

Tricyclic Antidepressant (TCA) Overdose

Tricyclic antidepressants jam sodium channels in the heart, block acetylcholine receptors all over the body, block alpha receptors on blood vessels, and turn down GABA in the brain. This creates a four-way crisis: the heart's electrical system slows and gets chaotic, blood pressure drops, the body swings into a hot-dry-mad pattern, and the brain loses its brake pedal and seizes. Sodium bicarbonate is the first-line medicine that helps restart the heart's sodium channels.

THE ONE-LINE TRUTH

Tricyclic antidepressants block sodium channels in the heart, shut off acetylcholine (the body's 'rest and digest' messenger), block alpha receptors on blood vessels, and turn down GABA (the brain's main calming signal).

The chain — how it unfolds

1. QRS widens past 100 milliseconds on the ECG. — why: Tricyclic antidepressants block fast sodium channels in the heart muscle, so the electrical signal that normally zips from cell to cell slows way down. The QRS complex—the spike on the monitor that shows the ventricles firing—gets wider and slower. A QRS over 100 ms, and especially over 120 ms, means the sodium channels are seriously jammed and the heart is at high risk for dangerous rhythms like ventricular a fast heart rate (tachycardia) or ventricular fibrillation.
2. A tall R wave appears in lead aVR (>3 mm). — why: When tricyclics block sodium channels, the electrical current in the heart's right ventricle can't travel the normal path, so it fires backward in a weird direction. Lead aVR—a monitor lead that normally shows a tiny downward blip—suddenly shows a tall upward spike (R wave). A tall R in aVR is a red flag that the heart's conduction system is severely poisoned and life-threatening arrhythmias are coming.
3. Blood pressure drops and doesn't respond well to IV fluids. — why: Tricyclics block alpha-1 receptors on the walls of blood vessels. Normally norepinephrine hits those receptors and keeps vessels squeezed tight enough to hold blood pressure steady. When the receptors are blocked, the vessels relax, blood pools in the legs and gut, and blood pressure falls. Fluids help a little, but they can't squeeze the vessels back—vasopressors (medicines that bypass the blocked receptors) are often needed.

4. Pupils blow wide open, mouth goes bone-dry, skin gets hot and flushed, and the patient can't urinate. — why: Tricyclics shut off muscarinic acetylcholine receptors all over the body. Acetylcholine normally keeps pupils small, keeps the mouth and skin moist, keeps the gut moving, and keeps the bladder emptying. When those receptors are blocked, the opposite happens: pupils dilate wide (because the muscle that squeezes them shut can't work), saliva stops flowing (dry mouth), sweat glands stop (hot dry skin), the bladder muscle goes limp (urinary retention), and gut sounds disappear. This is the classic anticholinergic toxidrome—'hot as a hare, dry as a bone, red as a beet, mad as a hatter, blind as a bat.'
5. The patient gets confused, agitated, or delirious. — why: Acetylcholine receptors in the brain help keep thinking clear and organized. When tricyclics block those receptors, the brain's normal 'rest and digest' brake comes off, and the patient swings into confusion, picking at the air, talking nonsense, or getting combative. This is part of the anticholinergic storm happening in the brain.
6. Seizures explode—usually generalized tonic-clonic (the whole body shaking). — why: Tricyclics turn down GABA-A receptors in the brain. GABA is the brain's main calming neurotransmitter—it acts like a brake pedal to keep nerve cells from firing too fast. When GABA gets turned down, the brake pedal lifts, nerve cells fire out of control, and a seizure starts. Seizures are especially dangerous in tricyclic overdose because they create lactic acid, which drops blood pH. A lower pH makes the sodium channel blockade in the heart even worse, which can tip the patient into cardiac arrest.
7. Ventricular a fast heart rate (tachycardia), ventricular fibrillation, or torsades de pointes starts. — why: Once the QRS is wide and the QT is long from sodium channel blockade, the heart's electrical system is unstable. Any extra trigger—a seizure, low potassium, low magnesium, or just the drug level peaking—can flip the rhythm into fast chaotic beats (v-tach, v-fib, or the twisting pattern called torsades). These rhythms don't pump blood, so the patient loses pulses and crashes into cardiac arrest if the team doesn't act immediately.
8. Sodium bicarbonate is pushed IV, and the QRS starts to narrow. — why: Sodium bicarbonate raises blood pH (makes it more alkaline) and floods the bloodstream with extra sodium. The higher pH and extra sodium help unblock the jammed sodium channels in the heart, so the electrical signal can travel faster again. The QRS narrows back toward normal, the risk of deadly arrhythmias drops, and the heart stabilizes. Sodium bicarbonate is the key first-line antidote in severe tricyclic overdose—it's given as soon as QRS is over 100 ms or the patient has low blood pressure (hypotension), arrhythmias, or seizures.

