Swansea Bay University Health Board

Clinical Guideline for the Management of Hyperkalaemia in Adults

Dr Balan Natarajan
Dr Andrew MacNab
Owain Brooks
Dr Tim Scale
Dr Sacha Moore

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(Recognition of Acute Deterioration and Resuscitation)
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SBUHB Emergency Management of Hyperkalaemia in Hospitalised Adults

Patient addressograph

Date: ___/___/___ Time: ___:___ Clinician:_____

Potassium (K+) (mmol/L):	Bicarb (mmol/L):	Urea (mmol/L):
pH:	pCO2 (kPa):	Creat (umol/L):

Fully clinical assessment using an ABCDE approach + 12-lead ECG + VBG
Consider pseudohyperkalaemia (utilise Lithium Heparin tube to exclude)
If dialysis-dependent and K^+ ≥6.0, contact renal team urgently

MILD
K^+ 5.5-5.9mmol/L
Repeat value if unexpected
Consider cause, review diet & medication
Does not usually require specific treatment

MODERATE
K^+ 6.0-6.4mmol/L
Treat as per ECG, clinical condition & rate of K^+ change

SEVERE
K^+ ≥6.5mmol/L
Emergency treatment indicated

ECG Changes?

No

Yes

30mL 10% calcium gluconate *OR* **10mL 10% calcium chloride** & repeat ECG

Protect the heart — 1

Check blood glucose, then give IV Insulin-Dextrose infusion
10 units soluble insulin (Actrapid) in 25g glucose (see glucose regimen list) over 15-30mins

If pre-treatment blood glucose <7.0mmol/L, the insulin-dextrose infusion should be immediately followed by **a further 25g glucose** (10% dextrose @50mL/hr for 5hrs)

Temporary shift of potassium into cells — 2

*As an adjunctive therapy, also **consider**:*

Nebulised Salbutamol 10-20mg
Reduce dose if tachyarrhythmia, caution in IHD

Give Lokelma (Sodium Zirconium Cyclosilicate) 10g TDS PO (*or* Patiromer 8.4g OD PO) (in emergency drug cupboards)
If overloaded consider IV diuretics

Remove potassium from the body — 3

Monitor laboratory potassium & capillary (cap) glucose as per table, consider cause including medication review to prevent recurrence

If K^+ ≥6.5mmol/L despite medical therapy, liaise with nephrology/ICU regarding suitability for renal replacement therapy

SUPPORTING INFORMATION

Complete all three steps rapidly

ECG Changes
Tented T Waves , Flat/absent p waves, Broad QRS, Sine wave pattern, Bradycardia, VT

IV Calcium (6.8mmol)
30mL 10% Calcium Gluconate IV over 10 minutes via large bore access
OR
10mL 10% Calcium Chloride IV over 5 minutes via large bore access

Ensure ECG is repeated to confirm resolution of changes, consider further dose after 5 minutes if changes persist.

Glucose Regimen (25g glucose)
=50mL 50% dextrose
=125mL 20% dextrose
=250mL 10% dextrose

IV Sodium Bicarbonate
Outside of a critical care setting, and on the advice of a nephrologist/internal medicine physician/intensive care physician, 500mL 1.26% (or 1.4%) sodium bicarbonate can be administered IV over 2-4hrs if metabolic acidosis associated with hyperkalaemia.

Monitoring	Cap Glucose (mmol/L)	Potassium (mmol/L)
Baseline		
30min		
60min		
120min		
180min		
240min		
360min		

(Adapted from the UK Kidney Association Guideline for the Emergency Management of Hyperkalaemia in Adults, 2020)

Emergency Treatment Algorithm for Hyperkalaemia (Potassium ≥5.5 mmol/l)

Acute management of hyperkalaemia in in-patients

Hyperkalaemia is a potentially life-threatening emergency, as it can lead to arrhythmias and cardiac arrest (mortality 20 to 30% if K^+ >6.5 mmol/L). The incidence of hyperkalaemia (K^+ > 5.5 mmol/L) in the community is 3-7% and it can be up to 10% in hospital in-patients.
This guideline is adapted from the UK Kidney Association Hyperkalaemia Management Guideline (June 2020)[1] and incorporates NICE recommendations[2,3] for newer hyperkalaemia therapies.

