

Hyperkalemia: Student Handout

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March 2026

Hyperkalemia: A Student Guide to High Potassium

Learning Objectives

- Define hyperkalemia and recognize when it's an emergency
- Understand the three-pronged treatment approach
- Interpret ECG changes in hyperkalemia
- Know the onset, duration, and efficacy of each treatment
- Recognize reversible causes (especially urinary obstruction)

Quick Definition

Hyperkalemia = Serum potassium >5.5 mEq/L

Critical fact: Hyperkalemia is DANGEROUS because it affects cardiac conduction. High K⁺ can cause sudden, fatal arrhythmias with **NO WARNING**.

Risk Assessment: When is it an Emergency?

Feature	Emergency?	Action
ECG changes	YES	Treat immediately, even before confirming K ⁺
K⁺ >7.0	YES	Treat regardless of ECG (may change any moment)
K⁺ 6.0-7.0, no ECG changes	NO	Monitor, but treat soon
K⁺ <6.0, asymptomatic	NO	Address underlying cause, begin treatment

Bottom line: If you SEE ECG changes treat FIRST, confirm later. Don't wait for results.

The Three-Pronged Treatment Approach

Prong 1: Stabilize the Cardiac Membrane

Goal: Antagonize K⁺ effects on heart immediately (doesn't lower K⁺!) **Duration:** 30-60 minutes only

Calcium Chloride vs. Calcium Gluconate: - **Calcium Chloride:** 10 mL of 10% solution = 13.6 mEq elemental calcium - Much more potent, acts faster - MUST use central line (very acidic, burns veins) - Preferred in cardiac arrest

- **Calcium Gluconate:** 10 mL of 10% solution = 4.5 mEq elemental calcium
 - Safe through peripheral IV
 - Slower acting
 - Better in most hospital situations
 - Can give 30 mL if needed

Dosing: 10 mL of 10% solution (either form) IV over 2-3 minutes - Can repeat once in 5 minutes if needed - **AVOID in digoxin toxicity** (calcium + digoxin = deadly arrhythmias)

Prong 2: Shift K⁺ Intracellularly

Goal: Move K⁺ from blood into cells (lowers serum K⁺) **Duration:** Hours (varies by agent) **Onset:** 15 minutes to hours

Agent	Onset	Duration	Reduction	Pros	Cons
Insulin + Glucose	15 min	4 hours	0.6-1.0 mEq/L	Reliable	Hypoglycemia risk
Albuterol	Rapid	2-4 hours	0.5-1.0 mEq/L	Additive with insulin	Tachycardia
Sodium bicarbonate	Variable	1-2 hours	Variable	Only if acidotic	Limited efficacy

Typical regimen: - Insulin 10 units IV + Dextrose 50% 25g (same syringe) - Can reduce to 5 units in renal failure patients - Albuterol 20mg nebulized simultaneously for additive effect

Prong 3: Remove K⁺ from the Body

Goal: Permanently lower K⁺ by eliminating from body **Duration:** Hours to days

Method	Onset	Amount Removed	Pros	Cons
Loop diuretics	1-2 hours	Modest	If good kidney function	Requires preserved renal function

Method	Onset	Amount Removed	Pros	Cons
Patiromer	7 hours	Slow	Safe, oral	Slow onset, chronic use
Sodium zirconium Hemodialysis	1 hour	0.7 mEq/L/4hr	Faster than patiromer	Still slow for acute
	Minutes to start	Rapid, complete	Most efficient	Time to get access (30-120 min)

Critical point: Dialysis is most effective but takes TIME (vascular access, setup, priming). While waiting, use insulin/glucose and calcium.

ECG Changes by Severity

Understand the progression:

K+ Level	ECG Changes	Clinical Risk
5.5-6.5	Tall, peaked T waves (narrow base)	Mild, watch
6.5-8.0	PR prolongation, P wave flattening, QRS widening	Moderate, treat
>8.0	Sine wave pattern, loss of P waves	CRITICAL, emergency
>9.0	Ventricular fibrillation, cardiac arrest	Immediate intervention

Peaked T waves = Most common early finding. Look in precordial leads (V2-V4). Narrow base distinguishes from normal variant.

Special Situation: Urinary Obstruction

Remember: ~5-10% of hyperkalemia has correctable cause!

Clinical clue: Check post-void residual (bedside ultrasound) or palpate bladder.

If obstruction present: Foley catheter can reduce K+ by 0.8-1.1 mEq/L in 4-6 hours through post-obstructive diuresis.

Mechanism: Obstruction impairs K+ excretion. Relieving it allows kidneys to work again.

Time-to-Effect Summary

Treatment	Onset	Peak Effect	Duration
Calcium	Minutes	5 min	30-60 min

Treatment	Onset	Peak Effect	Duration
Insulin+glucose	15 min	30-60 min	4 hours
Albuterol	Rapid	30-60 min	2-4 hours
SZC	1 hour	4 hours	24 hours
Patiromer	7 hours	Many days	24 hours
Dialysis	30-90 min to start	Continuous	Rebound in 6-12 hours

Clinical pearl: Standard treatment in acute severe hyperkalemia = Calcium + Insulin/Glucose + Albuterol (first-line medications). Dialysis arranged while these work.

