EM CASE OF THE WEEK.

BROWARD HEALTH MEDICAL CENTER
DEPARTMENT OF EMERGENCY MEDICINE

BROWARD HEALTH Care Warriors

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Hyperkalemia

A 71 year-old woman with a past medical history of Parkinson's disease, hypertension, diabetes and osteoarthritis presents to the emergency department with an altered mental status. The daughter explains that the patient has lost her ability to perform most of her activities of daily living over the past week and she has had moments of nonsensical speech. Her current medications include Lisinopril, Spironolactone, Metformin and Naproxen. She has an appointment with her neurologist next week to start treatment for her Parkinson's disease. Her BP is 103/71, HR is 59, temperature is 98.7 F and her O2 saturation is 98% on room air. On physical examination, she is oriented to person and place but not time. Her heart sounds are faint and she has an irregular rhythm. A 4Hz pill-rolling tremor is noted in bilateral upper extremities. What is the next best test in order to diagnose the underlying cause of the patient's recent deterioration?

A. Serum thiamine

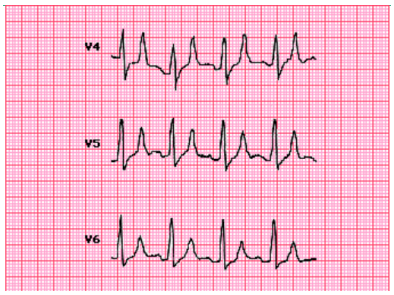
B. Echocardiogram

C. Basic metabolic panel

D. MRI of the head

E. CT scan of the abdomen

F. Lumbar puncture with CSF analysis



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Lateral precordial leads showing peaked, narrow (tented) T waves and prolongation of the QRS complex (0.14 to 0.16 seconds) associated with moderate to severe hyperkalemia.

Hyperkalemia is defined as a serum potassium over 5.2 mmol/L. Patients with severe hyperkalemia (>6.5mmol/L) or moderate hyperkalemia with renal impairment may present with a hyperkalemic emergency. Common presenting symptoms include muscle weakness or paralysis, cardiac conduction abnormalities or arrhythmias. It is important to be aware of characteristic EKG changes in hyperkalemia.

EM Case of the Week is a weekly "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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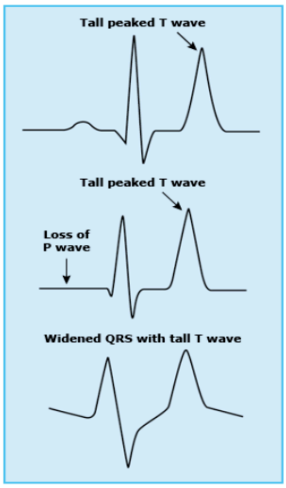
The correct answer is C. Basic metabolic panel.

Hyperkalemia is a dangerous electrolyte imbalance commonly found in patients who have chronic kidney disease or patients that are taking medications which inhibit the renin-angiotensin-aldosterone-system (RAAS). These risk factors lead to a decreased urinary excretion of potassium and can potentially lead to a hyperkalemic emergency. The patient is taking several medications which could predispose her to hyperkalemia including an ACE inhibitor, an aldosterone antagonist and NSAIDs. Her history of HTN and DM likely predisposes her to some degree of CKD. Patients with Parkinson's disease and prior dementia are at increased risk for delirium, which this patient likely has. Underlying electrolyte imbalances or infections are common triggers. A new onset of an abnormal heart rhythm is a cardinal finding of hyperkalemia and a potential sign of cardiac failure if the serum potassium is not corrected.

Discussion

It is crucial to recognize and treat hyperkalemia early in a patient's clinical course. Special attention should be given to patients who have renal insufficiency or those who are taking several medications that alter the metabolism of potassium. Most of these patients will present with a moderate level of chronic hyperkalemia that can quickly progress with even a minor insult such as the addition of a new medication or changes in dietary habits. Concurrent tissue breakdown, crush injuries, tumor-lysis syndrome and gastrointestinal bleeds can be other more serious inciting factors. Patients with severe hyperkalemia may present with clinical symptoms such as muscle weakness, paralysis or cardiac conduction abnormalities. There is a small subset of patients who may experience redistributive hyperkalemia, such as those with diabetic ketoacidosis or hyperosmolar hyperglycemic state. These patients tend to present more acutely since hyperosmolality and insulin deficiency lead to a transcellular shift of potassium from the intracellular space to the extracellular fluid.



