

Practice Parameter: The Neurodiagnostic Evaluation of the Child With a First Simple Febrile Seizure

Provisional Committee on Quality Improvement, Subcommittee on Febrile Seizures

ABSTRACT. The American Academy of Pediatrics and its Provisional Committee on Quality Improvement, in collaboration with experts from the Section on Neurology, general pediatricians, consultants in the fields of neurology and epilepsy, and research methodologists, developed this practice parameter. This parameter provides recommendations for the neurodiagnostic evaluation of a child with a first simple febrile seizure. These recommendations derive from both a thorough review of the literature and expert consensus. Interventions of direct interest include lumbar puncture, electroencephalography, blood studies, and neuroimaging. The methods and results of the literature review and data analyses can be found in the technical report that is available from the Publications Department of the American Academy of Pediatrics. This parameter is designed to assist pediatricians by providing an analytic framework for the evaluation and treatment of this condition. It is not intended to replace clinical judgment or establish a protocol for all patients with this condition. It rarely will be the only appropriate approach to the problem.

DEFINITION OF THE PROBLEM

This practice parameter provides recommendations for the neurodiagnostic evaluation of neurologically healthy infants and children between 6 months and 5 years of age who have had their first simple febrile seizures and present within 12 hours of the event. This practice parameter is not intended for patients who have had complex febrile seizures (prolonged, focal, and/or recurrent), nor does it pertain to those children with previous neurologic insults, known central nervous system abnormalities, or histories of afebrile seizures.

TARGET AUDIENCE AND PRACTICE SETTING

This practice parameter is intended for use by pediatricians, family physicians, child neurologists, neurologists, emergency physicians, and other providers who treat children for febrile seizures.

INTERVENTIONS OF DIRECT INTEREST

1. Lumbar puncture;
2. Electroencephalography (EEG);
3. Blood studies—serum electrolytes, calcium, phosphorus, magnesium, and blood glucose, and a complete blood count (CBC); and

4. Neuroimaging—skull radiographs, computed tomography (CT), and magnetic resonance imaging.

BACKGROUND

A febrile seizure is broadly defined as a seizure accompanied by fever without central nervous system infection, occurring in infants and children between 6 months and 5 years of age. Febrile seizures occur in 2% to 5% of all children and, as such, make up the most common convulsive event in children younger than 5 years of age. In 1976, Nelson and Ellenberg,¹ using data from the National Collaborative Perinatal Project, further defined febrile seizures as being either simple or complex. Simple febrile seizures were defined as primary generalized seizures lasting less than 15 minutes and not recurring within 24 hours. Complex febrile seizures were defined as focal, prolonged (>15 minutes), and/or occurring in a flurry. Those children who had simple febrile seizures had no evidence of increased mortality, hemiplegia, or mental retardation. During follow-up evaluation, the risk of epilepsy after a simple febrile seizure was shown to be only slightly higher than that of the general population, whereas the chief risk associated with simple febrile seizures was recurrence in one third of the children. The report concluded that simple febrile seizures are benign events with excellent prognoses, a conclusion reaffirmed in the 1980 National Institutes of Health Consensus Statement.²

Despite progress in understanding febrile seizures and the development of consensus statements about their diagnostic evaluation and management, a review of practice patterns of pediatricians indicates that a wide variation persists in physician interpretation, evaluation, and treatment of children with febrile seizures.³

This parameter is not intended for the evaluation of patients who have had complex febrile seizures, previous neurologic insults, or known brain abnormalities. The parameter also does not address treatment.

The expected outcomes of this practice parameter include the following.

1. Optimizing practitioner understanding of the scientific basis for the neurodiagnostic evaluation of children with simple febrile seizures;
2. Using a structured framework to aid the practitioner in decision making;
3. Optimizing evaluation of the child who has had a simple febrile seizure by ensuring that underlying

The recommendations in this statement do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

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diseases such as meningitis are detected, minimizing morbidity, and enabling the practitioner to reassure the anxious parents and child; and

4. Reducing costs of physician and emergency department visits, hospitalizations, and unnecessary testing.

METHODOLOGY

Two hundred three medical journal articles addressing the diagnosis and evaluation of febrile seizures were identified. Each article was subjected to formal, semistructured review by committee members. These completed reviews, as well as the original articles, were then reexamined by epidemiologic consultants to identify those population-based studies limited to children with simple febrile seizures that examined the usefulness of specific diagnostic studies. Given the scarcity of such studies, data from hospital-based studies and comparable groups were also reviewed. Tables were constructed using data from 28 articles. A second literature search failed to disclose pertinent articles containing data on brain imaging in children with febrile seizures.

