Royal Cornwall Hospitals
NHS Trust

Adult Hyperkalaemia Management Clinical Guideline

V6.3

November 2023

Summary of Adult Hyperkalaemia Management

Assess patient using ABCDE approach.

12-lead ECG if $K^+ \geq 6.0$

Mild
K^+ 5.5-5.9

Moderate
K^+ 6.0-6.5

Severe
$K^+ \geq 6.5$

Are ECG Changes Present?

Cardiac stabiliser
Give 30 ml 10% Calcium gluconate IV over 5 minutes;
consider repeat doses if ECG changes persist after 5-10 minutes

Shift potassium into cells:

Give 10 Units of ActRapid and 10% glucose as per appendix 3 and consider risk of hypoglycaemia;

Consider 10-20 mg of nebulised salbutamol.

Eliminate K^+ from the body:

Ensure the patient is passing urine

If $K^+ \geq 6$ give sodium zirconium cyclosilicate (Lokelma®) 10 g TDS orally for 72 hours.

Monitor K^+ and blood glucose and consider cause.

If hyperkalaemia ≥ 6.5 is refractory to medical management escalate to senior and consider need for dialysis.

Monitoring requirements

Date: _____ **Time:** _____

Initial K^+ result: _____

12 lead ECG within 15 minutes of result recognition. ☐

3 lead cardiac monitor for all patients with $K^+ \geq 6.5$ or ECG changes.☐

Note: With persistent ECG changes/raised K^+ further calcium gluconate and ECGs are required.

Pre-treatment blood glucose: _____

Note: if pre-treatment BM <7.0, a further 25 g of IV glucose should be given over 5 hours after insulin treatment (e.g. 250 mls in 10% glucose over 5 hours). □

Repeat BMs post insulin infusion:

0 (baseline), 15, 30, 60, 90, 120, 180, 240, 360, 480 and 720 minutes.

Repeat K^+ Monitoring:

If baseline K^+ <6.0: within 24 hours.

If baseline K^+ >6.0: 1, 2, 4, 6 and 24 hours post treatment. A venous gas is sufficient to recheck potassium.
Repeat BMs.

Consider the cause/ Causative medications:

- AKI +/- CKD.
- Medications- ACE inhibitors, ARBs, spironolactone, NSAIDs, beta blockers, digoxin, trimethoprim, K+ supplements and co-trimoxazole.
- Hyperglycaemia.
- Consider spurious results – haemolysis of blood sample.

ECG Changes:

- Peaked T waves.
- Flat/loss of P waves.
- Broad QRS.
- Sine wave.
- Bradycardia.
- VT.

1. Aim/Purpose of this Guideline

1.1. This guideline is for the management of acute hyperkalaemia in adults in an in-hospital setting. It has been written in accordance with the Renal Association guidance for hyperkalaemia, published in 2020, to provide guidance on best clinical practice. It does however remain the clinicians' responsibility to use clinical judgement when applying the recommendations in this guideline.

1.2. This version supersedes any previous versions of this document.

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Data Protection Act 2018 and UK General Data Protection Regulations 2016/679 is applicable to all staff; this includes those working as contractors and providers of services.

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2. The Guidance

2.1. **Definition of hyperkalaemia**

This guideline follows the European Resuscitation Council (ERC) definition of hyperkalaemia, established in 2005 and maintained to current date. According to the ERC, hyperkalaemia is defined as a K+ level ≥ 5.5 mmol/L.

Hyperkalaemia is further classified into mild (5.5-5.9 mmol/L), moderate (6.0-6.4 mmol/L), or severe (≥ 6.5 mmol/L). The incidence of hyperkalaemia in hospital patients ranges between 1.1 and 10%. For patients with severe hyperkalaemia, the hospital mortality can be as high as 30.7% (An JN et al. Crit Care, 2012. 16: R225).

2.2. **The principles of hyperkalaemia management**

2.2.1. Successful treatment of hyperkalaemia involves 3 key steps:

1) Protecting the myocardium.

