

Seizure and Status Epilepticus Stabilization

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THE STORY IN ONE SENTENCE

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“Give a benzodiazepine (a calming medicine that hits the brakes on seizures) at 5 minutes. If still seizing, give a second seizure medicine at 20 minutes. If still seizing, use anesthetic (sleep medicine) at 40 minutes.”

Normal anatomy — the body's job

The brain runs on a careful balance between excitation (go-signals from glutamate, the brain's main gas pedal) and inhibition (stop-signals from GABA, the brain's main brake). Neurons talk to each other by releasing these chemical messengers across tiny gaps called synapses. Normally, the brake and gas pedal balance so precisely that your thoughts, movements, and awareness flow smoothly without runaway firing.

BODY'S JOB

GABA (gamma-aminobutyric acid, the brain's calming messenger) lands on receptors and opens gates that let negative charge into the neuron, which makes it harder for that cell to fire — think of it as pressing the brake. Glutamate (the brain's main excitatory messenger) does the opposite: it opens gates that let positive charge in, making the neuron fire — that is the gas pedal. In a healthy brain, these two signals balance each other second by second, so only the right neurons fire at the right time. This balance keeps your muscles steady, your thoughts clear, and your awareness smooth.

1. Glutamate (the gas pedal) is released at the synapse and lands on receptors, opening gates that let positive ions rush in and make the neuron fire.

2. GABA (the brake) is released at other synapses and lands on receptors, opening gates that let negative ions in and make the neuron harder to fire.
3. The balance between these two signals keeps brain activity steady — only the neurons that should fire do fire, and they fire at the right rhythm.
4. This balanced rhythm keeps your muscles moving smoothly, your thoughts flowing clearly, and your awareness continuous without random storms of activity.

What breaks

The brake system (GABA) fails or the gas pedal (glutamate) gets stuck wide open, so neurons fire in a runaway chain that spreads across the whole brain like a wildfire. Once the seizure starts, the longer it goes, the harder it is to stop — the brain's own brakes burn out from overuse and the neurons become resistant to the calming signals.

CLINICAL TERM

Status epilepticus (a seizure that will not stop) is a seizure lasting longer than 5 minutes, or recurrent seizures without return to baseline consciousness. The upstream break is loss of GABAergic inhibition or excess glutamatergic excitation, triggered by low antiepileptic drug levels, alcohol withdrawal (sudden loss of GABA-boosting effect), acute stroke (ischemia destabilizes neuronal membranes), CNS infection (meningitis or encephalitis causing inflammation and metabolic derangement), severe electrolyte disturbance (hyponatremia, low blood sugar (hypoglycemia), low calcium (hypocalcemia), or low magnesium (hypomagnesemia) all lower the seizure threshold), drugs (cocaine, sympathomimetics, or withdrawal from benzodiazepines or barbiturates), structural lesion (tumor, abscess, or bleeding (hemorrhage)), or eclampsia (cerebral vasospasm and endothelial injury). The downstream cascade is continuous neuronal firing, massive neurotransmitter release, excitotoxicity, ATP depletion, lactic acidosis (acid from oxygen-starved tissues), rhabdomyolysis, hyperthermia, and risk of permanent neuronal injury after 30–60 minutes of sustained seizure.

How the body compensates

The body tries to keep oxygen and blood flowing to the brain during the seizure by speeding up the heart, pumping blood pressure higher, and breathing faster between apneic pauses. These are rescue moves, not the real problem. Vital signs can look stable or even elevated in the early minutes while the brain is silently running out of energy and oxygen reserve — so a normal blood pressure or heart rate does not mean the patient is safe. The crash point to watch for is pauses in breathing (apnea) leading to low oxygen (hypoxia), aspiration of secretions into the

lungs, rhabdomyolysis causing kidney failure, and permanent brain injury after 30–60 minutes of continuous seizure.

1. A fast heart rate (Tachycardia) and high blood pressure (hypertension): The brainstem's autonomic centers fire in overdrive to keep blood pressure and heart rate up, pumping oxygenated blood to the seizing brain — this looks like the body is stable, but it is actually the body working at maximum effort to prevent collapse.
2. Fast breathing (Tachypnea) alternating with pauses in breathing (apnea): Between the muscle contractions of the seizure, the brainstem tries to hyperventilate to blow off the carbon dioxide building up from all the muscle work — but during the tonic (stiff) phase, the chest muscles lock and breathing stops, causing oxygen to drop in waves.
3. Lactic acidosis (acid from oxygen-starved tissues): Muscles and neurons burn glucose without enough oxygen (anaerobic metabolism), producing lactic acid that spills into the blood and lowers pH — this is the body's fuel crisis showing up in the blood gas.
4. In the groggy phase after a seizure (Postictal) confusion and somnolence: After the seizure stops, the brain is exhausted, neurotransmitters are depleted, and neurons are hyperpolarized (extra-negative and hard to fire) — so the person is deeply confused or asleep for minutes to hours while the brain resets; this is recovery, not a new problem.
5. Compensatory mechanisms fatigue: The longer the seizure runs, the more the body's rescue systems (heart, lungs, temperature control) fail under the strain — leading to low blood pressure (hypotension), respiratory failure, hyperthermia, and multi-organ injury.
6. The dangerous middle: A patient can look stable (normal pulse, normal pressure) for the first 10–20 minutes while the brain is silently cooking and oxygen reserve is running out — the team must treat based on time and seizure activity, not reassuring vital signs.