Severity

Mild Hyperkalaemia: Potassium 5.5 – 5.9 mmol/L - Mild, but of concern, and needs review.
Moderate Hyperkalaemia: Potassium 6.0 – 6.4 mmol/L - Needs urgent clinical review and treatment based on clinical features and ECG changes.
Severe Hyperkalaemia: Potassium ≥6.5 mmol/L - Needs emergency treatment.

Clinical features

Patients with hyperkalaemia often have no symptoms other than those due to the underlying disease. If severe hyperkalaemia presents, some patients may show signs of fatigue, weakness, paraesthesia, cramps/twitching and rarely respiratory depression. It would be useful to look for urinary bladder obstruction which would usually be associated with a history of AKI/ oliguria. Urinary drainage with a catheter or a nephrostomy should be considered if there is evidence of obstruction.

ECG changes

An ECG is mandatory in all in-patients with potassium ≥6 mmol/L.
ECG changes serve as a guide to the urgency of treatment to stabilise the cardiac membrane and reduce the risk of arrhythmia/cardiac arrest. There is no definite correlation between ECG changes and potassium levels. ECG changes are more common if potassium levels are rising acutely.

Immediate Management

Emergency treatment with IV calcium for cardiac stabilisation, and insulin/glucose and salbutamol should be given to all patients with potassium ≥ 6 mmol/L with ECG changes.

Cardiac stabilisation: IV calcium therapy

When ECG changes are present, **30ml** of 10% IV calcium gluconate should be given over 10 minutes through a large vein, with cardiac monitoring. The effect of calcium salts is temporary, lasting 30 to 60 minutes. Consider repeat doses if adverse ECG changes remain after 5 to 10 minutes.

If calcium gluconate is unavailable, give 10ml of 10% calcium chloride as an IV bolus, considering repeat doses if there is no improvement in ECG. Note that calcium chloride contains 3 times more calcium than calcium gluconate; therefore a dose of 10ml 10% calcium chloride (6.8 mmol Ca^{2+}) contains the same amount of calcium as 30ml 10% calcium gluconate (6.8 mmol Ca^{2+}). Calcium gluconate is less irritant to the veins and skin than calcium chloride, but both salts can cause venous irritation and tissue necrosis.

IV calcium should not be administered through the same IV cannula used for giving IV sodium bicarbonate as it will precipitate as calcium carbonate salts.

Shifting potassium into cells

Insulin-glucose therapy

Insulin-glucose therapy helps to drive potassium from the extracellular to intracellular compartment. The effect on serum potassium begins in 10-20 minutes, peaks at 30-60 minutes, and lasts for 4-6 hours.

As there is a significant risk of hypoglycaemia, checking capillary glucose levels prior to infusion is recommended.

If pre-treatment glucose levels are less than 7 mmol/l, initial therapy with 10 units of rapid acting insulin with 50 mls of 50% glucose (25g) infusion over 15-30 minutes, should be followed by an infusion of 10% glucose administered at a rate of 50ml/hour over 5 hours (250 ml, 25g glucose).

The dose can be repeated as necessary. Capillary glucose levels should be monitored at 15, 30, 60, 90, 120, 240, 360, 480 and 720 minutes.

Do not give dextrose in DKA. Give insulin only if capillary blood glucose is ≥20mmol/L.

Salbutamol

Salbutamol exerts its effects via activation of Na^+/K^+ ATPase. **The recommended dose is 10-20 mg of nebulised salbutamol**. A lower dose (5-10mg) should be used if patients are tachycardic or have a history of Ischemic Heart Disease. Its effects are seen at about 30 minutes and peak at 90 minutes, lasting for 2-6 hours. It reduces serum potassium by 0.5-1.0 mmol/L. Salbutamol should not be used alone to correct hyperkalaemia as the effects are variable.

Oral potassium binders

(N.B. these are used to complement rather than replace the use of insulin-glucose)
If continued after the initial correction phase, plans for monitoring and stopping oral potassium binders should be given to General Practitioners in the discharge summary.

Sodium Zirconium Cyclosilicate (SZC, Lokelma®)

Sodium Zirconium Cyclosilicate (SZC) is a non-absorbed potassium binder that preferentially exchanges H^+ and Na^+ for K^+ and ammonium ions throughout the gastrointestinal tract. Its onset of action is 1 hour.[4]

NICE has approved SZC as an option in the treatment of acute life-threatening hyperkalaemia alongside standard care in hospitalised patients.[2]

Correction phase:

The recommended dose is 10g orally three times a day until normokalaemia is achieved. The usual treatment duration is 24- 48 hours. The maximum duration is 72 hours. Sodium Zirconium Cyclosilicate should be discontinued after 72 hours if normokalaemia is not achieved.[4]

Maintenance phase:

If required, 5g SZC daily can be prescribed once normokalaemia is achieved. The dose may be titratred up to 10g per day or down to 5g on alternate days depending on serum K^+ levels.[4] The maintenance dose should be discontinued if hypokalaemia develops (serum K^+ < 4.0 mmol/L).

