Hyperkalaemia management

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Background

- Definition = a serum or plasma potassium that is higher than the upper limit of normal potassium, usually Serum K+ ≥ 5.5 mmol/L.
- Medical emergency if serum K+ ≥ 6.5 mmol/l or symptomatic (e.g. palpitations or syncope secondary to arrhythmia, muscular weakness, paresthesia) or there are ECG changes.
- Acute hyperkalaemia is a common manifestation of significant acidosis and responds to management of the acidosis.
- In children, most commonly seen from a haemolysed sample i.e. pseudohyperkalaemia.
- See notes section at the end for other causes.

Assessment

- Bloods: FBC, U&E, venous gas
- ECG
- Urine: electrolytes

Clinical signs / symptoms

These symptoms may be present:

- **Muscle weakness** or **paralysis**;
- **Paresthesia**;
- Symptoms of **cardiac conduction abnormalities** e.g.  
  o Palpitations;
  o syncope;
  o cardiac arrest.

ECG changes

These changes may be present:

- Peaked T waves;
- Prolonged PR interval;
- Widened QRS;
- Disappearing/ absent P waves.
Paediatric Clinical Practice Guideline

Management - Treatment Flowchart

- Stop all potassium enhancing fluids (including blood products);
- Stop medications which may increase serum potassium;
- Treat underlying cause if known (e.g. shock) – but consider avoiding / delaying blood products as these contain significant amounts of potassium
- Obtain an ECG (however, do not let ECG delay treatment)

Mild / Moderate Hyperkaemia
- 5.5 mmol/l ≤ K+ < 6.5 mmol/l and;
- no clinical signs/symptoms and;
- no ECG changes

If raised K+ confirmed on repeat test:
- Review medications (including fluids);
- Review diet (refer to dietitian);
- Escalate to Senior Clinician / Consultant.
- Discuss early with consultant on-call if evidence of AKI.
- Admit for observation and repeat blood tests if ongoing risk of continued rise in K+ (e.g. due to tissue breakdown/ crush injury/tumour lysis);
- Prior to discharge, make arrangements for repeat blood test in the community.

Severe Hyperkalaemia:
- K+≥6.5mmol/l or;
- patient symptomatic / clinical signs or;
- ECG changes

- Place on a cardiac monitor and confirm hyperkalaemia with blood gas;
- Escalate to Senior Clinician / Consultant responsible for patient

Immediate Management

Salbutamol 2.5mg via nebuliser (repeat as needed)
Or IV 4 micrograms/kg (max 250 micrograms) over 5 minutes (min. interval between IV doses is 2 hours)

AND/OR

Insulin / Glucose Infusion (see ‘Drugs’ section below for doses)
Further Management

Check potassium 30 mins after intervention
Liaise EARLY with paediatric nephrologist (may need dialysis)
Consider admission to HDU / retrieval to PICU

Repeat ‘Immediate Management’ as above if ongoing hyperkalaemia +/-
Consider Sodium bicarbonate if acidic (see ‘Drugs’ section 1 for dosing)
Do not give if corrected Ca <2.0 mmol/l or ionised Ca < 1.0 mmol/l +/-
Consider Furosemide
1mg/kg IV over 5-10 minutes (Maximum rate of administration: 4mg/min)
Higher doses may be required in renal failure.
May be given alongside salbutamol.

Ongoing Management (usually in liaison with Paediatric Nephrologist)

- Admit for observation and repeat blood tests if ongoing risk of continued rise in K+ (e.g. due to tissue breakdown / crush injury / tumour lysis)
- Regular Furosemide +/-
- Calcium resonium (or Sodium resonium if hyponatraemic) - see ‘Drugs’ section
- Dialysis (Especially in CKD / AKI e.g. HUS)
- Dietitian referral

Drugs:

1. Intravenous Calcium gluconate 10%:
   - 0.5mL/kg (max 20mL) given IV over 5-10 minutes (maximum rate: 0.5 mmol/minute = 2.5 mL/min) – use large peripheral vein or CVAD if available;
   - If patient is on digoxin, dose should be diluted with an equal volume of glucose 5% (preferred) or sodium chloride 0.9% and infused over 30 minutes.
   - Can be repeated after 5 mins if ECG changes persist.
   - If 2 doses given and ECG changes persist check blood gas for potassium and ionised Calcium and discuss with Paediatric Nephrologist.
   - Not to be administered through same IV line as IV sodium bicarbonate.
   - Preferred option if peripheral access or no calcium chloride available

2. Intravenous Calcium chloride 10%:
   - 20 mg/kg (maximum dose 1000 mg) given over 5 to 10 minutes preferably via central line (risk of tissue necrosis if extravasation);
   - If patient is on digoxin, dose should be diluted with 4 times its own volume in sodium chloride 0.9% and infused over 30 minutes.
3. Nebulised Salbutamol:
- All ages: 2.5 mg neb

4. IV Salbutamol dosing regime:
- 4 microgram/kg (max 250micrograms) as a single dose over 5 minutes.
- Repeat as necessary. Minimum interval between doses: 2 hours.
- Dilute to 50micrograms/1ml with 5% Glucose (preferably) or 0.9% Sodium Chloride. Draw up required dose and give over 5 minutes. Doses less than 50 micrograms should be further diluted (e.g. to 5ml) prior to administration.

