Insert your Directorate or Department here

Liverpool University Hospitals NHS Foundation Trust

Issue number: Version (1)

Subject: **Management of Acute Hyperkalaemia**

Objective: The objective of this guideline is to provide a clear quick reference guide to support clinicians in the prompt treatment of patients with acute hyperkalaemia (serum potassium ≥5.5mmol/L) in non-critical areas of Trust.

Target Level: Trust-wide

Prepared by: Dr C Wong, Consultant Nephrologist

Dr Rebecca Brown, Consultant Nephrologist

Helen Shields, Advanced Pharmacist in Surgery and Nutrition
Acknowledgments: Dr Wai Hon ting

'CG Approved' logo will be added by CG Dept.

Evidence Base: **Rank: A, B, C or D** (CSG/CG Dept will categorise evidence base)

Associated Documents: DKA guideline

Information Classification Label ☒ **Unclassified**

Date of Issue: month & year **Review Date:** month & year + 3

REVIEW HISTORY			
Issue No.	**Page**	**Changes made with rationale and impact on practice**	**Date**

Emergency Management of Acute Hyperkalaemia in Adults

Airway Breathing Circulation Disability Exposure (ABCDE) approach

Seek expert help if patient compromised, Check ABG and Lactate.

Exclude Pseudo-Hyperkalaemia if unexpected result. This shouldn't delay treatment Check venous blood gas for prompt K^+ result. If <5.5 and not acidotic with no other clinical concerns, no further action required. If >5.5 or acidotic, needs ECG and lab sample resending and treatment as below. Commence empirical treatment if clinical suspicion of hyperkalaemia or in presence of ECG changes. If known dialysis patient contact renal team

MILD

K^+ 5.5-5.9mmol/L

Consider cause and need for treatment

MODERATE

K^+ 6-6.5mmol/L

Treatment guided by clinical condition

URGENT 12-lead ECG and rate of rise

SEVERE

K^+ >6.5mmol

Potentially life threatening

Emergency treatment indicated

ECG Changes? -> Cardiac Monitor

Peaked T waves, Absent P waves, Broad QRS, Sine wave, Bradycardia, VT

YES

NO

STEP 1

Protect the heart

10 ml 10% Calcium Chloride or 30 ml of 10% Calcium Gluconate

Via large IV access over 5 min. Repeat ECG.

Consider further dose in 5 mins if ECG changes persist.

STEP 2

Shift K^+ Into cells

INSULIN-GLUCOSE INFUSION

Add **10 units soluble Insulin** (e.g. Actrapid) to **250ml 10% Glucose** IV over 30 min

If pre-treatment blood glucose < 7.0 mmol/L – follow initial infusion with 10% glucose IV @ 50ml/hr for 5 hours to prevent hypoglycaemia (target 4-7mmol/L)

Risk of hypoglycaemia – monitor blood glucose

Salbutamol

10-20mg via Nebuliser, Monitor heart rate, may cause tachycardia.

STEP 3

Remove K^+ From the body

Administer potassium binder by choosing one of the following options:

1. Sodium Zirconium Cyclosilicate 10 g stat + TDS until K<5.3mmol/L, 72 hrs max.
2. Patiromer 8.4g PO stat + OD (monitoring of serum magnesium required, note potential for drug interactions – binding with co-administered drugs)
3. Or Calcium (or sodium) resonium 15g tds PO or 30g bd PR can be used as alternative but much longer onset of action and can cause constipation, co-prescribe with laxatives).

DIALYSIS – seek expert opinion

K+>6.5 despite medical therapy.

Consider early in those patients with AKI, poor urine output.

STEP 4

Monitor and Prevent recurrence

Monitor Potassium and Glucose

Following treatment recheck K^+ at 30 mins, 1,2,4,6,24 and 48 hours post treatment.

Blood glucose monitoring required for up to 12 hours post insulin glucose infusion.

If potassium remains ≥6mmol/L step 2 can be repeated.

