Yield of Diagnostic Studies in Children Presenting With Complex Febrile Seizures

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Objective: The objective of this study was to determine the yield of diagnostic workup in children presenting with complex febrile seizures.

Methods: We performed a retrospective review of charts of patients who presented to our pediatric emergency department with complex febrile seizures (focal, prolonged, or recurrent). Patients with known seizure disorder, congenital central nervous system malformations, or hydrocephalus were excluded. The charts were reviewed for diagnostic workup.

Results: There were 71 eligible encounters (mean age, 1.5 years; 59.2% were males). None of the 71 patients had positive blood or urine cultures; none had abnormal blood count or serum chemistries. Only 1 patient who had a very abnormal presentation in febrile status epilepticus had positive cerebrospinal fluid culture and abnormal brain computed tomography scan and magnetic resonance imaging.

Conclusions: Most patients with complex febrile seizures do not require extensive diagnostic workup.

Key Words: complex febrile seizures, lumbar puncture, serum chemistry, complete blood count, CT scan, magnetic resonance imaging

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Febrile seizures are the most common type of seizures in children between the ages of 6 months and 6 years. In the United States, 2% to 5% of children have at least 1 febrile seizure before their fifth birthday, most of which are benign and self-limited. Most febrile seizures are simple. Approximately one third of febrile seizures are complex and are defined as either focal, lasting more than 15 minutes or recurring in 24-hour period. Recent published data have associated complex febrile seizures with viruses and metabolic and genetic causes.

The American Academy of Pediatrics has specific guidelines regarding management of simple febrile seizures. However, complex febrile seizures represent a heterogeneous group of patients, and there are no such practice guidelines for the management of these patients.

The chief objective of our study was to determine the yield of diagnostic studies in the evaluation of children presenting with complex febrile seizures.

METHODS

We performed a retrospective review of the discharge log in our urban tertiary care pediatric emergency department from January 2004 to October 2007 to compile a consecutive series of children with a diagnosis of complex febrile seizures. Cases were identified by using a computer-assisted screening tool applied to pediatric emergency physicians chart notes during the study period. The output from the screening tool was then manually reviewed by the authors (M.D.H. and M.S.). Our emergency department serves approximately 25,000 children per year. For the purpose of our study, we defined complex febrile seizures, as described by Waruiru and Appleton, as seizure associated with fever, that is, temperature greater than or equal to 38°C in a child between 6 months and 6 years of age with 1 or more than 1 of the following features: focal or prolonged duration (ie, seizure lasting >15 minutes) or occurring more than once during 24-hour period. Children were excluded from analysis if they had seizure disorder, hydrocephalus, or congenital central nervous system malformation. Each record was screened for features of complex febrile seizures. Additional data were extracted regarding age, sex, findings on physical examination, laboratory and imaging studies, and disposition.

As per the emergency department protocol, temperatures were obtained via rectal route in patients younger than 24 months and via oral, axillary, or rectal route in children older than 24 months. When urine specimens were obtained, they were procured by straight catheterization in children unable to void spontaneously. In children who were able to void spontaneously a clean midstream urine specimen was obtained. For urine culture, 0.001-mL aliquot of urine was plated on 5% sheep’s blood agar and MacConkey agar. A positive urine culture was defined as growth of a single organism greater than 100,000 colony-forming units per millimeter of urine. When obtained, 1 to 3 mL of blood for culture was processed with Bactec aerobic standard 10 culture vial (BD, Franklin Lakes, NJ). When obtained, cerebrospinal fluid (CSF) was plated on 5% sheep’s blood agar and MacConkey and chocolate agar. The study was approved by the institutional review board of the hospital.

RESULTS

There were 83 documented patient encounters for complex febrile seizures during the study period. Twelve were excluded from the study: 8 were simple febrile seizures, and 4 were known cases of seizure disorder, leaving 71 eligible patient encounters. Of the 71 patients with complex febrile seizures, 2 patients had focal febrile seizures, 1 had prolonged febrile seizure lasting more than 15 minutes, and the remaining 68 patients had more than 1 seizure in a 24-hour period. Boys accounted for 59.2% cases, and median age of patients was 1.5 years with SD of 1.13 (Fig. 1).

All patients, except one with status febrile seizures, had normal neurologic examination. Complete blood count was performed on all 71 patients (100%). The mean peripheral white count was 11,000/µL. All 71 patients (100%) had serum chemistries; none had abnormal electrolytes. All 71 patients (100%) had blood cultures and urine cultures performed; none were positive. Sixty-seven patients (93%) had lumbar puncture for CSF analysis. One patient (1/67) had abnormal findings for high protein and culture positive for Mycoplasma pneumoniae.
reviewed history and performs a thorough physical examination evaluating a patient with complex febrile seizures, the physician meters of simple febrile seizures, there are scant data or guide-

M. pneumoniae of meningoencephalitis (patient with positive CSF culture for M. pneumoniae). Of the 71 patients, 14 had magnetic resonance imaging of the brain, and one was positive for evidence of meningoencephalitis (patient with positive CSF culture for M. pneumoniae).