Domino effect

1. The balance between GABA (the brain's stop-signal) and glutamate (the brain's go-signal) breaks, triggered by low antiepileptic drug levels, alcohol withdrawal, stroke, infection, bad electrolytes, drugs, tumor, or eclampsia. — Without enough GABA braking or with too much glutamate gas, neurons start firing in a runaway chain — one neuron triggers the next, and the electrical storm spreads across the whole brain like a wildfire jumping from tree to tree.
2. The whole brain fires at once, causing a generalized tonic-clonic seizure: the body goes stiff (tonic phase), then shakes violently (clonic phase), breathing stops or becomes irregular, and the person loses consciousness. — The motor cortex (the part of the brain controlling movement) fires uncontrollably, sending chaotic signals down the spinal cord to every muscle, making them contract all at once — that is the stiffness and shaking you see; meanwhile, the reticular activating system (the brain's wake-up center) shuts down, so the person cannot respond or remember.

3. The longer the seizure runs, the more GABA receptors disappear from the neuron surface, and the brain becomes resistant to its own calming signals and to benzodiazepines. — Neurons pull GABA receptors inside the cell to protect themselves from the flood of signals, but this makes the brake pedal stop working — so a seizure that has run for 30 minutes is much harder to stop than one treated at 5 minutes.
4. Glutamate floods the synapse, calcium pours into neurons faster than they can pump it out, and the calcium overload kills cells from the inside (excitotoxicity) — leading to permanent brain damage after 30–60 minutes. — Neurons use calcium as a signal, but too much calcium turns on enzymes that chew up the cell's proteins and DNA, causing the neuron to die — this is why long seizures can leave someone with memory loss, weakness, or thinking problems even after the seizure stops.
5. Muscles contract so hard for so long that muscle fibers rip apart and spill myoglobin into the blood (rhabdomyolysis), the kidneys try to filter it and get clogged, and acute kidney injury follows. — Myoglobin is toxic to kidney tubules and physically blocks the filters, especially when the patient is dehydrated or acidotic — so the kidneys can fail days after the seizure if rhabdomyolysis is severe.
6. The brain's temperature center loses control, core temperature climbs above 104°F (hyperthermia), and the heat damages proteins in every organ, raising the risk of multi-organ failure. — The hypothalamus (the brain's thermostat) is overwhelmed by the seizure's electrical chaos and cannot regulate temperature, while the muscles generate heat faster than the body can cool itself — high fever then cooks enzymes and cell membranes throughout the body.
7. Breathing becomes chaotic — long pauses (apnea) alternate with gasping — oxygen levels drop, carbon dioxide builds up, and the patient can aspirate saliva or vomit into the lungs, causing aspiration pneumonia or acute respiratory distress syndrome. — The brainstem's breathing centers are disrupted by the seizure, the tongue and jaw muscles are stiff and block the airway, and the gag reflex is gone — so secretions slide down into the lungs instead of being coughed out.
8. After the seizure stops, the brain is exhausted and flooded with inhibitory signals (postictal state), so the person is deeply confused, sleepy, or cannot speak for minutes to hours while neurons recover. — Neurons are hyperpolarized (extra-negative inside) and depleted of ATP and neurotransmitters after firing nonstop, so they cannot fire normally until they recharge — that is why confusion and sleepiness after a seizure are normal recovery, not a new emergency, as long as the person gradually wakes up.

