Seizures in children

- Up to 10% of the population can have at least one seizure in their lifetime (provoked or unprovoked)
- 57% of these pts are under 25, and 71% are 15 years or younger
- Prevalence of epilepsy in US is 1-2% and seizures account for 1-2% of all ER visits
- Only one in six will have an identifiable cause

What is a seizure

- Sustained, abnormal electrical activity arising from the cerebral cortex with discrete beginning and end
- Evolution in amplitude, frequency, morphology
- Clinical presentation depends on origin, generalized versus focal

Seizure types

- Generalized
  - All seizures theoretically still derive from a focal location but what we see is the scalp representation
    - Tonic
    - Tonic/clonic
    - Myoclonic
    - Atonic
    - Absence
    - +/- Spasms

Seizure types

- Focal – new ILAE classification
  - Originating from within one hemisphere
  - Retained awareness versus loss of awareness (dyscognitive)
  - Formerly known as simple and complex partial
  - "localization related" has largely been abandoned, as cannot always give a specific structural or anatomic localization in some cases

Berg and Scheffer, 2011

Etiology

- Idiopathic, symptomatic, cryptogenic – proposed to be abandoned because they can carry certain negative/positive connotations
- New classification:
  - Genetic
  - Structural/metabolic
  - Unknown

Berg and Scheffer, Epilepsia 2011

Workup of new seizure

- If the pt is back to baseline and well-appearing with a normal exam, you can send them home with outpatient follow-up
- Consider outpatient EEG prior to follow-up visit
- EEG is only needed emergently if there is suspicion for non-convulsive status (pt stuporous or unable to arouse following seizure) or the pt was given paralytics (for intubation).

Workup of new seizure

- Neuroimaging:
  - in ER only if persistent focal deficit or not returning to baseline, or other red flags present (head trauma, h/o malignancy or predisposition to bleed).
  - CT only if concerned for bleed, otherwise MRI (with and without contrast)
- If focal features of seizure, can obtain MRI epilepsy protocol (with and without) as outpatient
- LP: not diagnostically useful in afebrile children

New onset seizures

- In otherwise neurologically normal child, 36% will go on to have a second seizure
  - 24% within one year
  - 46% within 14 years
- Recurrence risk higher in those with neurologic diagnosis
- Long term risk of epilepsy does not change with treatment after a single seizure

Shinnar et al. Pediatrics 1990 and Neurology 2005

Risk factors for recurrence

- Abnormal EEG is greatest predictor of recurrence
  - Risk of recurrence within one year jumps to 41%
  - Within three years jumps to 56%
  - Only 15% risk if normal EEG

Shinnar et al. Pediatrics 1990

- Abnormal MRI may also be predictive
  - In one study, MRI abnormality found in 16% and was associated with seizure recurrence within 9 months

Arthur et al. Epilepsia 2008

Treatment of new seizures

- AAN guidelines: treatment not indicated in children for prevention of recurrence, but can be considered if risks of second seizure outweigh risks of treatment
  - (in other words, most of the time treatment is not indicated)
- ACEP policy: normal neuro exam, normal child, normal scan = send them home with outpatient follow-up, no treatment needed

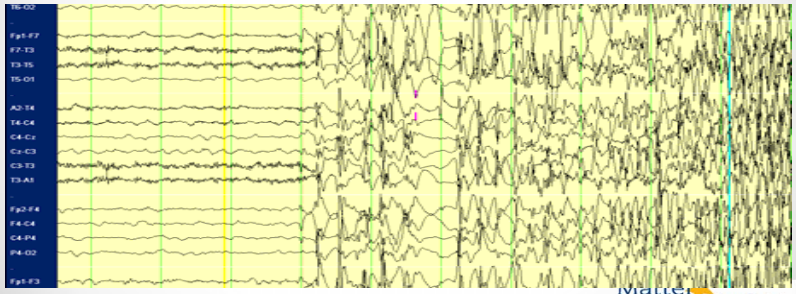
If it's a teenager - are they driving?

