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Febrile Seizure: Measuring Adherence to AAP Guidelines Among Community ED Physicians

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Abstract

Objective—In 1996, the American Academy of Pediatrics published practice parameters for the acute management of febrile seizure. These guidelines emphasize the typically benign nature of the condition and discourage aggressive neurodiagnostic evaluation. The extent to which these suggestions have been adopted by general emergency medicine practitioners is unknown. We sought to describe recent patterns of the emergency department (ED) evaluation of febrile seizures with respect to these parameters.

Methods—A retrospective review of records of children between 6 months and 6 years of age diagnosed with “febrile seizure” (International Classification of Diseases, Ninth Revision, Clinical Modification 780.31) at 42 community hospital general EDs nationwide was performed. Electronic records of an ED physician billing service from October 2002 to September 2003 were used to identify relevant records. Data had been entered into a proprietary template documentation system, and all charts were reviewed by a professional coder blinded to outcomes of interest. Rates of resource utilization (including lumbar puncture, radiography, hospital admission) were noted.

Results—A total of 1029 charts met inclusion criteria. The overall rate of lumbar puncture was 5.2%, and variations were strongly associated with age (8.4% <18 months old vs 3.3% >18 months old). This low rate and age discrimination were consistent with the guidelines of the American Academy of Pediatrics. Although not recommended in the routine evaluation of febrile seizure, computed tomography was part of the evaluation in 11%. The overall rate of admissions or transfers was 12%.

Conclusions—Six years after publication of practice parameters, the use of lumbar puncture in the evaluation of febrile seizure is uncommon and most patients are discharged home. However, the relatively frequent use of head computed tomography is inconsistent with these practice guidelines and merits further investigation.

Keywords

febrile seizure; practice variation; clinical guidelines

Pediatric febrile seizure is a relatively common event, with a prevalence of 2% to 5% in children between 6 months and 6 years of age.^{1,2} The occurrence of a generalized tonic clonic convulsion in an otherwise healthy child generally prompts caregivers to present the patient urgently or emergently to the nearest emergency department (ED). Thus, despite the exclusively pediatric nature of this condition, general community EDs bear the primary burden of assessing and managing these children.³

Febrile seizures have been studied extensively over the past 2 decades, and a large body of literature now exists to help practitioners assess the risks associated with such presentations.⁴ These studies were incorporated into a set of practice guidelines published by the American Academy of Pediatrics (AAP) in 1996, recommending minimal neurodiagnostic evaluations for most patients.⁵ Our previous examination of a cohort of febrile seizure patients from that time seen in community EDs (and children's hospitals) revealed that many children were subjected to fairly aggressive evaluations including lumbar puncture (LP).⁶

In a variety of settings, medical practitioners have been notoriously slow to adopt new approaches to common conditions, even in the face of compelling published evidence.⁷ An additional challenge may be present for emergency medicine physicians when clinical guidelines are developed and appear in the literature of other specialties (eg, pediatrics). With the AAP guidelines in mind, the objective of our study was to describe the current management of children diagnosed with febrile seizure in community EDs. We hypothesized that, 6 years after the publication of these guidelines, the management of pediatric febrile seizure in community EDs would reflect these recommendations.

METHODS

This was a retrospective review of patients assigned a diagnosis of "febrile seizure." A physician billing service database was used to identify cases and track patterns of resource utilization across a large number of community EDs. The billing data were used to identify the incidence of specific diagnostic testing and general patient clinical characteristics. However, no specific patient identifying information was available to investigators, and data regarding resource utilization of specific physician groups remained proprietary information of the billing service and was not analyzed for this study. Under these conditions, analysis of the database was categorized as exempt from institutional review board approval.

Apollo Information Systems, Inc (Fort Myers, Fla) provides physician billing services for all ED physician limited liability partnerships at 42 community hospitals across the United States. The cohort studied consisted exclusively of children older than 6 months and younger than 6 years who were billed for an emergency visit to one of the 42 partner hospitals. Visits to freestanding urgent care centers and primary care offices were not included.

Visits having a diagnosis of febrile seizure (International Classification of Diseases, Ninth Revision, Clinical Modification 780.31) from 1 October 2002 to 30 September 2003 were identified. A single quality management analyst at Apollo Information Systems reviewed the records. The analyst is a certified professional coder with experience reviewing and coding ED charts from the study hospitals. Blinded to the investigators' specific objectives and hypotheses, the analyst was trained for this study using a sample of febrile seizure records, reviewed with a nurse member of the Quality Management Committee.

