Febrile Seizures

2.0 Contact Hours

California Board of Registered Nursing CEP# 16140
American Medical Education Center

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Title: Febrile Seizures
Self Study Module 2.0 CONTACT HOURS
Suggestion: Read through these questions before the module as they will be the SAME questions on the required online exam.

Choose the Single Best Answer for the Following Questions and Place Answers on Form:

1. By definition, a febrile seizure occurs in children between the ages-
   a. 3 - 60 months
   b. First 12 months of life
   c. Prior to school age
   d. First month after delivery

2. What is false about simple febrile seizures?
   a. Tend to be focal
   b. Often last less than 15 minutes
   c. Do not recur within the next 24 hours
   d. May occur after an ear infection

3. The most common cause of simple febrile seizures is-
   a. Bacterial infections of the brain
   b. Viral infections
   c. Head Trauma
   d. Developmental delay

4. The American Academy of pediatrics recommends a lumbar puncture in children of what age?
a. Less than 3 months
b. All school age children
c. Children less than 18 months
d. All children below age 5

5. When a child with a febrile seizure presents to the ED, the first priority is to assess?
   a. Neurological status
   b. Airways
   c. Blood pressure
   d. Ear exam

6. Which is the antipyretic of choice for treatment of febrile seizures in a 2 year old child?
   a. Aspirin
   b. Indomethacin
   c. Acetaminophen
   d. Celecoxib

7. The drug of choice for treatment of a febrile seizure in the ED is-
   a. Phenytoin
   b. Carbamezepine
   c. Sodium valproate
   d. Diazepam
8. A 12 month old child is seen in the ER with a febrile seizure that is ongoing. The child has no IV access. The next best route of administration of a benzodiazepine is-

a. Intranasal
b. Inhalation
c. Rectal
d. Subcutaneous

9. Admission should be considered in a child with a febrile seizure in all the following situations except-

a. Unstable hemodynamic status
b. Uncertain home situation
c. Persistent fever
d. Progressive lethargy

10. The most common discharge medication for a child following a febrile seizure is-

a. Diazepam
b. Lorazepam
c. Phenytoin
d. Acetaminophen

11. Vaccination against which infection may help reduce risk of febrile seizures?

a. Measles
b. Rubella
c. Influenza A
d. Hepatitis B

12. The 2008 Clinical Practice Guidelines for long term management of child with simple febrile seizures recommends what treatment?
a. Prophylactic benzodiazepines
b. Prophylactic valproic acid
c. Motrin
d. None of the above

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Self Study Module 2.0 CONTACT HOURS

Objectives

At the completion of this program, the learners will:

1. Describe febrile seizures, their epidemiology and presentation.
2. Discuss how the diagnosis of febrile seizures is made.
3. List the drugs used to treat febrile seizures.

The most common type of seizures in children are febrile seizures. Very frequently, these children present to the emergency room and present a real dilemma for the healthcare provider.\(^1\)\(^2\)

Febrile seizures were first recognized by the ancient Greeks but the disorder was not fully recognized as a distinct clinically entity until the last century. About 30 years ago, the National Institute of Health held a conference and stated that a febrile seizure is:

"An event in infancy or childhood usually occurring between three months and five years of age, associated with fever, but without evidence of intracranial infection or defined cause."

Unfortunately, this consensus conference did not exclude children with previous central nervous system impairment, did not state the specific temperature, nor define what a seizure is. This lead to another definition by the International League Against Epilepsy (ILAE)\(^3\) which stated that a febrile seizure is:

"A seizure occurring in childhood after 1 month of age associated with a febrile illness not caused by an infection of the central nervous system (CNS), without previous neonatal seizures or a previous unprovoked seizure, and not meeting the criteria for other acute symptomatic seizures."
Today by definition, febrile seizure occurs in children between the ages 3 months to 5 years.⁴

**Pathophysiology**
Febrile seizures tend to occur in young children during the developmental phase when the seizure threshold is low. This time period is also associated with children also being very susceptible to a number of childhood infections such as ear infections, upper respiratory infections and numerous viral syndromes.⁵ What is important to understand is that children usually respond to these infections with potentially higher temperatures. Studies in animals indicate that endogenous proteins like interleukin-1beta may be playing a critical role in neuronal excitability, induction of fever and seizures.

There are some studies in children, which also appear to support the hypothesis that certain cytokines may become activated during an infection and lead to febrile seizures. Mutations in genes coding for the sodium channel and the GABA receptor have been found in some patients who suffer from febrile seizures.⁶

**Classification**
Febrile seizures are essentially classified into two general types:
Simple febrile seizures which tend to be generalized, often last less than 15 minutes and do not recur within the next 24 hours.

