Seizures and Spells

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Objectives

- Learn how to evaluate seizures and epilepsy
- Learn how to recognize seizure mimickers

Definitions

Which of the following is an example of epilepsy?

a. Convulsions while playing video games one time
b. Seizures induced by electroconvulsive therapy on multiple occasions
c. Convulsions from too much insulin
d. Seizures at the onset of a stroke
e. Seizures within one week of a head trauma

Credit: Dean Naritoku MD

Definitions

"Seizure" ? "Epilepsy"

Metabolic derangements
Medications / drugs
Acute symptomatic

Single
Unexplained

Sleep Deprivation
Photic Stimulation

Recurrent
Unprovoked

Credit: Dean Naritoku, MD

Definitions

- **Seizure:** transient occurrence of signs and/or symptoms due to abnormal excessive or synchronous neuronal activity in the brain

- **Epilepsy:** pathologic *and enduring tendency* to have recurrent seizures

R.S. Fisher et al **ILAE official report: a practical clinical definition of epilepsy**
Epilepsia, 55 (4) (2014), pp. 475-482

Definitions

- **Diagnostic criteria for Epilepsy (2014):**
  - At least two *unprovoked* (or reflex) seizures >24 hours apart.
  - One *unprovoked* (or reflex) seizure and a high probability of further seizures
    - epileptiform activity on EEG
    - a potential epileptogenic abnormality on brain imaging
  - Diagnosis of an epilepsy syndrome

R.S. Fisher et al **ILAE official report: a practical clinical definition of epilepsy**
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Definitions

- **Acute Symptomatic Seizure:** clinical seizures occurring in close temporal relationship with an acute CNS insult
  - Examples: metabolic/toxic derangements, *acute structural abnormalities (stroke/hypoxia, ICH, TBI),* infectious etiology, inflammation
  - Excluded: sleep deprivation, photic stimulation, reflex/photosensitive epilepsy
  - Time Frame: typically within 7 days of CNS insult (may vary by etiology)

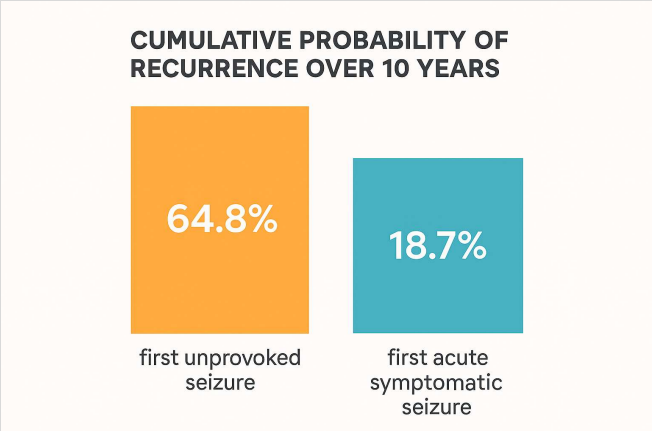
- **Unprovoked Seizure:** seizures occurring in the absence of a potentially responsible clinical condition or beyond the interval estimated for the occurrence of acute symptomatic seizures.

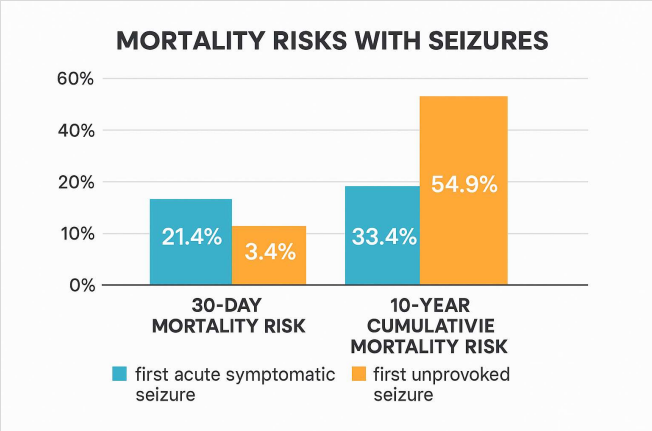
R.S. Fisher et al **ILAE official report: a practical clinical definition of epilepsy** Epilepsia, 55 (4) (2014), pp. 475-482
Beghi E, Carpio A, Forsgren L, et al. **Recommendation for a definition of acute symptomatic seizure.** Epilepsia (2010) ;51:671–675.