Demographic information; International Classification of Diseases, Ninth Revision, Clinical Modification codes; and procedure codes for each patient record were manually entered into computers running CLINIX software by professional staff employed by Apollo Information Systems, Inc. Demographic data at some of the hospitals were entered into the system via

direct computer download. All patient records were scanned (Optika) and an image of the chart was stored electronically.

The following descriptive variables were recorded for each visit: patient age, sex, disposition, arrival time, mode of arrival, physician examination time, and discharge time. Using specifically defined criteria, the analyst then reviewed each scanned chart for the study indicators. Specific outcomes included codes for diagnostic testing: blood culture, urine cultures, LP, and head computed tomography (CT). Extracted variables (stripped of any patient or hospital identifiers) were provided to the investigators and viewed as a standard Excel (Microsoft Inc, Redmond, Wash) file. This was then converted to SPSS 11.0 software (SPSS Inc, Chicago, Ill) for further analysis.

Utilization rates for specific diagnostic tests were determined by calculating the percentage of total visits for which a test was documented. Results were further stratified based upon particular clinical characteristics, and univariate analyses were performed. Logistic regression models incorporating these characteristics were used to assess individual management decisions. Selected variables within these models were then examined more closely for statistically significant contributions to the variance in test ordering. For example, age was analyzed within the models for a significant relationship to the incidence of LP.

RESULTS

A total of 1034 records met study criteria. Of these, 5 visits were excluded from review because substantial parts of the chart were missing or because the chart cannot be located within the Optika scanned chart repository. Thus, 1029 charts of a possible 1034 records (99.5%) were considered suitable for analysis.

Patient clinical characteristics are presented in Table 1. Although the sample represents the entire range of ages included in the case definition of febrile seizure, the data were tightly clustered around a median age of about 21 months. Nearly all patients (91%) had a temperature of ≥ 38.0 recorded in the ED. Those who were afebrile at presentation had a presumptive diagnosis of febrile seizure made based on data obtained from the caregiver's history. Very few patients (5%) had a history of a seizure lasting longer than 10 minutes. In fact, the most (75%) seizures were classified as "0 to 4 minutes." Nearly all patients (98%) had an examination for nuchal rigidity noted. Ninety-seven percent of records contained documentation of a global neurological examination. Of these, 83% were categorized as "alert and nonfocal."

Table 2 describes the management decisions associated with these visits. In a logistic regression model describing the decision to admit or transfer patients, age, temperature, and history of previous febrile seizure all failed as significant predictors. The decision to admit or transfer was, however, strongly associated with the reported length of seizure ($P < 0.01$). Of 31 patients described as having had a seizure lasting longer than 10 minutes, 9 (29%) were admitted or transferred. Whereas 60 of 550 patients (11%) with seizures of less than 5 minutes were admitted [odds ratio (OR) 3.3; 95% confidence interval (CI) 1.5, 4.9].

In similar models describing the decision to perform an LP, age ($P < 0.01$) and absence of history of prior febrile seizure ($P = 0.03$) were significant predictors, although temperature was not. In patients 6 to 18 months old, the LP rate was 8.4%, versus 3.3% in patients over 18 months old (OR 2.1; 95% CI 1.2, 3.6). For children with a first-time febrile seizure, the LP rate was 6.9% versus 2.3% for recurrent febrile seizures (OR 3.2; 95% CI 1.5, 7.1). The LP rate was also significantly higher (11% vs 4.1%) in those children with an "abnormal" versus an alert and nonfocal neurological examination recorded (OR 3.0; 95% CI 1.6, 5.7).

In a logistic regression model examining the decision to perform head CT, age was not a significant predictor. However, temperature ($P < .01$) and absence of history of previous seizure ($P = 0.02$) were predictor variables. Of the 89 patients who presented with temperatures $<38.0^{\circ}\text{C}$, 21 (24%) underwent head CT, versus just 9.1% of the patients with fever documented in the ED (OR 3.1; 95% CI 1.7, 5.4). Children who had no prior history of febrile seizure were also more likely to undergo head CT (13% vs 8.4%; OR 1.6; 95% CI 1.1, 2.6). CT rates for children with abnormal versus alert and nonfocal neurological examinations documented were 16% and 10%, respectively (OR 1.8; 95% CI 1.1, 2.9). There was a significant interaction between the decision to perform an LP and a head CT. Of the 53 patients who had an LP performed, 18 (34%) also had a head CT (OR 4.6; 95% CI 2.4, 8.8).

