Seizures Overview

Supported by HRSA MCHB Cooperative Agreement Number U23MC26252
Key Topics

• Seizure Definition
• Evaluation of Seizures
• Febrile Seizures: Practice Parameter
• Important Aspects of the History and Exam
• When to Refer
UNDERSTANDING SEIZURES:
THE BASICS
What is a Seizure/Convulsion?

• A sudden stereotyped episode with change in motor activity, sensation, behavior, and/or consciousness
  • Due to an abnormal electrical discharge in the brain
• The term convulsions is often used interchangeably with seizures. Convulsions are a type of seizure, but not all seizures are convulsions.
• Several types of seizures have symptoms other than shaking.

Seizure: Symptoms

*Symptoms often depend upon the area in the brain where the seizure starts and how the seizure propagates*

- Behavioral arrest
- Changes in behavior including mood changes
- Bitter /metallic taste
- Purposeless movements such as picking at one’s clothes (automatisms)
- Abnormal eye movements, eye deviation
- Drooling, frothing at the mouth
- Rhythmic twitching or jerking of limbs or face or the entire body
- Staring
- Eye lid fluttering
- Sudden fall(s)
- Loss of tone or stiffening of the extremities
- Teeth clenching
- Temporary stop in breathing

Seizures : Causes

Seizures can be

- **Provoked**: seizure with an acute antecedent cause, such as:
  - CNS infection (meningitis, encephalitis)
  - Trauma
  - Metabolic abnormality (abnormal levels of glucose, sodium)
  - Toxic exposure (drugs, alcohol)
  - Fever

- **Unprovoked seizure**: no immediate provoking factor

Source: Joshi and Shellhaas 2014
Seizures: Causes

• A cause is identifiable in < 20% of children with seizures.
• Other causes of seizures include:
  • Brain malformations
  • Genetic disorders
  • Disorders of metabolism
  • Traumatic or previous infectious injury of the brain
  • Neoplasms
• Neurodevelopmental abnormalities make it more likely a cause will be identified or may already have been determined before seizure onset.

Source:
http://pediatriccare.solutions.aap.org/content.aspx?resultClick=1&gbosid=165567#sec_59043243
Seizures: Epidemiology

• Prevalence
  • Seizures occur in approximately 1% of all children up to the age of 14 years.
  • Greatest in first year of life (~120 cases per 100,000 population).
  • Thereafter, 40–50 cases per 100,000 population until puberty.
  • ~10 cases per 100,000 population in the early and mid teens.
  • ~15% of children who have epilepsy have intractable seizures.
    • ~50% of these may be appropriate candidates for epilepsy surgery.

Source: [http://pediatriccare.solutions.aap.org/content.aspx?resultClick=1&gbosid=165567#sec_59043243](http://pediatriccare.solutions.aap.org/content.aspx?resultClick=1&gbosid=165567#sec_59043243)
FEBRILE SEIZURE
Febrile Seizures

• A seizure that occurs in association with a fever (temperature at or above 100.4°F or 38°C by any method)
• Very common in children (3-4%)
• Age of onset
  • Age 6 months to 5 years (median age 18-22 months)
• No evidence of a CNS infection, or acute neurologic illness
• Usually occurs in an otherwise normal child
• There may/may not be a family history of febrile seizures/epilepsy

Sources:
http://pediatrics.aappublications.org/content/127/2/389.full.pdf and
http://pediatriccare.solutions.aap.org/chapter.aspx?sectionId=56754849&bookId=1017&resultClick=1#56780691
Febrile Seizures

• Simple febrile seizures are generalized tonic-clonic convulsions that last less than 15 minutes and do not recur within 24 hours.

• Complex febrile seizures are less common and are focal or prolonged beyond 15 minutes or recur within 24 hours. These account for about 25% of febrile seizures.
Febrile Seizures

- Triggered by any illness that causes fever, most frequently by otitis media and upper respiratory tract infections, roseola, gastroenteritis.
- A febrile seizure can be the first sign of a febrile illness.
- 1/3 of children who have a febrile seizure will have another one with another febrile illness.
- The younger the child is at the time of the first episode, the greater the risk is of recurrence.
- Approximately 50% of the recurrences occur within 6 months of the initial seizure; 75% occur within 1 year.
Febrile Seizures: Evaluation