Definitions

Acute Symptomatic/Provoked vs Unprovoked Seizures

- Why Differentiate?





Hesdorffer DC, Benn EKT, Cascino GD, Hauser WA.
Is a first acute symptomatic seizure epilepsy?: mortality and risk for recurrent seizure.
Epilepsia (2009) 50:1102–1108.

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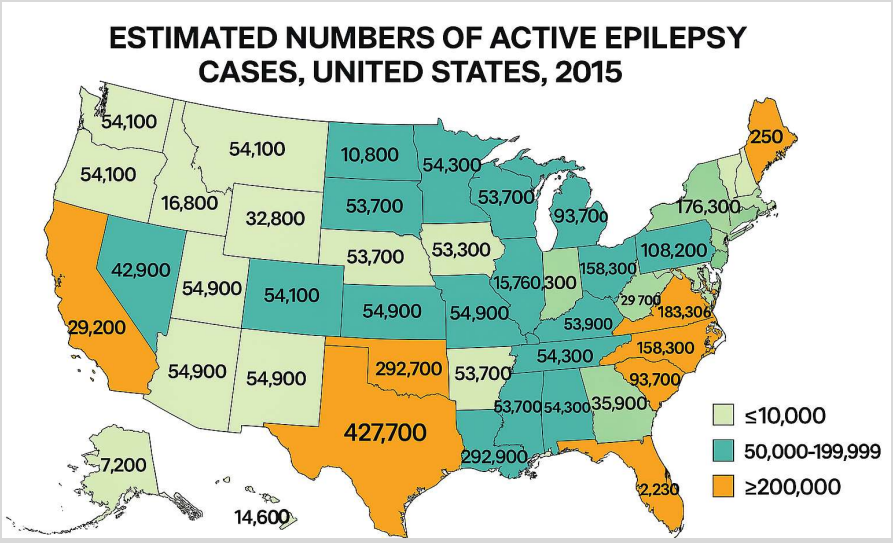
Epidemiology: Prevalence

Epilepsy is a common neurologic disorder resulting in substantial health, social, and mortality disparities.

In 2015, approximately 3 million U.S. adults and 470,000 children had active epilepsy.

Zack MM, Kobau R. National and State Estimates of the Numbers of Adults and Children with Active Epilepsy - United States, 2015. *MMWR Morb Mortal Wkly Rep*. 2017;66(31):821-825. Published 2017 Aug 11. doi:10.15585/mmwr.mm6631a1

Epidemiology: Prevalence



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Evaluation: History

Characteristics of Event

- Onset

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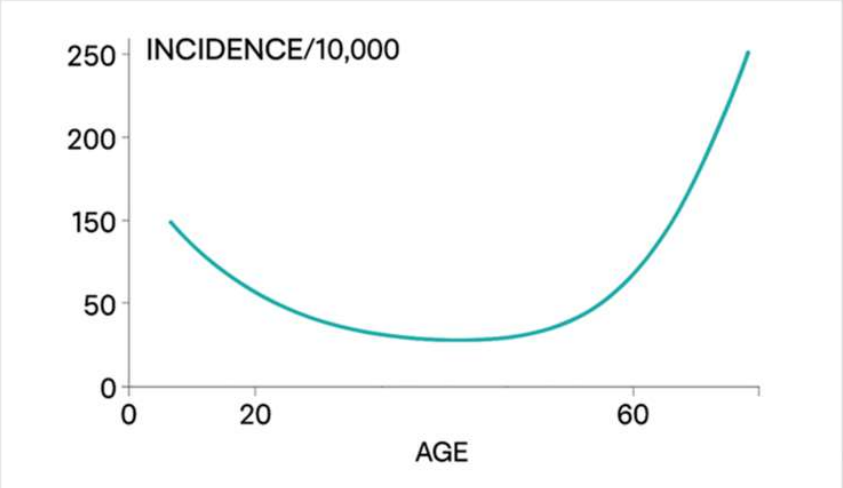

Engel, J., & Pedley, T. A. (2008). *Epilepsy: a comprehensive textbook*. Page 46

Evaluation: History

Characteristics of Event
- Onset
- **Semiology**
- FrequencyDuration
- Triggers

Antiepileptic Drugs (AEDs)
- AED/Dose/frequency
- Side effects
- Medication failures