Complex febrile seizures are often prolonged, tend to be focal and may occur more than once in the first 24 hours. When a complex febrile seizure is diagnosed, it usually is indicative of a more serious brain disorder like meningitis, abscess or encephalitis.⁷

**Epidemiology**
In the United States, febrile seizures occur in about 2-5% of children.⁸ The majority of the cases occur prior to age 5 but the peak incidence is around 18 months.⁹ Febrile seizures are slightly more common in boys and close to 70-90 percent of seizures in childhood are the simple type. Febrile seizures also appear at a similar rate in Western Europe. The incidence in other parts of the world varies from 1-10 percent. Unfortunately, these data are not reliable, as most developed countries do not keep a track of this disorder.

**Causes of Febrile Seizures**
The most common cause of febrile seizures in children are viral infections.¹⁰ Febrile seizures tend to run in families. If one sibling has had a febrile seizure, there is a 10 % probability that another sibling may also develop a febrile seizure. The risk is increased to 50% if the parents has a history of febrile seizures. Even though the genetic basis has been well studied, its inheritance patterns is not known.

Other risk factors for a first febrile seizure include day care attendance, the degree of fever as well as developmental delay. So far, there is no clinical data to support the notion that a sudden increase in temperature may be a cause of febrile seizures.
Risk of Recurrences
The risk of recurrence after a first febrile seizure is about 30% and about 10% will have three or more febrile seizures. Risk factors for recurrence include:

- Family history of febrile seizures
- Presence of any neurodevelopmental abnormality
- Having a complex febrile seizure
- Age less than 18 months at the time of first seizure
- Temperature < 40°C at time of seizure
- Seizure lasting less than 60 minutes.

Children who have presence of at least two of these risk factors have a 30% risk of developing a first febrile seizure. If the mother ingested alcohol and/or smoked during pregnancy, the risk of a febrile seizure is increased two fold.

The risk for epilepsy in the general population is about 1% by age 7. Overall, there is only a slightly greater risk for development of epilepsy in children with simple febrile seizures, with the risk increased to about two fold by age 7 years. even in those with multiple simple febrile seizures. Thus, parents should generally be reassured that the child is not likely to develop epilepsy.

Table 1
Risk factors for Recurrent Febrile Seizures
- Young age at time of first febrile seizure
- Family history of febrile seizures
- Developing High temperature
- Child with developmental delay
- Long term hospital admission as neonate suggesting severe illness
- Going to daycare

Meningitis and Febrile seizures
It is well established that meningitis can present with a seizure but the disorder rarely presents with a seizure as a first manifestation. There are several reports, which indicate that less than 5% of children who present with febrile seizures have meningitis. However, if the child does not improve and the mental status is not improving, a lumbar puncture may be prudent. The consequences of missing meningitis can be tragic for the patient and the doctor.

Risk factors for meningitis in patients presenting with seizure and fever include the following:

- Recent visit (Within the last 48 hours) to the healthcare provider.
- Ongoing seizure activity on arrival to the ED
- Focal seizure
- Presence of a rash, cyanosis, petechiae, hypotension, or lethargy on physical exam
- Abnormal neurologic examination
History of Presentation
When a child presents to the ED, the seizure has most often occurred and the only historian is the parent or caregiver. Therefore, to determine the type of seizure a detailed history should be obtained. The parent should be asked if the seizure was focal or generalized, its duration and state of consciousness. Unfortunately, most parents usually are not able to tell if the seizure was focal or generalized but they may provide a history of fever. The parent may also give a history of a recent ear or upper respiratory tract infection. In some cases, the mother may give a history of gastroenteritis.

It is important to ask if the child has been on any antibiotic or has had any recent hospital admission. It could be that the child may already have meningitis and is being treated with medications. Others facts to be determined in the history is presence of a developmental delay, prior neurological problems, history of seizures and recent head trauma or ingestions.

Physical Exam
The physical exam must be thorough to determine the cause of the fever. In children, the most common cases of fever include a middle ear infection. Upper respiratory throat infection of a viral skin rash. It is important to assess the patient's neurological status and serial examinations are often important. The child should be investigated for ingestion of any toxic substances or medications, trauma or presence of meningeal signs.

Diagnosis
Laboratory Studies
When a child under the age of 5 who present with seizures, the work up depends on the experience of the emergency room physician. In children under the age of 2 with complex febrile seizures, most physicians will perform an extensive workup.\textsuperscript{14} A urinalysis is recommended for patients with no obvious focus of infection.