- Thorough history and examination
  - Aimed at determining the cause of fever
- Diagnostic studies: Are these needed??
- Tests that are considered include
  - Lumbar puncture
  - EEG
  - Neuroimaging
  - Other blood tests

Source: Baumann RJ, Duffner PK. Pediatr Neurol. 2000
“In general, a simple febrile seizure does not usually require further evaluation, specifically EEG, blood studies, or neuroimaging.”
Clinical Practice Guideline

Febrile Seizures: Guideline for the Neurodiagnostic Evaluation of the Child With a Simple Febrile Seizure

• A lumbar puncture (LP) should be performed in any child who presents with a seizure and a fever and has meningeal signs and symptoms (eg, neck stiffness, Kernig and/or Brudzinski signs) or in any child whose history or examination suggests the presence of meningitis or intracranial infection.

Source:
http://pediatrics.aappublications.org/content/127/2/389.full.pdf
Clinical Practice Guideline

Febrile Seizures: Guideline for the Neurodiagnostic Evaluation of the Child With a Simple Febrile Seizure

• In any infant between 6 and 12 months of age who presents with a seizure and fever, a LP is an option when the child is considered deficient in Haemophilus influenzae type b (Hib) or Streptococcus pneumonia immunizations (ie, has not received scheduled immunizations as recommended) or when immunization status cannot be determined because of an increased risk of bacterial meningitis.

Source: http://pediatrics.aappublications.org/content/127/2/389.full.pdf
Clinical Practice Guideline

Febrile Seizures: Guideline for the Neurodiagnostic Evaluation of the Child With a Simple Febrile Seizure

• A LP is an option in the child who presents with a seizure and fever and is pretreated with antibiotics, because antibiotic treatment can mask the signs and symptoms of meningitis.

Source: http://pediatrics.aappublications.org/content/127/2/389.full.pdf
Clinical Practice Guideline

Febrile Seizures: Guideline for the Neurodiagnostic Evaluation of the Child With a Simple Febrile Seizure

• An electroencephalogram (EEG) should not be performed in the evaluation of a neurologically healthy child with a simple febrile seizure.

• The following tests should not be performed routinely for the sole purpose of identifying the cause of a simple febrile seizure: measurement of serum electrolytes, calcium, phosphorus, magnesium, or blood glucose or complete blood cell count.

• Neuroimaging should not be performed in the routine evaluation of the child with a simple febrile seizure.

Source: [http://pediatrics.aappublications.org/content/127/2/389.full.pdf](http://pediatrics.aappublications.org/content/127/2/389.full.pdf)
Febrile Seizures: Management

Febrile Seizures: Clinical Practice Guideline for the Long-term Management of the Child With Simple Febrile Seizures
Steering Committee on Quality Improvement and Management, Subcommittee on Febrile Seizures
*Pediatrics* 2008;121;1281

Source: [http://pediatriccare.solutions.aap.org/chapter.aspx?sectionId=56754849&bookId=1017&resultClick=1#56780691](http://pediatriccare.solutions.aap.org/chapter.aspx?sectionId=56754849&bookId=1017&resultClick=1#56780691)
Febrile Seizures

• Prognosis: excellent, except:
  • 30-50% risk of recurrence
  • Double the risk of epilepsy, 1% → 2%
Febrile Seizures: Recurrence

• Risk factors (after 1 simple febrile seizure):
  • age <18 months
  • family history of febrile seizures (1st degree relative)
  • low degree of fever at the time of the seizure
  • short duration of illness before occurrence of seizure

• Overall Recurrence Risk = 32% over next 2 years.

• Recurrence risk (based on above risk factors):
  • NO risk factors: 4%
  • 1 risk factor: 23%
  • 2 risk factors: 32%
  • 3 risk factors: 62%
  • 4 risk factors: 76%

Treatment

- Treatment of seizure
  - Often the seizure has stopped by the time the child is brought in for evaluation.
  - If the seizure continues, then lorazepam or diazepam should be administered.
- Treatment of fever
  - The temperature should be brought down by using rectal antipyretics, removing blankets and clothing, and sponging.
  - Once the seizure is controlled, evaluation is directed toward finding the cause of the fever.

Source: Fenton, 2014
Source: http://pediatriccare.solutions.aap.org/chapter.aspx?sectionId=56794849&bookId=1017&resultClick=1#56780691
Treatment

• Family education that addresses the benign nature of the seizures, the use of antipyretics, and first aid for seizures.

