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Original Article

Brief Cognitive and Behavioral Screening in Children With New-Onset Epilepsy: A Pilot Feasibility Trial

Regina L. Triplett MS [a], **Miya R. Asato MD** [b,c,*]

[a] *University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania*
[b] *Department of Pediatrics, Children's Hospital of Pittsburgh of the University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania*
[c] *Department of Psychiatry, University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania*

ABSTRACT

BACKGROUND: Minimal work has used psychometrically robust measures in a systematic fashion to identify and monitor children at risk for cognitive and behavioral comorbidities in current epilepsy care. We piloted a computerized cognitive battery and behavioral questionnaire for children with newly diagnosed epilepsy to determine clinical feasibility and acceptability to parents and patients. **METHODS:** We recruited medication-naïve children (ages 8-17 years) with recent-onset seizures and typical developmental history from an outpatient child neurology clinic. Children completed the CNS Vital Signs computerized battery, whereas parents completed the Strengths and Difficulties Questionnaire. Post-test interviews with parents and patients were completed regarding the acceptability of the assessment procedures. **RESULTS:** Forty-four families were eligible, and 39 agreed to participate (89%). All assessments were completed in less than 45 minutes. Parents rated testing in clinic as convenient and important, expressing strong interest in the cognitive and behavioral impact of epilepsy and medication. Children also rated the testing procedure as acceptable and agreed that they would recommend it to peers. **CONCLUSIONS:** Our brief battery was tolerated and well received by children and their parents. Computerized testing of children along with a parent questionnaire is a psychometrically viable approach that is acceptable to families. Our protocol is time efficient for clinical use with the potential to detect early cognitive and behavioral difficulties related to epilepsy. Ongoing longitudinal study will provide further information regarding the success of our screening methods in monitoring for disease- or treatment-related changes.

Keywords: computerized testing, neuropsychological comorbidity, epilepsy, executive function

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Introduction

It is well known that children with epilepsy have higher rates of cognitive, behavioral, and academic problems than healthy control subjects, siblings, and other age-matched children with chronic diseases.[1-3] These impairments are strongly related to poor educational and psychosocial outcomes for adults with a history of epilepsy in childhood.[4,5] They were previously believed to result from damage caused by frequent seizures or the effects of treatments (i.e., antiseizure drugs or surgery).[6] Yet, recent research has demonstrated the presence of cognitive, behavioral, and academic difficulties at the time of diagnosis or even before the first identified seizure.[7-9] In light of this growing awareness, a recent Institute of Medicine Report on Epilepsy recommends initial screening for cognitive and behavioral comorbidities at the time of diagnosis and continued monitoring throughout each child's treatment and development to prevent future difficulties at school, work, and home.[10]

Currently, children with epilepsy are only referred for cognitive and behavioral evaluation if they have suspected intellectual disability or decline, academic problems, or are

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* Communications should be addressed to: Dr. Asato; Department of Pediatrics; Division of Child Neurology; Children's Hospital of Pittsburgh of the University of Pittsburgh Medical Center; 4401 Penn Avenue; Pittsburgh, Pennsylvania 15224
E-mail address: asatomr@upmc.edu

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undergoing evaluation for epilepsy surgery; thus, most of the children with epilepsy are not routinely screened.[11] If all children with epilepsy were referred for initial and serial monitoring as recommended by the Institute of Medicine,[10] the present system is ill equipped to manage the high volume of referrals. Comprehensive neuropsychologic testing performed by a highly trained professional is the gold standard for evaluation. Formal testing can assess a large variety of cognitive and behavioral domains for children across a wide range of neurodevelopmental levels. Unfortunately, the evaluation takes several hours, is limited by availability of pediatric providers (often in short supply even at large academic institutions), and has strict restrictions for insurance coverage. Additionally, because of the time and resources required for traditional neuropsychologic testing, it is not an ideal method for serial monitoring. Yet, in spite of decades of research illustrating increased neuropsychologic dysfunction and resulting consequences among children with epilepsy and formal recommendations to identify children at risk to ameliorate poor outcomes, this unmet clinical need remains. There are currently no brief, standardized tools to screen for cognitive and behavioral vulnerabilities in children with epilepsy.[11,12]

Cognitive and behavioral screening is most valuable when performed as close to the time of epilepsy diagnosis as possible.[8,10] Screening at the time of initial diagnosis provides baseline data that most can help minimize factors such as seizure burden, disease duration, and exposure to antiseizure medications. Our study, therefore, emphasized the recruitment of medication-naive children with a recent diagnosis of epilepsy. The first aim of our prospective, longitudinal pilot study was to determine the "real time" clinical feasibility of a brief computerized testing assessment and behavioral questionnaire for cognitive and psychiatric screening in children with new-onset epilepsy. Our second aim was to determine the acceptability of our protocol to patients and parents.