- California law mandates reporting for episodes of loss of consciousness
- Google "Confidential Morbidity Report" for the county the pt lives in
- It never hurts to report but it can hurt you if you don't
- Recommend that the patient not to drive until they receive the paperwork from the DMV
- You aren't taking away their license, just reporting it - the DMV decides what to do

Generalized tonic, tonic/clonic, clonic

- Usually less than a minute to minutes, whole body stiff/shaking, post-ictal minutes to hours
- Can be associated with a variety of epilepsy syndromes
  - Epilepsy with GTCs upon awakening, LGS, Dravet
- Can be the first presentation of an epilepsy syndrome previously unrecognized
  - CAE/JAE, JME
- Many treatments possible, but avoid AEDs used for focal epilepsies
  - AVOID carbamazepine, oxcarbazepine, +/- lacosamide
  - Na channel inactivation

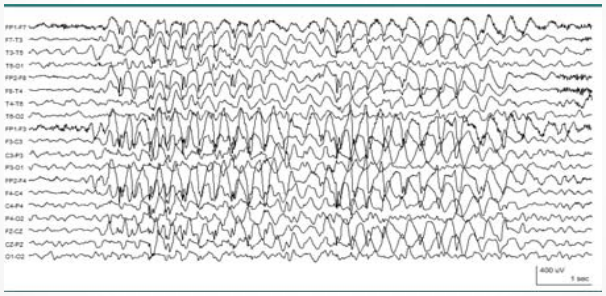
GTC



Absence seizures

- Brief, lasts seconds, no post-ictal period
- Can have one to hundreds per day
- Childhood absence (CAE) or Juvenile absence (JAE) based on age of onset
- Frequently goes unrecognized or can be misdiagnosed as ADHD
- Atypical features: eyelid myoclonus (Jeavon's), lip smacking, loss of tone
- Clinical diagnosis: behavioral arrest with hyperventilation
- EEG diagnosis: 3-4 Hz bifrontally-predominant generalized spike-wave
- Treatment: Ethosuximide, Valproate, Lamotrigine, others
- AVOID: carbamazepine, oxcarbazepine, +/- phenytoin, lacosamide

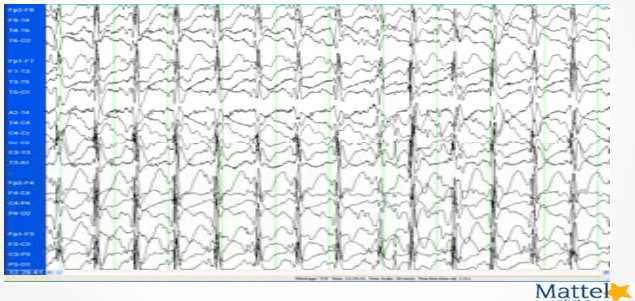
Absence seizure



Lennox-Gastaut syndrome

- Triad of slow spike-wave (1-2 Hz), mental retardation, multiple seizure types
  - Tonic, atypical absence, atonic
- Can develop from West syndrome
- Treatment: multiple AED choices (particularly felbamate, rufinamide, clobazam), VNS, ketogenic diet
- AVOID: carbamazepine, oxcarbazepine, +/- lacosamide

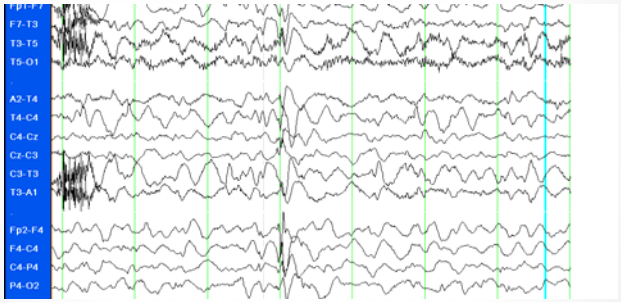
Lennox-Gastaut



Myoclonic seizures

- Brief, rapid jerk of extremities
- Associated with generalized polyspike-wave discharge
- Not to be confused with non-epileptic myoclonus (subcortical or spinal), sleep myoclonus
- Most commonly seen in JME, can also be seen in EMEI, PME, Doose, Dravet
- Commonly treat with levetiracetam, valproate, benzos

