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Brief Report

Emergent diagnostic testing for pediatric nonfebrile seizures☆

Ashley M. Strobel, MD [a,b,*], Vikramjit S. Gill, MD [a,b], Michael D. Witting, MD, MS [b], Getachew Teshome, MD, MPH [c]

[a] Department of Pediatrics, University of Maryland Children's Hospital, Baltimore, MD
[b] Department of Emergency Medicine, University of Maryland School of Medicine, Baltimore, MD
[c] Division of Pediatric Emergency Medicine, Department of Pediatrics, University of Maryland School of Medicine, Baltimore, MD

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ABSTRACT

Background: Guidelines from the American Academy of Neurology recommend laboratory studies or computed tomography (CT) for children who experience a nonfebrile seizure if anything in their history suggests a clinically significant abnormality.
Objective: To ascertain if any patient or seizure characteristics are associated with a greater likelihood that laboratory studies or CT scan will yield clinically significant results.
Methods: This retrospective case series reviewed 93 children with nonfebrile seizure, who were evaluated in an urban pediatric emergency department (ED) between July 2007 and June 2011.
Results: Laboratory studies were performed in 87% of the study group; 7% of those tests gave clinically significant results. Computed tomographic scans were obtained in 35% of our patients; 9% showed clinically significant findings. Presence of an active seizure in the ED or a first nonfebrile seizure had an 8% and 11% difference, respectively, for clinically significant laboratory abnormality. Children younger than 2 years showed a 7% difference of clinically significant laboratory abnormality.
Conclusion: This study did not identify statistically significant predictors of laboratory or CT abnormalities for children with nonfebrile seizure presenting to the ED. Age less than 2 years, having an active seizure in the ED, and experiencing a first-time seizure showed a trend toward an increased yield of laboratory testing. In accordance with the American Academy of Neurology guidelines, we conclude that the history of a child's present illness preceding the nonfebrile seizure, not characteristics of the seizure, should be used to determine the need for further testing.

1. Introduction

Nonfebrile seizures are a common reason children are brought to emergency departments (EDs) [1,2]. Guidelines issued by the American Academy of Neurology (AAN) recommend laboratory studies or brain computed tomography (CT) for children who have experienced a nonfebrile seizure if their history suggests a clinically significant abnormality [2]. This still leaves much ambiguity regarding decisions about when to order laboratory studies and CT imaging. Because of the broad nature of the guidelines, many practitioners obtain laboratory studies and emergent CT scans of the brain on every child with a seizure, even those who are alert, are interactive, and have returned to functional baseline [2]. Laboratory analyses and CT scans are actually of low yield in children who have had a seizure (Table 1) [3–10]. In parallel with this practice, health care providers are being encouraged to reduce the use of brain CT in children to reduce the lifetime risk of malignancy that it poses [11]. We suspect that physicians continue to request further studies because it is not clear what components of the history of present illness should guide their decisions. In the current study, our primary objective was to determine if characteristics of a nonfebrile seizure would be associated with an increased yield of useful information from laboratory or imaging studies and thus help physicians with the diagnostic evaluation for nonfebrile seizure.

2. Methods

We performed a retrospective case series of children with nonfebrile seizure, between July 2007 and June 2011, in the Pediatric Emergency Department at the authors' affiliated medical center. Patients eligible for this study were identified in 3 ways: the chief concern recorded at our ED's triage station, the primary discharge diagnosis of seizure, or electroencephalographic (EEG) diagnosis of seizure. Children younger than 2 months were excluded because they are a neonatal seizure [12–14]. Children with a fever (temperature ≥38°C or ≥100.4°F) were excluded because our study focused on nonfebrile seizure [15,16]. The resulting eligible study group was 93 children. The institutional review board approved this study.

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* Corresponding author at: Emergency Medicine, University of Maryland, 110 South Paca St, 6th Floor, Suite 200, Baltimore, MD 21201.
E-mail address: ashley.strobel@gmail.com (A.M. Strobel).

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Table 1
Comparison of results from previous investigations of children with seizure and our study

Study	n	Mean age	Nonfebrile (NF) vs febrile (F)	Percent Laboratories Drawn	Clinically significant laboratories	Percent CT obtained	Clinically significant CT	Seizure characteristic: recurrent	Seizure characteristic: focal
Current	93	5.4 y	NF	87%	7%	35%	9%	76%	30%
Landau et al [4]	85	7.5 y	NF	84%	<5%	8%	0%	54%	40%
Sharma et al [3][a]	500	5.2 y	NF	NA	NA	91%	8%	NA	28%
Maytal et al [5]	66	4.9 y	NF + F	NA	NA	NA	18%	NA	NA
Akhavan et al [9]	75	NA[b]	NF + F[c]	NA	9.3%	0.1%	0.02%	57%	NA
Scarfone et al [7]	134	5.7 mo	NF + F	50%	7%	NA	NA	48%	NA
Saz et al [6]	55	5.5 y	NF + F[c]	92%	0%	NA	6%	NA	NA

Comparing the results of similar previous studies by Landau et al, Sharma et al, Maytal et al, Akhavan et al, Scarfone et al, and Saz et al, only analyzing nonfebrile seizures. Abbreviation: NA, not available.

