Seizures in Children
The “quick and dirty” for primary care

Kevin Hamann, M.D.
Department of Pediatrics
Kaiser Permanente, Rohnert Park

Case Presentation
• 4m old presents to clinic after episode:
  – 3-5 sec full body tonic-clonic while BF last night, repeated this a.m.
  – No apnea, cyanosis, post-ictal state, weakness
  – ROS: no fever, no URI, no v/d, no recent trauma
    • Seen in clinic 1w prior with similar episode: dx as “Sandifer’s”
  – PMH:
    • GER dx at age 2m
    • Unremarkable birth hx
  – Dev Hx: rolls, smiles, reaches, babbles
  – No meds, no allergies
  – Social Hx: lives with mom and dad, no suspicion of abuse, no suspicion of accidental ingestion
  – FHx: negative

Outline
• Definitions and Classification
• Epidemiology
• Etiology
• Approach
  – History and exam
  – Differential diagnosis
  – Evaluation
• Treatment
• Conclusions

Definition of Seizure
• "A transient, involuntary alteration of consciousness, behavior, motor activity, sensation, or autonomic function caused by an excessive rate and hypersynchrony of discharges from a group of cerebral neurons”
  – Variable post-ictal period
  – Status epilepticus: continuous/recurrent > 30min
  – Clinical symptom of an underlying pathologic process

Definition of Epilepsy
• Condition of susceptibility to recurrent seizures without obvious precipitants
  – "Idiopathic": no identifiable cause, normal development
  – "Cryptogenic": underlying abnormal brain function (specific lobe location)
  – "Symptomatic": identifiable brain lesion
    • Inherited Genetic
    • Congenital
    • Acquired

Classification of Seizure and Epilepsy Types
1981 International League Against Epilepsy

• Partial
  – Simple Partial
    • + motor signs
    • + somatosensory
    • + autonomic
    • + psychic
  – Complex Partial
    • Simple onset → AMS
    • Initial AMS
  – Secondary generalized
    • Simple partial → general
    • Complex partial → general

• Generalized
  – Absence
  – Typical
  – Atypical
  – Myoclonic
  – Clonic
  – Tonic
  – Tonic-Clonic
  – Atonic
**Epidemiology**

Seizures
- Most common pediatric neurologic disorder
  - 4-10% have 1 or more prior to 16yo
  - 3-5% will have febrile sz prior to 5yo
- 30% will have 1 or more additional sz
- 3-6% will develop epilepsy
- Partial sz most common type

Epilepsy
- Prevalence 0.4-0.9% (1/3 have dev d/o)
- Incidence highest at extremes of life

**Causes of Seizures**

- **Infectious**
  - Brain abscess
  - Encephalitis
  - Febrile seizure
  - Meningitis
- **Neurologic/Developmental**
  - Birth injury
  - Congenital anomalies
  - Degenerative dz
  - Hypoxic-ischemic
  - Neurocutaneous syndrome
  - VP shunt malfunction
- **Metabolic**
  - ↑CO₂, ↓Ca, ↓Mg, ↓O₂, ↓glucose
  - Inborn errors of metabolism
  - Pyridoxine deficiency
- **Traumatic/Vascular**
  - Cerebral contusion
  - Cerebrovascular accident
  - Child abuse
  - Head trauma
  - Intracranial bleed
- **Toxicologic**
  - Alcohol, amphetamines, cocaine, CO, INH, lead, lithium, organophosphates, salicylates, TCA's, theophylline
- **Substance withdrawal**
- **Oncologic**

**Causes of Epilepsy**

- **Inherited Genetic**
  - Channelopathies
  - Chromosomal abn
  - Mitochondrial DNA d/o
  - Metabolic d/o
  - Hereditary neurocutaneous d/o
- **Acquired**
  - Trauma
  - Neurosurgery
  - Infection
  - Vascular disease
  - Hippocampal sclerosis
  - Tumors
  - Neurodegenerative d/o
  - Metabolic d/o
  - Toxic d/o
- **Congenital**
  - Cerebral tumor
  - Vascular malformation
  - Prenatal injury
  - Cortical malformation
- **Idiopathic**