Laboratory evaluation directed towards the work-up of fever is the same as for any child presenting with fever alone, and does not need to be done routinely in every case. It is based on age, height of fever, and a good clinical history and physical examination. Routine laboratory studies, such as measurement of serum electrolytes and glucose are of very low yield. These studies are only of benefit in situations where there is a suspicious clinical scenarios, such as a child appearing ill, lethargic, dehydrated or presents with a history of vomiting and diarrhea.

Lumbar Puncture
There is controversy regarding the need for a lumbar puncture (LP) in a child with a simple febrile seizure. However, some physicians do order a lumbar puncture if the etiology of the febrile seizure is in doubt.\textsuperscript{15}

The American Academy of Pediatrics (AAP) recommends a lumbar puncture in children younger than 12-18 months who present with a febrile seizure. In children older than 18
months, a lumbar puncture is not always performed. This is a conservative recommendation because the diagnosis of meningitis in children can be difficulty and also depends on the experience of the healthcare provider. An LP is recommended if the child was prescribed antibiotics prior to the seizure and may have been only partially treated for meningitis. In some cases, the testing for cerebrospinal fluid may come back negative as a result of the antibiotic treatment. In such circumstances, if suspicion is high, one should continue treatment for meningitis.

**Imaging Studies**

The role of imaging studies in the evaluation of a patient with febrile seizures is not established. Most physicians do not obtain a CT scan when children present with simple febrile seizures in the ED.

There is no data available showing that children with febrile seizures have an increased incidence of underlying central nervous system abnormalities, nor any evidence that febrile seizures lead to structural brain damage. One should consider neuroimaging in children with underlying CNS defects, recurrent complex febrile seizures or if there is a preexisting neurological deficit. However, the benefits of neuroimaging are questionable.

Magnetic resonance imaging is more sensitive than computed tomography for brain disorders that may present with seizures.

**Electroencephalography (EEG)**

An EEG is not indicated in the evaluation of the neurologically healthy child with a first simple febrile seizure. So far studies do not show any benefit of obtaining an EEG even after a complex or recurrent febrile seizure. An EEG may be considered in patients with underlying neurological problems or developmental delay.

**Emergency Department Care**

In the majority of cases of febrile seizures, by the time the child is seen in the ED, the seizure is over. However, in some cases the child may either have status epilepticus or may have an ongoing seizure in the ED. These individuals need to be managed by first assessing the airways and breathing.

Those children who present with a history and have a physical exam, which is consistent with a simple febrile seizure, should undergo complete neurological examination to assess mental status. It is important to rule out other causes of seizures in children even if one suspects a simple febrile seizure.

In most cases of febrile seizures, the drugs of choice are antipyretics. One may use acetaminophen (Tylenol) and ibuprofen (Motrin).

Anticonvulsants may be required if the seizure does not cease. Intravenous benzodiazepines are effective in most cases. Rectal diazepam is appropriate when intravenous access is difficult.
Patients who have a fever should receive supportive care and antipyretics as appropriate. If the child appears dehydrated, hydration (oral and/or IV) may be of benefit.

Once the child has been stabilized, the next step is to focus and rule out any potentially life threatening infections for seizures like encephalitis, meningitis, toxic ingestion or trauma. Before a diagnosis of a simple febrile seizure can be made one should always rule out electrolyte abnormalities and hypoglycemia. Many of the above causes can be ruled out by a detailed history, physical examination, and clinical appearance after the seizure has ended.

**Medications**

Children who present in status epilepticus are treated with the anti-seizure medications including phenytoin, benzodiazepines and phenobarbital.

**Antipyretics**

Antipyretics are recommended in children who appear ill or uncomfortable from the high fever. It is important to know that these drugs do not prevent recurrence of febrile seizures.

Acetaminophen (Tylenol) and ibuprofen (Advil) act by lowering fever by acting directly the heat regulating centers in the hypothalamus. This leads to dissipation of the excess body heat by increased sweating and vasodilatation of blood vessels.

**Anticonvulsant agents**

For a first time simple febrile seizure, most physicians do not start an anticonvulsant. Prophylactic treatment with an anti-seizure medication is usually considered for subsequent febrile episodes. For status epileptics or an acute seizure in the ED, the drugs of choice are the benzodiazepines. These agents increase the actions of the inhibitory neurotransmitter gamma-amino butyric acid (GABA) in the brain. This results in depression of CNS activity especially in the reticular formation and limbic system. These drugs are also useful adjuncts for relief of muscle spasms. After benzodiazepines, blood pressure monitoring is required.

