Acute management of hyperkalemia

NHS Gloucestershire Hospitals NHS Foundation Trust

- Assess patient using ABCDE approach
- 12-lead ECG and monitor cardiac rhythm if serum $K^+ \geq 6.0$ mmol/l
- Exclude pseudohyperkalaemia (check VBG K^+ if haemolysis suspected, or send Lithium heparin tube sample)
- In cardiac arrest or life-threatening arrhythmias with suspected hyperkalaemia follow ALS algorithms and treat as severe hyperkalaemia with urgent IV calcium

K^+ 5.5-5.9
No acute treatment needed – consider the cause

Moderate K^+ 6-6.4

Severe K^+ >6.5

Give **Sodium zirconium cyclosilicate 10g PO** if able to tolerate oral medication

ECG Changes?
- Peaked T waves
- Broad QRS
- Bradycardia
- Flat/ absent P waves
- Sine wave
- VT

NO / YES

IV Calcium (6.8 mmol):
= 30ml 10% Calcium Gluconate IV
- Use large IV access & give over 5min
- **Repeat ECG**
- Consider further dose after 5 min if ECG changes persist

First 15 minutes

AIM: Protect the heart

Insulin–Glucose IV Infusion:
Give 10 Units Actrapid in 25 g Glucose* over 15mins

*25g glucose =
- 50ml 50% dextrose
- 125ml 20% dextrose
- 250ml 10% dextrose

If pre-treatment blood glucose is < 7.0mmol/l
Start 10% dextrose @ 50ml/hr for 5 hrs post initial infusion

Salbutamol 10-20mg nebulised
(10mg dose if history of IHD)

Next 30-60 minutes

AIM: Shift K^+ into cells & remove from body

AIM: Monitor & prevent recurrence

Further steps:
- Repeat K+ level
- Regular monitoring of K+ and glucose – see page 2
- Consider cause, and prevent further rise or recurrence
- Consider Sodium Zirconium 10g TDS for 72hours

K^+>6.5 after treatment

Repeat previous treatments. Seek expert help (cardiology or renal)

Approved by Drug & Therapeutics Committee March 2023
Review date: March 2026

NHS
Gloucestershire Hospitals
NHS Foundation Trust

Hyperkalemia prescription sheet and monitoring *

Initial Investigations	result	date	time
VBG K+			
VBG Glucose			
Lab k			

time	ECG Changes	
Document ECG and sign	Yes	No

If tolerating oral medication consider immediate Sodium Zirconium, does not delay need for prompt assessment and administration other treatments

Time	Date	Drug	Dose	Route	Prescriber	Time Given	Given By
		Sodium zirconium	10 g	PO			

ECG Changes or K+ >6.5

Time	Date	Drug	Dose	Route	Prescriber	Time Given	Given By
		Calcium Gluconate 10%	30mls	IV over 5-10 min			
Repeat ECG 5-10mins post Dose, if changes not resolved repeat dose							
Time	Date	Drug	Dose	route	Prescriber	Time given	Given by
		Calcium Gluconate 10%	30mls	IV over 5-10min			

K+ >6.0

Time/ Date	Fluid	Volume	Additive	Dose	Infusion Rate	Prescriber	Time started	Time finished	Given by
	50%Dextrose	50ml	Actrapid	10Units	15 mins				

Time	Date	Drug	Dose	Route	Prescriber	Time Given	Given By
		Salbutamol	10 mg** 20mg	Neb			
** 10mg dose if hx of IHD							

Glucose <7.0 prior to treatment To be started immediately after initial Ins/Dex infusion finished

Time/ Date	Fluid	Volume	Infusion Rate	Prescriber	Time started	Time finished	Given by
	10% Dextrose	250ml	50mls/hr				

Monitoring
Glucose to be maintained 4-7
Aim for Potassium <6 at 2hrs
Glu <4 or >7 or Potassium >6 at 2hrs or rising at any point– Contact Dr

Post Treatment	Time/Date	Glucose	Potassium	Results seen - signature
0 min				
15 mins				
30mins				
1hr			*VBG*	
1hr 30mins				
2hr			*VBG*	
3hr				
4hr			*VBG*	
5hr				
6hr			*Lab*	

* **Important:** Once completed on discharge must be filed in charts and forms section of patient's health record

Notes

Start with assessment of the patient (ABCDE) and the risk of arrhythmia, including potential rate of rise in serum potassium (e.g. rhabdomyolysis or other tissue necrosis or oliguric renal failure). Perform 12 lead ECG if Serum K+ ≥ 6.0

Protect Cardiac Membrane

If required, administer 30ml calcium gluconate 10% neat over 5 minutes via large peripheral vein, with continuous cardiac monitoring. If large vein is not available, administer over 10 minutes and watch for extravasation. Repeat dose after 5 minutes if ECG changes persist; can be repeated every five minutes. Effects are transient (30-60 minutes). **Administer over 30 minutes if patient taking digoxin**
Do not administer sodium bicarbonate simultaneously via same access (risk of formation of insoluble calcium salts) or mix with any other drugs (risk of incompatibility).