**Febrile Seizures**

- Occur in 2-5% of all children
- Familial predisposition
- Distinguish typical from atypical
  - Typical (Simple)
    - Recurrence = 30-50%
    - Only slight increased risk of epilepsy
    - No increased risk of mortality, MR, hemiplegia
  - Atypical (Complex)
    - 2-13% likelihood of future epilepsy

**Febrile Seizures**

<table>
<thead>
<tr>
<th>Typical</th>
<th>Atypical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>3m – 6y</td>
</tr>
<tr>
<td>Development and neuro exam</td>
<td>Normal</td>
</tr>
<tr>
<td>Duration</td>
<td>&lt; 15 min</td>
</tr>
<tr>
<td>Sz type</td>
<td>Generalized</td>
</tr>
<tr>
<td>Number of sz</td>
<td>1/fever episode</td>
</tr>
<tr>
<td>Postictal deficit</td>
<td>None</td>
</tr>
<tr>
<td>CNS infection</td>
<td>No</td>
</tr>
</tbody>
</table>

**Approach to Seizures**
History

• HPI
  – LOT, motor/sensory (local vs generalized) symptoms, LOC, eye movement, incontinence, tongue-biting, postictal state, recurrence, frequency

• ROS
  – Fever, trauma, HA, emesis, aura
  – Precipitating events: sleep deprivation, stress, drugs, ingestion, alcohol w/d, recent IZ

• PMH
  – h/o head trauma, stroke, meningitis, prior sz, GER, syncope, migraine, psychiatric dx, tics, VP shunt

History continued...

• Birth/Prenatal Hx
  – Fetal US, meds, alcohol, tobacco, drugs, trauma
  – Labor/delivery details, prematurity, Ht/Wt/OFC

• Developmental Hx
  – Fine/gross motor, language, social skills, school fxn

• Family Hx
  – Epilepsy, febrile sz, mental retardation

• Social Hx
  – Family stress, school/employment hx, travel

• Meds/Allergies

Physical Exam

• Full vital signs

• General:
  – Level of consciousness, language, social skills

• Neuro
  – Head: dysmorphism, head size/OFC, trauma, AF
  – Eyes: EOMI, PERRL, papilledema, retinal hem
  – Cranial nerves, cerebellar function
  – Neck/back: ROM, Kernig’s, Brudzinski’s
  – Extremities: motor/sensory function, reflexes, gait

Physical Exam continued...

• HEENT
  – Source of fever

• CV/Pulm

• GI
  – Hepatomegaly, splenomegaly

• Derm
  – Café-au-lait spots, adenoma sebaceum, ash leaf spots, port wine stains, bruising
**Differential Diagnosis**

- Disorders with AMS
  - Apnea and syncope
  - Breath-holding spells
  - Cardiac dysrhythmias
  - Migraine
- Sleep disorders
  - Daydreaming
  - Narcolepsy
  - Night terrors
  - Sleepwalking
- GER/Sandifers
- Paroxysmal movement
  - Acute dystonia
  - Benign myoclonus
  - Pseudoseizures
  - Tics
  - Shuttering attacks
- Psychologic disorders
  - ADHD
  - Hyperventilation/hysteria
  - Panic attacks
  - Hallucinations/delusions

**Evaluation**

- Guided by Hx and Exam
  - Higher risk: prolonged sz, age < 6m, diabetes, metabolic d/o, dehydration, excess free water, AMS
- Possible serum/urine studies
  - Rapid glucose test
  - Chem 10 (Ca/Mg/Ph), NH4, CBC
  - Toxicology screen
  - Anticonvulsant level
  - (karyotype, lactate/pyruvate, amino acids, urine organic acids, acylcarnitine profile)
- Routine LP not indicated
  - Consider if neonate, AMS, meningeal irritation, prolonged postictal state

**Evaluation continued...**

- Neuroimaging
  - Goal: identify structural abnormality
  - MRI more sensitive, CT more available
- EEG
  - 21 electrodes on scalp measure voltage fluctuations of superficial neurons in relation to time
  - Confirms dx, type of epilepsy, location
  - Rarely needed acutely
  - 10-20% with epilepsy have normal EEG’s
  - 5% of normal kids have abnormal EEG’s