Newer Potassium Binders

Patiromer (Veltassa)

- Exchanges **calcium** for potassium in GI tract
- Onset: ~7 hours (slower)
- Efficacy: 76% achieve normal K⁺ after 4 weeks
- **Best use:** Chronic hyperkalemia, outpatient

Sodium Zirconium Cyclosilicate (Lokelma)

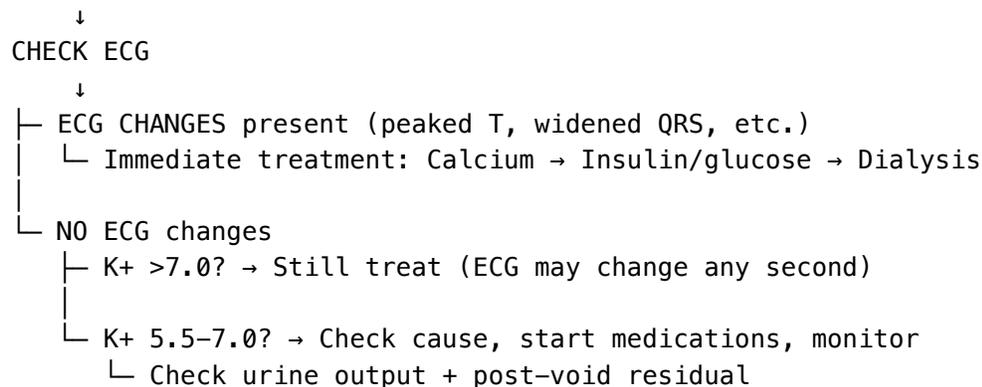
- Exchanges sodium/hydrogen for potassium
- Onset: 1 hour (faster than patiromer)
- Loading: 10g three times daily for 48 hours
- Maintenance: 10g daily
- **Best use:** Both acute and chronic; faster onset than patiromer

Avoid Sodium Polystyrene Sulfonate (Kayexalate)

- **Risk:** Colonic necrosis, especially with sorbitol
- **Problem:** Even without sorbitol, serious GI injury reported
- **Recommendation:** Use newer binders instead

Clinical Algorithm

HYPERKALEMIA detected (K⁺ >5.5)



└ If obstruction → Foley catheter first

Addressing Underlying Causes

Cause Category	Examples	Treatment
Medications	ACE-I, ARBs, K-sparing diuretics	Hold or switch (CRITICAL in renal failure)
Renal failure	Oliguria, severe CKD	Dialysis, binders
Acidosis	DKA, uremia	Treat underlying condition
Tissue destruction	Rhabdomyolysis, TLS	Aggressive hydration, dialysis
Obstruction	Urinary retention	Foley catheter (fast, simple!)
Pseudohyperkalemia	Hemolysis, prolonged tourniquet	Redraw sample

Practice Questions

Question 1: A 68-year-old with CKD and EKG showing peaked T waves and widened QRS has K⁺ 7.2. He denies chest pain. What's your first move?

Answer

Calcium gluconate 10-30 mL IV immediately—don't wait for troponin or any other tests. His ECG changes mean his myocardium is already affected. Calcium stabilizes the membrane within minutes while you arrange insulin/glucose and dialysis.

Question 2: A patient in cardiogenic shock receives insulin 10U + dextrose for hyperkalemia but becomes hypotensive. What went wrong?

Answer

Dextrose can cause osmotic diuresis and volume depletion in shock patients, making hypotension worse. In hemodynamically unstable patients, consider lower-dose insulin or focus on other measures (calcium, albuterol, dialysis). Insulin is great but requires adequate renal perfusion and volume.

Question 3: A 52-year-old man with prostate cancer presents with confusion, K⁺ 6.8, and cannot void. Post-void residual is 1200mL. After Foley placement and 2L NS, his K⁺ drops to 5.9 in 6 hours. Did you need to give insulin?

Answer

Probably not! Relieving obstruction allowed post-obstructive diuresis and potassium loss. He may have improved adequately with catheter + fluids alone. Sometimes the simplest solution—fixing a correctable cause—works better than medications.

Key Takeaways for Exams

- **Hyperkalemia can kill silently** - ECG changes may be only warning before arrest

- **Three-pronged approach:** Stabilize heart (calcium) shift K⁺ in (insulin/glucose) remove K⁺ (dialysis)
- **Calcium doesn't lower K⁺,** it just buys time
- **Insulin + glucose is most reliable** for shifting K⁺ intracellularly
- **Check for obstruction** - Foley catheter is simple and effective
- **Discontinue RAAS inhibitors** in renal failure (major cause)
- **Peaked T waves** in precordial leads = classic early finding
- **Avoid Kayexalate** - use patiromer or zirconium cyclosilicate instead
- **Post-dialysis rebound** occurs in 6-12 hours - keep monitoring

Clinical Pearls

1. **Always check a 12-lead ECG** - don't rely on potassium level alone
2. **Peaked T waves have narrow base** - distinguishes from normal
3. **Digoxin toxicity contraindication** - calcium worsens it
4. **Arrhythmias may occur with NO ECG changes** - hyperkalemia is unpredictable
5. **Oliguric renal failure patients need dialysis** - medical therapy often insufficient
6. **ACEI/ARB stopping is hard** - document urgency in chart for re-evaluation

Exam strategy: If you see hyperkalemia with ANY ECG change your answer should include calcium immediately. Don't overthink it.

See Also

Related Student Handouts

- Hypokalemia Management
- Acid-Base Disorders
- AKI Workup and Diagnosis
- Rhabdomyolysis
- RAAS Inhibitors and Renal Protection

Clinical Content (01-Clinical-Medicine/Nephrology)

- Electrolyte Disorders Hub
- Essential Renal Laboratory Tests

Butler-COM Resources

- Butler COM - Nephrology Deep Dive

Clinical Resources

- Clinical Review: Ekg Changes In Hyperkalemia — Comprehensive clinical review with PubMed references

- Clinical Review: Hyperkalemia Treatment Report — Comprehensive clinical review with PubMed references
- Clinical Review: Mercy Nursing Hyperkalemia — Comprehensive clinical review with PubMed references
- Clinical Review: Hyperkalemia Renamed — Comprehensive clinical review with PubMed references