



Chapter 102 – Seizures

Episode Overview

1. Define status epilepticus
2. List 10 Causes of status epilepticus
3. List the differential diagnosis of ALOC post seizure
4. What factors predict abnormal CT findings in seizure patients?
5. Describe the 1st, 2nd and third line management options for seizure
6. List 4 antidotes for specific causes of refractory seizure
7. List 5 regular anti convulsants that can be re-initiated in the emergency department
8. List the acute Complications of seizures
9. Describe the legal implications of diagnosis of new seizure

WiseCracks

1. Contrast Seizure vs Syncope
2. Review differential diagnosis of seizure
3. What is neurogenic pulmonary edema and how does it occur?
4. Seizure meds and dose for no IV access
5. What is a psychogenic non-epileptic seizure?

Rosens in Perspective

As an ER doc you will see seizures!

Bimodal age distribution with vast majority being in infants (febrile seizures) and the elderly over age 75 (structural brain abnormalities)

For neurons to work properly, we need a balance milieu inside and out of the cell membrane. This includes the balance between excitatory neurotransmitters (think glutamate and acetylcholine) and inhibitory neurotransmitters (think GABA).

So things like infection, Infection, toxins, electrolyte imbalances, and other pathologic processes come around, we get badness. Once a mini electrical storm starts to happen, surrounding neurons start to become recruited in the chaos. If this happens in the motor cortex, we get the typical Jacksonian March, when focal motor seizure symptoms spread in a step-wise fashion.

If we start recruiting deeper brain centers - ie the reticular activating system, then we alter our mentation.



Some important definitions:

- ❑ **Seizure:** “excessive abnormal neuron activity associated with alterations in sensory, motor, autonomic, and/or cognitive function.”
- ❑ **Convulsion:** “refers specifically to the motor manifestations of a seizure”
- ❑ **ictal Period:** “is the time during which a seizure or seizure-like activity occurs.”
- ❑ **Post-ictal period:** “A postictal period is an interval of altered mental status immediately following a seizure, generally lasting less than 1 hour.”
- ❑ **Epilepsy:** “Epilepsy refers to a condition of recurrent unprovoked seizures.”

Seizures can be partial (focal) or generalized

- ❑ **Partial seizure:** “involve abnormal neuronal firing within a confined population of neurons in one brain hemisphere, and the clinical manifestations tend to reflect the area of electrical activity.
- ❑ **Generalized:** “Generalized seizure denotes abnormal neuronal firing throughout both brain hemispheres and always involves alterations of consciousness. Secondly generalized seizures start as a focal seizure and then progresses to a generalized event.”

Simple vs Complex seizure reflects whether the patient is fully aware and mentating (simple) versus ALOC or altered mentation (complex)

Partial subtypes:

- **Motor** (eg. facial twitching or rhythmic ipsilateral extremity movements)
- **Autonomic** (eg tachycardia or diaphoresis)
- **Somatosensory** (eg tingling or perceiving a certain smell)
- **Psychic** (eg déjà-vu).

Note: Psychic and somatosensory are usually classified as auras.

Generalized subtypes:

- Absence
- tonic (stiffening)
- clonic (rhythmic jerking)
- Tonic-clonic
- Myoclonic (discrete violent muscle contractions),
- atonic (loss of muscle tone).

Note: The common term grand mal seizure refers to generalized tonic-clonic seizures

See Figure 92.1 for a simplified classification of seizures.

What is Todd's Paralysis



- Focal motor deficit (eg complete hemiplegia) after seizure
 - Can last up to 24 hrs
 - Caused by focal cerebral hypoperfusion
 - Associated with high likelihood for underlying structural abnormality
-

[1] Define status epilepticus:

Status Epilepticus:

- A. Seizure lasting longer than greater than 5 minutes duration, or
- B. recurrent seizure activity without intervening return to baseline mental status

Status epilepticus is divided into two basic categories:

- Generalized convulsive status epilepticus (GCSE)
- Non-convulsive status epilepticus (NCSE).

GCSE: MEDICAL EMERGENCY

- typically tonic-clonic seizures
- Mortality correlated directly to seizure event

NCSE: can be subtle presentation

- Think about in patients with alteration in mentation (coma to subtle motor signs, such as twitching, blinking, eye deviation, persistent aphasia, or somatosensory aura)
- EEG will show epileptiform discharges

REFRACTORY STATUS EPILEPTICUS = a seizure that does not terminate after treatment with a benzo plus second antiepileptic drug.

