

MUSCULOSKELETAL • RENAL • CRITICAL CARE

Rhabdomyolysis

A life-threatening syndrome of skeletal muscle breakdown that releases toxic intracellular contents — myoglobin, potassium, phosphate, CK — into the circulation, with acute kidney injury and lethal hyperkalemia as the headline complications.

NGN NCLEX 2026

RENAL

HYPERKALEMIA RISK

AGGRESSIVE IV FLUIDS

1 Definition & Overview

- **Rhabdomyolysis** = rapid breakdown ("lysis") of skeletal muscle ("rhabdo-myo") with leakage of cellular contents into the bloodstream.
- The dangerous contents released: **myoglobin, creatine kinase (CK), potassium, phosphate, and uric acid.**
- Myoglobin precipitates in renal tubules → **acute kidney injury (AKI)**; potassium release → **lethal cardiac dysrhythmias.**
- Mortality is driven by hyperkalemia first, AKI second — both are the priority targets of nursing care.

5×

CK ABOVE
NORMAL =
DIAGNOSTIC

10-50%

DEVELOP AKI

200+
mL/hr

TARGET URINE
OUTPUT

⚡ Common Causes

TRAUMA / PRESSURE

- Crush injury, prolonged immobility
- Compartment syndrome, long lie after fall
- Electrical injury, lightning strike

EXERTION / HEAT

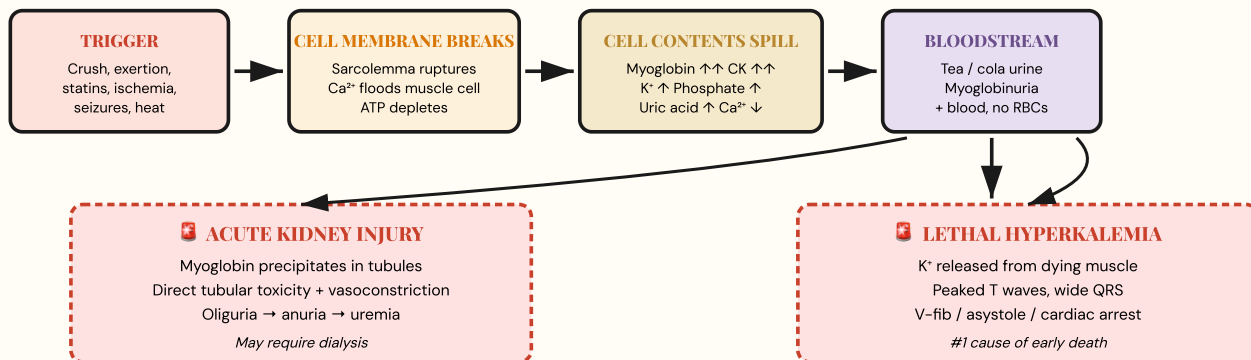
- Marathon, CrossFit, military training
- Heat stroke, malignant hyperthermia
- Status epilepticus, severe shivering

DRUGS / TOXINS

- **Statins** (esp. with fibrates / grapefruit)
- Cocaine, amphetamines, alcohol
- Neuroleptic malignant syndrome

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Pathophysiology — Why Muscle Death Kills the Kidneys & Heart



3 Signs & Symptoms

Classic Triad: Muscle pain · Muscle weakness · Tea / cola-colored urine

EARLY / MILD

- Muscle pain (myalgia), especially proximal — thighs, shoulders, lower back
- Muscle weakness, stiffness, tenderness
- Swelling of affected muscle groups
- Generalized malaise, fatigue, low-grade fever
- Nausea, vomiting

LATE / SEVERE

- **Tea-colored / cola / brown urine** (myoglobinuria)
- Decreasing urine output → oliguria → anuria
- Hyperkalemia: muscle cramps, paresthesias, arrhythmias
- Confusion, lethargy (uremia)
- Compartment syndrome: 6 P's — Pain, Pallor, Paresthesia, Pulselessness, Paralysis, Poikilothermia

🚨 **RED FLAGS:** peaked T-waves on ECG · urine output < 30 mL/hr · $K^+ > 5.5$ · CK > 5,000 · "the limb feels tight as a drum" (compartment syndrome).