Consider cause, prevent rise and recurrence

Discontinue medication that may contribute to hyperkalaemia. Common examples: ACE-Inhibitors, Angiotensin 2 receptor blockers, Potassium sparing diuretics, eplerenone, Trimethoprim.

Renal dietician review / stop gap low potassium diet advice. Consider need for potassium binder.

If serum bicarbonate low consider adding oral sodium bicarbonate starting at 500mg TDS

If further advice is required contact nephrologist on call

All patients presenting with hyperkalaemia should undergo a full medical and drug history and clinical examination to identify risk factors for and determine the cause of hyperkalaemia. Symptoms may be non-specific or absent, muscle weakness and/ or paraesthesiae may occur in severe cases.

If known dialysis patient contact renal team urgently.

Hyperkalaemia associated with diabetic ketoacidosis – refer to DKA guideline.

Once serum potassium result obtained see flow chart to interpret the severity of hyperkalaemia and on-going management. Commence empirical treatment if high clinical suspicion of hyperkalaemia or in presence of ECG changes, if biochemical results not yet available.

Exclude pseudo-hyperkalaemia if an unexpected result is reported – this should not delay treatment. Send paired blood samples in a clotted tube (serum) and a lithium heparin tube (plasma). Pseudo-hyperkalemia is present if [Serum K^+] - [Plasma K^+] >0.4mmol/L. Send FBC to exclude haematological disorder.

Risk factors for Hyperkalaemia:

- Acute Kidney Injury (e.g. diarrhoea & vomiting, infection).
- Dialysis dependency – contact renal team urgently
- Chronic Kidney Disease Stages 4 & 5 (eGFR < 30 ml/min/1.73m^2)
- Drugs (renin-angiotensin-aldosterone inhibitors, NSAIDs, potassium sparing diuretics, trimethoprim)
- Cardiac failure
- Diabetes mellitus (renin-angiotensin drugs, diabetic keto-acidosis)
- Liver disease (spironolactone, hepato-renal failure)
- Addison's Disease (primary adrenal insufficiency)
- Hyporeninaemic hypoaldosteronism (Type IV renal tubular acidosis)

ECG & Cardiac Monitoring

All patients with a serum potassium level of ≥ 6.0 mmol/L must have an urgent 12-lead ECG performed to assess for changes of hyperkalaemia.

Any patients with ECG changes and/or serum potassium ≥ 6.5 mmol/L should receive a minimum of continuous 3-lead ECG monitoring i.e. cardiac monitor.

Cardiac monitoring should also be considered for patients where a rapid rise in serum potassium is anticipated.

Step 1: Protect the heart

Administer 10 ml of 10% Calcium Chloride **or** 30 ml of 10% Calcium Gluconate intravenously over 5 minutes for patients with ECG changes (peaked T waves, flat/absent P waves, broad QRS, sine-wave pattern, bradycardia, cardiac arrhythmias, cardiac arrest). IV calcium remains essential even if emergency dialysis is planned/initiated.

Intravenous calcium antagonises cardiac membrane excitability provoked by hyperkalaemia, protecting against arrhythmias. Calcium does not lower serum potassium so further interventions are urgently required –see above flow chart. IV calcium protects the heart allowing time for the other interventions to take effect.

Repeat 12-lead ECG after 5 minutes. ECG changes should improve within 3 minutes – repeat the dose if no effect seen in 5-10 minutes. Due to the duration of action of IV calcium, if hyperkalaemia remains uncontrolled or returns after 30-60 minutes further doses of IV calcium may be required.

IV calcium salts undiluted may cause venous irritation and tissue damage in cases of extravasation. If a central venous access device is unavailable, administer via a large peripheral vein. Monitor site closely using a recognised phlebitis scoring tool and re-site cannula at first signs of inflammation.

Step 2: Shift potassium into cells

Insulin – Glucose infusion

Insulin-Glucose infusion is indicated for patients with **serum potassium ≥6.0mmol/L**. Check pre-treatment blood glucose.