2) Moving potassium intracellularly; and

3) Removal of potassium from the body.

2.2.2. **Stabilising the myocardium:** IV calcium gluconate is indicated for all patients with a potassium ≥ 6.5, regardless from the ECG, and for patients with a potassium between 6.0 and 6.5 and ECG changes. A repeat ECG 5-10 minutes following calcium gluconate infusion is essential to assess its effect on ECG changes. Further doses of calcium gluconate may be required with non-resolution of hyperkalaemia or non-resolution of ECG changes.

2.2.3. **Moving potassium intracellularly**: Insulin-glucose (10 units of Insulin ActRapid in 25g of glucose) by intravenous infusion is indicated to treat moderate and severe hyperkalaemia (K+ ≥ 6.0). Potassium concentrations will start to fall within 15 mins. The reduction with be sustained for up to 2 hours, following which there will be a gradual rebound. The main risk of insulin-glucose treatment is iatrogenic hypoglycaemia.

Administration of Insulin and glucose infusion: Due to adherence to PVC insulin cannot be added directly to a glucose bag. See Appendix 3 for guidance.

2.2.4. **Removal of potassium from the body**: The majority of potassium excretion occurs via urine production. Additionally, some medications such as Sodium Zirconium cyclosilicate are able to bind potassium throughout the entire gastrointestinal tract. Potassium removal from the body is required in stage 3 of successful hyperkalaemia management.

2.2.5. NICE have now approved the use of Sodium Zirconium cyclosilicate (Lokelma®) as an option in life threatening severe hyperkalaemia (K+≥ 6). This drug is a non-absorbed potassium binder which preferentially exchanges H+ and Na+ for ammonium and potassium in the whole gastrointestinal tract to aid potassium removal from the body. Sodium Zirconium cyclosilicate should not replace calcium gluconate, insulin-glucose or salbutamol in the first two stages of treatment, but it should be started alongside them as soon as possible, as the onset of action of Sodium Zirconium cyclosilicate starts within an hour from ingestion.

2.3. Avoiding Iatrogenic Hypoglycaemia

2.3.1. Patients with a pre-treatment blood glucose of <7.0, should receive a pre- emptive infusion of 25 g over 5 hours (250mls of 10% glucose) following the insulin infusion to avoid hypoglycaemia.

2.3.2. Blood glucose should be ideally monitored at the following intervals: 0 (baseline), 15, 30, 60, 90, 120, 180, 240, 360, 480 and 720 minutes. Aim for BMs 4.0 – 7.0. Several risk factors contribute to hypoglycaemia in this situation, the prolonged half-life of insulin in renal failure, low body weight, older age, non-diabetic status.

2.4. ECG monitoring

2.4.1. A 12-lead ECG should be performed within 15 minutes of recognition of potassium ≥ 6.0 assessing for changes associated with hyperkalaemia.

2.4.2. We recommend at least 3-lead continuous monitoring in patients either:

1) A serum potassium ≥ 6.5.

2) Those with ECG changes.

3) Patients with a potassium of 6.0-6.4 who are clinically unwell or in whom a rapid increase in serum potassium is anticipated; or

4) Any other concerns about the patient's clinical situation.

2.4.3. In patients with ECG changes and arrythmias caution should be used with salbutamol. Consider senior clinician advice.

2.4.4. Cardiac protective agents should be used in patients with ECG changes and a potassium above 5.5.

2.5. Blood Potassium monitoring

2.5.1. Monitoring of potassium is essential to assess efficacy of treatment and monitoring for rebound hyperkalaemia following insulin-glucose infusion.

2.5.2. We recommend that a potassium >5.5 is repeated within 24 hours.

2.5.3. We recommend a potassium ≥ 6.0 is rechecked at 1, 2, 4, 6 and 24 hours post treatment. A venous gas is sufficient to recheck potassium at 1, 2, 4 and 6 hours blood test should be rechecked at 24hours.