Risk Factors
- postnatal antecedents
- Severe TBI
- CNS infection,
- neurodegenerative dz,
- complicated febrile sz,
- stroke/cancer (any structural brain abnormality)
- Family history
- drug/EtOH abuse, depression, suicidality, migraine w/ aura, HTN and other stroke risk factors

Evaluation: History

Characteristics of Event
- Onset
- **Semiology**
  - Aura
  - Postictal state
  - Loss of awareness/consciousness *(need to talk to a witness in this case)*
  - Multiple event types
- Frequency
  - h/o clustering
- Duration
  - h/o status epilepticus
- Triggers
  - Poor sleep, poor PO intake, drugs/EtOH, illness

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Evaluation: History

Characteristics of Event
- Onset

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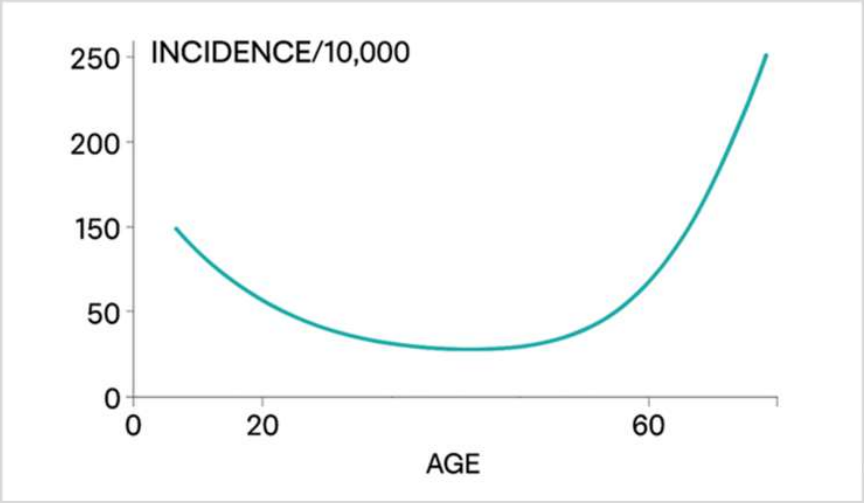

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Evaluation: History

Characteristics of Event

- **Semiology**
  - Aura
  - Postictal state
  - Loss of awareness/consciousness *(need to talk to a witness in this case)*
  - Multiple event types

Evaluation: History

Characteristics of Event

Semiology: MOST IMPORTANT ASPECT OF EVALUATION

- General tonic-clonic seizures
  - Ictal cry
  - Tonic phase
  - Clonic phase
  - Postictal phase with sonorous breathing
  - Secondary generalization (starts with focal seizure): head version, eye deviation, fencer posture, figure-of-4 posturing
- Common auras/semiology:
  - Temporal lobe:
    Auras: rising sensation, déjà vu/jamais vu, impending doom
    Semiology: oral/manual automatisms, staring/loss of awareness, "lost time," wandering