[2] List 10 Causes of status epilepticus

- See Box 92.1 in Rosens 9th Edition
- Broken down by:
 - Metabolic
 - Infectious
 - Withdrawal syndromes
 - CNS lesions
 - Intoxication



[3] List the differential diagnosis of ALOC post seizure

See Box 92.2 – Differential Diagnosis of AMS in Patient Who Has Seized

Post-ictal Period

- NCSE or subtle convulsive status epilepticus can mimic
 - Hypoglycemia
 - CNS infection
 - CNS vascular event
 - Drug toxicity
 - Psychiatric disorder
 - Metabolic encephalopathy
 - Migraine
 - Transient global amnesia

[4] What factors predict abnormal CT findings in seizure patients?

See Box 92.3 – Differential Diagnosis of AMS in Patient Who Has Seized

- Focal abnormality on neurological examination
- Malignancy
- Closed head injury
- Neurocutaneous disorder
- Focal onset of seizure
- Absence of a history of alcohol abuse
- History of cysticercosis
- Altered mental status
- Patient older than 65 years old
- Seizure duration more than 15 minutes

[5] Describe the 1st, 2nd and third line management options for seizure

See table 15.1 in 9th Edition of Rosens – Seizure chapter

In summary, they discuss abortive options for seizure, with dosing and precautions, particularly:

- Initial therapy of either:
 - Diazepam
 - Lorazepam
 - Midazolam
- Second tier treatments of either:
 - Phenytoin
 - Fosphenytoin
 - Valproic acid
 - Levetiracetam
- Third-tier treatments
 - Pentobarbital
 - Phenobarbital
 - Midazolam infusion
 - Propofol infusion



[6] List 4 antidotes for specific causes of refractory seizure

Table 92.1 in Rosens

Management of Special Situation Seizures in the ED

Clinical Situation	Agent of Choice	Dosage/Comment
Hyponatremia	Hypertonic saline	2-3ml/kg of 3% NaCl in rapid sequential boluses until seizures stop
Hypocalcemia	CaCl or gluconate	Sequential ampules until seizures stop
TCA overdose	Alkalization	Administer 0.5 to 1.0 mEq/kg IV bolus; repeat as needed to maintain a blood pH of 7.4 to 7.5
Salicylate overdose	Alkalization; hemodialysis for severe cases	Administer 0.5 to 1.0 mEq/kg IV bolus; repeat as needed to maintain a blood pH of 7.4 to 7.5
Isoniazid overdose	Pyridoxine	5g IV (adult) or 70mg/kg (pediatric)
Cocaine intoxication	Benzodiazepines	As per idiopathic seizures
Lithium toxicity	Hemodialysis	
Alcohol-associated	Lorazepam	0.05-0.10mg/kg
MDMA	Benzodiazepines	Be aware of possible hyperthermia or hyponatremia
Eclampsia	Magnesium	IV loading dose of 4-6g over 15-20 minutes then 1-2g/h infusion; monitor patients for hyporeflexia. Alternatively, Ativan 4mg IV over 2-5 min or Valium 5-10mg IV slowly until seizure controlled, after which magnesium sulfate is administered.

[7] List 5 regular anti-convulsants that can be re-initiated in the emergency department

See table 92.2 in 9th Edition of Rosens

- Carbamazepine
- Gabapentin
- Lacosamide
- Lamotrigine
- Levetiracetam
- Fosphenytoin
- Valproate

[8] List the acute complications of seizures

- Hypoglycemia
- neurogenic pulmonary edema
- skeletal muscle damage
- Rhabdomyolysis
- Autonomic discharge & bulbar muscle involvement may result in
 - urinary or fecal incontinence
 - Vomiting



- tongue biting
- potential airway impairment.
- Posterior shoulder dislocations or fractures

[9] Describe the legal implications of diagnosis of new seizure

According to the Government of British Columbia [here](#)

New onset seizure has a private driving restriction:

- with a seizure free period up to 6 months; Or
- Medical clearance to drive by a Neurologist

Professional Drivers must be:

- Seizure free without medications for 12 months; Or
- On medications and seizure free for 5 years

See your local government guidelines for more information

Wisecracks

1. Contrast Seizure vs Syncope:

Likely seizure if:

- ☐ Tonic phase preceding tonic-clonic activity
- ☐ Vigorous tonic-clonic movements
- ☐ Retrograde amnesia
- ☐ post -ictal period
- ☐ Urinary incontinence
- ☐ Tongue biting
- ☐ Lactic acidosis
- ☐ Prolactinemia

2. Review differential diagnosis of seizure

Throw back to episode 18!!!