• Oral [diazepam](http://pediatriccare.solutions.aap.org/chapter.aspx?sectionId=56754849&bookId=1017&resultClick=1#56780691) (0.33 mg/kg body weight administered every 8 hours during febrile illness) reduces the risk of recurrent febrile seizures.

Source: [http://pediatriccare.solutions.aap.org/chapter.aspx?sectionId=56754849&bookId=1017&resultClick=1#56780691](http://pediatriccare.solutions.aap.org/chapter.aspx?sectionId=56754849&bookId=1017&resultClick=1#56780691)
Treatment

- Prophylactic treatment with anticonvulsant agents could be considered if neurologic development is abnormal, it is a complex febrile seizure, or the child is younger than 1 year.
- Valproate and phenobarbital appear to be effective in prophylaxis; phenytoin and carbamazepine do not prevent recurrences. The adverse effects of anticonvulsant therapy must be weighed against the possible benefits.
- No evidence has been found that prophylactic treatment reduces the risk of subsequent epilepsy.

Source: [http://pediatriccare.solutions.aap.org/chapter.aspx?sectionId=56754849&bookId=1017&resultClick=1#56780691](http://pediatriccare.solutions.aap.org/chapter.aspx?sectionId=56754849&bookId=1017&resultClick=1#56780691)
If seizures continue repeatedly after the underlying problem is treated, the condition is called epilepsy.
What is Epilepsy?

• Epilepsy is defined by recurrent unprovoked seizures.
• Lifetime prevalence of epilepsy to be 10.2/1000 or 1% (Russ et al, Pediatrics 2012).
• Approximately 1 in 26 people will develop epilepsy at some point in their lives.
• Epilepsy affects an estimated 2.2 million people in the United States.
Epilepsy

- Living with epilepsy is about more than just seizures; it is often defined in practical terms, such as challenges, uncertainties, and limitations in school, social situations, employment, driving, and independent living. People with epilepsy are also faced with health and community services that are fragmented, uncoordinated, and difficult to obtain (IOM Report, 2012).
What is Epilepsy?

- Epilepsy is more than seizures, it is a complex disease with several neurological and psychiatric co-morbidities:
  - Depression
  - ADHD
  - Anxiety
  - Conduct problems (Russ et al, Pediatrics 2012)
  - Developmental delay
  - Autism/ Autism Spectrum disorder
<table>
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<tr>
<th></th>
<th>No. in Sample (Unweighted)</th>
<th>No. Ever Diagnosed (Unweighted)</th>
<th>Weighted Prevalence per 1000</th>
<th>95% CI per 1000</th>
<th>Adjusted RR</th>
<th>95% CI</th>
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<td><strong>Total</strong></td>
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<td>977</td>
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<td>&lt;100% FPL</td>
<td>10,956</td>
<td>170</td>
<td>12.8</td>
<td>9.6–17.1</td>
<td>1.95</td>
<td>1.16–3.27</td>
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<td>100%–199% FPL</td>
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<td>300%–399% FPL</td>
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<td>8.8–13.5</td>
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<td>Hispanic</td>
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<td>4.9–13.4</td>
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<td>More than HS</td>
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<td>9.5</td>
<td>7.7–11.8</td>
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<td><strong>Child age, y</strong></td>
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<td><strong>Child gender</strong></td>
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<td>469</td>
<td>8.6</td>
<td>7.2–10.3</td>
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FPL, federal poverty level.

Source: [http://pediatrics.aappublications.org/content/129/2/256.full.pdf](http://pediatrics.aappublications.org/content/129/2/256.full.pdf)
Categorizing Epilepsy Syndromes

- Clusters of signs and symptoms
  - Age of onset, severity
  - Diurnal or nocturnal occurrence
  - Clinical course
  - Associated neurologic dysfunction
  - Inheritance

Source: http://pediatriccare.solutions.aap.org/chapter.aspx?sectionId=56754849&bookId=1017&resultClick=1#56780637
Classification of Seizures and Epilepsy Syndromes

Generalized seizures
- Absence
- Myoclonic
- Atonic, astatic
- Tonic-clonic

Generalized Epilepsy Syndromes
- Childhood absence epilepsy
- Juvenile myoclonic epilepsy
- Infantile spasms (West syndrome)
- Lennox-Gastaut syndrome

Focal Seizures
- Simple partial *
- Complex partial *
- Partial seizures with secondary generalization *

Focal Epilepsy Syndromes
- Benign epilepsy of childhood with centrotemporal spikes (BECTS)
- Benign occipital epilepsy
- Focal epilepsy with mesial temporal sclerosis

* Terminology from old classification

Source: http://pediatriccare.solutions.aap.org/chapter.aspx?sectionId=56754849&bookId=1017&resultClick=1#56780637
Important Aspects of the History and Exam

• Primary care physician is usually the first point of contact after a child has a seizure (Basco et al, Pediatrics 2013).

