

● NGN NCLEX 2026 · ELECTROLYTE IMBALANCE SERIES

VOL. 22 · ENDOCRINE / MUSCULOSKELETAL

Hypocalcemia *vs.* Hypercalcemia

Calcium drives nerve transmission, muscle contraction, blood clotting, and bone integrity. When it tips out of range, the story is written in nerves, muscles, and the cardiac rhythm strip.

CLINICAL JUDGMENT

NCJMM FRAMEWORK

PRIORITY INTERVENTIONS

PHARMACOLOGY

PATIENT EDUCATION

◀ HYPOCALCEMIA

< **9.0** mg/dL

Excitable — nerves fire on their own

NORMAL SERUM Ca^{2+}

9.0 – 10.5 mg/dL

Ionized Ca^{2+} : 4.5 – 5.6 mg/dL

HYPERCALCEMIA ▶

> **10.5** mg/dL

Sedated — everything slows down

SECTION 01 — THE BIG PICTURE

Definition & *Overview*



Hypocalcemia

SERUM Ca^{2+} < **9.0** MG/DL



Hypercalcemia

SERUM Ca^{2+} > **10.5** MG/DL

Calcium is the brake for nerve cells. When it drops, sodium rushes in too easily — neurons fire without permission. The result is **neuromuscular excitability**: tetany, spasms, seizures.

TOP CAUSES

- **Hypoparathyroidism** — especially post **thyroidectomy** (parathyroids nicked)
- **Vitamin D deficiency** — can't absorb Ca from gut
- **Chronic kidney disease** — retains phosphate, binds Ca
- **Acute pancreatitis** — Ca binds to fat necrosis
- **Massive blood transfusion** — citrate preservative binds Ca
- **Alkalosis** — more Ca binds to albumin → less ionized Ca
- Hypomagnesemia, hyperphosphatemia, loop diuretics

Too much calcium **sedates** nerve and muscle cells. Everything slows — reflexes, gut, heart conduction. Bones empty as Ca pours into the blood, and kidneys strain to excrete it all.

TOP CAUSES

- **Hyperparathyroidism** — the #1 cause overall
- **Malignancy** — breast, lung, multiple myeloma, bone mets
- **Prolonged immobility** — Ca leaches from bone
- **Thiazide diuretics** — retain Ca in kidneys
- **Excess vitamin D** or calcium supplements
- **Paget disease**, sarcoidosis, lithium therapy
- Milk-alkali syndrome (chronic antacid abuse)

