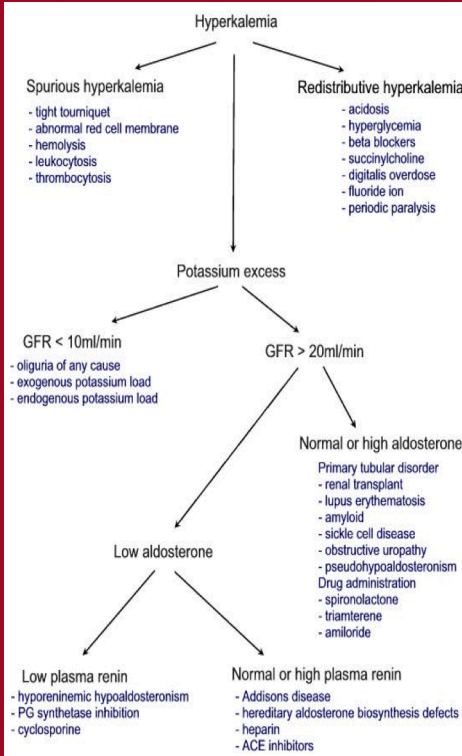


# EM CASE OF THE WEEK

BROWARD HEALTH MEDICAL CENTER DEPARTMENT OF EMERGENCY MEDICINE



## Hyperkalemia in the Emergent Setting

*S 32 year old male with PMH of dialysis dependent CKD signs into the ED with 3 days of SOB and fatigue. His vital signs are T 98.7, HR 110, RR 20, BP 140/80, O2 sat 98%. He is triaged and sent to fast track with a CXR ordered, which was read as normal. He is seen by the medical student for further history, and admits he usually goes to dialysis 3 times per week, but has not gone in 3 weeks. What is the **most important** test to order in evaluation of this patient at this time?*

- A. The flu swab should be ordered on all patients with CKD and symptoms of influenza.
- B. CBC to check Hgb & Hct
- C. EKG to check for conduction abnormalities/ cardiac arrhythmias
- D. CMP to check for electrolyte disturbances
- E. BNP to check for possible CHF exacerbation

## EM CASE OF THE MONTH




EM Case of the Month is a monthly “pop quiz” for ED staff. The goal is to educate all ED personnel by sharing common pearls and pitfalls involving the care of ED patients. We intend on providing better patient care through better education for our nurses and staff.



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## Hyperkalemia

**The correct answer is C.**

Serum potassium	Typical ECG appearance	Possible ECG abnormalities
Mild (5.5-6.5 mEq/L)		Peaked T waves Prolonged PR segment
Moderate (6.5-8.0 mEq/L)		Loss of P wave Prolonged QRS complex ST-segment elevation Ectopic beats and escape rhythms
Severe (>8.0 mEq/L)		Progressive widening of QRS complex Sine wave Ventricular fibrillation Asystole Axis deviations Bundle branch blocks Fascicular blocks

### Discussion:

*Hyperkalemia is a common problem in patients with acute or chronic kidney disease (CKD), and in patients that are taking drugs that inhibit the renin-angiotensin-aldosterone axis. Hyperkalemia should always be in the back of your mind as a diagnosis while treating these patients because they may present asymptotically or even with non-specific symptoms that can quickly turn into life threatening events. The most important/ life saving test to order is an EKG to check for any cardiac conduction abnormalities. CMP is most accurate in determining how high K levels are; however, symptoms can occur at higher or lower levels of hyperkalemia depending on whether the issue is acute or chronic for the specific patient.*

*The urgency of treatment of hyperkalemia varies depending on cause, as well as symptoms. The most serious symptoms consist of cardiac conduction abnormalities/arrhythmias and muscle paralysis. Symptoms typically manifest at K levels  $\geq 7$  meq/L with chronic hyperkalemia, but may begin at lower levels with acute rises in K in patients with marked tissue breakdown (rhabdomyolysis, crush injury, tumor lysis syndrome, etc). In cases such as these, large amounts of K are released from cells leading to rapid elevations in K levels, and should receive aggressive therapy, even if there is only a mild degree of hyperkalemia.*

## Take Home Points

- Keep a high clinical suspicion for patients who are high risk for hyperkalemia
- EKG is the most important test. CMP is the most accurate test
- There is no “universal” K level that warrants therapy, use your clinical judgement on a case by case basis.
- Progression and severity do not correlate well with serum K concentration
- 3 main goals in treatment:  
Protect cardiac membrane potential by antagonizing effects of K with Ca.  
Drive extracellular K into cells.  
Removing excess K from body

### Evaluation of “at risk” patients:

By the time a patient has been triaged, you should be suspicious of hyperkalemia based on past medical history, and possibly symptoms. The most **important** test to order is an EKG. The most **accurate** test to order is a CMP, which will tell you the patients K level definitively.

