# Seizures in the Hospitalized Setting

Seizures are a common neurologic emergency in hospitalized patients, often reflecting underlying brain dysfunction or systemic illness. This pamphlet provides students with a detailed guide to recognize, evaluate, diagnose, and treat seizures, with case scenarios to apply the knowledge.

## Presentation

- **Definition:** A seizure is an abnormal, uncontrolled electrical discharge in the brain, leading to transient changes in behavior, movement, sensation, or consciousness.
- **General Presentation:**
  - **Symptoms:** Sudden onset of convulsions, altered consciousness, staring spells, automatisms (e.g., lip-smacking), sensory changes (e.g., aura), or postictal confusion.
  - **Duration:** Typically 1-2 minutes (prolonged if >5 minutes = status epilepticus).
  - **Postictal State:** Confusion, lethargy, Todd's paralysis (focal weakness), lasting minutes to hours.
- **Associated Signs:**
  - **Vital Signs:** Tachycardia, hypertension (ictal); hypoxia, fever (if provoked).
  - **Neurologic:** Focal deficits (e.g., hemiparesis), altered mental status, gaze deviation.
  - **Systemic:** Tongue biting, urinary incontinence, trauma (e.g., shoulder dislocation).

## Types of Seizures and Clinical Recognition

- **Focal Seizures:**
  - **Simple Partial (No Loss of Consciousness):**
  - **Clinical:** Focal motor (e.g., arm twitching), sensory (e.g., tingling), autonomic (e.g., sweating), or psychic (e.g., déjà vu).
  - **Recognition:** Localized symptoms, patient remains aware, no postictal state.
- **Complex Partial (Impaired Consciousness):**
  - **Clinical:** Staring, automatisms (e.g., lip-smacking, hand movements), confusion.

    - **Recognition:** Impaired awareness, postictal confusion, often temporal lobe origin.
- **Focal to Bilateral Tonic-Clonic:**
    - **Clinical:** Starts focally (e.g., arm twitching), spreads to generalized convulsions.
    - **Recognition:** Focal onset, then bilateral tonic-clonic activity, postictal state.
- **Generalized Seizures:**
    - **Tonic-Clonic (Grand Mal):**
    - **Clinical:** Loss of consciousness, tonic phase (stiffening), clonic phase (rhythmic jerking), postictal confusion.
    - **Recognition:** Generalized from onset, urinary incontinence, tongue biting.
- **Absence (Petit Mal):**
    - **Clinical:** Brief staring spells (5-10 seconds), no postictal state, often in children.
    - **Recognition:** Sudden onset/offset, no aura, 3 Hz spike-and-wave on EEG.
- **Myoclonic:**
    - **Clinical:** Sudden, brief muscle jerks (e.g., arm flinging), often bilateral.
    - **Recognition:** No loss of consciousness, often in epilepsy syndromes (e.g., juvenile myoclonic epilepsy).
- **Atonic (Drop Attacks):**
    - **Clinical:** Sudden loss of muscle tone, fall to the ground, brief duration.
    - **Recognition:** No postictal state, often in Lennox-Gastaut syndrome.
- **Status Epilepticus:**
    - **Clinical:** Seizure >5 minutes OR ≥2 seizures without recovery between.
    - **Recognition:** Continuous convulsions, altered mental status, high mortality (20- 30% if untreated).
- **Key Tips:**
    - **Focal onset:** Suggests structural lesion (e.g., stroke, tumor)—requires imaging.
    - **Generalized from onset:** Consider metabolic/provoked causes (e.g., hypoglycemia, alcohol withdrawal).