SECTION 02 — HOW IT GOES WRONG

Pathophysiology *Simplified*

Low Calcium Cascade

1 Serum Ca^{2+} drops below 9.0 mg/dL



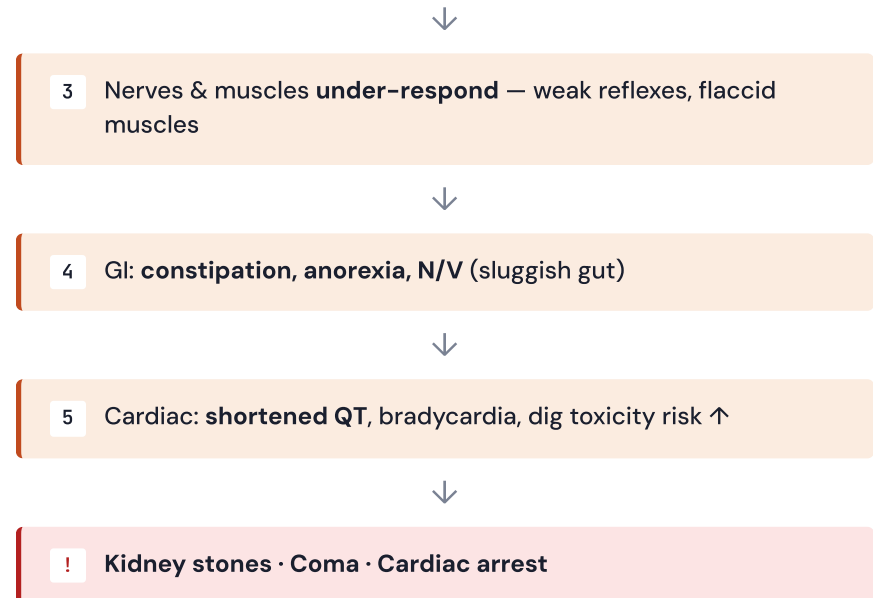
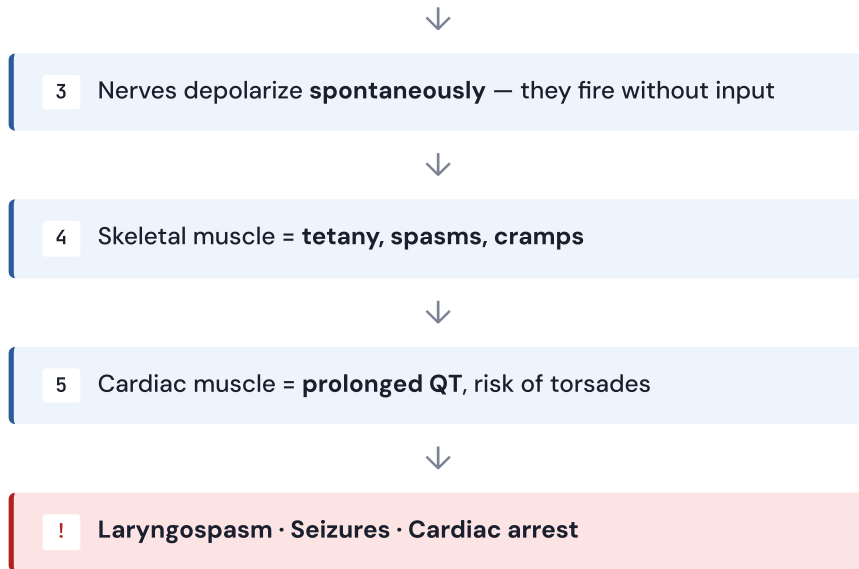
2 Cell membranes become **unstable** — sodium leaks in

High Calcium Cascade

1 Serum Ca^{2+} rises above 10.5 mg/dL



2 Cell membranes become **stabilized** — hard to depolarize



SECTION 03 — RECOGNIZE THE CUES

Signs & Symptoms *Visualized*



Hypocalcemia

KEY WORD: **EXCITABILITY**

EARLY / MILD CUES



Paresthesia

Numbness, tingling —
circumoral, fingers, toes



Muscle cramps

Especially calves, feet,
hands



Hypercalcemia

KEY WORD: **SEDATION / SLOWING**

EARLY / MILD CUES



Muscle weakness

Flaccid, fatigue,
difficulty rising



↓ DTRs / Hyporeflexia

Sluggish, diminished
reflexes



↑ DTRs / Hyperreflexia

Brisk, jumpy reflexes (3+ to 4+)



Hyperactive bowel

Diarrhea, abdominal cramping

RED FLAG / CLASSIC SIGNS



Trousseau's Sign

BP cuff inflated > 3 min
→ carpal spasm (hand flexes in)



Chvostek's Sign

Tap facial nerve →
cheek / lip twitches



Laryngospasm

Stridor, airway closure
— AIRWAY EMERGENCY



Tetany & Seizures

Prolonged QT →
torsades de pointes



Constipation / N/V

Anorexia, sluggish peristalsis



Polyuria / thirst

Kidneys dump Ca, lose water with it

RED FLAG / CLASSIC SIGNS



Kidney "Stones"

Renal calculi — flank pain, hematuria



"Bones"

Bone pain, pathologic fractures, osteoporosis



"Groans"

Abdominal pain, constipation, ileus, ulcers



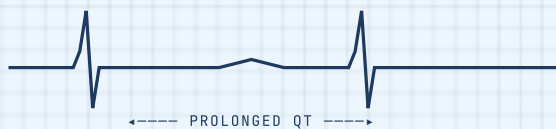
"Psych Overtones"

Confusion, lethargy → coma, depression

The Cardiac Rhythm Tells the Story

Calcium controls the plateau phase of cardiac repolarization — watch the QT interval.

