REVIEW ARTICLE

Febrile Seizures: Clinical Manifestations and Management

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KEYWORDS

Febrile seizure

Febrile status epilepticus

Seizure

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ABSTRACT

Febrile seizures are a common age-dependent phenomenon that affects up to 5% of children in the United States, typically between 6 months and 5 years of age. These seizures are triggered by a rapid increase in body temperature, most often due to an underlying viral illness. Febrile seizures typically occur shortly after the onset of fever and can present clinically as either generalized tonic-clonic or focal activity, depending on the classification. While febrile seizures often cause significant parental concern, most children recover fully without any long-term neurologic or developmental effects. The majority of febrile seizures are self-limiting and do not require immediate medical intervention or long-term pharmacologic prophylaxis. Risk of developing an initial or recurrent febrile seizure is influenced by several factors, including family history, child's age at the time of the first seizure, and presence of certain underlying medical conditions that may predispose the child to seizures. In this article, we will explore the underlying pathophysiology of febrile seizures, their clinical manifestations, and potential long-term consequences, as well as review current approaches for evaluating and managing affected children.

METHODOLOGY

A literature search was conducted using keywords related to febrile seizures in databases including PubMed and Google Scholar. Searches were limited to articles published in English within the last 20 years. Inclusion criteria were peer-reviewed journal articles and high-quality clinical reference sources (e.g., StatPearls) addressing febrile seizures in pediatric patients. Exclusion criteria were non-English articles, nonscholarly websites, and case reports. A total of 34 articles meeting inclusion criteria were reviewed. Findings were synthesized to highlight trends in epidemiology, risk factors, clinical manifestations, and management of febrile seizures.

INTRODUCTION

Febrile seizures are a common, age-related phenomenon, affecting up to 5% of children throughout the United States.[1] These seizures typically occur in the setting of an underlying illness, most commonly a viral infection that triggers a fever. Rapid rise in body temperature causes an excited state within the cerebral cortex, ultimately leading to a seizure.[2] Febrile seizures primarily affect young children, especially those between the ages of 6 months and 5 years. Febrile seizures may raise concerns about potential future neurologic issues, though the vast majority of children recover fully without lasting effects.[1] This article will provide a comprehensive overview of febrile seizures, covering their epidemiology, pathophysiology, clinical features, management strategies, and potential long-term effects on neurologic development, aiming to enhance understanding of this common yet often alarming condition.

Definition

A febrile seizure is an episode of convulsions triggered by a fever, typically characterized by a body temperature above 100.4°F (38°C).[3] The elevated body temperature alters electrical activity within the cerebral cortex, leading to an excited state that results in a seizure. Involvement of the entire cerebral cortex results in a generalized seizure, whereas a focal seizure results from unilateral cortical involvement, leading to focal neurologic activity during the seizure.[4] Cerebral cortex involvement contributes to the varying clinical manifestations of febrile seizures, which are further explained in the "Classification" section below.

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Any underlying pathogen that causes fever can trigger febrile seizures, though they are most commonly linked to viral infections. However, even if the causative virus is identified in an ill child, it is not possible to predict the risk of a febrile seizure based solely on the viral species.[5] These seizures usually occur within the first few hours of illness, typically with a fever above 102°F (39°C). However, they can occur with lower fevers, potentially even before the child exhibits symptoms.[2] In general, likelihood of febrile seizures increases as temperature increases.[6] Of note, seizures that occur in the presence of an underlying central nervous system (CNS) infection, and seizures in children with history of prior afebrile seizures, are not included in this definition.[7]

Epidemiology

Febrile seizures are the most common neurologic condition seen in children, affecting about 5% of children in the United States and Western Europe. They typically occur between 6 months and 5 years of age, with peak incidence between 12 and 16 months, though rare cases have been documented as young as 3 months and as old as 7 years.[7] Febrile seizures tend to follow a seasonal pattern, with higher rates in winter, likely due to increased prevalence of viral illnesses.[8] There is accruing research on the relationship between temperature extremes and febrile seizures, which may also contribute to the increase in incidence in winter months.[9]

Data also suggest higher risk of febrile seizures in children of lower socioeconomic backgrounds. One study reported a prevalence of 5.6% in lower-income homes, versus 3.3% in higher-income homes (P=0.001).[10] Contributing factors may include parental health literacy, access to care, and insurance status.[6] There is a lack of research addressing the relationship between febrile seizures and healthcare disparities, highlighting the need for further study.