2.6. Medications reviews in hyperkalaemia

Medication to consider the impact on a raised potassium include: This is not an exhaustive list but should be considered when reviewing patients with hyperkalaemia, consider the whole condition of the patient prior to discontinuing therapy.

Medications that effect Potassium transmembranal movement include amino acids, beta-blockers, calcium channel blockers, suxamethonium, and mannitol.

Reduced renal potassium excretion are mainly represented by angiotensin-converting enzyme inhibitors (ACEi) e.g. ramipril, angiotensin-II receptor blockers, direct renin inhibitors e.g. aliskiren, nonsteroidal anti-inflammatory drugs, calcineurin inhibitors, heparin and derivatives, aldosterone antagonists e.g. spironolactone, potassium-sparing diuretics, trimethoprim, and pentamidine.

Potassium-containing agents represent another group of medications causing hyperkalaemia e.g. potassium chloride.

Although the mechanism is unknown – erythropoietin stimulating agents can raise potassium levels.

2.6.1. Use of calcium gluconate

Calcium gluconate can increase the effects of oral digoxin. Digoxin toxicity can result in hyperkalaemia and use of calcium gluconate as a cardiac stabiliser can enhance this process. Consider digoxin toxicity prior to administration.

2.6.2. Use of Sodium Bicarbonate for treatment of acidosis

Consider the use of sodium bicarbonate in patients with acidosis, this can provide renal protection and promote renal excretion of excess potassium. This should be discussed with a senior clinician on an individual patient basis.

3. Monitoring compliance and effectiveness

Information Category	Detail of process and methodology for monitoring compliance
Element to be monitored	ECG monitoring, blood potassium monitoring, prescription of calcium gluconate, glucose and insulin, salbutamol, and Sodium Zirconium cyclosilicate.
Lead	Giorgio Gentile, Consultant Nephrologist RCHT. Aleksandar Sokerov, Renal Pharmacist, RCHT. Rachel Tan, Critical Care Pharmacist, RCHT.
Tool	Audit performed against UK renal association guidelines.
Frequency	Every 24 months
Reporting arrangements	Medicines Practice Committee.
Acting on recommendations and Lead(s)	Renal Governance Committee.
Change in practice and lessons to be shared	Junior doctor education Nursing education.

4. Equality and Diversity

4.1. This document complies with the Royal Cornwall Hospitals NHS Trust service Equality and Diversity statement which can be found in the Equality Diversity And Inclusion Policy or the Equality and Diversity website.

4.2. Equality Impact Assessment

The Initial Equality Impact Assessment Screening Form is at Appendix 2.

Appendix 1. Governance Information

Information Category	Detailed Information
Document Title:	Adult Hyperkalaemia Management Clinical Guideline V6.3
This document replaces (exact title of previous version):	Adult Hyperkalaemia Management Clinical Guideline V6.2
Date Issued/Approved:	September 2022
Date Valid From:	November 2023
Date Valid To:	07 July 2026
Directorate / Department responsible (author/owner):	Giorgio Gentile, Consultant Nephrologist, RCHT. Lucy Andralojc, Foundation Doctor, RCHT. Miles Geldart, Foundation Doctor, RCHT. Leia Alston, Foundation Doctor, RCHT. Rachel Tan, Pharmacist, RCHT.
Contact details:	01872 252590
Brief summary of contents:	Adult Hyperkalaemia Management Guideline
Suggested Keywords:	Hyperkalaemia - Emergency treatment - Potassium - Metabolic disorders - Water balance disorders - Water electrolyte imbalance - Hyperkalaemia - Adults - Prescribing - Medicines management - Drug therapy.
Target Audience:	**RCHT:** Yes **CFT:** No **CIOS ICB:** No
Executive Director responsible for Policy:	Chief Medical Officer
Approval route for consultation and ratification:	Renal Governance Meeting. Medicines Practice Committee.
Manager confirming approval processes:	Rachael Pearce
Name of Governance Lead confirming consultation and ratification:	Siobhan Hunter