Seizure Types and Clinical Recognition Table

| Type | Clinical Features | Recognition | Notes |
|---|---|---|---|
| Focal (Simple Partial) | Focal motor, sensory, psychic | No loss of consciousness, no postictal state | Suggests focal lesion (e.g., stroke). |
| Generalized Tonic-Clonic | Loss of consciousness, tonic-clonic movements | Bilateral from onset, postictal confusion | Tongue biting, incontinence common. |
| Absence | Brief staring spells (5-10 sec) | Sudden onset/offset, no postictal state | 3 Hz spike-and-wave EEG; common in children. |

| Type | Clinical Features | Recognition | Notes |
|---|---|---|---|
| Status Epilepticus | Seizure >5 min OR no recovery | Continuous convulsions, altered mental status | Medical emergency; 20-30% mortality. |

## Differential Diagnosis

- **Syncope:**
  - **Features:** Brief loss of consciousness, often preceded by lightheadedness, pallor, no postictal state.
  - **Clues:** Upright posture, rapid recovery, no tonic-clonic movements.
- **Psychogenic Non-Epileptic Seizures (PNES):**
  - **Features:** Asynchronous movements, prolonged (>5 min), emotional trigger, eyes closed during event.
  - **Clues:** Normal EEG during event, no postictal confusion, often history of trauma.
- **Movement Disorders:**
  - **Features:** Tremor, myoclonus, dystonia (e.g., Parkinson's, essential tremor).
  - **Clues:** No loss of consciousness, stereotyped movements, no postictal state.
- **TIA/Stroke:**
  - **Features:** Focal neurologic deficits (e.g., hemiparesis), no rhythmic movements.
- **Clues:** Negative symptoms (weakness), no postictal confusion, imaging findings (MRI).
  - **Metabolic/Toxic:**
  - **Features:** Hypoglycemia, hyponatremia, alcohol withdrawal (delirium tremens).
  - **Clues:** Metabolic abnormalities (e.g., glucose <50 mg/dL), history of substance use.
- **Key Tips:**
  - **Video recording (if available):** Helps differentiate seizure vs. PNES (asynchronous movements, eyes closed in PNES).
  - **Postictal state:** Suggests true seizure, absent in syncope/PNES.

## Causes

- **Provoked Seizures (Acute Symptomatic):**
  - **Metabolic:**
    - **Hypoglycemia:** Glucose <50 mg/dL (e.g., insulin overdose, DKA).
    - **Electrolyte Imbalances:** Hyponatremia (<120 mEq/L), hypocalcemia (<7 mg/dL), hypomagnesemia (<1.2 mg/dL).

        - **Uremia:** CKD (creatinine >5 mg/dL), often with AKI.
    - **Infections:**
        - **Meningitis/Encephalitis:** S. pneumoniae, HSV, TB (fever, headache, altered mental status).
        - **Brain Abscess:** S. aureus, anaerobes (focal seizures, fever, MRI with ring- enhancing lesion).
    - **Sepsis:** Cytokine storm, metabolic derangements (e.g., gram-negatives, S. aureus).
    - **Toxic:**
        - **Alcohol Withdrawal:** 48-72h after cessation, often generalized tonic-clonic.
        - **Drugs:** Cocaine, amphetamines, tramadol, bupropion (lowers seizure threshold).
        - **Medication Withdrawal:** Benzodiazepines, barbiturates (abrupt cessation).
- **CNS Injury:**
    - **Stroke:** Ischemic (cortical), hemorrhagic (ICH, SAH), within 1-2 weeks.
    - **Traumatic Brain Injury (TBI):** Early (<7 days) or late (>7 days) post- injury.
    - **Hypoxic-Ischemic Injury:** Post-cardiac arrest, prolonged hypoxia.
- **Unprovoked Seizures (Epilepsy or Structural):**
    - **Structural:**
        - **Brain Tumor:** Primary (e.g., glioma), metastatic (e.g., lung, breast), focal seizures.
        - **Stroke:** Chronic cortical scar, late-onset seizures (months-years post-event).
        - **Arteriovenous Malformation (AVM):** Hemorrhage, focal seizures.
- **Epilepsy Syndromes:**
    - **Juvenile Myoclonic Epilepsy:** Myoclonic jerks, generalized tonic-clonic, often triggered by sleep deprivation.
    - **Temporal Lobe Epilepsy:** Complex partial seizures, often with aura (e.g., déjà vu).
- **Genetic:**
    - **Channelopathies:** SCN1A mutations (e.g., Dravet syndrome), generalized seizures.
- **Other Causes:**
    - **Autoimmune:** Anti-NMDA receptor encephalitis (psychiatric symptoms, seizures), limbic encephalitis.
    - **Post-Surgical:** Craniotomy, shunt placement (e.g., VP shunt), often focal.
    - **Pregnancy:** Eclampsia (seizures + hypertension, proteinuria), often generalized.