We examined a subset limited to those patients with first-time febrile seizure, temperatures documented in the ED $\geq 38.0^{\circ}\text{C}$; and an alert and nonfocal neurological examination affirmatively recorded ($n = 457$). This allowed for comparisons with the report of a historical cohort of ED visits before the widespread dissemination of the AAP practice parameters.⁶ Comparisons between the historical cohort and this matched cohort from our current data are presented in Table 3. The historical cohort did not differ significantly from the matched cohort on any of the following: mean age, sex, or mean temperature. In this analysis, LP rates and the incidence of admission or transfer declined significantly. Rates of urine and blood cultures remained unchanged. The use of head CT increased.

DISCUSSION

Since 1996, the premise that most febrile seizures carry a benign prognosis has not been challenged. In fact, several additional reports have further supported the AAP Practice Parameters urging a conservative neurodiagnostic approach.^{8–10} At the time the guidelines were published, a cohort, comprised exclusively of well-appearing children with first-time simple febrile seizures, was subjected to an LP 30% of the time—a rate that has been described as distressingly high.¹¹ These children were also admitted or transferred to another facility 14% of the time (a pattern also difficult to justify). Those findings suggested that adherence to the guidelines required a change in common practice (ie, the guidelines were not simply an affirmation of the prevailing standard of care). Interestingly, head CTs were performed relatively infrequently at that time (5.1%).

With respect to the performance of LPs, our current study presents encouraging results regarding adherence to the guidelines. For all patients in the cohort, the LP rate was only 5.2%. Even when patients with recurrent febrile seizures (and children with abnormal neurological examinations) are excluded from the analysis, the rate rises insignificantly to 5.3%. There is also evidence that this low LP rate stems from practitioners closely following the AAP's specific suggestions regarding the relationship between the patient's age and the need for LP (the guidelines do suggest that LP be "considered" for patients <18 months old).⁵ In our earlier cohort, 19% of children older than 18 months underwent LP. In our current study, a mere 3.3% of such patients received an LP.

Although the overall rate of admission or transfer (12%) for our entire study population seems high, the rate in a matched subset of well-appearing first-time febrile seizures (7.6%) represents a significant decline from our previous study (14%). This decline is even more impressive when one considers that roughly a quarter of our earlier cohort had been seen in children's hospitals' EDs, where the admission rate was low (4%), and no transfers were recorded. If children's hospitals are excluded from our previous analysis, 18% of children had been admitted or transferred, suggesting that the current rate of 7.6% actually represents a 58% decline in admissions in the community hospital setting.

These results may imply closer adherence to guidelines, but the decision to admit or transfer a child after a febrile seizure is less algorithmic than other elements of the evaluation. Factors such as parental anxiety, lack of primary care, or extended support and follow-up may all play a role.¹² We are also unable to account for other temporal trends in pediatric ED admissions in general. In addition, it is possible that having performed a head CT more frequently, practitioners felt more confident discharging patients home (although this effect cannot explain the entire difference observed).

The relatively high rate of head CTs (11%) is a bit puzzling. Inasmuch as a CT is of little value in ruling out meningitis, it is unlikely that physicians simply “compensated” for the low LP rate by performing more CTs. Nor does it appear that the use of CT was entirely routine or indiscriminate: children without a fever in the ED or without a previous history of seizure were most likely to undergo CT. However, removing these patients from the analysis still leaves a rate of 9.6%.

One possible explanation is that access to a CT scanner has now become a standard of care for nearly all general EDs. The ubiquity of these scanners may also have reached the public consciousness, causing parents to put additional pressure on ED providers. Although the fixed costs of purchasing and maintaining a scanner are still relatively high, the variable costs associated with performing a single scan are low. Therefore, ED practitioners may have viewed this as a quick, easily obtainable, noninvasive, low-cost, low-risk test. We would caution, however, that the performance of this procedure in children, especially when sedation and/or restraints are used, may introduce a higher risk than that associated with adults.^{13,14}

As implied earlier, it is widely accepted that the occurrence of a febrile seizure adds no independent risk for serious bacterial illness.⁹ However, by definition, all children with febrile seizures have fever. The search for an etiology of the fever should be guided by known risk factors for serious bacterial illness, such as age, sex, height of fever, and general appearance.¹⁵ Therefore, it is not surprising that our current cohort differs little from our previous one in the evaluation of patients for bacteremia and urinary tract infection.

