Pediatric Seizures

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Disclosures

Relevant Financial Relationship(s)

None

Off Label Usage

None

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Learning Objectives

- Review the key concepts of pediatric seizures.
- Appreciate how to evaluate a child with spells concerning for seizure.
- Highlight the different types of treatment of pediatric seizures.
- Be able to identify some common pediatric seizure disorders.
- Differentiate between seizures and nonepileptic spells.

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Overview

- Perinatal acquired/congenital neurologic disorders
- Genetic, Metabolic, Neurocutaneous disorders
- Neurodevelopmental disorders
- Epilepsy
- Nonepileptic paroxysmal disorders
- Headaches
- Movement and balance disorders
- Brain injury and disorders of consciousness
- Hydrocephalus
- Infections of the nervous system
- Tumors of the brain and spine
- Cerebrovascular disease
- Neuromuscular disorders

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5-year-old male with “seizure”

- What do we want to know about:
  - Spell and immediate history?
  - Past medical history?
- Physical exam?
- Diagnostic evaluation?
- Treatment?

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Definitions

- **Seizure**: clinical expression of abnormal, excessive, synchronous discharges of neurons residing primarily in the cerebral cortex.
- **Epilepsy**: at least two unprovoked seizures occurring more than 24 hours apart.
- **Provoked seizure**: secondary cause such as hyponatremia, hypocalcemia, high fever, toxic exposure, intracranial bleeding, or bacterial meningitis.

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Epidemiology

- 0.5-1% kids will experience at least one afebrile seizure by adolescence
- 3-5% kids at least one febrile seizure
  - 3-6% will develop epilepsy
- 3.6% experiencing at least one seizure in an 80-year lifespan
- Risk of having a seizure is greatest in infancy and after age 60
- M>F, higher in lower socioeconomic groups

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Seizure Semiology

- Generalized seizures
  - Tonic/Tonic-Clonic
  - Absence
  - Myoclonic
- Focal seizures
  - Tonic/Tonic-Clonic
  - Temporal lobe
  - Secondary generalization

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Pediatric Etiology

- Genetic
- Structural: injury, neurodevelopment
- Metabolic: fever, hypocalcemia, hyponatremia
- Infectious/Immune: meningitis, encephalitis, sepsis, autoimmune
- Unknown: genetic?

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Adult Etiology

- **Ischemic or hemorrhagic stroke**
- Traumatic head injury and bleeds
- Brain tumors and vascular malformation
- Neurodegenerative dementia
- Infection (brain abscess)
- Metabolic disturbance
- Substance

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Metabolic Disturbances

- Hypoglycemia and hyperglycemia
  - Diabetic patients
- Hyponatremia: AMS, high risk of mortality
- Hypocalcemia: rare, more common in neonates
  - Thyroid/parathyroid surgery, renal failure, hypoparathyroidism, pancreatitis
- Hypomagnesemia: agitation, confusion, myclonus, tetany
- Uremia: renal failure/dialysis patients, myoclonic seizures
- Hyperthyroidism

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Substances

- Withdrawal
  - Alcohol and benzodiazepines
- Drug intoxication, poisoning, overdose
  - Cocaine and amphetamines
- Prescription medications

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Medications

Category	Examples
Analgesics	Opioids (eg, meperidine, tramadol)
Anticancer drugs	Busulfan, chlorambucil,cytarabine, doxorubicin, etoposide, fluorouracil, interferon alfa, methotrexate, mitoxantrone, nelarabine, platinum-based drux (eg, cisplatin), vinblastine, vincristine
Antimicrobials	Carbapenems (eg, imipenem), cephalosporins (4 gen), flouroquinolones (eg, ciprofloxacin), isoniazid, penicillins
Hypoglycemic agents	Any antidiabetic Tx that can cause hypoglycemia

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Medications

Category	Examples
Immunosuppressants	Azathioprine, cyclosporine, mycophenolate, tacrolimus
Psychiatric medications	Antipsychotics (clozapine), atomoxetine, bupropion, buspirone, lithium, MAO inhibitors, SSRIs, SNRIs, serotonin modulators, TCAs
Pulmonary medications	Aminophylline, theophylline
Stimulants	Amphetamines, methylphenidate
Sympathomimetics and decongestants	Anorexients (including nonprescription diet aids), phenylephrine, pseudoephrine

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Evaluating Pediatric Seizures

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History

- Events prior to spell
  - Illness or injury?
  - Substance or Medication?
- Characterization of spell
  - What did it look like? Video?
  - First time? Frequency? Duration?
- Events after spell
  - Confusion or drowsiness?