◀ HYPOCALCEMIA



Prolonged QT Interval

Risk: Torsades de Pointes

▶ HYPERCALCEMIA



Shortened QT Interval

Risk: Bradycardia, AV block, Dig toxicity

SECTION 04 — TAKE ACTION

Priority Nursing *Interventions*

ABC · Safety · Airway First

AIRWAY → BREATHING → CIRCULATION

⚡ Hypocalcemia Actions

01 Assess & maintain airway

Keep tracheostomy tray & suction at bedside — laryngospasm can close the airway without warning.

02 Initiate seizure precautions

Padded side rails up, bed low, suction ready, quiet environment.

03 Administer IV calcium gluconate SLOWLY

Severe/symptomatic: IV push over 10+ min via central line preferred.
Rapid infusion → bradycardia / cardiac arrest. Place on cardiac monitor.

04 Monitor ECG continuously

Watch for prolonged QT & torsades. Check Trousseau's / Chvostek's each shift.

05 Give oral Ca + Vitamin D for chronic

Calcium carbonate with meals; Vit D (calcitriol) enables absorption.

06 Correct magnesium first

Low Mg blocks PTH release — Ca won't come up until Mg is replaced.

⚡ Hypercalcemia Actions

01 Infuse IV 0.9% Normal Saline — aggressively

First-line! Dilutes Ca & promotes renal excretion. Often 200–300 mL/hr. Monitor for fluid overload.

02 Give LOOP diuretic — furosemide (Lasix)

AFTER hydration only. Loops waste Ca. *Never thiazide* — those retain Ca.

03 Administer bisphosphonates / calcitonin

Pamidronate or zoledronic acid for malignancy-related. Calcitonin for rapid effect.

04 Encourage weight-bearing activity

Ambulation drives Ca back into bone. Immobility makes it worse.

05 Strain urine / monitor for stones

Encourage 3–4 L fluid/day if not contraindicated. Acidify urine (cranberry, prune juice).

06 Hold Ca & Vit D supplements · safety

Fall precautions (confusion, weakness). Watch digoxin toxicity — hypercalcemia mimics & amplifies it.

SECTION 05 — DRUG KNOW-HOW

Pharmacology *Deep Dive*

DRUG	TREATS	MECHANISM	KEY NURSING CONSIDERATIONS
Calcium Gluconate IV CALCIUM SUPPLEMENT • EMERGENCY	↓ Ca	Directly replaces serum Ca ²⁺ ; stabilizes cell membranes.	Infuse SLOWLY (cardiac monitor). Extravasation causes tissue necrosis — large vein or central line. Do NOT mix with phosphate or bicarbonate (precipitates). Caution with digoxin — can trigger toxicity.
Calcium Chloride IV CALCIUM SUPPLEMENT • CODE	↓ Ca	3× more elemental Ca than gluconate; used in cardiac arrest.	Central line only — extremely vesicant. Push over 10+ min even in codes unless arrested. Incompatible with most drugs — flush line.
Calcium Carbonate (Tums, Os-Cal) ORAL SUPPLEMENT • ANTACID	↓ Ca	Provides elemental Ca + neutralizes gastric acid.	Take with meals for best absorption. Separate from iron, thyroid meds, tetracycline by 2 hr. Watch constipation. Max ~500 mg at a time (absorption limit).
Calcitriol / Vitamin D ACTIVATED VIT D	↓ Ca	Enhances intestinal Ca absorption.	Monitor Ca to avoid swinging into hypercalcemia. Especially important in CKD (kidneys can't activate Vit D).
0.9% Normal Saline IV ISOTONIC FLUID • FIRST LINE	↑ Ca	Dilutes serum Ca & flushes it through kidneys.	Run 200–300 mL/hr. Assess lungs & JVD every 2–4 hr for fluid overload, especially in CHF / elderly.

DRUG	TREATS	MECHANISM	KEY NURSING CONSIDERATIONS
Furosemide (Lasix) LOOP DIURETIC	↑ Ca	Blocks Ca reabsorption in loop of Henle → wastes Ca in urine.	Give AFTER hydration. Monitor K ⁺ (can drop). Strict I&O. Never give a thiazide — raises Ca.
Calcitonin (Miacalcin) THYROID HORMONE ANTAGONIST	↑ Ca	Opposes PTH: drives Ca back into bone, blocks bone breakdown.	Rapid onset (hours) — bridge therapy. Skin-test for allergy if salmon-derived. Effect wanes in 48 hr (tachyphylaxis).
Pamidronate / Zoledronic Acid BISPHOSPHONATE	↑ Ca	Inhibits osteoclast activity — stops bone from releasing Ca.	First-line for malignancy-related. Slow IV infusion (over 2–24 hr). Monitor renal function. Watch for flu-like symptoms, osteonecrosis of jaw with long-term use.