Critical Diagnosis

- Status epilepticus
- Non-convulsive status epilepticus
- Seizures with specialized treatments:



- Eclampsia
- Toxic ingestion
- Hypoglycemia
- Hyponatremia
- Increased ICP

Emergent Diagnosis

- Infection
- Post-traumatic seizures
- Serious mimics of seizure activity (eg. Cardiogenic syncope)

[3] What is neurogenic pulmonary edema and how does it occur?

According to LITFL [here](#)

Neurogenic pulmonary edema = clinical syndrome characterized by the acute onset of pulmonary edema after significant central nervous system (CNS) insult

- Etiology = surge of catecholamines that results in cardiopulmonary dysfunction

“Several theories have been proposed to explain how the catecholamine surge causes pulmonary edema:

- ❑ Neuro-cardiac (direct myocardial injury)
- ❑ Neuro-hemodynamic (ventricular compliance is indirectly altered by the abrupt increases in systemic and pulmonary pressures following CNS injury)
- ❑ “Blast theory” (acute (transient) rise in capillary pressure induces a degree of barotrauma capable of damaging the capillary-alveolar membrane, in addition to neuro-hemodynamic effects causing transudative pulmonary edema)
- ❑ Pulmonary venule adrenergic hypersensitivity (massive sympathetic discharge following CNS injury directly affects the pulmonary vascular bed, and that the edema develops regardless of any systemic changes)”

Two clinical types:

- ❑ Early = minutes to hours after CNS insult
- ❑ Delayed = 12 to 24 hours after CNS insult

Management:

- ❑ Supportive care
- ❑ protective lung ventilation strategy with relative high PEP



- ❑ alpha-blockers (phentolamine and phenoxybenzamine) -> no high quality evidence available
- ❑ *** avoid excessive diuresis -> need to maintain systemic perfusion and cerebral blood flow
- ❑ treat underlying CNS insult (e.g. ICP control)

[4] Pediatric seizure medications and dosage for no IV access

No IV... well get an IO. Dose is the same. If no IO, then go:

- Midazolam 0.2mg/kg IM/IN/buccal
- Diazepam 0.5mg/kg PR
- Lorazepam 0.1mg/kg IM

[5] What is a psychogenic non-epileptic seizure?

“Psychogenic seizures (also known as pseudoseizures or nonepileptic seizures) have been reported in 12% to 18% of patients with transient loss of consciousness and can exist concomitantly with neurogenic seizures. Psychogenic seizures are rarely caused by malingering but instead are more commonly a **functional** neurological symptom disorder, formerly called a conversion disorder.”

Characteristic features:

- out-of- phase tonic-clonic activity
- forward pelvic thrusting
- voluntary eye movements away from the examiner

Bust out that optokinetic drum app!!!

Watch out for other causes of Nonepileptic attacks (AKA *nonepileptic spells*)

“... these are nonepileptic paroxysmal neurologic events that may resemble seizures in appearance but do not result from abnormal cortical discharge.”

Etiologies include

- Breath-holding spells
- Involuntary movements
- Decerebrate or decorticate posturing
- Psychogenic seizures.

Think About the other Mimics!

“NMSS TPA TOX”



Narcolepsy with cataplexy (sudden falls)
Movement disorders - hemiballismus, tics
Syncope
Stroke

Transient global amnesia
Pseudoseizure (aka PNES)
Atypical migraines

Tox:

- ☐ Extrapyrarnidal symptoms as side effects
- ☐ ETOH withdrawal
- ☐ Hypoglycemia
- ☐ PCP use - buccolingual spasms
- ☐ Tetanus/strychine/camphor - tonic spasm