## Labs and Diagnostic Tests

- **Initial Labs:**
  - **Metabolic Panel:** Glucose, sodium, calcium, magnesium (rule out hypoglycemia, hyponatremia).
  - **CBC:** Leukocytosis (infection), anemia, thrombocytopenia (sepsis, DIC).
  - **Inflammatory Markers:** CRP, procalcitonin (infection/sepsis).
  - **Toxicology Screen:** Alcohol, drugs of abuse (e.g., cocaine, amphetamines).
  - **Renal/Hepatic Function:** Creatinine, LFTs (uremia, hepatic encephalopathy).
- **Diagnostic Tests:**
  - **EEG (Electroencephalogram):**
  - **Indications:** Unclear diagnosis, status epilepticus, or suspected non-convulsive seizures.
  - **Findings:** Epileptiform discharges (e.g., spikes, sharp waves), focal slowing (structural lesion), 3 Hz spike-and-wave (absence).
  - **Timing:** Ideally within 24-48h of seizure (higher yield for abnormalities).
- **Lumbar Puncture (LP):**
  - **Indications:** Suspected meningitis/encephalitis (fever, headache, altered mental status).
  - **Tests:** Cell count, glucose, protein, Gram stain, culture, HSV PCR, TB PCR.
  - **Contraindications:** Increased ICP (e.g., mass lesion on CT), coagulopathy.
- **Imaging:**
  - **CT Head (Non-Contrast):**
  - **Indications:** First-line, emergent (rule out hemorrhage, mass effect).
  - **Findings:** ICH, SAH, mass lesion (tumor, abscess), edema.
- **MRI Brain:**
  - **Indications:** Higher sensitivity for structural lesions, ischemia, encephalitis.
  - **Findings:** Cortical stroke, tumor, AVM, mesial temporal sclerosis (temporal lobe epilepsy).
- **CT/MRI Angiography:**
  - **Indications:** Suspected AVM, mycotic aneurysm (endocarditis-related seizures).
- **Other Tests:**
  - **Blood Cultures:** If fever/sepsis (e.g., S. aureus, gram-negatives).
  - **Autoimmune Panel:** Anti-NMDA receptor antibodies, ANA (if autoimmune encephalitis suspected).
  - **Toxicology:** Serum alcohol level, drug levels (e.g., tramadol, bupropion).

## When to Consult Neurology

- New-onset seizure in adults (rule out structural lesion, epilepsy).
- Status epilepticus (>5 min, requires urgent management).
- Suspected non-convulsive seizures (altered mental status, normal CT, EEG needed).
- Focal seizures (suggests structural lesion—requires MRI, EEG).
- Refractory seizures (failure of first-line therapy, e.g., lorazepam-resistant).
- Suspected autoimmune encephalitis (e.g., anti-NMDA, psychiatric symptoms).
- Need for long-term antiepileptic drug (AED) management (e.g., epilepsy diagnosis).

## Treatment

- **Acute Seizure Management:**
  - **First-Line (Benzodiazepines):**
    - Lorazepam 0.1 mg/kg IV (max 4 mg) OR diazepam 0.15 mg/kg IV (max 10 mg), repeat x1 if needed.
    - Midazolam 10 mg IM (if no IV access, e.g., pre-hospital).
  - **Second-Line (AEDs):**
    - Phenytoin/Fosphenytoin 20 mg/kg IV (loading dose, max 50 mg/min to avoid hypotension).
    - Valproic Acid 20-40 mg/kg IV (loading dose, faster infusion).
    - Levetiracetam 1,000-3,000 mg IV (preferred, fewer side effects).
  - **Status Epilepticus (Refractory >20 min):**
    - Intubate if airway compromised.
    - Midazolam 0.2 mg/kg IV bolus, then 0.1-0.4 mg/kg/h infusion OR propofol 1-2 mg/kg IV bolus, then 2-10 mg/kg/h infusion.
    - Continuous EEG monitoring (rule out non-convulsive status).
- **Underlying Cause:**
  - **Metabolic:**
    - **Hypoglycemia:** D50W 50 mL IV (if glucose <50 mg/dL), then D10W infusion.
    - **Hyponatremia:** 3% hypertonic saline 100-150 mL IV over 20 min (if sodium <120 mEq/L, symptomatic).
  - **Infections:**
    - **Meningitis:** Ceftriaxone 2 g IV q12h + vancomycin 15 mg/kg IV q12h; add acyclovir 10 mg/kg IV q8h (if HSV suspected).