Spot it — what you see, and why

- You find a patient who is drowsy
- QRS is wide

- Blood pressure is low
- Anticholinergic poisoning signs are there
- The electrocardiogram shows QRS over 100 or tall R in aVR
- This means arrhythmia risk

Red flags — act now

- QRS complex wider than 100 milliseconds on the EKG — the single most important danger sign in TCA overdose. It predicts seizures and deadly heart rhythms, and it is the trigger to give IV sodium bicarbonate right away.
- A tall R wave in lead aVR (taller than 3 mm) — an EKG fingerprint of the sodium-channel poisoning TCAs cause in the heart's wiring.
- Rapid crash in the first 1 to 2 hours — a TCA patient can go from awake and talking to seizing, with low blood pressure (hypotensive), and unconscious (comatose) in minutes. Never trust an early 'looks fine.'
- Seizures — each seizure makes the blood more acidic, and too much acid in the blood (acidosis) makes the TCA grip the heart's sodium channels even harder (a vicious cycle: treat aggressively and re-check the EKG).
- Blood pressure that stays low after IV fluids — both the heart pump and the blood vessels are poisoned; norepinephrine is the vasopressor of choice.

Treat it — in this order

1. Sodium bicarbonate 1-2 mEq/kg IV bolus, repeat to keep arterial pH between 7.45 and 7.55 → Extra sodium floods the heart muscle and competes with the tricyclic drug, forcing the sodium gates back open. Higher pH also weakens the drug's grip. Together, the QRS narrows and dangerous rhythms are stopped before they start.
2. IV normal saline bolus (500-1,000 mL) and norepinephrine infusion (starting 0.05-0.1 mcg/kg/min) to raise blood pressure → Fluid refills the tank; norepinephrine squeezes blood vessels tight again. Together they push blood pressure back up so the brain, heart, and kidneys get oxygen.
3. Benzodiazepine (lorazepam 2-4 mg IV or diazepam 5-10 mg IV) for seizures → Benzos turn up GABA (the brain's main brake signal). Tricyclics turned GABA down, so neurons fired out of control; the benzo puts the brakes back on and stops the seizure.
4. Activated charcoal 1 g/kg by mouth or nasogastric tube if the patient took the pills within 1-2 hours and can protect their airway → Charcoal sticks to tricyclic molecules still sitting in the stomach so they cannot cross into the bloodstream.

5. Continuous cardiac monitor and repeat 12-lead ECG every 2–4 hours until QRS stays normal for 24 hours → You catch QRS widening or new tall R waves early, so you can push more bicarbonate before the heart collapses into ventricular fibrillation.

Your top priorities at the bedside

1. Place patient on continuous cardiac monitor and obtain 12-lead ECG immediately, checking QRS width and looking for tall R wave in lead aVR — why: Sodium channel blockade (TCA stopping normal electrical flow in heart cells) widens the QRS complex over 100 milliseconds and creates tall R wave in aVR, which predicts life-threatening ventricular arrhythmias and need for sodium bicarbonate treatment
2. Establish large-bore IV access and prepare sodium bicarbonate 1 to 2 milliequivalents per kilogram for immediate bolus if QRS is over 100 milliseconds or patient has low blood pressure or arrhythmia — why: Sodium bicarbonate increases blood sodium levels and raises pH (makes blood less acidic), which overcomes sodium channel blockade by flooding channels with sodium ions and reducing TCA binding to heart tissue, narrowing the QRS and preventing cardiac arrest
3. Check blood pressure every 5 to 15 minutes and start IV fluid bolus of normal saline 500 to 1000 milliliters; prepare norepinephrine infusion if systolic pressure stays below 90 despite fluids — why: Tricyclics cause vasodilation (blood vessel widening from alpha receptor blockade) and direct heart muscle depression, dropping blood pressure; norepinephrine (a vasopressor that tightens blood vessels) reverses this better than dopamine or epinephrine