Symptoms · what the patient feels, and why

- Repeating jerking movements of the arms, legs, or whole body that the person cannot stop: Electrical storms in the motor cortex (the strip of brain that controls movement) send wild, uncontrolled signals down the nerves to the muscles, making them fire over and over in a rhythm the person cannot control.
- Staring blankly and not responding when you call their name or touch them: Abnormal electrical activity spreads across both halves of the brain at once, shutting down the networks that keep you awake and aware—like a power surge that blacks out the whole building instead of lighting it up.
- Confusion or sleepiness that does not clear up after a few minutes: After a seizure the brain's neurons (nerve cells) are exhausted from firing too much and need time to recharge; in status epilepticus (a seizure that will not stop) the seizures keep restarting before the brain can recover, so confusion lingers or deepens.
- Eyes rolled back, eyelids fluttering, or unusual eye movements: The seizure discharge spreads to the brainstem and the cranial nerve nuclei (tiny control centers for eye muscles deep in the brain), causing the eyes to move in ways the person is not choosing.
- Lips turning blue or skin looking dusky gray: During a tonic-clonic seizure the chest muscles lock up and breathing pauses; oxygen in the blood drops, so hemoglobin (the red protein that carries oxygen) turns dark purple-blue and shows through the skin.
- Foaming or drooling at the mouth: The person cannot swallow normally during the seizure, so saliva pools in the mouth; fast breathing or jaw clenching churns it into foam.
- Loss of bladder or bowel control: The seizure's electrical storm disrupts the brain circuits that keep the sphincters (ring muscles around the bladder and rectum) tightly closed, so urine or stool leaks out.
- Fever: Continuous muscle contractions during prolonged seizures generate heat like an engine running at full throttle; also, the hypothalamus (the brain's thermostat) can be thrown off by the abnormal electrical activity.

Focused exam

- Active shaking or stiffness in arms and legs: This is the seizure itself — the brain's stop signals (GABA, the calming messenger) are overpowered, so the go signals (glutamate, the activating messenger) take over and make muscles fire. Status epilepticus (a seizure that will not stop) means this keeps happening or does not stop within 5 minutes.
- Confusion or not waking up after the shaking stops: The brain is exhausted from the seizure. In status epilepticus (a seizure that will not stop), this confusion keeps going because seizures come back again and again. This tells you the brain's balance is still broken.

- Breathing that is fast, slow, or stopping for a few seconds: During seizures the muscles controlling breathing fire out of control too. In status epilepticus (a seizure that will not stop), the airway can get blocked or the patient forgets to breathe. This is why we help them breathe first.
- Skin that is blue or pale, or lips that look dark: This means the blood is not getting enough oxygen because breathing is broken during status epilepticus (a seizure that will not stop). The body is failing to deliver oxygen — a red flag that says act now.
- Fever, stiff neck, or a rash that does not blanch when you press it: These point to infection (like meningitis or encephalitis) as the upstream break that started the seizure in status epilepticus (a seizure that will not stop). Infection is one of the big causes we must rule out first.
- Low blood sugar on a finger stick, or patient sweating and trembling: Low blood sugar (hypoglycemia) can trigger status epilepticus (a seizure that will not stop) and is easy to fix. We check this in the first five minutes because giving glucose is the quickest fix if this is the cause.
- Muscle breakdown signs: very dark urine (like cola), or swelling and tenderness in the legs: Long seizures in status epilepticus (a seizure that will not stop) make muscles break down (rhabdomyolysis). The muscles release their insides (myoglobin) into the blood, which can clog the kidneys and hurt them.

Diagnostics · every test answers a question

- Bedside glucose (finger-stick) → Is low blood sugar the reason the brain is seizing?
- Basic metabolic panel (BMP): sodium, potassium, calcium, magnesium, creatinine, BUN → Are the brain's electrical signals messed up by bad electrolytes or failing kidneys?
- Anti-epileptic drug (AED) levels: phenytoin, valproate, carbamazepine, or levetiracetam → Did the patient stop taking their seizure medicine or is the dose too low?
- Complete blood count (CBC) with differential → Is there infection causing the seizures?
- Urine or blood toxicology screen (drug screen) → Did the patient take a drug or toxin that triggered the seizures?
- Non-contrast CT scan of the head → Is there bleeding, a stroke, or a tumor in the brain causing the seizures?
- Electroencephalogram (EEG) → Is the brain still seizing even if the shaking has stopped?
- Lumbar puncture (spinal tap) with cerebrospinal fluid (CSF) analysis → Is there infection or inflammation in the brain or spinal fluid?