• If the patient is not actively seizing at the time of evaluation
  • Obtain a clear history of the event, preferably in person and from a witness, so as to be able to distinguish the event from other non-epileptic events (to be discussed separately).

Source: http://www.epilepsy.com/information/professional/s/diagnosis-treatment/emergency-department-care/first-or-unknown-seizure
Past and Recent Medical History

• Known risk factors
  • Pre/peri/post-natal complications
  • Head trauma
  • CNS infections
  • Febrile Seizures
  • Other medical conditions

• Recent symptoms (illness, head injury, lack of sleep, dehydration)

• Developmental history

• Medications/toxin exposures (EtOH, illicits, Rx meds, etc.)

• Family history
  • Febrile seizures or epilepsy, 1st and 2nd degree relatives

Source: Fenton, 2014
Seizure-Specific History

- Context of event(s)
  - Circumstances under which the events occur
  - Timing and circadian distribution
  - Position (lying, sitting, standing, transitions)
  - Associated activities at the time of the event (at rest, during exercise)
  - Triggering factors (crying, fever, etc)
  - Facilitating factors (dehydration, illness, alcohol/illicit drug consumption, sleep deprivation)

- Detailed description of all event(s)
  - Was the onset witnessed?
  - Description from start to end, including the aura and postictal effects, until recovery to normal.

Source: Fenton, 2014
Seizure-Specific History

- Difficulty in diagnosis and potential misdiagnosis can result from failure to obtain a detailed description of the event
  - Not enough time to spend taking detailed history
  - Inexact historian
  - Witness not available
  - Onset not witnessed
- Importance of documentation of detailed history to help facilitate care coordination between primary care and specialists.

Source: Fenton, 2014
Seizure-Specific History: Staring

- Spells noted in multiple environments (absence)
- Spells interrupt activities (absence) or have postictal manifestations (focal)
- Spells don’t stop with physical touch
- Spells precipitated by hyperventilation during exam

Source: Fenton, 2014
Seizure-Specific History: Convulsions

• Was there a warning right before the convulsion (behavioral arrest, affective change)?
• Did the head/eyes deviate upward or to one side?
• Did the movements start unilaterally or bilaterally?
• How did the seizure progress?
• How long did the seizure last?
• What was the child like immediately after and how long to recover to baseline?

Source: Fenton, 2014
Neurologic Examination

• A screening neurologic exam is most appropriate, assessing for multiple signs indicative of neurologic injury.

• Cranial nerves: Pupil reactivity, nystagmus, facial symmetry/ strength, palate elevation, tongue protrusion.

• Motor: muscle bulk, tone, and strength (assess for asymmetries), reflexes, Babinski response

• Coordination: finger to nose movements (assess for focal tremors)

• Gait: Look for ataxia, circumduction.
Condition-Specific Assessment

- CNS infection
  - Fever, headache, prolonged seizure, prolonged postictal state
  - Stiff neck, confusion
- Head trauma
  - History, external evidence, focal deficit
- Brain tumor
  - Headache, focal seizure, focal deficits

Source: Fenton, 2014
Condition-Specific Assessment

- Genetic syndromes and brain malformations
  - Developmental delay, Dysmorphism
- Cerebral hemorrhage
  - Trauma, family history of cerebral cavernous malformations, focal seizures, focal deficits
- Neurocutaneous disorders
  - Birthmarks (hypopigmented macules, café au lait spots etc)

Source: Fenton, 2014
Recap: Key Areas of Focus

• Seizure-specific history
  • Assure the event(s) is/are seizures
  • Categorize seizure type
  • Suggest possible etiology

• Past and recent medical history
  • Identify risk factors

• General physical examination
  • Looking for a symptomatic etiology

• Neurological examination
  • Looking for evidence of a symptomatic etiology

Source: Fenton, 2014
Questions About Seizures?