Shift potassium into cells

Insulin Actrapid + dextrose
Administer 10 units of insulin Actrapid in 50ml of 50% dextrose. Effects peak at 30-60 min & last for up to 6 hours. Do not give dextrose in DKA, give insulin only if CBG is ≥20.
Nebulised Salbutamol
Administer 10mg-20mg nebulised salbutamol (10mg in patients with IHD, severe tachycardia). In combination with insulin/dextrose, salbutamol can lower serum potassium by an additional 0.5-1mmol/L. Effect lasts up to 2 hours. Nebulised salbutamol may not be effective, especially in those patients taking beta-blockers or digoxin and should only be used as first-line treatment while awaiting IV access for dextrose and insulin.
Intravenous Sodium bicarbonate
Can shift potassium from the extracellular to intracellular by increasing blood pH. The evidence for routine use in hyperkalaemia is controversial, its effects are of variable onset and not sustained. Its use should be limited to cases of severe metabolic acidosis when recommended by an Intensivist or Nephrologist. Oral sodium bicarbonate is unlikely to be harmful and may be used in the presence of acidosis

Remove potassium from body

New potassium binding agents are now available which are effective for acute and chronic use. See details of sodium zirconium cyclosilicate below. Their use may reduce the need for repeat cycles of insulin and dextrose and even dialysis.
Haemodialysis or haemofiltration are the most effective but invasive treatments for severe resistant hyperkalaemia, where other measures have been unsuccessful or if there is ongoing tissue damage. Critical Care or the on-call Renal Consultant should be consulted early in these circumstances.

Prevent recurrence

Stop offending medications, it may not be appropriate to stop all. Those most commonly implicated are as follows:
Potassium supplements, salt substitutes (e.g. LoSalt), ACE-I, Angiotensin II Receptor Blockers, NSAIDs, spironolactone, eplerenone, amiloride, trimethoprim, digoxin. Once urgent treatment has been instigated ensure patient is placed on a low potassium diet. It is essential to refer patients with CKD stage 4 and 5 to a dietician prior to discharge.

Monitoring

ECG: Repeat 12 lead ECG should always be performed after administration of calcium gluconate to confirm resolution of ECG changes.
Typical ECG changes include peaked T waves, prolonged PR interval, absent or flattened P waves, bradycardia, broad QRS, VT, sine wave morphology.
Ongoing ECG monitoring is available on AMU and the Stroke wards as well as Cardiology and Critical Care Units.
Do not delay emergency treatment while awaiting patient transfer.
Potassium: measure potassium at 1, 2, 4, 6 hours after initial treatment to determine if potassium serum has decreased sufficiently and to detect any rebound. Measure potassium at 24 hours to ensure that this has been maintained.
Aim to achieve serum potassium <6.0 mmol/L within 2 hours
Glucose: Delayed hypoglycaemia is commonly reported with insulin/dextrose management. Monitor capillary glucose at 0, 15, 30 minutes after starting treatment and then hourly up to 6 hours.

Sodium zirconium cyclosilicate (Lokelma) is indicated for the treatment of hyperkalaemia in adult patients.
Dose:
The recommended acute starting dose of zirconium cyclosilicate is 10 g, administered three times a day orally as a suspension in water.
A dose of 5-10g once daily can be used to allow continuation/optimisation of ACEI/ARB/ARA use in patients with LVSD or proteinuric CKD where no other reversible cause of hyperkalaemia has been found. Consult Cardiologist or Nephrologist before initiation . Careful follow up will be needed and GP agreement to continue prescribing.

Missed dose:
If a patient misses a dose they should be instructed to take the next usual dose at their normal time.

Method of administration:
The entire contents of the sachet should be emptied in a glass containing approximately 45 ml of water and stirred well. The powder will not dissolve. The tasteless liquid should be drunk while still cloudy. If the powder settles, the water should be stirred again. It should be ensured that all of the content is taken.
The suspension can be taken with or without food.
Zirconium can transiently increase gastric pH by absorbing hydrogen ions and can lead to changes in solubility and absorption kinetics for co-administered medicinal products with pH-dependent bioavailability. Zirconium should be administered at least 2 hours before or 2 hours after administration of oral medications whose bioavailability is gastric pH dependent. Examples of such drugs are azole antifungals (ketoconazole, itraconazole and posaconazole), anti-HIV drugs (atazanavir, nelfinavir, indinavir, ritonavir, saquinavir, raltegravir, ledipasvir and rilpivirine) and tyrosine kinase inhibitors (erlotinib, dasatinib and nilotinib).
There are no reported drug-drug interactions after co-administration of zirconium with amlodipine, clopidogrel, atorvastatin, furosemide, glipizide, warfarin, losartan or levothyroxine. Dabigatran C_{max} and AUC values were approximately 40% lower when co-administered with zirconium. No dose adjustments or separation of time of dosing are required for any of these medicinal products.

Mechanism of action
Sodium zirconium cyclosilicate is a non-absorbed, non-polymer inorganic powder with a uniform micropore structure that preferentially captures potassium in exchange for hydrogen and sodium cations. Sodium zirconium cyclosilicate is highly selective for potassium ions, even in the presence of other cations, such as calcium and magnesium, *in vitro*. Sodium zirconium cyclosilicate captures potassium throughout the entire gastrointestinal (GI) tract and reduces the concentration of free potassium in the GI lumen, thereby lowering serum potassium levels and increasing faecal potassium excretion to resolve hyperkalaemia.

Storage:
Sodium zirconium cyclosilicate does not require any special storage conditions.