Treatment logic

- Lorazepam 4 mg IV (or midazolam 10 mg IM/IN) within the first 5 minutes → Benzodiazepines flood the brain's GABA receptors (the main stop-signal switches) and tell the overactive neurons to quiet down. This stops the seizure in its tracks within 1–2 minutes in most cases.
- Check blood glucose and give dextrose 50% (25–50 mL IV) if low; check electrolytes (sodium, magnesium, calcium); start IV line and draw blood → Brain cells need the right fuel (glucose) and the right electrical balance (electrolytes) to fire correctly. Fixing these restores the balance between go-signals and stop-signals the brain is fighting to keep.
- Give fosphenytoin 20 PE/kg IV, or levetiracetam 60 mg/kg IV, or valproate 40 mg/kg IV (within 5–40 minutes) → These long-acting drugs block the go-signals (sodium or calcium channels) in the brain so neurons fire less easily. Unlike benzos, they stay in the body for hours and prevent the seizure from restarting after the fast-acting benzo wears off.
- Ask history: prior seizures or epilepsy? AED levels or missed doses? Alcohol use or sudden stopping? Pregnancy? Recent drugs, infections, or head injury? → Each answer points backward to what broke the brain's balance: a low AED level means the patient skipped pills, alcohol stopping causes brain rebound, infection causes inflammation, eclampsia (in pregnancy) breaks electrolyte balance. You find the upstream cause so you can fix it, not just treat the shaking.
- If still seizing after 40 minutes: intubate the airway, start propofol or midazolam drip or pentobarbital, watch continuous EEG for burst suppression → Anesthetic drips put the entire brain into a controlled sleep-state (burst suppression on EEG) so no neurons can fire a seizure. The breathing tube (endotracheal tube) protects the airway because seizure muscles can close it off and anesthetics slow breathing.
- Treat the cause: thiamine 500 mg IV plus glucose for alcohol withdrawal; antibiotics (ceftriaxone plus vancomycin) for suspected meningitis; magnesium sulfate 4–6 g IV for eclampsia; correct electrolytes; load on chronic AED (phenytoin, levetiracetam, valproate); imaging (CT/MRI) for stroke or tumor → Fixing the upstream break (the one broken thing that started everything) restores the brain's balance so it stops making seizures on its own. An infection dies when antibiotics kill it; low AED comes back up when you restart the pill; low magnesium comes back up when you infuse it; eclampsia stops when magnesium calms the brain.

Medications

Lorazepam (Ativan) · Benzodiazepine (first-line for active seizure)

Lorazepam boosts GABA, the brain's main 'stop' signal. GABA tells neurons to slow down and rest. During a seizure, brain cells fire wildly without stopping. Lorazepam makes GABA

receptors more sensitive, so each GABA molecule has a stronger calming effect. This quiets the electrical storm and stops the seizure within two to three minutes.

1. Lorazepam enters the brain and finds GABA-A receptors on the surface of neurons.
2. It sits next to the receptor's chloride channel (a tiny tunnel that lets chloride ions flow into the cell).
3. When GABA lands on the receptor, lorazepam makes the chloride channel open wider and stay open longer.
4. More chloride rushes into the neuron, making the inside more negative.
5. A more negative neuron is harder to fire, so the wild electrical bursts slow down and stop.
6. The seizure ends, and the brain's normal rhythm returns.

SAFETY WATCH

Can slow breathing, especially if given too fast or in someone already on opioids or alcohol; watch oxygen levels and be ready to help breathing. · Lowers blood pressure in some people; check blood pressure after giving it. · May cause deep sleepiness or confusion after the seizure stops; this is normal but watch the airway. · Needs to be given slowly by IV (no faster than 2 mg per minute) to avoid stopping breathing. · If no IV line is available, midazolam by muscle or nose works faster than waiting for an IV.

Midazolam (Versed) · Benzodiazepine (alternative first-line, especially when no IV yet)

Midazolam works the same way as lorazepam—it boosts GABA, the brain's natural brake signal, to stop the wild electrical firing of a seizure. The difference is midazolam can be given into muscle (IM) or sprayed into the nose if an IV line is not ready yet. It works within two to five minutes.

1. Midazolam is absorbed quickly from muscle or the nose lining into the bloodstream.
2. It crosses into the brain and finds GABA-A receptors on neurons.
3. It makes the chloride channel of the receptor stay open longer when GABA binds.
4. Chloride floods into the neuron, making it more negative and harder to fire.
5. The seizure's electrical storm slows and stops.
6. The brain settles back to normal rhythm.

SAFETY WATCH

Can slow or stop breathing, especially at higher doses or combined with opioids; monitor oxygen and be ready to assist breathing. · May drop blood pressure; check vitals after giving it. · Causes deep sleepiness after seizure stops; protect the airway and watch for vomiting. · If given by continuous drip for status epilepticus (a seizure that will not stop), can build up in the body and cause prolonged sedation. · Nasal spray stings briefly but is safe; IM injection is faster than waiting for IV access.

Fosphenytoin (Cerebyx) · Sodium channel blocker (second-line, given after benzodiazepine if seizure continues)

Fosphenytoin blocks sodium channels on neurons. Sodium channels are tiny gates that let sodium rush into a neuron to make it fire. During a seizure, these gates open and close wildly. Fosphenytoin jams the gates in the closed position, so neurons cannot fire over and over. This stops the seizure from restarting and keeps the brain calm after the benzodiazepine has stopped the initial storm.