SZC administration:

The contents of the sachet should be emptied into a glass containing approximately 45 mL of water and stirred well. The powder will not dissolve. Advise the patient to drink the tasteless liquid while still cloudy, if the suspension settles it should be stirred again.[4]

Prescribing information can be found in the medicine's Summary of Product Characteristics:
Home - electronic medicines compendium (emc)

SZC supply:

Lokelma is kept in the 'Emergency Drugs' rooms in Morrison and Singleton Hospital, and on selected wards on both sites. For Emergency Lokelma prescriptions, if there is any difficulty getting the drug immediately, please contact your pharmacy team during normal working hours or the on-call pharmacist out of hours.

Patiromer and calcium resonium

Patiromer and calcium resonium are alternative oral potassium binding agents if Sodium Zirconium Cyclosilicate is contraindicated, not tolerated or unavailable. SZC is preferred in acute hyperkalaemia due to its quicker onset of action and more favourable tolerability. Calcium resonium should not be used in the emergency management of severe hyperkalaemia but may be considered in patients with moderate hyperkalaemia.[1]

Patiromer

Patiromer is a non-absorbed cation-exchange polymer that acts as a potassium binder in the gastro-intestinal tract. **The recommended starting dose is 8.**4 g once daily; adjusted in steps of 8.4g as required. Dose adjustments should be made at intervals of at least one week; maximum 25.2 g per day.[5] Onset of action is 4–7 hours (therefore should be used in conjunction with emergency hyperkalaemia treatment). The dose should be reduced or stopped if serum potassium is below the desired range.[5]

Full prescribing information can be found in the Summary of Product Characteristics:
Home - electronic medicines compendium (emc)

Calcium Resonium

Calcium polystyrene sulphonate (CPS, calcium resonium) is a cation exchange resin that works in the lower GI tract to enhance the elimination of K^+ in the faeces.[1]

The recommended dose is 15g TDS orally.[6]

Calcium resonium has a slow onset of effect (at least 4 hours).[1] It can cause severe gastrointestinal side-effects and tends to be poorly tolerated by patients. Calcium resonium causes constipation, therefore lactulose should be co-prescribed to accelerate resin transit and increase K^+ excretion in stools.[1] Macrogol 3350 (Laxido®, Movicol®) should be avoided as it contains potassium.[1] Calcium resonium should not be used in those with bowel obstruction or an ileus due to risk of colonic necrosis.[6]

Full prescribing information can be found in the Summary of Product Characteristics:
Home - electronic medicines compendium (emc)

Resistant hyperkalaemic cardiac arrests

Consider urgent hemodialysis if return of spontaneous circulation achieved (ROSC) and facilities are available immediately.

Post acute-therapy management

If hyperkalaemia is resistant to therapy, ask for an urgent senior review. Discussion with renal team or ICU should be considered for urgent dialysis/hemofiltration.
Please discuss all dialysis or renal transplant patients with the renal SpR or renal consultant on-call.
IV bicarbonate should be limited to cases of severe metabolic acidosis when recommended by an Intensivist or Nephrologist. The recommended dose is 1.26% or 1.4% sodium bicarbonate infused intravenously at a rate determined by the patient's fluid status and degree of acidosis.
Hyperkalaemia and metabolic acidosis with cardiac arrest should be treated with 50mL of 8.4% sodium bicarbonate.

IV hydration:

In many patients with prerenal AKI, intravenous fluid therapy will help to resolve hyperkalaemia.

Diuretics:

In the acute setting with non-oliguric, fluid overloaded patients, diuretics can be used. The diuretic most often used is intravenous furosemide. The dose will vary depending on renal function, but in those with significant renal impairment, up to 250mg IV furosemide may be used to try and promote urinary potassium excretion. The effect is mild, especially in the setting of an AKI.

Monitoring

After initial hyperkalaemia treatment, a venous gas must be checked hourly until the potassium level is below 6 mmol/L, and thereafter at 2 and 6 hours.