Myoclonic seizure

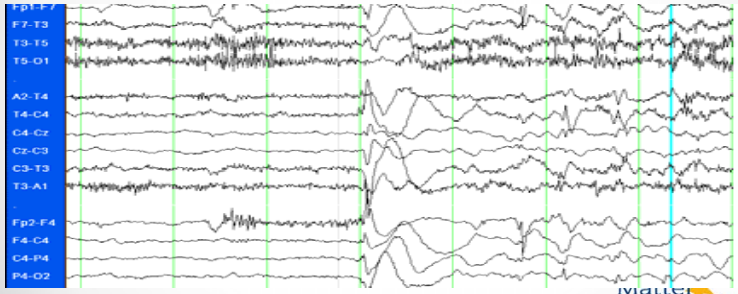


Infantile spasms

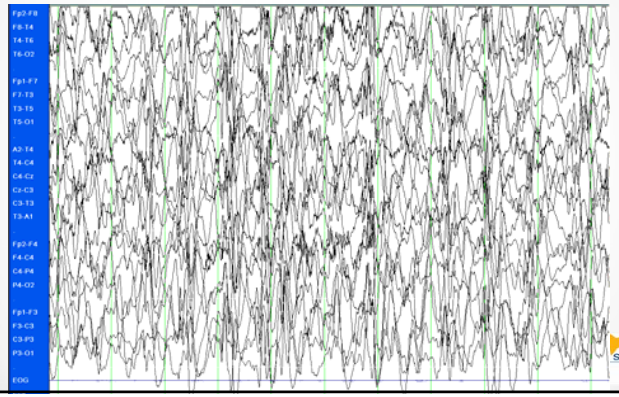
- Brief (but not rapid) flexion/extension of neck, upper extremities
- Associated with high amplitude spike and slow wave with electrodecrement
- Hypsarrhythmia and mental retardation = West syndrome
- Can West syndrome be prevented?
- Treat with prednisolone or ACTH, vigabatrin (preferred if TSC or structural), topiramate/zonisamide, benzos

Hussain et al. Epilepsia 2014

Infantile spasms



Hypsarrhythmia



Focal infantile/epileptic spasms

- UCLA changed the definition of epileptic spasms as a generalized seizure
- Can arise from a focal lesion such as cortical dysplasia, hemimegalencephaly
- Potentially curative with resective surgery, potential reversal of epileptic encephalopathy

Chugani et al, Ann Neurol 1990

Focal seizures

- Focal dyscognitive (complex partial) – first video
- Focal seizures without loss of awareness (simple partial) – second video
- Features depend on anatomic localization
  - Motor – involving motor or premotor cortex (head turn, vocalization, Jacksonian march)
  - Autonomic – usually mesial temporal (epigastric rising, sweating)
  - Sensory – auditory, olfactory, visual
- Can have automatisms (lip smacking, eye opening), movement of ipsilateral extremity
- Treatment: AEDs, surgery, VNS, ketogenic diet, RNS

Other focal epilepsy syndromes

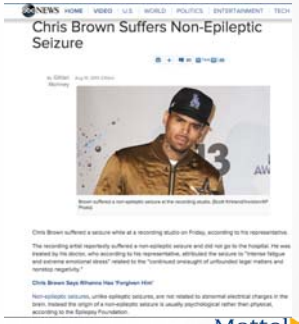
- Benign Rolandic Epilepsy (BRE) or Benign Epilepsy with Centrotemporal Spikes (BECTs)
- Panaiyotopoulos or Gastaut type epilepsy
- Autosomal dominant nocturnal frontal lobe epilepsy (ADNFLE)

Seizure vs. NES

	Seizure	Non-epileptic seizure
Timing/onset	Sporadic May occur out of sleep	Usually history of stressor (frequently abuse) During the day, rarely out of sleep
Duration	Usually < 5 mins	Often > 5 mins
Movements	Stereotyped Eyes open, deviation	Variable – bicycling, pelvic thrusting, head side-side Eyes closed, especially forced eye closure

Non-epileptic seizures

- EEG capturing an event critical to diagnosis - even experienced neurologists can be fooled by semiology alone!
- Some estimate up to 20% of patients referred to tertiary epilepsy centers with refractory epilepsy actually have NES on video EEG
- Up to 10-15% of patients with epilepsy also have non-epileptic seizures
- Treatment: education, support, and therapy



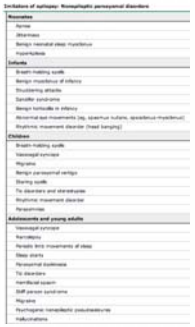
Benbadis et al, Epilepsia 2004
Uldall et al, Arch Dis Child 2006

Other paroxysmal disorders

- Movement disorders
  - Tics
    - Simple versus complex
    - Motor versus vocal
  - Stereotypies
    - Habitual, often volitional
    - Associated with but not pathognomonic for autism
  - Paroxysmal dyskinesias (kinesigenic versus non-kinesigenic)
    - Episodic dystonia, chorea, athetosis
    - Often associated with channelopathies (many also epilepsy-related genes)

Other paroxysmal disorders

- Migraine
  - Benign paroxysmal vertigo (BPV)
  - Complicated migraine
- Syncope
  - Can be convulsive
- GERD
  - Sandifer syndrome



Conclusions

- Seizures are common in the pediatric population
- Seizures are classified as generalized versus focal, as well as by etiology
- Many treatments exist for seizures, some are specifically beneficial and some should be avoided, important to recognize what you are treating
- Also important to recognize seizure versus non-seizure