Evaluation: History

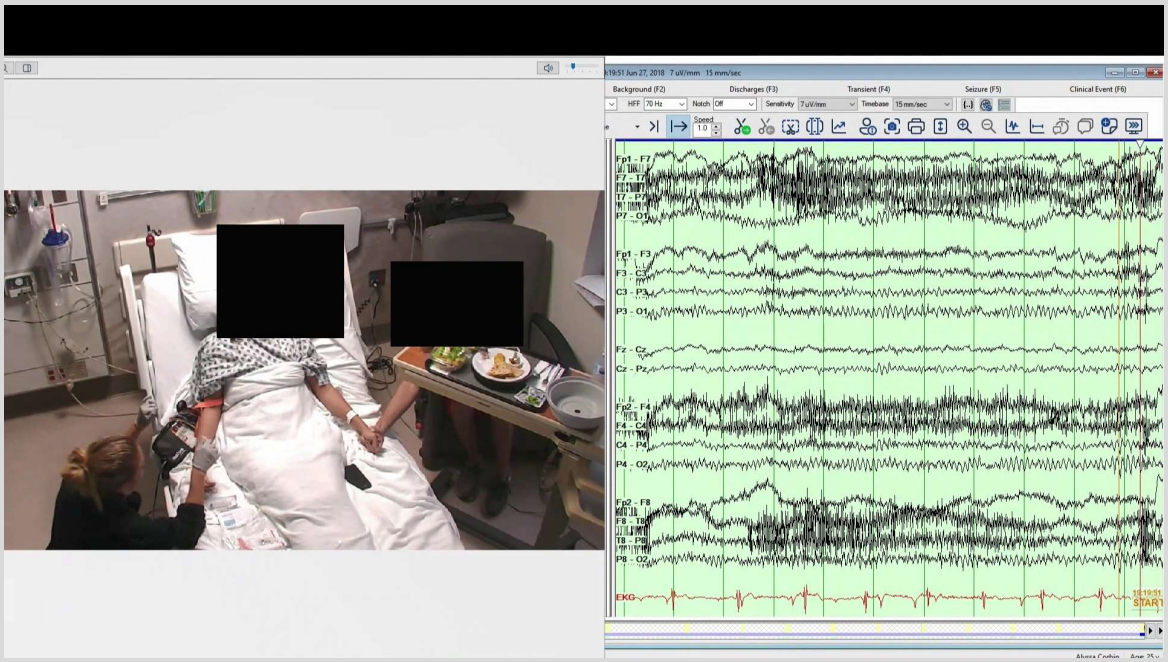
Characteristics of Event

Semiology: MOST IMPORTANT ASPECT OF EVALUATION

- Ddx:
  - TIA
  - TGA
  - Panic attack / psychogenic nonepileptic events (PNEE)
  - Syncope / convulsive syncope
    - Cardiac
    - Vasovagal
    - hypotension/orthostasis
      - Iatrogenic (BP medication)
      - Hypovolemia
      - Autonomic dysfunction
    - hypoglycemia

Evaluation: History

Evaluation: History



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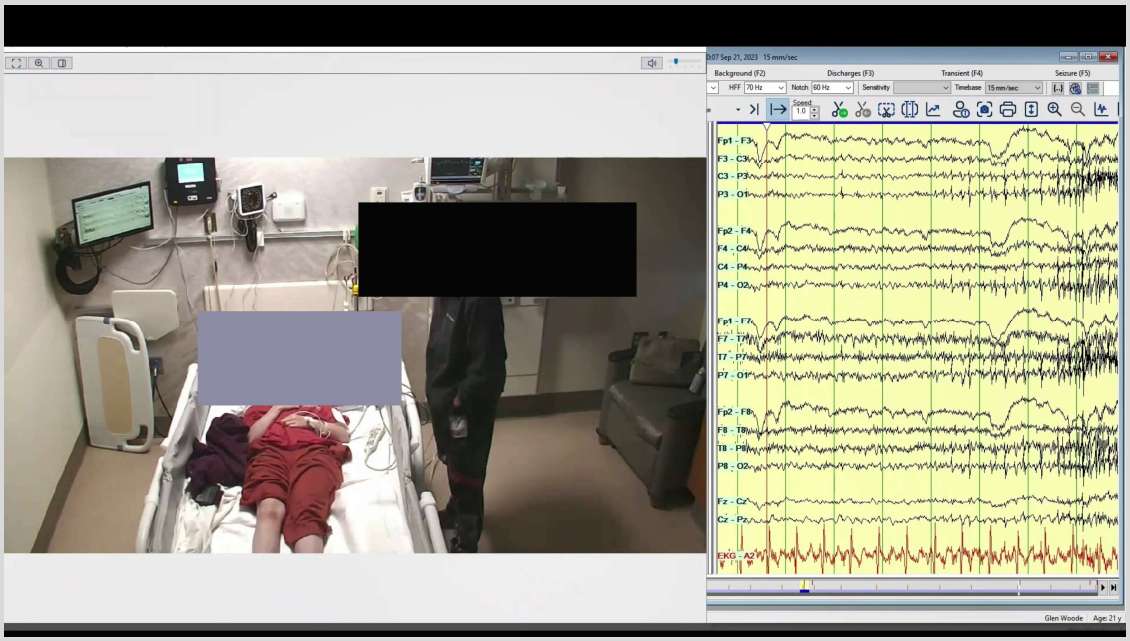