Risk Factors

Risk factors for febrile seizures include family history of febrile seizures (odds ratio [OR] 4.5, 95% confidence interval [CI] 2.09-9.83), viral illnesses (OR 3.5, 95% CI 2.2-5.6), high fevers (OR 1.8, 95% CI 1.3-2.5), and developmental delay (OR 4.9, 95% CI 1.55-15.5).[7] While there is no established pattern of inheritance, it has been found that having one sibling or one parent with history of febrile seizure puts a child at 20% or 33% increased risk of having a febrile seizure, respectively.[11] There are many proposed genes that are thought to play a role in increasing febrile seizure risk, although the exact translocation and method are unknown.[6] The SCN1A gene is widely regarded as the most common gene to be involved in epilepsy, with a variable range of severity.[12] Further research is needed on gene-environment interactions.

Several viral illnesses are associated with febrile seizures, including influenza, parainfluenza, enterovirus, adenovirus, respiratory syncytial virus, human herpesvirus 6 (HHV-6), and human metapneumovirus.[13] The seasonal peak in fall and winter supports this link.[8] Additionally, it is rather common for children to develop a fever after routine immunizations, such as measles-mumps-rubella (MMR) and 13-valent pneumococcal conjugate vaccine (PCV13). Fevers following vaccination increase risk for febrile seizure in genetically predisposed children. However, vaccination lowers overall risk by preventing viral infections that can trigger seizures.[7] Expert recommendations encourage maintaining the standard vaccination schedule and discussing concerns with the physician.

Classification

Currently, there are three acknowledged classifications for febrile seizures as depicted in Table 1: simple, complex, and febrile status epilepticus. Both simple and complex febrile seizures are time-limited events. A simple febrile seizure is generalized, lasting less than 15 minutes, and does not recur within 24 hours. After a simple febrile seizure, there is typically a brief postictal period, followed by a gradual return to baseline mental status without development of neurologic deficits. Complex febrile seizures may have generalized or focal onset, last between 15 and 30 minutes, can recur within 24 hours, and are often associated with lingering neurologic symptoms in the postictal period.[11] Alternatively, if a patient's seizure lasts longer than 30 minutes or if multiple seizures occur without regaining consciousness between episodes, the patient is considered to have febrile status epilepticus. This occurs when the body's inhibitory mechanisms fail to stop seizure activity; this is considered a life-threatening emergency.[13]

TABLE 1: Classification of febrile seizures.

SIMPLE	COMPLEX	STATUS EPILEPTICUS
15-minute duration and Only 1 seizure within 24 hours	> 15-minute duration or Multiple seizures within 24 hours	>30-minute duration or Multiple seizures without regaining consciousness between seizures
Generalized Onset	Generalize or Focal Onset	

Acute Management

Most febrile seizures resolve before the patient reaches a medical facility. Early intervention or termination of simple febrile seizures is not required. However, prolonged seizure activity, such as febrile status epilepticus, rarely resolves on its own, highlighting the need for early intervention and medical management.[7] Early recognition and intervention of status epilepticus are shown to lower associated consequences such as acute need for intubation to longer-term sequelae including neurologic injury.[14] Benzodiazepines remain the first-line treatment for seizure termination, with the choice of agent depending on medication availability and available route for administration. Lorazepam is preferred over diazepam when intravenous (IV) access is available. If vascular