Information Category	Detailed Information
Links to key external standards:	Renal Association Guidelines 2020. HYPERKALAEMIA GUIDELINE 2019 (ukkidney.org)
Related Documents:	Acute Kidney Injury Guideline
Training Need Identified?	No
Publication Location (refer to Policy on Policies – Approvals and Ratification):	Internet and Intranet
Document Library Folder/Sub Folder:	Clinical / Renal

Version Control Table

Date	Version Number	Summary of Changes	Changes Made by
March 2006	V1.0	Adult Hyperkalaemia Management guideline.	Renal consultants
7 October 2010	V2.0	Adult Hyperkalaemia Management guideline revised.	Dr Steve Dickinson, Renal Consultant
6 August 2013	V3.0	Adult Hyperkalaemia Management guideline, no changes made.	Dr Steve Dickinson, Renal Consultant
23 June 2014	V3.1	Addition of mobile summary as appendix 1.	Andrew Rogers, Corporate Records
14 July 2016	V4.0	Adult Hyperkalaemia Management guideline – updated in light of new Renal Association and Resuscitation Council UK joint guidelines 2014 i.e. 1. In the cardiac stabilizer section, 30mls Calcium Gluconate is now recommended 2. In the intracellular shift section, the use of salbutamol nebulisers is now recommended and has been adopted. 3. When patients are already taking digoxin, give calcium gluconate over 30 mins rather than 20 mins- see guideline.	Dr Steve Dickinson, Renal Consultant

Date	Version Number	Summary of Changes	Changes Made by
11 September 2019	V5.0	No changes made, as no new national guidance since the previous review. Moved to latest Trust template.	Dr Steve Dickinson, Renal Consultant
June 2022	V6.0	Adult Hyperkalaemia Management guideline – updated in light of new Renal Association guidelines 2020: 1. Recommend that patients with K+≥ 6.0 should receive Sodium Zirconium cyclosilicate 10g TDS for 72 hours. 2. Recommend that blood glucose should be measured prior to the insulin-glucose infusion. 3. Recommend that if the pre-treatment blood glucose is <7 mmol/L the patient should receive a further 25g of glucose over 5 hours, post insulin infusion. Addition of appendix 1 for insulin – glucose infusion preparation	Dr Giorgio Gentile, Renal Consultant Dr Lucy Andralojc, Junior Doctor Dr Miles Geldart, Junior Doctor Dr Leia Alston, Junior Doctor Pollyanna Bastian, Renal Governance Lead, Highly Specialised Renal pharmacist Rachel Tan, Critical Care Pharmacist
July 2022	V6.1	Appendix 3. Preparation and administration of Actrapid and Glucose added to guideline.	Pollyanna Bastian, Lead Pharmacist for General Medicine
September 2022	V6.2	Summary – Left panel updated to show as ‘appendix 3’ and Section 2.2.3.1. updated to show as Appendix 3.	Dr Giorgio Gentile, Renal Consultant
November 2023	V6.3	Summary- Cardiac stabiliser section amended to explicitly mention the need for repeat calcium gluconate doses in case of persistent ECG changes after 5-10 minutes.	Dr Giorgio Gentile, Renal Consultant

Controlled Document.

This document has been created following the Royal Cornwall Hospitals NHS Trust The Policy on Policies (Development and Management of Knowledge Procedural and Web Documents Policy). It should not be altered in any way without the express permission of the author or their Line Manager.

Appendix 2. Equality Impact Assessment

Section 1: Equality Impact Assessment (EIA) Form

The EIA process allows the Trust to identify where a policy or service may have a negative impact on an individual or particular group of people.