Evaluation: History

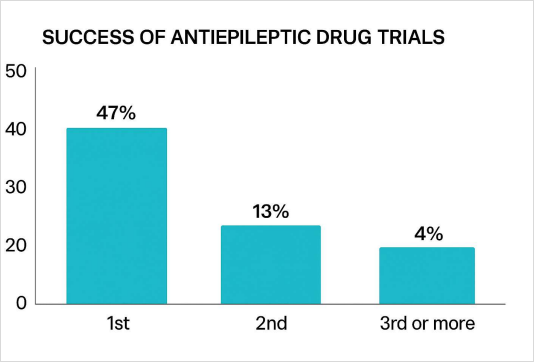
Characteristics of Event

- Frequency/Duration
  - h/o clustering
  - h/o status epilepticus
  - Objective measure of progress
- Triggers
  - Poor sleep, poor PO intake, drugs/EtOH, illness

Evaluation: History

Antiepileptic Drugs (AEDs)

- AED/Dose/frequency
- Side effects
- Medication failures



- ~50-70% will be seizure-free on AEDs alone
- Diminishing returns with more AED trials

Kwan P, Brodie MJ **Early identification of refractory epilepsy.** N Engl J Med 2000 Feb 3;342(5):314-9 ***AI generated image***

Evaluation: History

Risk Factors

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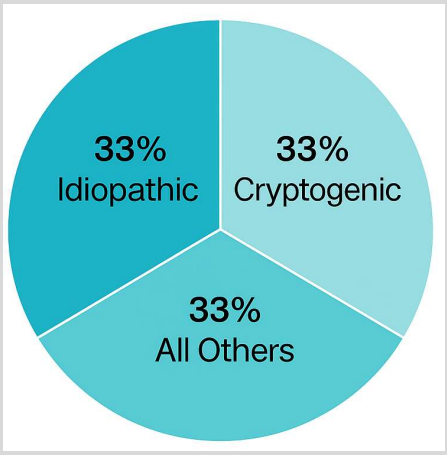
Etiology



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Evaluation: Physical

In a broad/simplified sense, seizures are due to cortical lesions

- Temporal: memory, language
  - Registration, recall, naming, repetition, multi-step command, reading, writing
- Frontal: motor execution, executive function, perseveration, visuospatial function
  - Strength/tone, complex-figure copy/draw (cube, clock), luria sequencing
- Parietal: higher order sensory function, praxis (precursor to motor planning/execution)
  - Ideomotor apraxia, double simultaneous extinction (visual/sensory)/hemineglect, stereoagnosis, graphesthesia,
- Occipital: visual function
  - Visual fields, blindsight, cortical blindness

Evaluation: Physical

For differential diagnosis

- Orthostatic vitals
- Carotid bruits
- Cardiac auscultation
- Peripheral pulses
- Sensory/reflexes

Evaluation: Physical

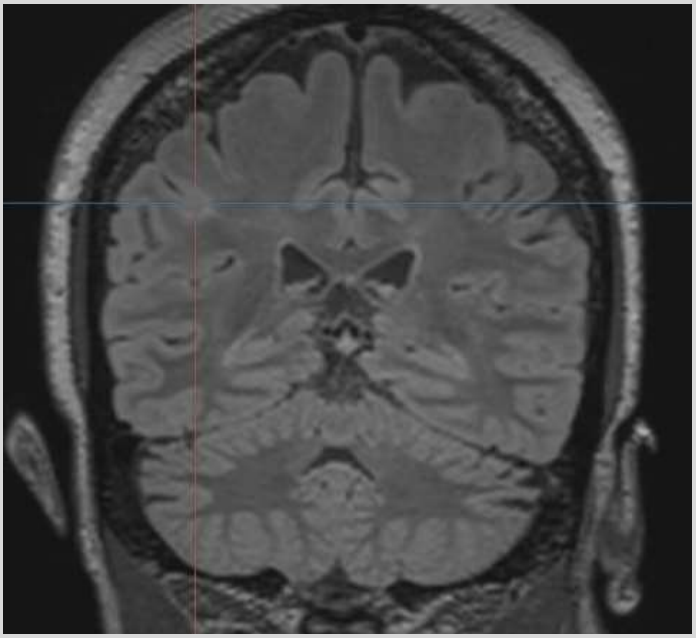
Acute repetitive seizures / status epilepticus