1. Fosphenytoin is given by IV and quickly converts in the blood to phenytoin, the active form.
2. Phenytoin enters the brain and binds to sodium channels on neurons.
3. It locks the channel in the inactive (closed) state after the neuron fires once.
4. This prevents the rapid, repeated firing that drives a seizure.
5. The electrical activity stays steady and controlled.
6. The seizure does not restart, and the brain remains stable.

SAFETY WATCH

Can cause dangerous heart rhythm changes if given too fast; must infuse no faster than 150 phenytoin-equivalents (PE) per minute, with heart monitoring. · May drop blood pressure during infusion; give slower if pressure falls. · Can cause 'purple glove syndrome' (painful, purple swelling) if it leaks out of the vein; fosphenytoin is much safer than old phenytoin for this. · Interacts with many drugs (birth control, blood thinners, other seizure medicines); check drug levels and adjust doses. · Requires monitoring of blood levels after a few days to make sure the dose is right.

Levetiracetam (Keppra) · SV2A modulator (second-line, alternative to fosphenytoin)

Levetiracetam attaches to a protein called SV2A on the surface of synaptic vesicles (tiny bubbles inside nerve endings that hold neurotransmitters). When SV2A is tweaked by levetiracetam, neurons release less glutamate, the brain's main 'go' signal. Less glutamate

means less wild firing, so the seizure stops and does not restart. Levetiracetam is very safe and does not mess with heart rhythm or blood pressure the way fosphenytoin can.

1. Levetiracetam is given by IV and spreads quickly into the brain.
2. It binds to SV2A proteins on vesicles inside the nerve ending.
3. This changes how vesicles fuse with the cell membrane and dump their glutamate into the synapse.
4. Less glutamate is released, so the next neuron gets a weaker 'fire' signal.
5. The chain reaction of wild firing slows and stops.
6. The seizure ends, and normal brain activity resumes.

SAFETY WATCH

Very few serious side effects; safe for the heart, liver, and kidneys. · Can cause irritability, mood swings, or aggressive behavior in some people after repeated doses; usually not an issue in the emergency setting. · No drug interactions with most other medicines, so it is very flexible. · Safe to give quickly by IV without heart monitoring (unlike fosphenytoin). · Dose is weight-based: 60 mg per kilogram, up to 4500 mg, given over ten minutes.

Valproate (Depacon) · Multiple mechanisms: boosts GABA, blocks sodium channels, calms calcium channels (second-line alternative)

Valproate works on several brain targets at once. It boosts GABA (the brain's brake signal) by blocking the enzyme that breaks GABA down, so GABA stays around longer. It also jams sodium channels to stop rapid firing, and it calms certain calcium channels that help neurons talk to each other. This triple action makes valproate very effective against many seizure types, but it has more side effects than levetiracetam.

1. Valproate enters the brain and blocks GABA transaminase, the enzyme that breaks down GABA.
2. GABA levels rise, so neurons get more 'stop' signals.
3. Valproate also binds to sodium channels and holds them in the inactive state, preventing rapid firing.
4. It calms T-type calcium channels, which stops rhythmic bursts from the thalamus.
5. All three actions combine to shut down the seizure and keep it from restarting.
6. The brain's electrical rhythm steadies.

SAFETY WATCH

Can cause serious liver damage, especially in children under two or people with metabolic disorders; check liver enzymes before and after if possible. · May trigger pancreatitis (painful inflammation of the pancreas); watch for severe belly pain. · Drops platelet count and can cause bleeding problems; check blood counts if giving for more than a day. · Absolutely must NOT be used in pregnant women unless no other option exists—causes birth defects (spina bifida, low IQ) in up to 10% of babies. · Can cause high ammonia levels, leading to confusion even without liver failure. · Dose is 40 mg per kilogram by IV, given over ten minutes.

Propofol (Diprivan) · GABA-A agonist anesthetic (third-line, for refractory status epilepticus (a seizure that will not stop))

Propofol is a powerful anesthetic that acts like a super-strong benzodiazepine. It directly opens GABA-A chloride channels without even needing GABA to bind first. This floods neurons with chloride, making them completely silent. Propofol is used when seizures continue despite two rounds of medicine (refractory status epilepticus (a seizure that will not stop)). It puts the brain into a deep sleep so the electrical storm can fully stop. Brain waves are monitored with EEG to reach 'burst suppression'—a pattern where the brain fires briefly then goes quiet, showing the seizure is controlled.

1. Propofol is given as a continuous IV drip and reaches the brain within seconds.
2. It binds to GABA-A receptors and forces the chloride channel wide open.
3. Massive amounts of chloride pour into neurons, making them hyperpolarized (far too negative to fire).
4. All electrical activity, including seizures, stops.
5. EEG monitoring confirms burst suppression: short bursts of brain waves, then flat silence.
6. The seizure is controlled, and the team can search for and fix the cause.