Review causes of hyperkalaemia

Pseudohyperkalaemia – If high potassium results are unexpected, rule out pseudohyperkalaemia by using a venous blood gas or a lithium heparin sample.

Conditions causing hyperkalaemia:

- Acidosis/DKA - Avoid glucose in the insulin infusion. Follow DKA protocol
- Renal Failure
- Aldosterone deficiency / resistance (Addison disease, pseudohypoaldosteronism,Type 4 RTA)
- Tumour lysis (discuss with Oncology/Haematology for treatment of the cause)
- Rhabdomyolysis/ crush injury / burns
- Blood transfusions

Medication review

Drugs commonly associated with hyperkalaemia include ACE inhibitors, Angiotensin Receptor Blockers (ARBs), NSAIDs, trimethoprim, beta blockers, amiloride, spironolactone, eplerenone, finerenone, ciclosporin, tacrolimus, digoxin toxicity, heparin and potassium supplements.

Dietary Review

A dietary review, preferably by a dietitian is needed in all patients with moderate to severe hyperkalaemia to reduce dietary intake of potassium-rich foods like salt substitutes, bananas, dried fruit, nuts, avocado, tomatoes, coffee, potatoes, chocolate etc.

Hyperkalaemia in patients from the community

Non-renal patients with severe hyperkalaemia ($K^+ \geq 6.5$ mmol/L) detected in the community should be admitted for immediate assessment and treatment on an Acute Medical Unit. Patients already known to the renal team should be discussed with a Nephrologist urgently.

Patients found to have mild hyperkalaemia (K^+ 5.5-5.9 mmol/L) should have a repeat electrolyte check as soon as possible, preferably in less than a week. If an episode of moderate hyperkalaemia
(K^+ 6.0 – 6.4 mmol/L) is detected in the community, Serum K^+ should be repeated within 1 day to ensure further management. On weekends, a repeat serum K^+ should be arranged through the Acute Medical Unit.

Acute GP Unit and Singleton Admission Unit

Investigations

Blood tests:

- Repeat serum measurement of potassium to identify pseudohyperkalaemia, and urine electrolytes and creatinine
- Further investigations may be necessary to examine co-existing illnesses:
    - Capillary and serum glucose to evaluate for hyperglycemia
    - Serum renin, aldosterone, and cortisol to further investigate kidney and adrenal function
    - FBC for signs of acute haemolysis
    - CK if rhabdomyolysis / crush injury suspected
    - Digoxin levels if appropriate
    - Urine dip – haematuria etc.

ECG:

- Peaked T waves - can be difficult to determine
- Prolongation of the PR interval - Widening of the QRS
- Reduced, or loss of, P wave
- AV dissociation
- Sine wave pattern
- Asystole
- In patients with heart disease and abnormal baseline ECG, bradycardia may be the only new ECG abnormality

Admission criteria from AGPU/SAU

Admit all patients with severe hyperkalaemia ($K^+ \geq 6.5$ mmol/L) and patients with $K^+ \geq 5.5$ mmol/L associated with any ECG changes or symptoms including:

- Muscle weakness
- Flaccid paralysis
- Palpitations
- Paranesthesia

For patients with K^+ 5.5-6.4mmol/L without ECG changes:

- Repeat test to rule out spurious result
- Address cause of hyperkalaemia and correct it
- Medication review (see above)
- Low potassium diet
- Repeat and monitor K^+

Patients already known to the renal team should be discussed with a Nephrologist.

References

1. Renal Association Clinical Practice Guidelines. Treatment of Acute Hyperkalaemia in Adults, June 2020
2. Sodium Zirconium Cyclosilicate for treating Hyperkalaemia: NICE Technology Appraisal Guidance (TA599), September 2019
3. Patiromer for treating Hyperkalaemia: NICE Technology Appraisal Guidance (TA623), February 2020
4. Sodium Zirconium Cyclosilicate (Lokelma) Summary of Product Characteristics: Home - electronic medicines compendium (emc)
5. Patiromer (Veltassa) Summary of Product Characteristics: Home - electronic medicines compendium (emc)
6. Calcium resonium Summary of Product Characteristics: Home - electronic medicines compendium (emc)

COIN clinical online information network

Swansea Bay University Health Board

Authorisation Form for Publication onto COIN

PLEASE ENSURE THAT ALL QUESTIONS ARE ANSWERED – IF NOT APPLICABLE PLEASE PUT N/A

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