        - **Brain Abscess:** Ceftriaxone 2 g IV q12h + metronidazole 500 mg IV q8h; surgical drainage if >2.5 cm.
    - **Toxic:**
        - **Alcohol Withdrawal:** Lorazepam 2-4 mg IV q15-30 min (titrate to symptom control), thiamine 100 mg IV.
        - **Drug Overdose:** Supportive care, naloxone (if opioid-related, e.g., tramadol).
    - **Long-Term AED Therapy:**
        - **Indications:** Unprovoked seizure, epilepsy diagnosis, high recurrence risk (e.g., structural lesion, abnormal EEG).
    - **First-Line AEDs:**
        - **Focal Seizures:** Levetiracetam 500 mg PO BID (titrate to 1,000-3,000 mg/day), lamotrigine 25 mg PO daily (titrate to 100-400 mg/day).
        - **Generalized Seizures:** Valproic acid 500 mg PO BID (titrate to 1,000-2,000 mg/day), lamotrigine (as above).
        - **Monitoring:** Serum levels (e.g., valproic acid 50-100 µg/mL), LFTs (valproic acid hepatotoxicity), CBC (carbamazepine agranulocytosis).
- **Key Tips:**
    - **Status Epilepticus:** Treat within 5 min (lorazepam); second-line AED within 20 min.
    - **AED Choice:** Levetiracetam preferred in hospital (IV/PO, minimal drug interactions).
    - Avoid abrupt AED withdrawal (precipitates seizures).

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Treatment Guidelines Table

| Condition | Treatment Agent/Dose | Notes |
|---|---|---|
| Acute Seizure | Lorazepam 0.1 mg/kg IV (max 4 mg) | Repeat x1 if needed; midazolam IM if no IV access. |
| Status Epilepticus | Fosphenytoin 20 mg/kg IV<br>Midazolam 0.2 mg/kg IV | Continuous EEG; intubate if airway compromised. |
| Hypoglycemia | Glucose D50W 50 mL IV | Follow with D10W infusion; recheck glucose q1h. |
| | Levetiracetam 500 mg PO BID | |

| Condition | Treatment Agent/Dose | Notes |
|---|---|---|
| Focal Seizures (Long-Term) | | Titrate to 1,000-3,000 mg/day; monitor renal function. |

## Complications

- **Acute:**

o **Status Epilepticus:** 20-30% mortality; neuronal injury, rhabdomyolysis, lactic acidosis.

o **Aspiration:** Pneumonia, ARDS (postictal state, impaired airway protection).

o **Trauma:** Tongue laceration, shoulder dislocation, head injury (falls).

- **Chronic:**

o **Post-Traumatic Epilepsy:** Late seizures after TBI/stroke (scar formation).

o **Cognitive Decline:** Recurrent seizures (e.g., temporal lobe epilepsy), status epilepticus.

- **Other:**

o **SUDEP (Sudden Unexpected Death in Epilepsy):** 1/1,000 patient-years, often nocturnal, generalized seizures.

o **AED Toxicity:** Stevens-Johnson syndrome (lamotrigine), hepatotoxicity (valproic acid), ataxia (phenytoin).

## Key Pearls

- **Types:** Focal (structural lesion), generalized (metabolic/provoked), status epilepticus (>5 min).

- **Clinical Recognition:** Focal (no loss of consciousness), tonic-clonic (generalized, postictal), absence (brief staring, children).

- **Differential:** Syncope (no postictal), PNES (asynchronous, eyes closed), metabolic (e.g., hypoglycemia).

- **Causes:** Provoked (metabolic, infection, toxic), unprovoked (epilepsy, structural), genetic (channelopathies).