A summary of the technical report describing the analyses used to prepare this parameter begins on page 773.

RECOMMENDATIONS

Lumbar Puncture

Recommendation. The American Academy of Pediatrics (AAP) recommends, on the basis of the published evidence and consensus, that after the first seizures with fever in infants younger than 12 months, performance of a lumbar puncture be strongly considered, because the clinical signs and symptoms associated with meningitis may be minimal or absent in this age group. In a child between 12 and 18 months of age, a lumbar puncture should be considered, because clinical signs and symptoms of meningitis may be subtle. In a child older than 18 months, although a lumbar puncture is not routinely warranted, it is recommended in the presence of meningeal signs and symptoms (ie, neck stiffness and Kernig and Brudzinski signs), which are usually present with meningitis, or for any child whose history or examination result suggests the presence of intracranial infection. In infants and children who have had febrile seizures and have received prior antibiotic treatment, clinicians should be aware that treatment can mask the signs and symptoms of meningitis. As such, a lumbar puncture should be strongly considered.

The clinical evaluation of young febrile children requires skills that vary among examiners. Moreover, published data do not address the quantification of such skills adequately. Because this practice parameter is for practitioners with a wide range of training and experience, the committee chose a conservative approach with an emphasis on the value of lumbar puncture in diagnosing meningitis.

The committee recognizes the diversity of opinion regarding the need for routine lumbar puncture in children younger than 18 to 24 months with first

febrile seizures. In approximately 13% to 16% of children with meningitis, seizures are the presenting sign of disease, and in approximately 30% to 35% of these children (primarily children younger than 18 months), meningeal signs and symptoms may be lacking.^{4,5} On the basis of published evidence, cerebrospinal fluid is more likely to be abnormal in children initially seen with fevers and seizures who have had: (1) suspicious findings on physical and/or neurologic examinations (particularly meningeal signs); (2) complex febrile seizures; (3) physician visits within 48 hours before the seizures; (4) seizures on arrival to emergency departments; (5) prolonged postictal states (typically most children with simple febrile seizures recover quickly); and (6) initial seizures after 3 years of age.^{6,7} An increased risk of failure to diagnose meningitis occurs in children: (1) younger than 18 months who may show no signs and symptoms of meningitis; (2) who are evaluated by a less-experienced health care provider; or (3) who may be unavailable for follow-up.⁵⁻⁸ A recognized source of fever, eg, otitis media, does not exclude the presence of meningitis. All recommendations, including those for lumbar puncture, are also given in the Algorithm.

EEG

Recommendation. The AAP recommends, based on the published evidence and consensus, that EEG not be performed in the evaluation of a neurologically healthy child with a first simple febrile seizure.

No published study demonstrates that EEG performed either at the time of presentation after a simple febrile seizure or within the following month will predict the occurrence of future afebrile seizures. Although the incidence of abnormal EEGs increases over time after a simple febrile seizure, no evidence exists that abnormal EEGs after the first febrile seizure are predictive for either the risk of recurrence of febrile seizures or the development of epilepsy. Even studies that have included children with complex febrile seizures and/or those with preexisting neurologic disease (a group at higher risk of having epilepsy develop) have not shown EEG to be predictive of the development of epilepsy.⁹⁻¹⁰

Blood Studies

Recommendation. On the basis of published evidence,^{7,8,11} the AAP recommends that the following determinations not be performed routinely in the evaluation of a child with a first simple febrile seizure: serum electrolytes, calcium, phosphorus, magnesium, CBC, or blood glucose.

There is no evidence to suggest that routine blood studies are of benefit in the evaluation of the child with a first febrile seizure. Although some children initially seen with febrile seizures are dehydrated and have abnormal serum electrolyte values, their conditions should be identifiable by obtaining appropriate histories and performing careful physical examinations. A blood glucose determination, although not routinely needed, should be obtained if the child has a prolonged period of postictal obtundation. CBCs may be useful in

the evaluation of fever, particularly in young children, because the incidence of bacteremia in children younger than 2 years of age with or without febrile seizures is the same.¹²

When fever is present, the decision regarding the need for laboratory testing should be directed toward identifying the source of the fever rather than as part of the routine evaluation of the seizure itself.

Neuroimaging

Recommendation. On the basis of the available evidence and consensus, the AAP recommends that neuroimaging not be performed in the routine evaluation of the child with a first simple febrile seizure.