Serum potassium	Major change
5.5-6.5	Tall peaked T waves
6.5-7.5	Loss of P waves
7.0-8.0	Widening of QRS
8.0-10.0	Sine wave, ventricular arrhythmia, asystole

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There are several characteristic EKG changes that accompany hyperkalemia. The earliest visible conduction abnormalities can be seen at a potassium level of 5.5 to 6.5 and that included tall peaked T-waves. As the serum potassium level increase, changes such as a loss of P-waves, widening of the QRS complex and ventricular arrhythmias can be seen. It is important to note, however, that the progression of EKG changes may not correlate with the serum potassium level. In addition, various other conduction abnormalities can be seen in hyperkalemia such as bundle branch blocks, sinus bradycardia, sinus arrest, atrial flutter and asystole among many others. Patients with chronic hyperkalemia may be more likely to have slower progressions in EKG changes.

Management

Treatment of hyperkalemic emergencies can be placed into two different categories: rapid acting therapies intended for cardiac protection and acutely decreasing serum potassium and longer acting therapies aimed at definitively decreasing serum potassium. See Table 1.

For a list of educational lectures, grand rounds, workshops, and didactics please visit ***BrowardER.com*** and **click** on the ***"Conference"*** **link**.

All are welcome to attend!

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Table 1: Therapies for Hyperkalemic Emergencies

Therapy	Mechanism of Action	Administration
Rapid Acting Therapies		
Calcium Gluconate	Calcium directly antagonizes the membrane effects of potassium on cardiac cells	1000mg over 2-3 minutes
Calcium Chloride	See Calcium Gluconate	500-1000mg over 2-3 minutes
Insulin with Glucose	Enhances the activity of the Na-K-ATPase in skeletal muscle, driving K+ into cells.	10-20 units of regular insulin in 500mL of 10% Dextrose
Long Acting Therapies		
Loop diuretics	Increased potassium loss in the urine	40mg Furosemide every 12 hours
Gastrointestinal cation exchanges	Binds potassium in the gastrointestinal tract	Depends on the cation exchanger
Hemodialysis	Directly removes serum	N/A

Continuous EKG monitoring should be performed on all patients with hyperkalemia that require rapid acting therapies. Serum potassium should be measured 1-2 hours after the initiation of treatment and repeatedly to monitor response to treatment. Cardiac membrane stabilizers such as calcium are intended to prevent lethal arrhythmias in hyperkalemia and are short-lived (30-60 minutes). Calcium chloride has three times the elemental calcium as calcium gluconate however calcium chloride can cause injection site irritation. When infusing insulin for hyperkalemia, glucose should always be co-administered. Loop diuretics can be extremely effective in patients with satisfactory renal function, otherwise cation exchangers such as patiromer, zirconium cyclosilicate, and sodium polystyrene are acceptable options. Hemodialysis can also be highly effective in patients with poor renal function but the patient requires a functional vascular access. Other therapies include beta-2-adrenergic agonists and sodium bicarbonate but they should not be used independently in the treatment of hyperkalemia

Take Home Points

- Hyperkalemic emergencies can lead to life-threating arrhythmias and should be highly suspected in patients with renal insufficiency and those taking medications that inhibit the RAAS.
- EKG changes may not correlate with serum potassium levels, however they include tall-peaked T-waves, loss of P-waves and widening of the QRS complex.
- Management of hyperkalemic emergencies should include cardiac membrane stabilization and therapies that decrease serum potassium levels.
- When treating a hyperkalemic emergency, it is important to maintain the patient on continuous EKG monitoring and measure the serum potassium levels to track responses to therapies. Renal function and vascular access are important considerations when deciding on therapeutic options.

ABOUT THE AUTHOR

This month's case was written by Luai Sobhi Mustafa. Luai is a 4th year medical student from Florida International University Herbert Wertheim College of Medicine. He completed his Emergency Medicine rotation at BHMC in February 2020. Luai intends on pursuing a career in Orthopaedic Surgery after graduation.

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