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History

- Past medical history
  - Pregnancy, labor and delivery, neonatal period
  - Growth and development
  - Surgeries or hospitalizations
  - Chronic illnesses
  - Medications
  - Education/Academic performance
  - Social History
  - Family History

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Physical Exam

- Observation
- Mental status
- Neurologic exam
  - Focal deficits
  - Upper motor neuron signs
- Hyperventilation

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Diagnostics

- Physical exam
  - Spell during exam
  - Hyperventilation
- EEG
- Labs
  - Serum and urine
  - CSF
- CT head/MRI brain

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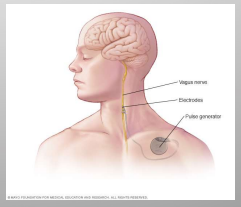
Treatment

- Daily preventative medications
- Rescue medications
  - Diazepam rectal or buccal
  - Clonazepam
- Ketogenic diet
- Vagal nerve stimulator
- Epilepsy surgery



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Daily Preventative Medications

- **Levetiracetam**
- **Ethosuximide** (absence seizures)
- **Oxcarbazepine** (focal seizures)
- Clonazepam (acute illness?)
- Infantile spasms: ACTH, Vigabatrin
- Other: Brivaracetam, Carbamazepine, Clobazam, Felbamate, Gabapentin, Lacosamide (focal), **Lamotrigine**, Phenobarbital, Rufinamide, **Topiramate**, **Valproate**, Zonisamide

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Levetiracetam (Keppra)

- MOA: Binds SV2A
- Dosing: 10 mg/kg divided BID x 1 week, then 20 mg/kg divided BID
  - 20-100 mg/kg/day
  - May switch to TID dosing in young kids
- Adverse effects: Behavioral in 10% kids
- Monitoring: Drug level sometimes

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Ethosuximide (Zarontin)

- MOA: Blocks T-type calcium channels
- Dosing: Start 10 mg/kg/day divided BID
  - 20-40 mg/kg/day
- Adverse effects:
  - Common: GI upset, drowsiness, hiccups
  - Serious: Stevens-Johnson syndrome
- Monitoring:
  - Drug levels if necessary
  - CBC, LFTs, urinalysis every 6 months

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Pediatric Seizure Disorders

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18 mo F with febrile seizures

- Hx global developmental delay since birth
- 3 seizures with fever requiring multiple seizure rescue medications, 2 of them lasting hours
- Often GTCS, may have focal jerking of the RUE at the start
- Family history of epilepsy

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Simple vs. Complex Febrile Seizures

Simple	Complex
• 6 months to 6 years	• 6 months to 6 years
• GTCS, atonic, tonic	• Focal seizures
• < 15 minutes, self-resolves	• > 15 minutes, requires Tx
• Don't recur w/in 24 hrs	• Recurrence w/in 24 hrs
• Return to baseline quicker	• Longer postictal phase
• Normal development	• Developmental delay
• Family Hx febrile seizures	• Family Hx epilepsy

Febrile status epilepticus: > 30 minutes

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Absence Epilepsy

- Most common in school-aged kids
- Behavioral arrest and blank stare
- Duration: 10-15 seconds
- May see eyes going upward, eyelid fluttering, oral automatisms, finger/hand movements
- No postictal state
- Dx: Hyperventilation and EEG
- Tx: Ethosuximide

https://www.youtube.com/watch?v=H3iLQi6wt94

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Temporal Lobe Epilepsy

- Most common in adolescence
- Preceded by auras
- Behavioral arrest, eye deviation, oral automatisms, posturing of arms
- Duration: 30-60 seconds
- Postictal period typical
- Dx: EEG and MRI brain
  - Hippocampal sclerosis: Hx febrile seizures common, often complex
- Tx: Surgery can be curative