- **Labs/Tests:** Glucose, electrolytes, EEG (epileptiform discharges), MRI (structural lesion).

• **Neurology Consult:** New-onset, status epilepticus, focal seizures, suspected autoimmune.

• **Treatment:** Lorazepam (acute), levetiracetam (long-term), treat underlying cause (e.g., hypoglycemia).

## References


• **UpToDate:** “Seizures and Epilepsy in Adults: Diagnosis and Management” (2025).

• **AAN:** “Guidelines for the Management of Status Epilepticus” (2024).

• **NEJM:** “Status Epilepticus: Pathophysiology and Treatment” (2023).

• **Epilepsia:** “Autoimmune Encephalitis and Seizures” (2024).


## Case Scenarios

### Case 1: A 65-Year-Old Male with New-Onset Seizure

• **Presentation:** A 65-year-old male with a history of hypertension presents after a witnessed seizure—sudden right arm twitching, progressing to generalized tonic-clonic activity, lasting 2 minutes. Postictal confusion lasts 20 minutes. Exam shows right-sided weakness (Todd’s paralysis), no fever.

• **Labs/Imaging:** Glucose 90 mg/dL, sodium 138 mEq/L, calcium 8.5 mg/dL. CT head: Left frontal lobe hypodensity (suspected stroke). MRI: Acute ischemic stroke in left frontal cortex. EEG: Focal epileptiform discharges (left frontal).

• **Diagnosis:** Focal Seizure (Secondary to Stroke) → Focal onset, MRI-confirmed stroke.

• **Management:** Neurology consult. Start levetiracetam 500 mg IV BID (titrate to 1,000 mg BID PO). Monitor for recurrence (EEG shows epileptiform activity). Stroke workup: Carotid ultrasound, lipid panel, aspirin 81 mg PO daily. No further seizures during admission; discharge on levetiracetam with outpatient follow-up.

### Case 2: A 30-Year-Old Female with Status Epilepticus

• **Presentation:** A 30-year-old female with a history of epilepsy (on levetiracetam) presents with continuous generalized tonic-clonic seizures for 10 minutes. No recent medication changes, no trauma. Exam shows ongoing convulsions, BP 160/90 mmHg, HR 110 bpm, SpO2 88%.

• **Labs/Imaging:** Glucose 110 mg/dL, sodium 135 mEq/L. CT head: Normal. EEG: Generalized epileptiform discharges.

• **Diagnosis:** Status Epilepticus → Seizure >5 minutes, history of epilepsy.

• **Management:** Lorazepam 4 mg IV x 2 doses (seizures stop at 15 min). Load fosphenytoin 20 mg/kg IV (1,500 mg). Intubate for airway protection (SpO2 88%).

Transfer to ICU with continuous EEG (rule out non-convulsive status). Levetiracetam increased to 1,500 mg BID. Neurology consult—seizures controlled, extubated on day 2. Discharge with adjusted AED regimen.

## Case 3: A 50-Year-Old Male with Fever and Seizure

• **Presentation:** A 50-year-old male with a history of alcohol use presents with fever (39°C), headache, and a generalized tonic-clonic seizure lasting 3 minutes. Exam shows nuchal rigidity, photophobia, postictal confusion.

• **Labs/Imaging:** WBC 18,000/µL, glucose 80 mg/dL. CT head: Normal. LP: CSF WBC 1,200/µL (80% neutrophils), glucose 30 mg/dL, protein 150 mg/dL, Gram stain positive for gram-positive diplococci (S. pneumoniae). Blood cultures positive for S. pneumoniae.

• **Diagnosis:** Generalized Seizure (Secondary to Meningitis) → Fever, nuchal rigidity, CSF findings.

• **Management:** Neurology and ID consult. Start ceftriaxone 2 g IV q12h + vancomycin 15 mg/kg IV q12h x 14 days. Acyclovir 10 mg/kg IV q8h (pending HSV PCR—later negative). Dexamethasone 10 mg IV q6h x 4 days (S. pneumoniae meningitis). Lorazepam 2 mg IV PRN (no further seizures). MRI brain (day 3): No abscess. Patient improves, discharged on oral antibiotics to complete 14 days.