SAFETY WATCH

Requires a breathing tube and ventilator because it completely suppresses breathing. · Drops blood pressure severely; needs IV fluids and often vasopressor drugs (medicines to squeeze blood vessels and raise pressure). · Can cause 'propofol infusion syndrome' if used for more than 48 hours at high doses: dangerous lactic acidosis (acid from oxygen-starved tissues), heart failure, and muscle breakdown. Watch for rising lactate, low blood pressure that will not respond, and irregular heart rhythms. · Increases risk of infection because it is made with egg and soybean oil, which bacteria love; use strict sterile technique. · Turns urine green (harmless but startling). · Must be given in an ICU with continuous EEG, heart, and blood-pressure monitoring.

Midazolam continuous infusion · Benzodiazepine anesthetic drip (third-line alternative to propofol)

When given as a continuous drip instead of a one-time dose, midazolam keeps GABA receptors strongly activated around the clock. This holds the brain in a calm, controlled state and prevents the seizure from restarting. It is used for refractory status epilepticus (a seizure that will not stop), just like propofol, but may be chosen if propofol's heart risks are too high or if the patient has a soybean or egg allergy.

1. Midazolam drip is started by IV and kept running at a steady rate.
2. It continuously enhances GABA-A receptor activity, keeping chloride channels open.
3. Neurons stay hyperpolarized and cannot fire in wild bursts.
4. EEG shows burst suppression or complete seizure control.
5. The team adjusts the drip rate based on brain waves and vital signs.
6. Once stable, the drip is slowly weaned while monitoring for seizure return.

SAFETY WATCH

Requires a breathing tube and ventilator because it suppresses breathing completely. · Drops blood pressure, though usually less than propofol; may still need IV fluids or vasopressors. · Builds up in body fat and can cause very prolonged sedation (days) after stopping, making it hard to assess the brain. · Risk of withdrawal seizures if stopped too quickly; must wean slowly. · Must be given in ICU with continuous EEG and vital-sign monitoring. · No propofol infusion syndrome risk, making it safer for longer use in some patients.

Pentobarbital (Nembutal) · Barbiturate anesthetic (third-line, deepest suppression for super-refractory status)

Pentobarbital is the most powerful seizure-stopping drug available. Like propofol and midazolam, it acts on GABA-A receptors, but it also directly opens chloride channels even when GABA is absent, and it blocks glutamate receptors (the brain's 'go' signal). This double action creates the deepest brain suppression possible. It is reserved for super-refractory status epilepticus (a seizure that will not stop)—seizures that keep going even after propofol or midazolam. The goal is burst suppression on EEG for 24 to 48 hours, giving the brain time to reset.

1. Pentobarbital is given as a loading dose by IV, then a continuous drip.
2. It binds to GABA-A receptors and forces chloride channels open, hyperpolarizing neurons.
3. It also blocks AMPA receptors, so glutamate cannot excite the next neuron.
4. All electrical activity is suppressed; EEG shows burst suppression or near-flat line.

5. The seizure is completely controlled.
6. After 24 to 48 hours, the team slowly lightens the drip and watches for seizure return.

SAFETY WATCH

Requires a breathing tube, ventilator, and often invasive blood-pressure monitoring (arterial line). · Drops blood pressure dramatically; almost always needs multiple vasopressor drips to keep pressure safe. · Suppresses the immune system, increasing infection risk. · Builds up in fat and causes extremely prolonged sedation (sometimes a week or more after stopping). · Can cause a stalled gut (ileus) (the intestines stop moving), so feeding through a tube into the intestine is often needed. · Risk of withdrawal seizures when weaning; must taper very slowly. · Must be used in ICU with continuous EEG, full hemodynamic monitoring, and expert neuro-critical care.

Dextrose (D50 or D10) · Glucose replacement (treats hypoglycemic seizures)

The brain runs entirely on glucose (blood sugar). If blood sugar drops below about 40 mg/dL, neurons run out of fuel and start misfiring, which can cause a seizure. Dextrose is pure glucose given by IV to instantly raise blood sugar and restore the brain's energy supply. The seizure stops within seconds to minutes once glucose is back to normal. This is why every seizing patient gets a fingerstick glucose check and IV dextrose if the level is low.

1. Dextrose is pushed by IV and raises blood sugar immediately.
2. Glucose crosses the blood-brain barrier into brain tissue.
3. Neurons take up glucose and restart their ATP (energy) production in mitochondria (the cell's power plants).
4. With energy restored, sodium-potassium pumps work again, membrane potentials stabilize, and wild firing stops.
5. The seizure ends, and the patient begins to wake up.
6. The team investigates why blood sugar dropped (missed meal, too much insulin, liver failure, sepsis).