**Evaluation: First Febrile Sx**

- If meets typical (simple) criteria:
  - EEG No
  - Neuroimaging No
  - Blood studies Not routinely
    - Only if meets “fever” criteria (refer to my previous lecture)
  - Lumbar puncture
    - < 12m: strongly consider
    - 12-18m: consider
    - > 18m: only if meningeal signs

**Treatment of Seizures**

1. ABC’s:
2. Check FSG → IV glucose if needed
3. Benzodiazepines
   - Lorazepam 0.05-0.1mg/kg IM/IV
   - Diazepam 0.2-0.4mg/kg IV/IO (0.5mg/kg PR)
   - Midazolam 0.2mg/kg IM/IV
   ↓ 5-15 min
   - Repeat benzo
   ↓ 5-15 min
   - Phenytoin/fosphenytoin (15-20mg/kg IV)
   ↓ 15-30 min
   - Phenobarbital (20mg/kg IV)
   ↓ 15-30 min
4. Continuous infusion, intubate, general anesthesia
Chronic Management

- Consult with a pediatric neurologist:
  - Determine whether to start long-term tx
- General Guidelines:
  - Choose agent effective for particular type of seizure
  - Initiate therapy with single agent
  - Start at low end of dosage range
  - Continue same drug long enough to reach steady state
  - > 5x the half-life of the drug
  - Increase dosage until seizures controlled
  - Consider adding second agent if sz activity persists
  - Follow above guidelines, later wean first drug to reach monotherapy
  - Monitor for side effects and lab abnormalities

Medication Choices

- Start Tx After First Seizure?
  Arts WF, Geerts AT. EJ Peds Neuro; 2008
  - Absence seizure: YES
    - Risk of accidents and learning problems high
  - Tonic-clonic seizure (unprovoked): NO
    - General recurrence risk is 50%
    - Many studies: tx after first sz does not decrease likelihood or outcomes of epilepsy vs delaying tx until recurrence of sz
  - Status epilepticus (SE): Not studied

Chronic Management: Education

- Demystify condition
- Discuss potential precipitating factors
- Provide seizure first aid instruction
- Address social concerns
  - Normal participation in most sports
  - Avoid unsupervised time (ie swimming, biking)
  - Driving restrictions

Start Tx After First Seizure?

- Absence seizure: YES
  - Risk of accidents and learning problems high
- Tonic-clonic seizure (unprovoked): NO
  - General recurrence risk is 50%
  - Many studies: tx after first sz does not decrease likelihood or outcomes of epilepsy vs delaying tx until recurrence of sz
- Status epilepticus (SE): Not studied

Epilepsy Prognosis

- Child epilepsy NOT a progressive dz
  - 65-75% long-term remission
  - 10-15% intractable
  - 10-25% uncertain
- Variables for worse outcome:
  - girls > boys
  - postictal signs
  - non-idiopathic etiology
  - h/o febrile sz
  - failure of 1 or 2 AED’s

Conclusions

- Most common pediatric neuro d/o
- Classification of sz type is KEY
- Many etiologies (don’t memorize)
- Look for TYPICAL febrile sz
- Specific history, focused exam
- Not all shaking/AMS is a sz
- Not all sz require a full eval
  - eval may not need to be urgent
- Not all sz merit immediate therapy
Case Presentation

- 4m old with new onset short tonic-clonic bx
  - Normal exam
  - Discussion with on-call neuro and family:
    • Normal labs (chem 10, tox screen, glucose)
    • Outpatient EEG: mildly abnormal
    • Met with pediatric neurologist, examined
    • Outpatient MRI: normal
  - Family opted not to treat with AED
    • 3-4 known sz episodes over ensuing 1-2 months
    • Pt “seizure-free” x 2 years

References

4. Arts WFM, Geerts AT. When to Start Drug Treatment for Childhood Epilepsy. *EJPN* 2008 (in print)
5. Arts WFM, et al. Course and Prognosis of Childhood Epilepsy: 5 year follow-up of the Dutch study of epilepsy in childhool. *Brain* 2004; 127(8)1774-1784