access is not established, intranasal (IN) administration of diazepam or midazolam is appropriate, or alternatively, midazolam can be administered via intramuscular (IM) injection.[15] Dosing is generally weight-based and varies depending on the agent and route of administration. Although these medications are known to be effective in children experiencing seizures of other etiologies, their efficacy in treating febrile seizures specifically is still not fully understood.[16] After the initial dose of benzodiazepine, the patient should continue to be monitored and the physician should be prepared to administer a second dose at the same dosage, if the seizure continues for another 5 minutes. If two doses of benzodiazepines are administered and the seizure persists, a second-line anticonvulsant should be given, as additional benzodiazepine doses increase risk of respiratory depression.[17] Second-line antiepileptic agents, including but not limited to fosphenytoin, phenytoin, levetiracetam, or phenobarbital, should be chosen based on medication availability and vascular access.[18] When managing seizure activity, it is essential to maintain a patent airway and continuously monitor the patient's hemodynamic status. For patients with medication-refractory status epilepticus, intubation is necessary for airway protection and ventilatory support. Choice of induction agents depends on medication availability and provider preference. While propofol and benzodiazepines are commonly used for their known antiepileptic properties, a recent small study in adults found that choice of induction agents had no impact on seizure incidence, duration of mechanical ventilation, or time to regain consciousness.[19] While stabilizing the patient, the appropriate clinical evaluation should be completed, which is outlined below.

Clinical Evaluation

Initial assessment

The majority of children experiencing a febrile seizure will no longer be seizing by the time of evaluation and typically do not require urgent intervention. However, if febrile status epilepticus is suspected, immediate intervention is critical, as it is unlikely to resolve spontaneously and poses a risk for neurologic injury.[7] For guidance on the medical termination and acute stabilization of febrile seizures, refer to the "Acute Management" section. Evaluation of a febrile seizure begins with a thorough history and physical examination. Key aspects of the history include previous seizure episodes, family history of febrile or afebrile seizures, recent illnesses, immunizations, medications, and relevant medical or birth history. It is also essential to obtain detailed information about the seizure event itself, such as duration, clinical features, and the child's level of activity before and after the seizure. Certain red flags, outlined in Table 2, are linked to increased risk of seizure recurrence.[20] Complete physical examination should be performed with focus on the child's mental status, ensuring no focal neurologic deficits, and assessing for signs of meningitis, such as increased irritability, nuchal rigidity and bulging of the anterior fontanelle.[21]

Additionally, the exam should look for signs of external trauma, possible tongue injuries, and incontinence. Nonfebrile causes of seizures should be considered, such as hypoglycemia or hyponatremia, and clinicians should be alert for signs of underlying epilepsy, including infantile spasms. Syncopal episodes, sleep disorders, and psychological conditions can mimic seizure-like episodes but are not true convulsions. A brief example of the differential diagnosis to consider with a suspected febrile seizure is provided in Table 3.

TABLE 2: Red flags indicating increased risk for febrile seizure recurrence.

Red Flags
Family history of febrile seizures
Seizure with low-grade fever
Age under 18 months
Seizure occurring within 1 hour of fever onset
Underlying neurologic disorder

TABLE 3: Abbreviated differential diagnosis to consider with a suspected febrile seizure.

Neonates – Infants:

- Benign Sleep Myoclonus
- Benign Resolved Unexplained Event (BRUE)

All Ages:

- Hypoglycemia
- Trauma
- Infection
- Syncope
- Toxic Ingestion
- Epilepsy
- Panic Disorder
- Psychogenic Nonepileptic Seizure (PNES)

Laboratory investigations

When a child presents with a suspected seizure, it is crucial to assess their blood glucose level to rule out a hypoglycemia-induced seizure. However, in most cases, further laboratory testing is not necessary after a suspected febrile seizure. Febrile seizures have not been linked to electrolyte or biochemical abnormalities.[22] Additionally, white blood cell counts, and other inflammatory markers are often elevated following a seizure, which limits their usefulness in evaluating a potential infectious cause.[23] The workup should be tailored to the individual patient, based on their specific signs, symptoms, and any possible comorbidities.

Neuroimaging

Use of neurologic imaging is variable, but it is generally not recommended after a simple febrile seizure, provided the child returns to baseline without any concerning factors.[22] Similarly, neuroimaging is typically not needed following a

complex febrile seizure, as it has not been shown to offer additional benefits.[24] Neuroimaging may be considered in certain situations, such as in development of focal neurologic deficits, presence of an underlying neurologic disorder, suspicion of afebrile triggers, or concerns about alternative diagnoses. This again highlights the importance of tailoring clinical management to an individual patient's presentation.