SAFETY WATCH

Very safe; the main risk is infiltration (leaking out of the vein), which can damage skin because D50 is very concentrated. Use a good IV line or give D10 (diluted) if veins are fragile. · If the patient is an alcoholic or severely malnourished, give thiamine (vitamin B1) BEFORE or WITH dextrose to prevent Wernicke encephalopathy (a brain injury from thiamine deficiency that dextrose can trigger). · Recheck blood sugar after giving dextrose to make sure it came up and stays up. · If blood sugar does not rise, consider adrenal crisis or severe liver failure.

Thiamine (Vitamin B1) · Vitamin replacement (prevents Wernicke encephalopathy in alcoholics and malnourished patients)

Thiamine is a vitamin the brain needs to burn glucose for energy. Chronic alcohol use and severe malnutrition deplete thiamine stores. If you give dextrose to someone without thiamine, their brain tries to use the glucose but cannot process it properly, and this can trigger Wernicke encephalopathy—a devastating injury to the memory and balance centers (mammillary bodies, thalamus, cerebellum). Giving thiamine first or at the same time as dextrose prevents this. Thiamine does NOT stop the seizure directly, but it protects the brain during resuscitation.

1. Thiamine is given by IV (100–500 mg) before or with dextrose.
2. It enters cells and becomes thiamine pyrophosphate, a helper molecule for enzymes that process glucose.
3. These enzymes (like alpha-ketoglutarate dehydrogenase) break glucose into ATP in the mitochondria.
4. With thiamine on board, neurons can safely use the incoming glucose without injury.
5. Wernicke encephalopathy is prevented.
6. The patient's overall recovery is better.

SAFETY WATCH

Very safe; allergic reactions are rare. · Must be given BEFORE or WITH dextrose in any alcoholic, homeless, or severely malnourished patient. · IV form works faster than oral; use IV in emergencies. · No monitoring needed; just give it.

Magnesium sulfate · Electrolyte replacement and NMDA receptor blocker (treats eclamptic seizures and severe magnesium deficiency)

Magnesium is an electrolyte that normally sits inside cells and helps keep neurons calm. It blocks NMDA receptors (a type of glutamate receptor that can cause excitotoxicity—damage from too much firing). In eclampsia (seizures during pregnancy caused by very high blood pressure), magnesium levels drop and blood vessels in the brain spasm. Magnesium sulfate raises magnesium, stops blood vessel spasm, and blocks NMDA receptors, ending the seizure and protecting the baby and mother. It is the first-line treatment for eclamptic seizures, NOT a benzodiazepine.

1. Magnesium sulfate is given by IV, raising blood magnesium levels quickly.
2. Magnesium enters the brain and blocks NMDA receptors, stopping glutamate's excitatory signals.
3. It relaxes spasming cerebral blood vessels, improving blood flow and lowering pressure.

4. Neurons stop firing wildly, and the seizure ends.
5. Blood pressure begins to drop as vessels relax throughout the body.
6. The mother stabilizes, and the team prepares for delivery to cure the eclampsia.

SAFETY WATCH

Can stop breathing if levels get too high (above 12–15 mg/dL); monitor respiratory rate, oxygen, and deep tendon reflexes (knee jerk). If reflexes disappear, stop the infusion. · Drops blood pressure; watch carefully and give IV fluids as needed. · Can cause flushing (feeling hot and red) and sweating; this is harmless. · Antidote is IV calcium gluconate if magnesium toxicity occurs (breathing stops, heart slows). · Typical dose: 4–6 grams IV load over 15–20 minutes, then 1–2 grams per hour continuous infusion. · Used in pregnancy, so very important to get the diagnosis of eclampsia right.

Antibiotics (e.g., ceftriaxone, vancomycin, acyclovir) · Antimicrobials (treat CNS infections causing seizures)

Infections of the brain (encephalitis) or the lining around the brain (meningitis) cause inflammation and swelling, which irritate neurons and lower the seizure threshold. Bacteria, viruses, and fungi can all do this. Antibiotics kill bacteria (ceftriaxone for common bacteria like pneumococcus and meningococcus; vancomycin for resistant staph). Acyclovir stops herpes simplex virus from copying itself, which is critical because herpes encephalitis loves the temporal lobes (the same area that starts many seizures) and causes severe, repeated seizures. Treating the infection reduces inflammation, stops neuron irritation, and prevents more seizures.

1. Antibiotics or antivirals are given by IV and cross into the CSF and brain tissue.
2. Ceftriaxone breaks down bacterial cell walls; bacteria burst and die.
3. Vancomycin blocks bacterial cell wall assembly; bacteria cannot grow or divide.
4. Acyclovir is taken up by herpes-infected neurons, turned into its active form, and jams viral DNA polymerase, stopping the virus from multiplying.
5. As bacteria or virus die, inflammation decreases.
6. Swelling goes down, irritation of neurons stops, and seizures become less frequent or stop entirely.
7. The patient's fever drops, and mental status improves over days.

