (N = 14)	11% (N = 5)	/	0.022
>5	67% (N = 29)	89% (N = 42)	/	
Socioeconomic status				
Urban	**24**	**27**	**40**	**0.551**
Rural	**19**	**20**	**24**	
Treatment				
No medication	7% (N = 3)	6% (N = 3)		0.230
Monotherapy	72% (N = 31)	85% (N = 40)	/	
Duotherapy	21% (N = 9)	9% (N = 4)	/	
Epileptic seizure				
No	56% (N = 24)	79% (N = 37)	/	0.014
Yes	33% (N = 14)	8% (N = 4)	/	
Unknown	11% (N = 5)	13% (N = 6)	/	

Abbreviations:
BECTs = Benign childhood epilepsy with centrotemporal spikes
CAE = Childhood absence epilepsy
/ = There was no data in control group
Bold values indicate *P* = 0.551.