Methods

Participants

Children (ages 8-17 years) with recent-onset seizures and diagnosed with active epilepsy were consecutively recruited from and tested at the Children's Hospital of Pittsburgh ambulatory neurology clinic from 2012 to 2014. They were enrolled and tested before the initiation of antiseizure therapy and were excluded if they had taken antiseizure medications within the past year. As in other studies of medication effects on cognition, our criteria also included children with epilepsy previously thought to be in remission who would be resuming medical therapy.[13] Children spoke and read English as a native language. They had no history of delayed achievement of developmental milestones based on parental report. Children with reported comorbid conditions which would significantly impact test performance or tolerance including autism, hemiparesis, or severe visual or hearing impairments were excluded. However, because psychiatric comorbidities such as attention deficit hyperactivity disorder, depression, and anxiety are common among children with epilepsy and otherwise "normal intelligence,"[14] children with previously identified behavioral difficulties were included in the present study. Children were excluded if they had seizures attributed to known trauma, tumor or malformation, intoxication or other medical causes based on clinical history, and available imaging studies at the time of diagnosis. Epilepsy diagnosis was informed by electroencephalography (EEG) findings, but not required.

All eligible patients willing to participate were enrolled in the study after speaking with a member of the research team. Participants provided written assent, and their parents/legal guardians provided informed consent. The study protocol was approved by the University of Pittsburgh Institutional Review Board and complied with the Declaration of Helsinki. Participants were paid $25 for each completed testing session.

Testing procedures

On the day of study enrollment, children completed the CNS Vital Signs (CNSVS) testing battery, whereas their parents or guardians completed the Strengths and Difficulties Questionnaire (SDQ). Subsequent evaluations took place within the context of standard clinical care. Patients and their parents repeated testing procedures when they returned to clinic for regularly scheduled follow-up visits after medication initiation. Follow-up testing took place between 2 and 12 months (for the first follow-up) and 12 and 18 months (for the second follow-up) from the time of enrollment. At each of those visits, patients were retested on CNSVS, and parents completed the SDQ.

CNS Vital Signs

CNSVS is a 30-minute computerized evaluation of multiple cognitive domains. It has been standardized across large populations aged 7-90 years old and features reasonable psychometric properties: good test-retest reliability in 99 subjects (Pearson r for domain scores from $r = 0.65$-0.87) and significant correlations with traditional neuropsychologic tests (Pearson r from $r = 0.64$-0.84).[15] CNSVS has been used to detect subtle cognitive changes in a variety of disorders such as adult traumatic brain injury and pediatric attention deficit hyperactivity disorder.[16,17] It was recently studied in pediatric neurology patients (with various diagnoses) and controls (ages 7-19 years), with neurology patients scoring significantly lower than controls on many of the domains and subtests.[12]

The CNSVS testing battery evaluates the neuropsychologic domains of memory (verbal and visual), processing and psychomotor speed, executive function, reaction time, complex attention, and cognitive flexibility using seven measures including the Verbal and Visual Memory Tests, Finger Tapping Test, Symbol Digit Coding Test, Stroop Test, Shifting Attention Test, and Continuous Performance Test. These tests are based on conventional paper-pencil (or computerized, in the case of the Shifting Attention Test) neuropsychologic tests and described in further detail by Gualtieri and Johnson.[15] CNSVS domain scores are generated from the combination of selected subtest scores (Table 1). Each domain score is scaled based on age-matched normative data to a mean score of 100 with a standard deviation (SD) of 15. The Neurocognition Index (NCI) represents an overall composite score, also scaled to mean of 100 with a SD of 15. Scores are generated automatically on completion of the test

TABLE 1.
CNSVS Domain Scores and the Corresponding Composite Tests

CNSVS Domain Scores	VBM	VIM	FTT	SDC	CPT	SAT	ST
Verbal memory	✓						
Visual memory		✓					
Composite memory	✓	✓					
Psychomotor speed			✓	✓			
Processing speed				✓			
Reaction time							✓
Executive function					✓		
Cognitive flexibility						✓	✓
Complex attention					✓	✓	✓
Neurocognition index	✓	✓	✓	✓	✓	✓	✓

Abbreviations:
CPT = Continuous performance test
FTT = Finger tapping test
SAT = Shifting attention test
SDC = Symbol digit coding test
ST = Stroop test
VBM = Verbal memory test
VIM = Visual memory test