SECTION 06 — THE SETUPS

NCLEX Test *Traps*



"Post-thyroidectomy patient c/o tingling around mouth"

Always think **hypocalcemia first**. Parathyroids sit behind the thyroid and can be nicked or removed in surgery. Assess for Chvostek's & Trousseau's.
Do NOT dismiss tingling as post-op anxiety.



"What IV fluid for hypercalcemia?"

Answer is **0.9% Normal Saline** — NOT LR (contains Ca!), NOT D5W (no sodium to drive excretion). Lasix comes *after* hydration, never before — would worsen dehydration.



"Thiazide vs loop diuretic"

Thiazides RETAIN calcium (raise it) — avoid in hypercalcemia, can cause it. **Loops WASTE calcium** (lower it) — use them in hypercalcemia. *One letter different — billion-dollar distinction.*



"Rapid IV calcium"

Never push fast. Rapid IV calcium causes **bradycardia and cardiac arrest**. Always on a cardiac monitor, slow infusion, central line preferred. Watch for extravasation → tissue necrosis.



"Hypercalcemia + Digoxin = ?"

Digoxin toxicity risk ↑↑↑. High Ca makes the heart more sensitive to digoxin. Watch for yellow-green halos, N/V, bradycardia. Hold dig & notify HCP if Ca is high.



"Massive blood transfusion → tingling"

Citrate in blood preservative **binds calcium**, dropping it fast. Tingling, Chvostek's, and muscle spasms post-transfusion = hypocalcemia. Expect Ca gluconate order.



"Alkalosis causes hypocalcemia"

In alkalosis, more Ca binds to albumin → less **ionized (active)** Ca. Total Ca may look normal but the patient is symptomatic. Hyperventilation → anxiety → tetany is a classic NCLEX vignette.



"Immobile patient's calcium rises"

Bed rest causes **bone resorption** — calcium pours into the blood. Early mobilization & weight-bearing prevents hypercalcemia. Don't let "rest" become the answer.

SECTION 07 — CLINICAL JUDGMENT IN ACTION

NCJMM *Scenario*

The Next Generation NCLEX Clinical Judgment Model

RECOGNIZE · ANALYZE · PRIORITIZE · EVALUATE

SCENARIO

A **52-year-old woman, post-op Day 1 from total thyroidectomy**, calls the nurse. She reports numbness around her mouth and "a weird tingling" in her fingertips. Vitals: BP 128/76, HR 92, RR 20, SpO₂ 96%, T 98.9°F. On assessment, the nurse taps the facial nerve anterior to the ear and the corner of the mouth twitches. Serum calcium: **7.4 mg/dL**. Serum magnesium: 1.9 mg/dL.

STEP 01

Recognize Cues

STEP 02

Analyze Cues

STEP 03

Prioritize / Act

STEP 04

Evaluate

Relevant findings: post-thyroidectomy, **circumoral tingling**, paresthesia in fingers, positive **Chvostek's sign**, Ca 7.4 (low). These cluster into neuromuscular excitability from low calcium.

Hypothesis: Acute hypocalcemia from parathyroid injury during thyroidectomy. **Risk:** progression to tetany, laryngospasm, seizures, prolonged QT → torsades. Mg is normal — not contributing.

First: ensure airway — tracheostomy tray & suction at bedside. Notify HCP. Initiate seizure precautions. Anticipate **IV calcium gluconate slow push** on cardiac monitor. Check Trousseau's.

Expected outcome: resolution of tingling, negative Chvostek's / Trousseau's, Ca 9.0+ mg/dL, QT normal, no stridor. If symptoms persist → recheck Ca & Mg, assess for worsening airway compromise.

SECTION 08 — TEACHING POINTS

Patient & Family *Education*

Hypocalcemia Teaching

Build calcium stores through diet, medication adherence, and sunlight.