SAFETY WATCH

Ceftriaxone can cause severe allergic reactions (anaphylaxis) in people allergic to penicillin (about 10% cross-react); watch for rash, throat swelling, low blood pressure. · Vancomycin can cause 'red man syndrome' (flushing, itching, low blood pressure) if infused too fast; give over at least one hour. · Acyclovir can damage kidneys, especially if the patient is dehydrated; give IV fluids and monitor kidney function. · Acyclovir can cause confusion or even more seizures if it builds up in people with kidney failure; adjust dose. · Start antibiotics and acyclovir immediately if CNS infection is suspected—do NOT wait for lumbar puncture or culture results. Minutes matter in bacterial meningitis and herpes encephalitis.

Red flags

- Seizure lasting longer than 5 minutes, or a second seizure starting before the person wakes up fully
- Lips or face turning blue, gasping, or not breathing normally
- Pregnant woman having a seizure
- Seizure after a head injury
- Confusion or weakness that does not improve 15–20 minutes after shaking stops

Nursing priorities

1. Protect the airway by turning the patient on their side, removing objects from the mouth, and suctioning if needed; give oxygen by nasal cannula or non-rebreather mask to keep oxygen saturation above 94%. — Seizures stop normal breathing and the tongue can block the airway (the breathing tube); low oxygen damages the brain within 4 to 6 minutes, so keeping oxygen flowing to the brain prevents permanent injury.
2. Check blood glucose with a finger-stick immediately; if glucose is below 60 mg/dL, give 1 ampule (25 grams) of dextrose 50% IV push after securing IV access. — The brain needs glucose (sugar) for energy and cannot store it; low blood sugar stops brain cells from working and causes seizures that will not respond to seizure medicine until the sugar is corrected.
3. Give lorazepam (Ativan, a benzodiazepine that calms brain electrical activity) 4 mg IV push over 2 minutes, or midazolam 10 mg into the muscle or nose if no IV access, within the first 5 minutes of seizure. — Benzodiazepines stop seizures by increasing GABA (a brain chemical that slows electrical signals); early treatment within 5 minutes stops status epilepticus (a seizure that will not stop) before brain cells start dying from overactivity and lack of energy.

4. Start two large-bore IV lines (18-gauge or larger) and draw blood for complete blood count, comprehensive metabolic panel (tests for electrolytes, kidney, and liver), magnesium, anti-epileptic drug levels, and toxicology screen. — IV access allows fast delivery of seizure medicines; blood tests find reversible causes like low sodium (below 125 mEq/L), low magnesium (below 1.5 mg/dL), or toxic drug levels that change treatment decisions.
5. If seizure continues after 5 minutes, give a second-line anti-seizure medicine: fosphenytoin 20 PE/kg IV (phenytoin equivalent per kilogram of body weight) at 100 to 150 PE per minute, OR levetiracetam (Keppra) 60 mg/kg IV over 10 minutes, OR valproate 40 mg/kg IV over 10 minutes. — These medicines stop seizures by blocking sodium channels or increasing GABA in brain cells; giving them early (before 20 minutes) prevents refractory status epilepticus (a seizure that will not stop) (seizures that will not stop and need ICU intubation and coma medicines).
6. Monitor blood pressure, heart rate, and oxygen saturation continuously; watch for blood pressure drop (systolic below 90 mmHg) or slow breathing (respiratory rate below 10 per minute) after benzodiazepines. — Seizure medicines depress (slow down) breathing and lower blood pressure by relaxing muscles and blood vessels; catching this early allows quick treatment with IV fluids or breathing support before the patient stops breathing.
7. Document seizure type (whole body shaking or one-sided), duration in minutes, eye position, and how long after the seizure until the patient responds to commands. — Seizure details tell the neurologist (brain doctor) which part of the brain is misfiring and predict whether this is epilepsy or a structural problem like stroke or tumor that needs imaging; prolonged confusion suggests continued brain electrical activity even without shaking.
8. Keep the patient on their side after the seizure stops and do not give food or drink until the patient is fully awake and can protect their airway. — The in the groggy phase after a seizure (postictal) period (time after a seizure when the brain recovers) leaves patients confused and unable to cough or swallow; aspiration (breathing in food or liquid) causes pneumonia and respiratory failure.

Sources

- American Academy of Neurology (AAN) 2016 guideline on status epilepticus
- Neurocritical Care Society status epilepticus guideline 2012 (updated 2016)
- American Epilepsy Society
- CDC Epilepsy Program

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