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Behavioral Staring Spells

- "Extreme form of daydreaming"
- Blank staring, may have random movements
- Distractibility
- Can last much longer
- More often seen when bored or inactive
  - Watching TV, sitting in class
- **ADHD**, dev delay, autism
- Dx: Physical exam, EEG

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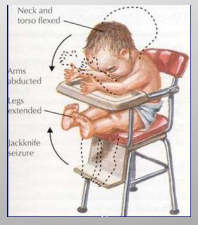
Infantile Spasms

- Onset 3-7 months, after 18 months rare
- Developmental plateau and regression
- EEG: Hypsarrhythmia
- Tx: ACTH and Vigabatrin



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Nonepileptic Paroxysmal Disorders

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Nonepileptic Paroxysmal Disorders

- Psychogenic nonepileptic spells
- Sleep-wake disorders
- Syncope/POTS
- Breath-holding spells
- Headaches and variants
- Benign shuddering attacks
- Inattention/staring spells
- GERD/Sandifer syndrome
- Benign myoclonus
- Tics
- Stereotypies
- Self-stimulation/soothing

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Psychogenic Nonepileptic Spells

- Stress response
- No EEG correlate
- Rarely under the control of the child
  - Not malingering, attention seeking, "faking it"
- Do not respond to anti-seizure medications

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Epileptic events

- Stereotyped, rhythmic, synchronous
- Not distractible or suppressible
- Eyes open
- More often associated with injury
- More often associated with incontinence
- More likely to have post-ictal confusion
- Can occur during wakefulness or sleep

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Non-epileptic behavioral event

- Arrhythmic, asynchronous shaking of limbs
- No-no head shaking
- Pelvic thrusting ("hips-arrhythmia")
- Intermittent responsiveness
- Forced eye closure
- Prolonged without post-ictal confusion
- Do not arise out of sleep

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Syncope

- Neurocardiogenic (aka vasovagal)
  - Positional
  - Often triggered by stimulus (heat, blood, etc)
  - Lightheaded, visual blurriness, "blacks out" or "curtain falls", tunnel vision
  - Fall limply
  - Regain consciousness shortly after falling
  - May be disoriented after, but not confused
  - Can have convulsions

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Orthostatic Hypotension and POTS

- Orthostatic hypotension (OH): drop in BP upon standing
- Postural (orthostatic) tachycardia syndrome (POTS): increase in HR upon standing
- Clinical features: lightheadedness, "weakness", blurred vision, and fatigue upon standing (POTS), syncope (OH)
- Dx: Orthostatic vitals, tilt-table test?
- Treatment
  - Water, salt, positional tactics, exercise
  - Fludrocortisone

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Breath-Holding Spells

- 6 months to 6 years
- Pathogenesis unclear
  - Autonomic nervous system dysfunction?
  - Iron deficiency anemia more prevalent
- Fam Hx in 20-35% patients
- Cyanotic and Pallid
- Dx: Clinical +/- EKG
- Tx: Education, iron supp

https://www.youtube.com/watch?v=e0640GTjScQ

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Benign Paroxysmal Vertigo

- Recurrent episodes of brief disequilibrium
- Frightened, off balance, reaching out for objects or people or laying flat on floor
- Nystagmus, diaphoresis, nausea, vomiting
- Consciousness intact
- Last less than a minute, cluster
- Migraine equivalent

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Resources

- Epilepsy Foundation. https://epilepsy.com
- Kotagal S. Parasomnias in childhood. Sleep Medicine Reviews. 2009; 13: 157-168.
- Mayo Clinic. https://mayoclinic.org.
- Mayo Clinic Professional Photography and Videography.
- Pina-Garza JE. *Fenichel's Clinical Pediatric Neurology*. 7th ed.
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- Swaiman KF et al. *Swaiman's Pediatric Neurology: Principles and Practice*. 5th ed.
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Questions?

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