Lab Findings

LAB	DIRECTION	RANGE
Creatine Kinase (CK)	↑↑↑↑	>5× normal; often >5,000–100,000 U/L
Myoglobin (serum/urine)	↑↑	Positive; urine dipstick + for blood, <i>no RBCs</i>
Potassium (K^+)	↑	>5.0 mEq/L — emergency
Phosphate	↑	>4.5 mg/dL
Calcium (early)	↓	Binds with phosphate
Uric acid	↑	From purine release
BUN / Creatinine	↑	Reflects AKI
Arterial pH	↓	Metabolic acidosis

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Priority Nursing Interventions

GOAL: FLUSH THE KIDNEYS · STOP THE K⁺ · WATCH THE HEART

1

Aggressive IV fluid resuscitation — the #1 priority.

Administer 0.9% Normal Saline at 200–1,000 mL/hr (per HCP order); titrate to urine output of **200–300 mL/hr**.

2

Continuous cardiac monitoring. Watch for peaked T-waves, widened QRS, prolonged PR — early signs of hyperkalemia (priority over labs returning).

3

Strict I&O hourly. Insert Foley if ordered; document urine color, amount, and dipstick blood result.

4

Treat hyperkalemia. Administer calcium gluconate (stabilize cardiac membrane FIRST), then insulin + D50 and/or sodium polystyrene per order.

5

Monitor for compartment syndrome. Assess 6 P's q1–2h; report tight, painful limb to HCP — fasciotomy may be needed.

6

Alkalinize urine. Administer sodium bicarbonate IV (target urine pH >6.5) per order to prevent myoglobin precipitation in tubules.

7

Hold nephrotoxic drugs. Notify HCP about NSAIDs, aminoglycosides, contrast dye, ACE-I/ARBs.

8

Prepare for dialysis if anuric, K⁺ refractory, or fluid-overloaded.

5

Pharmacology

0.9% NS

Volume expansion → dilutes myoglobin, restores renal perfusion.
First-line. Monitor for fluid overload (crackles, JVD).

Sodium bicarb

Alkalinizes urine (pH >6.5) → keeps myoglobin soluble. Monitor pH, watch for hypocalcemia & metabolic alkalosis.

Calcium gluconate

Stabilizes cardiac membrane in hyperkalemia. **Does NOT lower K⁺** — just buys time. Give first when peaked T-waves appear.

Insulin (regular) + D50

Drives K⁺ into cells. Monitor blood glucose q1h × 6h.

Sodium polystyrene

Removes K⁺ via GI tract. Slow onset — not for acute crisis.

Mannitol

Osmotic diuretic; controversial. Used only if patient produces urine.

AVOID

NSAIDs, aminoglycosides, IV contrast, ACE-I/ARB — all worsen AKI.

6 NCLEX Test Traps ⚠️

✗ WRONG THINKING

"Urine dipstick is positive for blood and the urine looks brown — must be a UTI or kidney stone, send for urinalysis."

✓ RIGHT THINKING

Dipstick + for blood with **no RBCs on microscopy** = **myoglobinuria**. Suspect rhabdomyolysis. Check CK immediately.

✗ WRONG THINKING

"K⁺ is 6.8 and there are peaked T-waves — give Kayexalate first."

✓ RIGHT THINKING

ECG changes = cardiac emergency. **Calcium gluconate FIRST** to stabilize the membrane, THEN insulin/D50, THEN Kayexalate.

✗ WRONG THINKING

"Patient is in AKI with low urine output — restrict fluids."

✓ RIGHT THINKING

In rhabdomyolysis-AKI, you **flood with NS** to flush myoglobin. Fluid restriction comes only if patient becomes anuric or fluid-overloaded.

✗ WRONG THINKING

"Patient on statins reports muscle aches — hold the statin and watch."

✓ RIGHT THINKING

Hold the statin **AND** draw a CK. Statin-induced rhabdo presents with myalgia first — early labs catch it before AKI.

