

Mg (magnesium) disorders

Magnesium disorders — low Mg drives unfixable potassium and calcium problems, high Mg paralyzes everything.

THE ONE-LINE TRUTH

Low magnesium (Mg) from diuretics, alcohol, PPIs, or diarrhea causes stubborn low potassium (K) that won't fix and low calcium (Ca), and can trigger torsades de pointes (a deadly spinning heart rhythm).

The chain — how it unfolds

1. Magnesium drops below 1.7 mg/dL, and the electrical gates (ion channels) in nerve and muscle cell walls lose their steady anchor. — why: Magnesium normally plugs into NMDA receptors (a type of calcium gate in nerves) and blocks extra calcium from flooding in; without enough magnesium, calcium rushes in and nerves fire over and over without a real signal—this causes muscle twitches, cramps, and spasms (tetany, where hands and feet curl up), and can trigger seizures if it reaches the brain.
2. At the same time, low magnesium opens the ROMK potassium channel in the kidney tubule too wide, so potassium pours into urine even when blood potassium is already low. — why: The kidney tries to save potassium by closing ROMK, but magnesium is the lock that keeps ROMK properly regulated—without it, the channel stays open and potassium leaks out (renal potassium wasting). Giving potassium by mouth or IV refills the blood temporarily, but it keeps draining into urine until magnesium is replaced first—this is refractory low potassium (hypokalemia), the hallmark clue that magnesium is the hidden problem.
3. Low magnesium also blocks PTH release from the parathyroid glands and makes bone and kidney cells ignore PTH, so calcium drops (hypocalcemia) and won't correct until magnesium is fixed. — why: Calcium and magnesium are partners: the calcium-sensing receptor on the parathyroid needs magnesium to work, and PTH needs magnesium to unlock calcium from bone and tell the kidney to save it. When magnesium is missing, the whole calcium-regulation system stalls, so patients get the numbness, tingling, and muscle cramps of low calcium on top of low magnesium.

4. In the heart, low magnesium and low potassium together prolong the repolarization phase (the reset between beats), stretching the QT interval on the EKG and triggering torsades de pointes—a rapid, twisting rhythm that looks like a spinning ribbon and can degenerate into cardiac arrest. — why: Magnesium and potassium both help close the potassium channels that reset the heart's electrical charge after each beat; without them, the reset drags out, the heart is vulnerable to extra beats (premature ventricular contractions), and one extra beat at the wrong moment can spin into torsades. This is the lethal endpoint of untreated low magnesium (hypomagnesemia).
5. When magnesium climbs above 4 mg/dL (hypermagnesemia), it floods the neuromuscular junction (the gap between nerve and muscle) and blocks calcium channels, so acetylcholine (the chemical signal to contract) can't be released—muscles go limp, deep tendon reflexes disappear, and the patient feels weak. — why: Muscle contraction depends on calcium flowing into the nerve terminal to trigger acetylcholine release; magnesium competes with calcium and wins when levels are high, so the signal never arrives. First the deep reflexes vanish (around 4–6 mg/dL), then skeletal muscles weaken (6–10 mg/dL), and finally the diaphragm stops contracting and breathing ceases (above 12 mg/dL)—this is why severe hypermagnesemia is a medical emergency.
6. High magnesium also relaxes smooth muscle in blood vessel walls, dropping blood pressure (hypotension), and slows the heart's pacemaker (bradycardia) by blocking calcium entry into SA node cells. — why: Blood vessels dilate because smooth muscle can't contract without calcium, so blood pressure falls; the SA node (the heart's natural pacemaker in the right atrium) fires more slowly because its automatic rhythm depends on calcium influx, and magnesium blocks that. If magnesium reaches very high levels, the heart can stop altogether (asystole).
7. Every one of these findings—twitching, refractory low potassium, low calcium, torsades, weak muscles, lost reflexes, slow breathing—is not the disease itself but the body's electrical and chemical system failing because magnesium, the hidden stabilizer, is missing or overwhelming the gates. — why: The body isn't misbehaving; it's revealing that one upstream control—magnesium—is broken. Fixing magnesium stops the whole domino line: replace magnesium and potassium stays in, calcium comes up, the heart rhythm steadies, and muscles relax. Remove excess magnesium (stop the infusion, give IV calcium to block its effects, use dialysis if kidneys can't clear it) and muscles wake up, reflexes return, blood pressure rises, and breathing restarts.

8. Trace backward from any symptom—shake, cramp, bad rhythm, weak muscle—and they all point to one broken step: magnesium homeostasis. Find the cause (diuretic, alcohol, diarrhea, PPI, kidney failure, caused by medical care (iatrogenic) load) and fix it, and the whole picture resolves. — why: This is the core of clinical reasoning for magnesium disorders: the constellation of findings (refractory low potassium (hypokalemia) + low calcium (hypocalcemia) + long QT, or absent reflexes (areflexia) + low blood pressure (hypotension) + respiratory depression) is not a list to memorize but a single mechanism to see—magnesium's role stabilizing ion channels and enzymes—so you recognize the pattern instantly and know exactly which upstream lever to pull.