[a] Sharma et al only included new-onset nonfebrile seizure in their study.

[b] Akhavan et al included children older than 1 month to 12 years.

[c] Results were not statistically significant between febrile seizure and nonfebrile seizure.

Historical, clinical, and neuroimaging data were abstracted from the medical record. Historical data included the following: medical record number, age, sex, race, whether this was a first or recurrent seizure, whether it was a generalized or focal seizure, whether the patient was having an active seizure upon arrival, whether antiepileptics were given in the ED, and medical history. Clinical data included complete blood count, basic metabolic panel, liver function tests, antiepileptic levels, whether neurology consult was obtained, whether an EEG was obtained, whether the head CT scan was read by an attending radiologist, and the patient's disposition.

The laboratory and CT results were categorized as normal, clinically significant, or not clinically significant. *Clinically significant* means that an outcome had therapeutic consequences, that is, an intervention could treat the abnormality that precipitated the seizure. *Hyponatremia* was defined as a sodium concentration less than 130 mmol/L (the point at which hyponatremic seizures become evident) [17,18]. *Hypocalcemia* was defined as a calcium concentration less than 7.0 mg/dL. Age categories of <2, 2 to 5, and >5 years were chosen to allow for direct comparison with the study by Saz and colleagues [6].

Data were analyzed using descriptive statistics. Confidence intervals for differences in proportions were calculated using a normal binomial approximation.

3. Results

There were 163 medical records reviewed and 93 children with nonfebrile seizure included in our study. The characteristics of the study group are summarized in Table 2. The median age was 4 years. The ED evaluation components are illustrated in Table 3. Seizure characteristics were evaluated as predictors of statistically significant differences in the results of laboratory tests (Table 4) and brain CT scans (Table 5).

Active seizure in the ED and first episode of seizure had an 8% and 11% difference, respectively, between clinically significant and normal laboratory results, suggesting a trend toward significance, but not reaching statistical significance (Table 4). No predictor had a significant yield in relation to obtaining clinically significant results on CT scan (Table 5).

Table 2
Characteristics of study population (N = 93)

Predictors	No. of patients (%)
Age	
2-23 mo	18 (19)
2-5 y	46 (50)
6-19 y	29 (31)
Male	59 (63)
Type of seizure	
First time	22 (24)
Focal	28 (30)
Active in ED	41 (44)
Discharged	24 (26)

4. Discussion

The AAN recommendations base the ordering of laboratory studies or head CT scans on the patient's preceding history and physical examination findings rather than seizure characteristics [2]. More focused diagnostic testing would shorten ED length of stay, increase patient comfort, and decrease radiation exposure [3–11]. Conversely, it must be considered that less testing might cause cases of nonaccidental trauma or inborn errors of metabolism to be missed [19–23]. Based on level B evidence, the standard evaluation for first nonfebrile seizure in an adult includes laboratory studies and a head CT scan. A reasonably beneficial yield can be expected under circumstances with clear indications including, that is, focal neurologic deficit, persistent altered mental status, fever, trauma, persistent headache, history of cancer, use of anticoagulant, or suspicion of acquired immunodeficiency syndrome [24–26]. For pediatric patients, despite the AAN recommendation, emergency physicians have high test rates and low yields for the same diagnostic tests (Table 1) [2–10]. Our results are consistent with previously published studies that examined the yield of routine laboratory studies and CT imaging in children after a nonfebrile seizure (Table 1) [2–10].

Laboratory studies were performed in 87% of our study group; their results were clinically significant in 7%. In the study by Landau et al [4], laboratory studies were performed in 84% of their patients, with significant results in less than 5%. Their study population and exclusion criteria were similar to ours. We also obtained similar results, increasing the validity of our study despite the small sample size and different geographic location. The median age in the 2 groups was 7.5 years in the study by Landau et al and 4 years in ours. Landau et al calculated prevalence ratios of 5.0 for active seizure in the ED and 4.8 for first time seizure, making these predictors more likely to have a clinically significant yield (Table 4).

Head CT imaging was performed in 35% of our patients with a 9% clinically significant yield. Previous studies did not identify predictors that increase the yield of clinically significant findings with brain CT imaging [3–5]. Only Sharma and colleagues [3] specifically looked at nonfebrile, new-onset seizure and tried to identify clinical variables that would differentiate high- and low-risk groups for clinically significant neuroimaging studies. Using recursive partition analysis, they found that a focal seizure occurring before 33 months of age and a predisposing history increased the yield of neuroimaging to 26%. Our use of

Table 3
Tests obtained during ed evaluation

	No. of obtained (%)	No. of positive (%)
Laboratory tests	81 (87)	5 (7)
CT scan	33 (35)	3 (9)
Antiepileptic measurement	33 (35)	14 (42)
EEG	48 (52)	30 (63)
Neurology consults	78 (84)	NA

Abbreviation: NA, not available.