**DISCUSSION**

Although there are sufficient data regarding practice parameters of simple febrile seizures, there are scant data or guidelines regarding management of complex febrile seizures. When evaluating a patient with complex febrile seizures, the physician reviews history and performs a thorough physical examination and then determines the need for diagnostic studies. Previous studies have evaluated need for either neuroimaging or lumbar puncture in children with complex febrile seizures. Our study, to our knowledge, not only is the first to evaluate the utility of imaging or CSF analysis in patients with complex febrile seizures but also explores the yield of other diagnostic tests such as complete blood count, blood culture, urinalysis, and chemistries. Most of our patients (68/71) with complex febrile seizures had 2 or more seizures in 24 hours, with a normal neurologic examination in between the seizure episodes. Routine blood work such as complete blood count, chemistries, urinalysis, blood and urine cultures, lumbar puncture, or neuroimaging did not reveal any abnormalities in such patients. Although we did not have many patients (only 2/71) with focal seizures, neither of these patients had abnormal neuroimaging or abnormal laboratory tests. Only 1 patient (1/71) presented with febrile status epilepticus and had CSF culture positive for M. pneumoniae and also had positive findings on neuroimaging.

**Yield of Neuroimaging in Patients With Complex Febrile Seizures**

Teng et al performed a retrospective study to determine risk of intracranial pathologic conditions needing emergent management in patients with complex febrile seizures. The study included 71 patients with complex febrile seizures, of which 38 patients underwent either CT scan of the head/magnetic resonance imaging of the brain, and none had an emergent pathologic intracranial lesion. Garvey et al performed a retrospective review of children presenting to the emergency department with new-onset seizures who had emergent neuroimaging. Of the 99 patients, 17 had complex febrile seizures; 3 of the 17 had abnormalities on CT scan. However, none needed emergent management. Al-Qudah studied the utility of neuroimaging in patients with complex febrile seizures; none of the 13 patients had abnormal findings. Yucel et al did a retrospective study of neuroimaging results for 45 children with complex febrile seizures. Of the 45 patients, 7 patients had CT scan abnormalities; however, none needed emergent management.

Our study results are also consistent with those of previous studies and suggest that most patients with complex febrile seizures do not require emergent neuroimaging.

**Yield of Lumbar Puncture in Patients With Complex Febrile Seizures**

Is there an increased risk of bacterial meningitis in patients with complex febrile seizures? Teach and Geil performed a retrospective case-control study of patients presenting with febrile seizures. Of the 243 eligible patient encounters, 29 (11.9%) were complex febrile seizures. Lumbar puncture was performed on all patients, and none had a positive CSF. Seltz et al studied the risk of meningitis/encephalitis in children with complex febrile seizures. Of the 366 patients, lumbar puncture was performed on 146 patients. Six of the 146 patients had positive CSF culture, and bacterial meningitis was diagnosed. However, 5 of these 6 patients were transfers from an outside facility. Of the patients who initially presented to their emergency department, the rate of meningitis was 0.3%. They concluded that lumbar puncture is unnecessary in patients with complex febrile seizures. Kimia et al performed a retrospective study of patients 6 months to 5 years of age with complex febrile seizures. Of the 526 patients, lumbar puncture was performed on 340 patients. Three of 340 had positive CSF culture for meningitis, 2 of which had very abnormal neurologic examinations. They concluded that few patients with complex febrile seizures had bacterial meningitis in the absence of other signs and symptoms.

Our study is also consistent with previous studies that found most patients with complex febrile seizures do not require CSF analysis.

One study that looked at the incidence of bacteremia, urinary tract infection, and meningitis in patients with febrile seizures, simple and complex, was that performed by Teach and Geil. They studied all children with febrile seizures, complex and simple. Of the 243 patients, 29 were complex febrile seizures. Blood cultures were done on 206 of 243 patients, and 6 were positive, but this was before introduction of Prevnar vaccine. Urine culture was performed on 130 of 243 patients, and 1 of 130 yielded a bacterial pathogen. Cerebrospinal fluid analysis and culture were done on 66 of 243 patients, and none were positive. They concluded that children with febrile seizures are not at an increased risk of bacteremia, urinary tract infection, or bacterial meningitis.

Our study, which evaluated patients with complex febrile seizures, also had similar results, and most patients do not have serious bacteremia or urinary tract infection. In addition, our study concluded that most patients have normal chemistries.

In our study, only 1 patient with febrile status epilepticus had meningitis and abnormalities on neuroimaging. This finding is similar to that of Chin et al, who reported meningitis in 17% of children with febrile status epilepticus, and Ofringa et al, who reported increased incidence of meningitis in patients with longer seizure duration.

Our study has several limitations, one it being a retrospective study; we depend on the accuracy and availability of medical records. There could have been more cases of complex febrile seizures that may have been missed because of differences in charting and International Classification of Diseases coding. And also we had a small sample of patients. In future studies, more number of patients are needed to ensure that the results are not due to a small number of patients.
CONCLUSIONS

Most patients with complex febrile seizures do not need routine workup or neuroimaging. Only patients with febrile status epilepticus have increased risk of bacterial meningitis/encephalitis.

REFERENCES