✗ WRONG THINKING

"Crush injury patient finally extricated — start morphine for pain control first."

✓ RIGHT THINKING

Crush injury = imminent rhabdomyolysis & hyperkalemia. **IV access + NS + cardiac monitor FIRST**. Treat pain after airway/circulation are addressed.

7 Patient & Family Education

Statin teaching: Report any new muscle pain, tenderness, weakness, or dark urine to your HCP immediately. Avoid grapefruit juice with most statins.

Hydrate before, during, and after exercise. Especially in heat, with new high-intensity programs, or with sickle cell trait.

Acclimate gradually to new training or hot environments — don't go from couch to CrossFit in week one.

Recognize dark urine. Tea, cola, or brown-tinged urine is an emergency — go to ED.

Avoid alcohol and illicit drugs (especially cocaine, amphetamines, MDMA) that cause hyperthermia & muscle damage.

Medication interactions: Tell every provider you're on a statin before starting fibrates, certain antibiotics (erythromycin, clarithromycin), or antifungals.

After recovery: Follow up for kidney function tests; some develop chronic kidney disease.

8 Memory Boosters

CRUSH

- C** CK sky-high (>5× normal)
- R** Red-brown urine (myoglobin)
- U** Urine output drops (AKI)
- S** Spasms / soreness in muscles
- H** Hyperkalemia — watch the heart

Tea, Weak, & Ache

The classic triad in plain English:

Tea-colored urine + muscle **Weak**-ness + muscle **Ache**.

"Flood, Filter, Fix the K"

The 3-F nursing priority sequence:

Flood with NS → **Filter** with alkaline urine (bicarb) → **Fix the K⁺** (calcium → insulin → Kayexalate).

9 NCJMM Clinical Judgment Scenario

A 24-year-old male is brought to the ED after being trapped under collapsed gym equipment for 4 hours during a power outage. He reports severe pain in both thighs, "feeling weak all over," and notes that the small amount of urine he produced before transport "looked like Coca-Cola." Vitals: BP 102/64, HR 118, RR 22, T 100.4°F, SpO₂ 96%. Initial labs: K⁺ 6.4 mEq/L, CK 38,400 U/L, creatinine 2.1 mg/dL, urine dipstick positive for blood but no RBCs on microscopy. ECG shows peaked T-waves.

Step 1

RECOGNIZE CUES

Crush mechanism × 4h, cola-colored urine, severe muscle pain, K⁺ 6.4, CK 38,400, peaked T-waves, dipstick + for blood with no RBCs, rising creatinine. Tachycardia and borderline hypotension.

Step 2

ANALYZE CUES

Pattern = rhabdomyolysis with hyperkalemia and early AKI. Peaked T-waves indicate hyperkalemia is already cardiotoxic — this is now a cardiac emergency layered on a renal one. Dipstick + / no RBCs = myoglobinuria, not bleeding.

Step 3

PRIORITIZE HYPOTHESES

#1 Hyperkalemia-induced lethal dysrhythmia (most immediate). #2 Myoglobin-induced AKI (developing). #3 Compartment syndrome of thighs (assess limb tension). #4 Hypovolemia from third-spacing.

Step 4

GENERATE SOLUTIONS

Immediate: IV calcium gluconate for cardiac stabilization; insulin + D50; 0.9% NS bolus then continuous infusion to UO 200–300 mL/hr; continuous cardiac monitoring; foley; sodium bicarb per order; assess thighs q1h for 6 P's; hold NSAIDs/contrast.

Step 5

TAKE ACTION

Administer calcium gluconate IV per order (stabilize membrane FIRST), then insulin/D50, start NS at ordered high rate, attach continuous ECG, insert Foley, draw repeat K⁺ and CK, notify nephrology, prepare for possible dialysis, document 6 P's.

Step 6

EVALUATE OUTCOMES

Expected: T-waves normalize on ECG, K⁺ trends to <5.0, urine output reaches ≥200 mL/hr, urine clears from cola to amber, CK begins to fall by 24–48h, creatinine stabilizes, no compartment syndrome develops, distal pulses remain palpable.