Electroencephalography

Electroencephalography (EEG) is not typically recommended in acute workup of a febrile seizure.[24] EEG may be used to assess risk of future afebrile seizures if a child develops focal neurologic changes, experiences recurrent febrile seizures, has a family history of seizures, or has underlying neurologic disorders.[25] EEG does not play a role in determining overall patient disposition.[26]

Lumbar puncture

Bacterial meningitis manifests clinically as seizure in 25% of cases, suggesting that lumbar puncture may be indicated following febrile seizure.[27] However, lumbar puncture is generally not recommended after a simple febrile seizure.[19] The need for a lumbar puncture following a complex febrile seizure may vary depending on the provider, and there are no established guidelines on this.[28] Lumbar puncture is recommended following febrile status epilepticus.[6,24] Additionally, children showing signs of meningitis should receive a lumbar puncture after a febrile seizure, regardless of seizure severity.[17]

Disposition

The disposition of a child following a febrile seizure largely depends on the nature of the seizure, the child's clinical condition, and any underlying concerns identified during evaluation. While a majority of febrile seizures are benign and self-limiting, allowing for safe discharge home, there are instances where admission and further inpatient management are necessary.[6] There is no minimum recommended observation period following a simple febrile seizure, nor is identifying a specific infectious cause required before discharge.[29] It should be ensured that the child has returned to their baseline mental status, they can tolerate oral intake, and that the family is comfortable with discharge. It is important for physicians to counsel the child's parents, address their questions, and discuss the child's long-term prognosis following the febrile seizure. Admission for further workup is warranted if the child does not return to baseline, has developed focal neurologic deficits, is undergoing meningitis workup, has comorbid neurologic pathology, or in those who experienced febrile status epilepticus.[19,17]

Prognosis

Parents often worry about long-term effects of febrile seizures. Research focuses on risk of recurrence, epilepsy risk, and neurologic outcomes. Children who experience one febrile seizure are more likely to have another.[17] Risk factors for recurrence can be referenced in Table 2. Risk of developing epilepsy rises by only 1%-2% after a simple febrile seizure, which is higher than the general population but not clinically significant. Complex febrile seizures carry a greater risk.[16,30] Importantly, simple febrile seizures are not associated with negative behavioral or academic effects. Prognosis for febrile seizures is highly favorable, despite how scary the event may be for caregivers and parents. Education on how to identify a febrile seizure, symptom management, and prognosis is essential.[30] From an osteopathic perspective, further research on the emotional and economic impact of febrile seizures would provide valuable insight to help clinicians better address the psychosocial effects on families.

Prevention

Medications with antipyretic properties, like acetaminophen and ibuprofen, are effective for reducing fever and improving symptoms, but they do not help in preventing initial or recurrent febrile seizures.[16] Prophylactic antiepileptic medications have been studied to reduce febrile seizures, but their potential benefits are often limited by the specific adverse effects of each agent.[31] Agents like phenobarbital or valproic acid, given on a daily basis, have been shown to reduce recurrence of simple febrile seizures. However, both medications carry risks of adverse effects, such as drowsiness, mood changes, and gastrointestinal impacts. Specifically, valproic acid is associated with hepatotoxicity and blood cell dyscrasias, while phenobarbital carries a risk of medication dependence and withdrawal.[32,33] Oral diazepam, when given at the onset of fever, has been shown to be effective in reducing recurrent simple febrile seizures, although it carries the risk of drowsiness and mood changes.[25,34] Due to limited benefits and potential risk of adverse effects, the American Academy of Pediatrics recommends against long-term use of antiepileptic medications for prevention of febrile seizures.[34]

CONCLUSION

Febrile seizures are common age-dependent occurrences that can be distressing, often prompting parents to seek urgent medical evaluation. While most cases resolve spontaneously without need for acute intervention and do not cause long-term deficits, these events can still raise concerns about a child's health. Despite their typically benign nature, there is some variability in managing febrile seizures, particularly regarding use of neuroimaging, prophylactic antiepileptic medications, and standardized discharge criteria. It is crucial for healthcare providers to adhere to the latest guidelines and recommendations to minimize variability in clinical management.

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