FOODS TO ENCOURAGE ✓

Milk / Yogurt

Hard cheese

Sardines (w/ bones)

Salmon

Tofu

Kale / collards

Broccoli

Fortified OJ

Almonds

FOODS / HABITS TO LIMIT ⚠

Cola / dark soda

Excess caffeine

Heavy alcohol

Spinach (with Ca)

KEY SELF-CARE

- Take calcium + vitamin D **as prescribed** — don't skip doses
- Report **tingling, muscle twitching, or seizures** immediately

Hypercalcemia Teaching

Move, hydrate, and back off the calcium — prevent stones & fractures.

FOODS TO LIMIT ⚠

Milk / dairy

Hard cheese

Yogurt

Canned sardines

Calcium-fortified foods

Tums / antacids

FOODS / FLUIDS TO ENCOURAGE ✓

3–4 L water/day

Cranberry juice

Prune juice

Lean protein

Fiber (↓ constipation)

KEY SELF-CARE

- **Weight-bearing exercise daily** — walking, standing — drives Ca back into bone
- Stop OTC Ca & vitamin D supplements — read labels

- Brief daily sunlight exposure supports Vit D activation
- Know the signs of a neck hematoma if post-thyroidectomy: tightness, stridor, difficulty swallowing
- Carry a medical alert ID if chronic

- Avoid thiazide diuretics; use loop if indicated
- Report **flank pain, blood in urine, severe constipation, or new confusion**
- Strain urine if stones suspected; bring to provider
- Fall prevention at home — weakness & confusion raise risk

SECTION 09 — LOCK IT IN

Memory *Boosters*

HYPOCALCEMIA MNEMONIC

CATS

Low Ca cues — think nine lives of twitching cats.

- C** **Convulsions** — seizures from nerve over-firing
- A** **Arrhythmias** — prolonged QT, torsades de pointes
- T** **Tetany** — tingling, muscle spasms, cramping
- S** **Spasms & Stridor** — carpopedal, laryngospasm

BEDSIDE CHECKS

Chvostek's → Cheek twitch · **Trousseau's** → Thumb tucks under fingers (carpal spasm with BP cuff)

HYPERCALCEMIA MNEMONIC

Stones, Bones, Groans, Moans

Classic "4-Groan" pattern — every system slows down.

- S** **Stones** — kidney stones, polyuria, flank pain
- B** **Bones** — bone pain, fractures, osteoporosis
- G** **Groans** — abdominal pain, constipation, N/V, anorexia
- M** **Moans (Psych)** — confusion, lethargy, depression, coma

ONE-LINER

"Calcium & phosphorus see-saw" — when Ca goes UP, phosphorus goes DOWN, and vice-versa.

SECTION 10 — SIDE BY SIDE

At-a-Glance *Comparison*

FEATURE	↓ HYPOCALCEMIA	↑ HYPERCALCEMIA
<i>Serum Level</i>	< 9.0 mg/dL	> 10.5 mg/dL
<i>Neuromuscular</i>	Hyper-excitable · tetany · ↑ DTRs	Sedated · weakness · ↓ DTRs
<i>GI</i>	Hyperactive · diarrhea · cramping	Sluggish · constipation · N/V
<i>Cardiac (ECG)</i>	Prolonged QT · risk torsades	Shortened QT · bradycardia
<i>Classic Signs</i>	Chvostek's · Trousseau's · laryngospasm	Stones · Bones · Groans · Moans
<i>Phosphorus</i>	Often elevated	Often decreased
<i>First-Line Therapy</i>	IV Ca gluconate (slow, monitored)	IV 0.9% NS, then loop diuretic
<i>Diet</i>	↑ Dairy, leafy greens, fortified foods	↓ Dairy · ↑ 3–4 L fluids/day
<i>Activity</i>	Seizure precautions · airway at bedside	Weight-bearing · fall precautions

FEATURE	↓ HYPOCALCEMIA	↑ HYPERCALCEMIA
<i>Diuretic to AVOID</i>	Loops (waste Ca)	Thiazides (retain Ca)
<i>Mnemonic</i>	C · A · T · S	Stones · Bones · Groans · Moans