

# Hypocalcemia and Hypercalcemia

Too little or too much calcium both wreck nerves, muscles, and the heart. Find the upstream cause, fix it gently, and never ignore the warning signs.

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## THE ONE-LINE TRUTH

Calcium keeps muscles and nerves firing smoothly; when it's off, everything from your heartbeat to your brain misfires.

## The chain — how it unfolds

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1. Parathyroid glands fail or go haywire, or vitamin D is missing or toxic — why: PTH and vitamin D are the only two dials that control calcium—when either breaks, the whole system tips because there is no backup.
2. In low calcium (hypocalcemia), blood calcium drops below the threshold nerves and muscles need — why: Calcium normally plugs sodium leak channels in nerve and muscle membranes; when calcium falls, those channels open and cells fire on their own without a signal.
3. Muscles twitch and cramp (tetany), you feel tingling around the mouth and in the fingers (paresthesias), tapping the facial nerve makes the face twitch (Chvostek sign), and inflating a blood-pressure cuff causes the hand to spasm into a claw (Trousseau sign) — why: Every motor nerve is hyper-excitabile, so even gentle touch or pressure triggers a full contraction—these signs prove the nervous system is on a hair trigger.
4. The voice box (larynx) can suddenly clamp shut (laryngospasm), or the whole brain seizes — why: The muscles around the vocal cords are especially sensitive to low calcium; when they spasm, the airway closes and the patient can't breathe. If the excitability spreads across the brain, synchronized firing causes a generalized tonic-clonic seizure.
5. The heart's ventricles take too long to reset after each beat, stretching the QT interval on the EKG and risking torsades de pointes (a chaotic, deadly rhythm) — why: Calcium closes potassium channels to end each heartbeat (repolarization); without enough calcium, potassium channels stay open longer, the ventricles reset slowly, and any extra beat can trigger a spiral into ventricular fibrillation.

6. In high calcium (hypercalcemia), the kidneys try to dump the flood of calcium, pulling massive amounts of water into the urine (polyuria) — why: High calcium in the kidney filters acts like an osmotic magnet, dragging sodium and water out with it—so the patient pees gallons and becomes severely dehydrated.
7. Dehydration makes calcium climb even higher, and the brain cells shrink, causing confusion, lethargy, or coma — why: As water leaves the body, blood calcium concentration rises further (less water to dilute it), and brain cells lose water too, so they can't fire signals properly—thinking gets foggy, then shuts down.
8. The gut slows to a crawl (constipation), kidney filters clog with calcium crystals (nephrocalcinosis, kidney stones), and bones ache as they dissolve — why: High calcium inside smooth-muscle cells in the gut wall makes them contract weakly, so stool barely moves. In the kidneys, calcium precipitates into hard crystals that scar the filters and form stones. Bones hurt because osteoclasts are chewing through them to release all that calcium into the blood.

## Spot it — what you see, and why

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- Muscle cramps and twitching (tetany): Calcium helps muscles relax after they squeeze. When calcium drops too low, nerves fire off extra signals and muscles stay tight or jerk on their own—especially in the hands, feet, and face.
- Tingling or numbness around the mouth, fingers, and toes (paresthesias): Nerves use calcium to send signals smoothly. Low calcium makes nerve cells jumpy, firing when they shouldn't, which feels like pins and needles or a buzzing sensation.
- Chvostek sign (face twitches when you tap the cheek): When calcium is low, the facial nerve becomes so sensitive that even a gentle tap in front of the ear makes the muscles around the mouth and nose jerk.
- Trousseau sign (hand cramps when a blood pressure cuff is inflated)
- Seizures: Calcium stabilizes the electrical activity in the brain. Severe low calcium (hypocalcemia) lets brain cells fire too easily, creating a storm of signals that shows up as a seizure.
- Long QT interval on ECG (heart rhythm change): Calcium helps heart muscle cells reset after each beat. Low calcium slows that reset, stretching out the electrical recovery time (the QT part of the heartbeat) and raising the risk of dangerous rhythms.

## Red flags — act now

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- Seizure or severe muscle spasms that won't stop
- Chest pain, fast heartbeat, or fainting (signs the heart rhythm may be dangerous)
- Severe confusion, trouble waking up, or coma

- Very high calcium (above 14 mg/dL) or very low calcium (below 7 mg/dL with symptoms)
- Sudden severe belly pain, vomiting, or signs of pancreatitis (which high calcium can trigger)

## Treat it — in this order

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1. IV calcium gluconate — 1-2 grams (10-20 mL of 10% solution) diluted in 50-100 mL normal saline, given over 10-20 minutes → Raises serum calcium immediately — within minutes. Stops muscle cramps, tetany, seizures, and tingling by restoring the calcium that nerves and muscles need to stabilize their membranes. Reverses the acute emergency and buys time to find the root cause.
2. IV magnesium sulfate — 1-2 grams (2-4 mL of 50% solution) IV over 15 minutes, or oral magnesium oxide 400 mg twice daily if not urgent → Magnesium allows the parathyroid glands to release PTH and allows PTH to work at its target (bone, kidney, gut). Without magnesium, calcium will not rise no matter how much calcium or vitamin D you give. Replacing magnesium restarts the body's own calcium-control system.
3. Oral calcium carbonate or calcium citrate — 1-2 grams elemental calcium daily in divided doses (e.g. 500 mg three times daily with meals) → Adds calcium directly to the blood by absorbing it from the gut. This is the long-term maintenance fix for chronic low calcium (hypocalcemia) (after parathyroid surgery, vitamin D deficiency, or chronic kidney disease). Works over days to weeks.
4. Active vitamin D — calcitriol 0.25-0.5 mcg by mouth twice daily, or ergocalciferol (vitamin D2) 50,000 units weekly if deficiency is the cause → Calcitriol is the active form of vitamin D — it tells the gut to absorb more calcium and tells the kidneys to reabsorb calcium instead of peeing it out. Use calcitriol if kidneys cannot activate regular vitamin D (chronic kidney disease, hypoparathyroidism). Use ergocalciferol if the problem is low vitamin D stores. This fixes chronic low calcium (hypocalcemia) from vitamin D deficiency over weeks.
5. IV normal saline — 200-300 mL/hour for several liters, then loop diuretic furosemide 20-40 mg IV once volume is restored → For high calcium (hypercalcemia): saline flushes calcium out through the kidneys by expanding blood volume and forcing the kidneys to dump calcium in the urine. Furosemide blocks calcium reabsorption in the kidney tubules. Together they lower calcium within hours. First-line for severe high calcium (calcium > 14 mg/dL) or symptomatic high calcium.

## Your top priorities at the bedside

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1. Place patient on continuous cardiac monitor and watch for prolonged QT interval on ECG (electrocardiogram, the heart tracing) — why: Low calcium lengthens the QT interval and can trigger torsades de pointes (a deadly spinning heart rhythm); high calcium shortens QT and causes a slow heart rate (bradycardia) (slow heart rate) or heart block
2. Check Chvostek sign (tap the facial nerve in front of the ear) and Trousseau sign (inflate blood pressure cuff above systolic pressure for 3 minutes and watch for hand spasm) — why: Positive signs mean nerves are hyperexcitable from low ionized calcium (the active form); this warns that seizures or airway spasm could happen soon
3. Keep IV calcium gluconate 1 to 2 grams at the bedside and ensure a patent large-bore IV line is in place — why: Severe low calcium can cause laryngospasm (vocal cord spasm blocking the airway) or seizures within minutes; immediate IV calcium reverses the muscle spasm and saves the airway