1. Are the events seizures?
   • Detailed description of events
   • EEG

2. What type of seizures are they?
   • Detailed description of events
   • EEG

3. What is the cause of the seizures?
   • Detailed description of events
   • Past and recent medical history
   • Family history
   • Lab studies

4. What is the likelihood of recurrence?
   • Detailed description of events
   • Past and recent medical history
   • Family history
   • EEG and other lab studies

5. What treatment should be given?
   • Safety precautions
   • Rescue medication
   • Preventive medication

Source: Fenton, 2014
Partnering with Parents After a Seizure

• Parents and patients may have many fears and need reassurance.
  • Explain the terms epilepsy or seizure disorder.
  • Help parents understand that diagnosis of epilepsy alone does not mean that the child has intellectual disability or a psychiatric disorder, but may co-occur with epilepsy.
• Give guidelines on what to do when child has a seizure, including positioning on the side and putting nothing in the mouth.
• Emphasize to parents that death from a seizure is rare.
• Educate parent/family over time to help process all information during high stress time of new diagnosis.

Source: http://pediatriccare.solutions.aap.org/content.aspx?resultClick=1&gbosid=165567#sec_59043243
Addressing Parents After a Seizure

• Discuss activities of patients with seizures.
  • Activities should be restricted as little as possible.
  • A child with a seizure disorder should not swim alone or go bike riding without a helmet (as for all children).
  • Contact sports are permissible when epilepsy is controlled.
  • The decision about climbing up to certain heights should be based on how well the child’s seizures are controlled. Extreme heights, such as rock climbing, should always have a belay.
  • Older children who are not supervised when bathing should be encouraged to take showers rather than baths to minimize risk of drowning if a seizure occurs.

Source: http://pediatriccare.solutions.aap.org/content.aspx?resultClick=1&gbosid=165567#sec_59043243
Connecticut Study of Childhood epilepsy first diagnosed 1993-1997
• Limited study to children with onset <3 years of age
• 17 pediatric neurologists serving about 500,000 children
• Assessed time from second seizure to diagnosis of epilepsy
• Regarded >1 month as a delay in diagnosis
• 1-4 months, 4-12 months, >12 months
• Looked for reasons for diagnostic delay; Correlated diagnostic delay with outcome
• Diagnostic delays occurred in 41% (21% at 1-4 months) (7% at 4-12 months) (13% at >12 months)
• Diagnostic delay less likely if: Patient had prior provoked seizure (neonatal, febrile); Sought medical attention for the first unprovoked seizure; Seizure was convulsive; Parent is college educated

Reasons for Delay

• Reasons for diagnostic delay
  • Parents not recognizing events as seizures  67%
  • Pediatricians missing or deferring diagnosis  21%
  • Neurologist deferring diagnosis after normal EEG  8%
  • Scheduling delays  16%

• Diagnostic delay associated with
  • 7.4 point drop in Vineland Scales of Adaptive Behavior motor score
  • 8.4 point drop in processing speed on WISC
  • 14.5 point drop in full scale IQ on WISC

When to Refer

• Referral to Neurology should happen at any point in which the practitioner feels the patient is beyond their comfort level or scope of practice. These can include, but are not limited to:
  • *New onset seizures in a young child (under 3 years of age)*
  • *Suspected infantile spasms*
  • Type of seizure is unclear
  • Seizures are refractory to medication
  • Complicated medication management
  • Unclear etiology
  • Multiple neurologic diagnoses

* Refer early

Source: [http://pediatriccare.solutions.aap.org/chapter.aspx?sectionId=56754849&bookId=1017&resultClick=1#56780691](http://pediatriccare.solutions.aap.org/chapter.aspx?sectionId=56754849&bookId=1017&resultClick=1#56780691)
When to Refer

• Other reasons to refer:
  • Complicated medication management
  • Questions about prognosis arise
  • Other neurologic issues arise or complicate the patient's clinical status

• When to admit to the hospital for urgent care
  • Seizures are uncontrolled or prolonged
  • Emergent continuous video EEG monitoring is needed
  • Rapidly anticonvulsant medication changes are needed

Source:
http://pediatriccare.solutions.aap.org/chapter.aspx?sectionId=56754849&bookId=1017&resultClick=1#56780691