The literature does not support the use of skull films in the evaluation of the child with a first febrile seizure.^{7,13} Although no data have been published that either support or negate the need for CT or magnetic resonance imaging in the evaluation of children with simple febrile seizures, extrapolation of data from the literature on the use of CT in children who have generalized epilepsy has shown that clinically important intracranial structural abnormalities in this patient population are uncommon.^{14,15}

CONCLUSION

Physicians evaluating infants or young children after first simple febrile seizures should direct their evaluations toward the diagnosis of the causes of the children's fevers. A lumbar puncture should be strongly considered in a child younger than 12 months and should be considered in children between 12 and 18 months of age. In children older than 18 months, the decision to do a lumbar puncture rests on the clinical suspicion of meningitis. The seizure usually does not require further evaluation—specifically EEG, blood studies, or neuroimaging.

The practice parameter, "The Neurodiagnostic Evaluation of the Child With a First Simple Febrile Seizure," was reviewed by the appropriate committees and sections of the AAP, including the Chapter Review Group, a focus group of office-based pediatricians representing each AAP district: Gene R. Adams, MD; Robert M. Corwin, MD; Lawrence C. Pakula, MD; Barbara M. Harley, MD; Howard B. Weinblatt, MD; Thomas J. Herr, MD; Kenneth E. Matthews, MD; Diane Fuquay, MD; Robert D. Mines, MD; and Delosa A Young, MD. Comments were also solicited from relevant outside organizations. The clinical algorithm was developed by Michael Kohrman, MD, Buffalo Children's Hospital, and James R. Cooley, MD, Harvard Community Health Plan.

The supporting data analyses are contained in the summary of the technical report, which begins on page 773.

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REFERENCES

1. Nelson KB, Ellenberg JH. Predictors of epilepsy in children who have experienced febrile seizures. *N Engl J Med.* 1976;295:1029-1033
2. Consensus statement. Febrile seizures: long-term management of children with fever-associated seizures. *Pediatrics.* 1980;66:1009-1012
3. Hirtz DG, Lee YJ, Ellenberg JH, Nelson KB. Survey on the management of febrile seizures. *Am J Dis Child.* 1986;140:909-914
4. Ratcliffe JC, Wolf SM. Febrile convulsions caused by meningitis in young children. *Ann Neurol.* 1977;1:285-286
5. Rutter N, Smales OR. Role of routine investigations in children presenting with their first febrile convulsion. *Arch Dis Child.* 1977; 52:188-191
6. Joffe A, McCormick M, DeAngelis C. Which children with febrile seizures need lumbar puncture? A decision analysis approach. *Am J Dis Child.* 1983;137:1153-1156
7. Jaffe M, Bar-Joseph G, Tirosh E. Fever and convulsions—indications for laboratory investigations. *Pediatrics.* 1981;57:729-731
8. Gerber MA, Berliner BC. The child with a "simple" febrile seizure: appropriate diagnostic evaluation. *Am J Dis Child.* 1981;135:431-433
9. Frantzen E, Lennox-Butchthal M, Nygaard A. Longitudinal EEG and clinical study of children with febrile convulsions. *Electroencephalogr Clin Neurophysiol.* 1968;24:197-212
10. Thorn I. The significance of electroencephalography in febrile convulsions. In: Akimoto H, Kazamatsuri H, Seino M, Ward A, eds. *Advances in Epileptology: XIIIth Epilepsy International Symposium.* New York, NY: Raven Press; 1982:93-95
11. Heijbel J, Blom S, Bergfors PG. Simple febrile convulsions: a prospective incidence study and an evaluation of investigations initially needed. *Neuropaediatr.* 1980;11:45-56
12. Chamberlain JM, Gorman RL. Occult bacteremia in children with simple febrile seizures. *Am J Dis Child.* 1988;142:1073-1076
13. Nealis GT, McFadden SW, Asnes RA, Ouellette EM. Routine skull roentgenograms in the management of simple febrile seizures. *J Pediatr.* 1977;90:595-596
14. Yang PJ, Berger PE, Cohen ME, Duffner PK. Computed tomography and childhood seizure disorders. *Neurology.* 1979;29:1084-1088
15. Bachman DS, Hodges FJ, Freeman JM. Computerized axial tomography in chronic seizure disorders of childhood. *Pediatrics.* 1976;58: 828-832

ALGORITHM

The Neurodiagnostic Evaluation of the Child With a First Simple Febrile Seizure

