

Hyperkalemia

By: Natalie Morris, B.S.; Paul McMackin, M.D.

Definition: Severe hyperkalemia occurs at levels of >7.5 mmol/L. Hyperkalemia is much more dangerous to individuals than hypokalemia.

Etiology & Work-Up: Order CBC, BMP, Ca, and EKG as initial work-up for hyperkalemia

- ❖ Confirm K^+ elevation is real and not due to pseudohyperkalemia (false K^+ elevation from lab abnormalities/hemolysis with difference in $[K^+]$ in serum v. plasma of >0.4 meq/L)
 - Evaluate CBC for leukocytosis and thrombocytosis; if suspect pseudohyperkalemia, can repeat blood draw
- ❖ If renal function is normal, evaluate for transcellular shift.
 - Hx of trauma \rightarrow rhabdomyolysis \rightarrow order creatine kinase
 - Hx of chemotherapy \rightarrow tumor lysis syndrome \rightarrow order phosphorous, uric acid
 - Hyperglycemia on BMP results \rightarrow consider insulin deficiency
 - Low HCO_3^- & low pH \rightarrow metabolic acidosis (H^+ / K^+ exchange) \rightarrow order arterial blood gas
- ❖ If renal function normal, consider increased intake & review medications.
- ❖ If above causes ruled out, evaluate for decreased K^+ excretion & order urine electrolytes (urine $K^+ < 40$ mmol/d = decreased K^+ excretion)
 - If urine $Na^+ < 25$ \rightarrow low Na delivery \rightarrow less Na resorption \rightarrow less K^+ excretion
 - May be due to AKI, CKD, or low circulating volume (CHF, cirrhosis)
 - Further work-up includes evaluating BUN, Cr from initial labs and pertinent imaging (echo, RUQ US)
 - If urine $Na^+ > 25$ \rightarrow suspect problem with K^+ secretion (sickle cell, obstruction)
 - Evaluate GFR (decreased K^+ excretion with GFR < 15)
 - Evaluate for deficiency of mineralocorticoids or adrenal insufficiency
 - Can be due to Addison's disease \rightarrow perform ACTH stimulation test (positive if serum cortisol < 500 nmol/L 30min-1hr after administration)
 - Can be due to Type IV RTA \rightarrow plasma renin and aldosterone will be low (< 0.6 ng/mL/hr and < 3.1 ng/dL, respectively), with urine pH < 5.5
 - Transtubular potassium gradient: $\frac{urine_K}{plasma_K} \div \frac{urine_{osm}}{plasma_{osm}}$
 - Occasionally used to compare potassium and osmolality in urine vs. plasma \rightarrow low values (< 7) indicate hypoaldosteronism (but TTKG not currently recommended for evaluation)

Presentation

Severe hyperkalemia may result in decreased deep tendon reflexes or flaccid paralysis. EKG findings follow progression of peaked T waves, loss of P waves, widened QRS, bradycardia, sine wave pattern, ventricular fibrillation.

- ❖ Associated symptoms are often related to the underlying cause of hyperkalemia.
 - Jaundice → consider hemolysis
 - Myalgias → consider rhabdomyolysis
 - Hypertension → consider renal disease
 - Heart failure → consider low circulating volume to kidneys
 - Hypotension → consider inadequate aldosterone

Treatment

Contingent on serum levels, rate of rise, symptoms, and cause → mnemonic **C BIG KD**

- ❖ **C: Calcium gluconate** (first line to stabilize cardiac membrane) -- given IV, 10 mL of 10% solution, rapidly over 5-10 minutes → second dose given 5 mins later if EKG changes persist
- ❖ **B: Beta agonists** (not given as monotherapy) -- typically given as nebulized albuterol, 10-20 mg, effect lasts 1-4 hours
- ❖ **I: Insulin** (second line to shift K⁺ into cells) -- given IV, 10 units regular insulin in 25-50g of glucose, effect last 2-6 hours (*important to give with glucose to prevent hypoglycemia - measure glucose every 2 hours)
- ❖ **G: Glucose** -- given IV, 50 mL of 50% dextrose (25 g glucose) with insulin to mitigate hypoglycemia (hold if patient very hyperglycemia)
- ❖ **K: Kayexalate** (not first line) & **Patiromer** (persistent outpatient hyperkalemia) – *Kayexalate* – given orally or rectally, 15-60 g up to 4x daily depending on severity, onset of action unclear - typically hours; *Patiromer* – given orally, 8.4 g daily (but can max at 25.2 g daily), effect lasts 12-24 hours
- ❖ **D: Diuretics & Dialysis** -- give loop diuretics if fluid overloaded, e.g. furosemide 40-80 mg IV with saline, effect lasts 2-6 hours; dialysis is last resort for refractory hyperkalemia that is severe, takes hours to cause an effect

Clinical Pearls

- ❖ Pseudohyperkalemia is the most common cause of hyperkalemia, so to ensure improper treatment, always repeat blood draws and ensure proper technique (e.g., patient not clenching fist) and an atraumatic blood draw.
- ❖ Any ECG changes warrant a cardiology consult and require 24/7 telemetry monitoring until resolution of hyperkalemia.

- ❖ A high index of suspicion and early treatment is needed as patients can be asymptomatic until levels are very high.