For guidance please refer to the Equality Impact Assessment Policy (available from the document library) or contact the Equality, Diversity, and Inclusion Team rcht.inclusion@nhs.net

Information Category	Detailed Information
Name of the strategy / policy / proposal / service function to be assessed:	Adult Hyperkalaemia Management Clinical Guideline V6.3
Directorate and service area:	Specialist Medicine, Renal
Is this a new or existing Policy?	Existing
Name of individual completing EIA (Should be completed by an individual with a good understanding of the Service/Policy):	Dr Giorgio Gentile, Renal Consultant
Contact details:	01872 253264

Information Category	Detailed Information
1. Policy Aim - Who is the Policy aimed at? (The Policy is the Strategy, Policy, Proposal or Service Change to be assessed)	To provide a written reference to guide the management of hyperkalaemia in adults.
2. Policy Objectives	To provide a written reference to guide the management of hyperkalaemia in adults.
3. Policy Intended Outcomes	Appropriate management of hyperkalaemia in adults.
4. How will you measure each outcome?	We will listen to feedback from all areas on this guideline
5. Who is intended to benefit from the policy?	Adult patients.

Information Category	Detailed Information
6a. Who did you consult with? (Please select Yes or No for each category)	• Workforce: Yes • Patients/ visitors: No • Local groups/ system partners: No • External organisations: No • Other: No
6b. Please list the individuals/groups who have been consulted about this policy.	**Please record specific names of individuals/ groups:** Renal Governance Group Medicines Practice Committee.
6c. What was the outcome of the consultation?	Approved.
6d. Have you used any of the following to assist your assessment?	**National or local statistics, audits, activity reports, process maps, complaints, staff or patient surveys:** No.

7. The Impact

Following consultation with key groups, has a negative impact been identified for any protected characteristic? Please note that a rationale is required for each one.

Where a negative impact is identified without rationale, the key groups will need to be consulted again.

Protected Characteristic	(Yes or No)	Rationale
Age	No	
Sex (male or female)	No	
Gender reassignment (Transgender, non-binary, gender fluid etc.)	No	
Race	No	
Disability (e.g. physical or cognitive impairment, mental health, long term conditions etc.)	No	
Religion or belief	No	
Marriage and civil partnership	No	

Protected Characteristic	(Yes or No)	Rationale
Pregnancy and maternity	No	
Sexual orientation (e.g. gay, straight, bisexual, lesbian etc.)	No	

A robust rationale must be in place for all protected characteristics. If a negative impact has been identified, please complete section 2. If no negative impact has been identified and if this is not a major service change, you can end the assessment here.

I am confident that section 2 of this EIA does not need completing as there are no highlighted risks of negative impact occurring because of this policy.

Name of person confirming result of initial impact assessment: Dr Giorgio Gentile, Renal Consultant.

If a negative impact has been identified above OR this is a major service change, you will need to complete section 2 of the EIA form available here:
Section 2. Full Equality Analysis

Appendix 3 Preparation and administration of Actrapid and Glucose

Step 1:

Obtain a 500ml bag of 10% Glucose (available on all wards) and check strength, expiry and product.

Step 2:

Using a 50ml syringe remove 50mls of Glucose 10% from the original 500ml bag. Label the syringe and securely place in preparation station. Keep the original 500ml bag for use later.

Step 3:

Using an insulin syringe remove 10units of Actrapid from a 100unit/ml vial and add to the 50ml syringe of Glucose 10% and ensure evenly mixed. (labelled with the additive information).

Step 4:

Place the 50ml syringe in a standard pump set to administer over 15minutes. (do not start pump until step 7)

Step 5:

Using the original bag of Glucose 10% retained in Step 2 containing a remaining 450mls remove and discard a further 250mls leaving a total of 200ml in the bag.

Step 6:

Ensure the patient has 2 peripheral lines available or 1 peripheral access point with a Y site connector.

Step 7:

Attach the 50ml syringe of 10% glucose and Actrapid pump (step 4) to one port and the remaining 200mls of Glucose 10% (step 5) to the second port and run both infusions simultaneously over 15mins.