- Vital signs (particularly fever)
- Coma (not reactive/minimally reactive to noxious stimuli)
- Encephalopathy/altered mental status
- Focal findings on neurological exam
- Subtle clinical activity (rhythmic twitching, gaze deviation)
- Obvious clinical activity (tonic, tonic-clonic, hemiconvulsions)
- Injuries (tongue bites, incontinence, signs of head/face trauma, shoulder dislocation)

Evaluation: Data (chronic & *acute*)

- **Labs:**
  - Blood glucose, BMP/CBC, *Mg, Ca*, AED levels, ***urine drug screen***
  - LFTs, *cardiac enzymes, coagulation studies, ABG*
- **Head imaging:**
  - Brain MRI
    - Typically do not need contrast *(unless you suspect neoplasm or infection)*
    - "Epilepsy Protocol": 3T, fine temporal cuts, quantitative analysis of hippocampal size
  - Noncontrast head CT
    - Chronic: if MRI is not feasible
    - *Acute: rule out obvious stroke/ICH*
  - *Lumbar puncture: if suspecting meningitis/encephalitis*

Evaluation: Data (chronic & *acute*)



Evaluation: Data (chronic & *acute*)

Other workup for suspected Ddx:

- Cardiac: EKG/mobile cardiac telemetry, TTE, stress test
- Vascular: CUS, CTA/MRA head/neck, dynamic TCD/CTA
- Autonomic testing: QSART, HRV, Tilt-table testing

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Evaluation: Data (chronic & *acute*)

Routine EEG (30-60min):

- Sensitivity (single recording) : ~30-50%
- ~20% of patients w/ epilepsy will not have interictal abnormalities
- Specificity: IEDs may be seen in 0.2-0.5% adults w/o epilepsy

-Salinsky M, Kanter R, Dasheiff RM **Effectiveness of multiple EEGs in supporting the diagnosis of epilepsy: an operational curve.** Epilepsia 1987 Jul-Aug;28(4):331-4.
-Pillai J, Sperling MR **Interictal EEG and the diagnosis of epilepsy** Epilepsia. 2006;47 Suppl 1:14-22
-King MA et al **Epileptology of the first-seizure presentation: a clinical, electroencephalographic, and magnetic resonance imaging study of 300 consecutive patients.** Lancet 1998 Sep 26;352(9133):1007-11.

Evaluation: Data (chronic & *acute*)

Routine EEG (30-60min):

- Strategies to increase yield:
  - Repeat recordings: Sn=84% by 3rd EEG, Sn=92% by 4th EEG
  - Sleep deprivation x24hr: increases yield by 20%
  - <24hr after a seizure: Sn=51% vs Sn=34% if done later
  - Activation Maneuvers:
    - Hyperventilation: increases yield in absence epilepsy
    - Photic stimulation: typically increases yield in primary generalized epilepsy (JME, JAE, etc)
  - Longer recordings (Epilepsy monitoring unit, ambulatory EEG)

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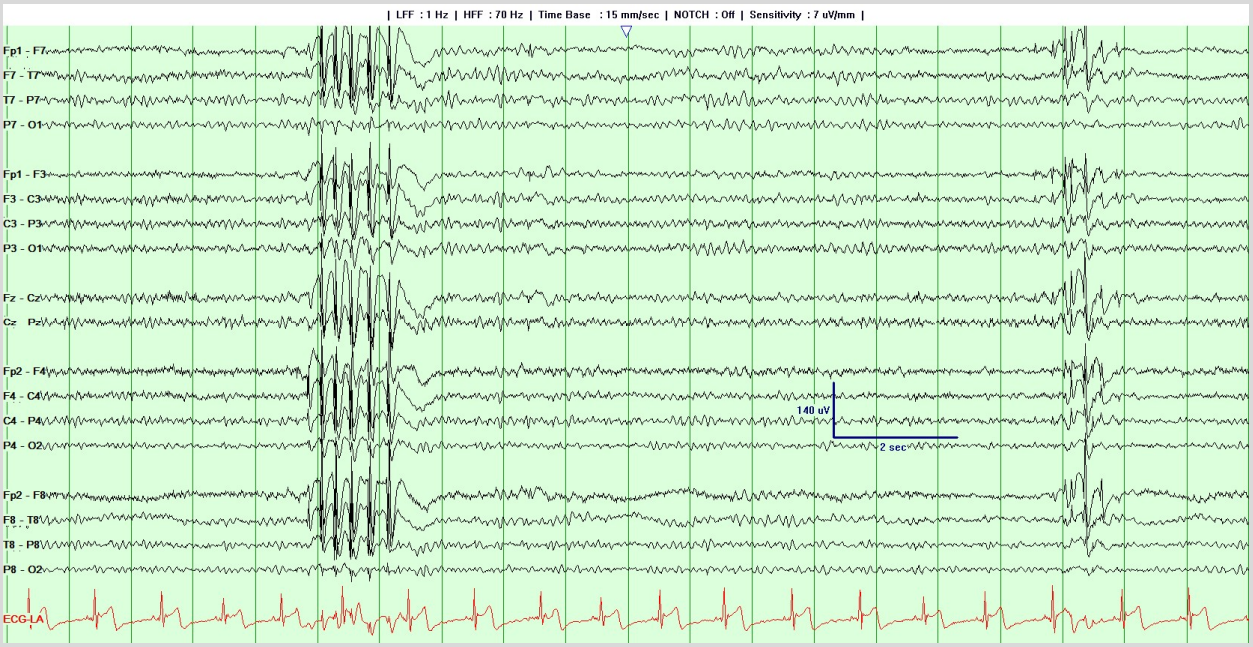