5. Insulin / glucose *both MUST be given at the same time*:
Onset 10-30 mins. Peak action 30-60 mins. Reduction of K+ 0.5-1.5 mmol/L

- If ECG changes / severe symptoms:
  - 0.1 units/kg of short-acting insulin (Novorapid or Actrapid insulin) in 10ml/kg of 10% Glucose IV given over 30 minutes.
  - Can be repeated after 1 hour if needed: effect on potassium lasts for approx. 1 hour, should reduce intravascular K+ by about 0.5 - 1.5 mmol/L
  - Check blood sugar 15 and 30 minutes after infusion finished

- If normal ECG, or mild / no symptoms, or hyponatraemia, or renal / cardiac impairment:
  - short-acting insulin (Novorapid or Actrapid insulin) 0.05-0.1 units/kg/hr IV (2.5 units/kg insulin in 50 ml 0.9% sodium chloride at 1-2 ml/hr) with 10% glucose / 0.9% sodium chloride 5-10 ml/kg/hr IV. Give through the same cannula.
  - Check blood sugar 30 – 60 minutely during infusion then until 3 normal levels once infusion finished
- If blood glucose less than 4 mmol/l, give 2ml/kg 10% glucose as IV bolus and repeat blood sugar in 15 minutes.
- NB Insulin/glucose should be given via a non-PVC giving set

6. Sodium bicarbonate 8.4% *Use in metabolic acidosis only*:

- 1 mmol/kg as a single dose infused over 30 minutes. Onset of Action: 30-60 minutes, should reduce intravascular K+ by 0.5. Duration: 2-3 hours
- The 8.4% solution should ideally be diluted 1 in 5 for central administration and 1 in 10 for peripheral administration. Suitable diluents include 0.9% sodium chloride, 5% glucose and 10% glucose.
- In arrest or other emergency situations, or in fluid restricted patients, the 4.2% solution can be given NEAT peripherally to patients under 2 years, and the 8.4% solution can be given NEAT peripherally to those over 2 years. However, exercise extreme caution and monitor infusion site closely.
- NB. check corrected or ionised calcium and treat hypocalcaemia before giving sodium bicarbonate - risk of severe hypocalcaemia and seizures/tetany
- NOT to be given through same IV line as Calcium*

7. Calcium Resonium ® (Calcium Polystyrene Sulfonate) dosing regime

- **Oral:** 1 month -18 years 125-250 mg/kg (max 15 g) 3-4 times daily
  - may take >24 hours to work and should be given with lactulose to avoid impaction, the hypokalaemic effect may persist so treatment should be stopped when potassium is high normal.
  - Suspend powder in 3-4ml of water per 1 g calcium resonium given. Do NOT dilute in fruit juice/squash.

- **Rectal:** Birth-18 years 125-250 mg/kg 3-4 times daily if necessary (Max dose: 30g/day)
  - irrigate colon to remove resin after 8-12 hours.
  - Suspend powder in 5ml of water per 1 g calcium resonium given

**NB:**
- Scoop included in tub – 1 level scoop = 15g
- one level 5mL spoon = 2g
Notes:

References

- UpToDate – ‘Causes, clinical manifestations, diagnosis, and evaluation of hyperkalemia in children’ and ‘Management of hyperkalemia in children’;
- “Guideline for the assessment and management of hyperkalaemia in paediatric patients” – V3 March 2019 – Nottingham Children’s Hospital;
- BNF for Children
- NHS Injectable Medicines Guide (Medusa)

Main Causes of hyperkalaemia

- **Haemolysed** sample (pseudohyperkalaemia) e.g. squeezed gas
- **Causes of increased potassium intake** such as:
  - Iatrogenic excess e.g. from IV fluids / TPN / massive transfusion / IV medications with high K+ content
  - Excess K+ in diet.
- **Causes of potassium leakage from cells**:
  - Cellular injury (e.g. from rhabdomyolysis, tumour lysis syndrome, severe haemolysis, extreme exercise / crush injury);
  - Metabolic acidosis (the most common cause of intracellular potassium leakage to the extracellular space without cellular injury);
- **Causes of reduced potassium excretion by the kidneys**:
  - Acute / chronic renal disease
  - Dehydration.