Diazepam (Valium, Diastat) can lower the number of subsequent seizures when given at the time of each febrile episode. After IV administration, the drug rapidly distributes to the fat stores. The dose of valium should be individualized to avoid side effects. Diazepam is available in several formulations including IV, oral and per rectum dosage forms. Acute treatment with diazepam administered IV (0.5 mg/kg), buccal (0.4-0.5 mg/kg) or intranasal (0.2 mg/kg) is effective for treatment of seizures that last more than 5 minutes.

Lorazepam (Ativan) is another benzodiazepine with rapid onset and a long half-life. It is important to monitor patient's respiration rate and blood pressure after administering the dose.
Inpatient Care
Admission is not necessary for all children with febrile seizures. If the seizure is attributed to a single source infection like the ear or urinary tract, the patient can be observed in the emergency room until he/she is alert and fully awake. It is also important to know the home situation prior to discharge. However, there are times when the child may have to be admitted. The following conditions require admission:

- More than one seizure within the first 24 hours
- Unstable hemodynamic status
- Progressive lethargy after the seizure
- Uncertain home situation
- Child leaves far and follow up is unclear

Outpatient Care
All children who are discharged home after a febrile seizure need to be seen in the clinic within 24-48 hours. The most common discharge medication for these children are antipyretics. Antibiotics may be prescribed depending on the type of infection (e.g. otitis media, urinary tract infection or pneumonia).

Prevention
It is difficult to prevent many infections but there are preventive measures one can take. One infection in children, which has been widely associated with febrile seizures, is influenza A. Thus, it is important to have children vaccinated against influenza A during the flu season. The success rate of the vaccine is about 90-95 percent.\(^{21}\)

So far no study has ever shown that prophylactic use of antipyretics and/or anticonvulsants is effective in preventing recurrence of febrile seizures. In fact ibuprofen and acetaminophen have been found to be no more effective than placebo for febrile seizures.\(^{22,23}\)

While both valproic acid or phenobarbital are effective anti seizure medications, they have a number of adverse effects. Neither phenytoin or carbamazepine have been shown to be effective in preventing recurrence of febrile seizures.

The 2008 Clinical Practice Guideline for Long-Term Management of the Child with Simple Febrile Seizures advocates neither intermittent nor continuous use of antipyretics, anticonvulsants, or benzodiazepines in children with one or more simple febrile seizures.\(^{24}\)

Prognosis
After a simple febrile seizure, some children may have an increased risk of developing epilepsy in future. Overall children with febrile seizures have a slightly higher incidence of epilepsy compared with the general population (2% vs. 1%).
However, the disorder has no adverse effect on cognition, behavior, or academic performance. Children who develop a complex febrile seizure, definitely have an increased risk for developing epilepsy in future. There is a strong correlation between febrile seizures characterized by focal symptoms and later development of temporal lobe epilepsy.²⁵

**Mortality/Morbidity**
Children who develop simple febrile seizures do not have an increased risk of death. However, the same is not true for the complex seizures. Seizures that are triggers by elevated temperature and occur before the age of 1 are associated with a 2 fold increased mortality rate during the first 2 years after the initial seizure development. Risk factors for seizures later in life include 1) presence of a complex febrile seizure, 2) family history of epilepsy 3) neurologic abnormality and 4) developmental delay. Patients with 2 risk factors have up to a 10% chance of developing afebrile seizures.

**Patient Education**
Education and counseling of parents with febrile seizures is necessary. Seizures can be very frightening and traumatic, and parents need to be reassured that the child will not die during a seizure. Parents have to be taught to keep the child safe during the seizure. Parents should be taught how to manage recurrent seizures, when to call the doctor and when to take the child to the ED. Parents should be reassured that simple febrile seizures do not lead to learning, behavior or other neurologic problems.

**Multidisciplinary Consultation**
Febrile seizures can be a dilemma in the ED for physicians. Thus, it is important to utilize other healthcare professionals in managing the disorder. A neurologist is often consulted to help manage treatment. If the child is found to have meningitis, the infectious disease expert can help guide therapy. Since simple febrile seizures are benign in most cases, education of the family is vital. Thus, social workers and nurses can initiate this process. Early treatment and multidisciplinary approach is the guarantee of reduction in mortality and morbidity following seizures and/or meningitis.²⁶

**Key Points**
1. Simple febrile seizures are almost always benign and are not linked to any adverse neurological consequences.
2. The aim of investigation is to rule out meningitis.
3. The role of EEG, CT scan and blood work in simple febrile seizures is limited.
4. Reassurance should be provided to parents about prognosis of febrile seizures.

**References**


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