This study has all the limitations inherent in any retrospective cohort design.¹⁶ In addition, the 42 community hospitals whose records were available for review were not randomly selected. They do represent a wide range of geographic and clinical environments throughout the United States. However, all the physician groups represented were contracted with the same billing company. Thus, quality assurance and monitoring procedures integral to this arrangement may limit the generalizability of our results to other groups of ED practitioners.

This limitation is even more relevant to our attempt to make inferences about changes in utilization rates over time. Our referent cohort consisted of patients seen in the Chicago metropolitan area. Although both cohorts were well matched with respect to clinical factors such as age and height of fever, it is conceivable that the differences we noted are not due to temporal trends, but rather geographic variation.¹⁷ However, geographic variation in the management of febrile seizure has never been described, and there is little a priori reason to suppose that it exists. In addition, the previous sample of 7 hospitals included both urban and suburban centers. More importantly, the earlier cohort included 125 visits to tertiary children’s hospitals. The lower utilization rates seen in those hospitals would bias comparisons toward the null.

Obviously, data missing from the reviewed records can cause us to underestimate utilization rates. However, all the participating physician groups used proprietary template-based documentation that has been shown to improve information capture.^{18,19} In addition, our

main outcomes of interest, including admissions, LPs, and head CTs, are fairly significant expenditures and were unlikely to be missed.

A fairly large number of hospitals were included in this study. However, for infrequent management decisions, it is possible that a relatively small number of “outlier” groups skewed our data. If there were a few EDs at which LPs and/or head CTs were routinely performed, this might cause us to overestimate utilization rates. Again, this would bias our comparisons with our previous cohort toward the null. In any case, given what is known about ED practice variation, the nonuniform distribution of various management decisions across physician groups is expected.^{6,20–23} Our fairly large sample of more than 40 EDs helps minimize this effect.

In relative terms, we have implied that the use of head CT is inappropriately high. However, it is still fair to question the clinical importance of this rate. Eighty-nine percent of the patients in our study did *not* undergo head CT. Future study would be useful to determine whether this increase compared with the historical cohort represents a steady trend that can lead to truly harmful rates of radiation exposure and unjustifiable costs. In fact, there is a growing body of evidence suggesting that head CT is also unnecessary for first-time afebrile seizure.²⁴ If this information is incorporated into practice in the same way our data suggest that the literature regarding LPs for febrile seizures has been, we would expect head CT rates for all types of pediatric seizures to soon decline.

Our results provide evidence that the evaluation of children with febrile seizure by ED physicians in community hospital settings is consistent with the minimally invasive approach suggested by the AAP guidelines. In particular, LP rates that had previously been recorded to be higher than 30% were only 5%. Rates of hospitalization were also relatively low. Investigations for bacteremia and urinary tract infections are not addressed by the guidelines, and rates were consistent with previous studies. Although overall usage rates remain low, the use of head CT for these patients seems to have increased. Further study is indicated to determine whether this finding represents a trend that will be sustained in the future.

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TABLE 1**Clinical Characteristics**

n	1029
Age (months)	
Mean	24
Median	21
Interquartile ranges	16, 21, 30
Male (%)	590 (57)
Temperature (°C)	
Mean	39.2
Median	39.4
Interquartile ranges	38.8, 39.4, 39.9
First-time febrile seizure (%)	635 (62)
Duration of seizure <5minutes (%)	772 (75)
“Alert, nonfocal” neurological examination (%)	828 (81)
Absence of nuchal rigidity (%)	1008 (98)

TABLE 2

Evaluation and Management Decisions

n	1029
Lumbar puncture (%)	53 (5.2)
Head computed tomography (%)	116 (11)
Admission or transfer (%)	128 (12)
Blood culture (%)	635 (62)
Urine culture (%)	327 (32)

TABLE 3

Comparison of Matched Cohort to Historical Cohort

	Matched Cohort, n = 457 (n, %)	Historical Cohort, n = 455* (n, %)	P	OR (95% CI)
LP	24 (5.3)	135 (30)	<0.0001	0.13 (0.08, 0.20)
Head CT	44 (9.6)	23 (5.1)	0.012	2.00 (1.19, 3.37)
Admission or transfer	35 (7.6)	64 (14)	0.003	0.51 (0.33, 0.78)
Blood culture	310 (68)	315 (69)	0.70	0.94 (0.71, 1.24)
Urine culture	157 (34)	171 (38)	0.344	0.87 (0.66, 1.14)

* Data from Hampers et al.⁶