Spot it — what you see, and why

- Muscle twitches or cramps that won't let up: Magnesium helps muscle cells relax after they squeeze. When magnesium drops too low, the cells stay jumpy and fire off even when you don't want them to—like a light switch that won't turn off. If magnesium climbs way too high, muscles get so relaxed they turn weak and floppy.
- Numbness or tingling around the mouth or in the hands and feet: Low magnesium often drags down calcium as well, because magnesium is needed to release the hormone (PTH) that keeps calcium steady. When calcium falls, nerves misfire and send false alarm signals—tickles and pins-and-needles—even though nothing is touching the skin.
- Heart racing or skipping beats (palpitations): Magnesium steadies the electrical gates in the heart muscle that open and close to make each beat. Too little magnesium makes those gates unreliable, so extra beats fire off or the rhythm wobbles. Too much magnesium can slow the heart's electrical system dangerously.
- Seizure or whole-body shaking you can't control: The brain's nerve cells need magnesium to keep their electrical activity calm. When magnesium is very low, neurons fire wild storms of signals all at once—a seizure—because there's not enough brake on the system.
- Feeling weak all over or trouble moving: Very high magnesium blocks the signal that tells muscles to contract. The muscles stay loose and floppy, so even simple movements—lifting your arm, standing up—become hard or impossible.
- Nausea, throwing up, or losing your appetite: High magnesium slows the gut's squeezing waves and can irritate the stomach lining, making you queasy or causing you to vomit. Low magnesium can upset the gut's rhythm too, though nausea is more common when levels are high.

Red flags — act now

- Heart rhythm suddenly turns very slow, very fast, or chaotic (arrhythmia) on the monitor
- Seizure or uncontrollable shaking

- Muscles so weak the person can't breathe deeply or move at all
- Confusion that gets worse quickly or the person becomes hard to wake up

Treat it — in this order

1. IV magnesium sulfate 1 to 2 grams over 1 hour for severe or symptomatic low magnesium; oral magnesium oxide 400 mg once or twice daily for mild, asymptomatic low magnesium → Restores magnesium to the blood, cells, and enzyme systems. This stops the tremor, muscle twitching, irregular heartbeat, and allows potassium and calcium to stay in the body again. IV works fast (within hours); oral works more slowly (over days).
2. Find and stop the cause: review and adjust diuretics, stop or reduce PPIs, treat diarrhea, support alcohol cessation → Stopping the ongoing loss (through kidneys or gut) prevents magnesium from falling again and allows the body to rebuild its magnesium stores over time. This is the only way to keep the problem from coming back.
3. Replicate potassium (usually 20 to 40 mEq oral or IV) and calcium (1 to 2 grams calcium gluconate IV or oral) after magnesium is corrected → Once magnesium is restored, the kidneys can hold onto potassium and the parathyroid glands can control calcium properly. Both will rise and stay stable. Without magnesium fixed first, potassium and calcium replacement will fail.
4. Continuous cardiac monitor and 12-lead EKG to watch for torsades de pointes or prolonged QT interval → Early spotting of dangerous heart rhythms from low magnesium allows you to treat faster with IV magnesium and prevent sudden cardiac arrest. Monitoring shows you when the heart is stabilizing as magnesium rises.
5. For high magnesium with symptoms (muscle weakness, lost reflexes, slow heartbeat, trouble breathing): give IV calcium gluconate 1 to 2 grams over 5 minutes, IV loop diuretic (furosemide 20 to 40 mg), and arrange urgent hemodialysis if kidney failure is present or magnesium is very high (above 4 mg/dL) → Calcium gluconate stabilizes the heart and muscle cell membranes against high magnesium — it acts like a shield that blocks magnesium from paralyzing the cells. Loop diuretics make the kidneys dump magnesium into the urine (if kidneys work). Dialysis physically removes magnesium from the blood when kidneys cannot.

Your top priorities at the bedside

1. Place patient on continuous cardiac monitor and obtain a 12-lead EKG immediately — why: Low magnesium prolongs the QT interval (the time the heart takes to reset between beats) and can trigger torsades de pointes, a deadly twisting heart rhythm that stops blood flow to the brain

2. Establish IV access and prepare to give IV magnesium sulfate 1 to 2 grams over 1 hour — why: IV magnesium replaces the body stores faster than oral forms and directly stabilizes the heart muscle membrane to prevent dangerous rhythms
3. Check potassium and calcium levels and prepare to replace both after magnesium is corrected — why: Low magnesium prevents potassium from entering cells (causing refractory low potassium (hypokalemia)) and blocks parathyroid hormone (a gland hormone that controls calcium), so these electrolytes will not correct until magnesium is fixed first