Evaluation: Data (chronic & *acute*)

Continuous EEG (ICU):

- Increased use of cEEG in ICU over last 20 years (>10x)
- NCS/NCSE associated with worse outcome
- Benefit of cEEG not clearly established but does appear to have impact on hospital outcomes

Hill C, et al. Neurology 2019; 92(1): e9-e18

Evaluation: Data (chronic & *acute*)

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Evaluation: Data (chronic & *acute*)

Continuous EEG (ICU):

- *Initial diagnosis made on clinical grounds*
- *Electrographic seizures/SE can persist when clinical activity improves (part of natural history of GCSE)*
- *Role of EEG*
  Confirm diagnosis
  Monitor treatment response
- *Do not delay treatment for EEG*

Evaluation: Data (chronic & *acute*)

Continuous EEG (ICU) Common Indications:

- **Known NCS or NCSE**
- **Traumatic brain injury**
- **Intracerebral hemorrhage**
- **Hypothermia after cardiopulmonary arrest**
- **Aneurysmal SAH**
- **Management of elevated intracranial pressure; monitoring level of sedation**
- **Other acutely ill neurologic patients**

Herman ST et al; Critical Care Continuous EEG Task Force of the American Clinical Neurophysiology Society. **Consensus statement on continuous EEG in critically ill adults and children, part II: personnel, technical specifications, and clinical practice.** J Clin Neurophysiol 2015 Apr;32(2):96-108. doi: 10.1097/WNP.0000000000000165.

Illustrative Case #1

You admitted an otherwise healthy 21yoF with new-onset seizure, described by a witness as generalized convulsions x1min followed by postictal confusion x30min. She is a college student who was sleep-deprived due to staying up several nights in a row studying for her final exams. She also describes increased twitching when she is tired, often worse in the morning.

Her physical exam is unremarkable

Labs and head imaging were normal.

Routine EEG with 4-6 Hz irregular generalized spike/polyspike-wave discharges.

Illustrative Case #1

Presence of a clinical seizure provoked by sleep deprivation and epileptiform abnormality on EEG fulfills the diagnostic criteria for epilepsy

This is a classic presentation of Juvenile Myoclonic Epilepsy (JME) based on:

-diurnal myoclonus

-EEG findings

Illustrative Case #2

30yoM admitted to the medicine service for dehydration and AKI.
You are paged STAT regarding an episode of loss-of-consciousness associated with diffuse shaking. Duration is unknown.

When you arrive the patient is back to baseline and vital signs are stable. He is in no acute distress and cardiopulmonary exam is normal.

Upon further questioning, the patient reports that he sitting in a chair and was getting blood drawn.
The last thing he remembered was feeling very lightheaded, hot, and dizzy prior to suddenly losing consciousness. The next thing he remembers is waking up on the floor with people standing over him.

Illustrative Case #2

Rapid return to baseline after diffuse shaking is more consistent with a nonepileptic etiology.

Presyncopal symptoms in association with a blood draw are most consistent with vasovagal syncope.

Note that presyncopal symptoms are nonspecific and can occur with epileptic auras as well