- Add 10 units soluble Insulin (e.g. Actrapid) to 250ml 10% Glucose IV infuse over 30 minutes.
- If pre-treatment blood glucose < 7.0 mmol/L – follow initial infusion with further 250ml 10% glucose IV @ 50ml/hour for 5 hours to prevent hypoglycaemia (target 4-7mmol/L).
- Check blood sugars at 30, 60, 90, 120 minutes then hourly for 6hours. If hypoglycaemia occurs follow usual protocol.

Insulin reliably shifts potassium into cells – following infusion, serum potassium begins to fall within 15 minutes. Effect may be sustained for up to 2 hours then gradual rebound usually occurs.

The main risk of insulin-glucose infusion is hypoglycaemia, risk is increased in patients with pre-treatment blood glucose <7mmol/l, non-diabetic patients and patients with renal impairment. A glucose infusion post insulin-glucose infusion may be required as above to prevent hypoglycaemia. Insulin doses lower than 10 units are not as effective in treating hyperkalaemia and do not prevent hypoglycaemic events.

Salbutamol

Administer 10-20mg salbutamol via nebuliser driven by air (10mg dose in patients with known cardiac disease).

Salbutamol should not be used as monotherapy - patients on non-selective beta-blockers and those with end stage renal disease may not respond to salbutamol. The efficacy of insulin-glucose is increased if given in combination with salbutamol and

co-administration of salbutamol may also reduce the risk of insulin-induced hypoglycaemia.

Step 3: Remove potassium from the body – potassium binders

Moderate to Severe hyperkalaemia (serum potassium ≥6.0mmol/L): Administer potassium binder by choosing one of the following options:

1) Sodium Zirconium Cyclosilicate 10g TDS. Stop once potassium <5.3mmol/L. Maximum of 72 hours.
    - Empty 10g sachet into approximately 45mL water and stir well. The powder will not dissolve and should be drunk while still cloudy.
    - Can transiently increase gastric pH therefore should be administered at least 2 hours before or 2 hours after oral medications with clinically meaningful gastric pH dependent bioavailability: ketoconazole, itraconazole, posaconazole, atazanavir, nelfinavir, indinavir, ritonavir, saquinavir, raltegravir, ledipasvir, rilpivirine, erlotinib, dasatinib and nilotinib.

OR

2) Patiromer 8.4g orally stat then once daily. Stop once potassium <5.3mmol/L.
    - Patiromer should be separated by 3 hours from other medications.
    - Pour contents of 8.4g sachet into approximately 40mL water then stirred, top up with further 40mL water and stir thoroughly. The powder will not dissolve. If powder remains in the glass, add more water until entire dose is administered.

OR

3) Calcium (or sodium) resonium 15g TDS PO or 30g OD PR only if oral route unavailable. Stop once potassium <5.3mmol/L. Maximum of 72 hours.
    - Can cause constipation – considering adding laxatives e.g. lactulose 15ml BD regular.
    - Administer at least 3 hours before or 3 hours other oral medications.
    - For enema: 30g in 150ml of water as a daily retention enema retained for at least 9 hours.
    - Sodium resonium can be used in hypercalcaemia.

Step 4: Monitor and prevent recurrence

Recheck serum potassium at least 1, 2, 4, 6 and 24 hours after identification and treatment of moderate or severe hyperkalaemia.

If serum potassium remains >6.5mmol/L despite medical management refer to nephrology for consideration of dialysis. If haemodynamic instability/multiorgan failure refer to critical care.

Suspend potential causative medications:

ACE inhibitors e.g. ramipril
Angiotension receptor blockers e.g. candesartan
Potassium sparing diuretics e.g. spironolactone, eplenerone
Trimethoprim/co-trimoxazole

Not exhaustive list - review other medications

Contact renal dietitian for low potassium diet advice

If serum bicarbonate low (<22mmol/L) consider adding oral sodium bicarbonate starting at 500mg TDS. IV sodium bicarbonate is not routinely recommended for treatment of hyperkalaemia outside of cardiac arrest situation (see ALS guidance on hyperkalaemia in cardiac arrest) it can be considered in non-arrest situation this should be discussed with senior clinician.

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