Clinical manifestations typically occur in patients who begin to have EKG changes, earliest changes being tall peaked T waves and shortened QT intervals. At higher levels, you will see progressive lengthening of the PR interval and QRS duration. Next, p waves may disappear and QRS waves further widen to sine waves. Finally, ventricular standstill with a flat line on EKG with complete absence of electrical activity occurs. Again, progression and severity do NOT correlate well with serum K concentration, so your level of clinical suspicion must always remain high in certain high-risk populations.

*For a list of educational lectures, grand rounds, workshops, and didactics please visit*

*<http://www.BrowardER.com>*

*and click on the “Conference” link. All are welcome to attend !*

**Treatment:**

There are 3 main goals in the treatment of hyperkalemia:

- Protect cardiac membrane potential by antagonizing effects of K with Ca
- Drive extracellular K into cells
- Removing excess K from body

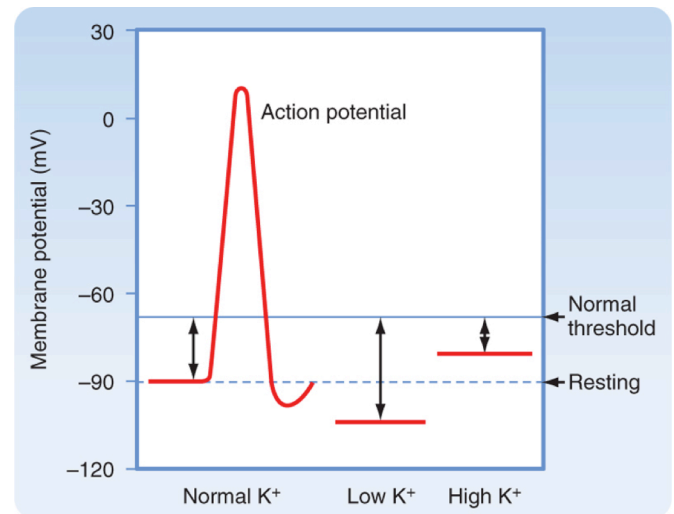
Therapies in order of rapidity of action:

1. **Calcium**- IV calcium directly antagonizes hyperkalemia induced depolarization of resting membrane potential leading to inactivation of Na channels and decreased membrane excitability. Onset of action is minutes, but has a short half life (15-30 minutes), therefore it should be used in conjunction with other therapies, not as monotherapy
  2. **Insulin with glucose**- Insulin drives K back intracellularly by enhancing the Na-K ATPase pump in skeletal muscle. Effect begins in 10 to 20 minutes, peaks at 30-60 minutes and lasts for about 6 hours.
  3. **Beta-2 adrenergic agonists**- Drives K intracellularly by increasing the activity of Na-K ATPase pump, like insulin. Also activates the inwardly directed Na-K-Cl cotransporter. Albuterol and insulin have an additive effect, but caution should be taken in patients with active coronary artery disease, and rebound hyperkalemia post dialysis may occur, so it is important to monitor these patients post treatment.
  4. **Sodium bicarbonate**- raising the systemic pH releases hydrogen ions from the cells creating a buffer, and accompanying K movement intracellularly to maintain electroneutrality. Evidence only supports use for prolonged therapy for metabolic acidosis.
- Additional therapies indicated if the above treatments are insufficiently effective, or the hyperkalemia is severe or the levels of K are expected to increase rapidly: loop or thiazide diuretics, cation exchange resin, dialysis.

**Patient education:**

There are many ways to treat hyperkalemia once it has occurred; however, it is important to educate high-risk patients of the life threatening risks that can occur with high levels of K, and how to prevent these problems from occurring in the first place.

- Explain the importance of dialysis, and how the risk of missing a single session can increase their chances of serious medical conditions such as cardiac arrhythmias and death that can be easily prevented just by attending scheduled dialysis sessions
- Avoid episodes of fasting, which can lead to increased extracellular concentration of K due to reduced insulin secretion.
- Avoidance of certain OTC medications such as NSAIDs that impair K excretion.



Koepfen & Stanton: Berne and Levy Physiology, 6th Edition.  
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