

GAIN 

GUIDELINES AND AUDIT
IMPLEMENTATION NETWORK

GUIDELINES FOR THE TREATMENT OF HYPERKALAEMIA IN ADULTS

December 2008

PREFACE

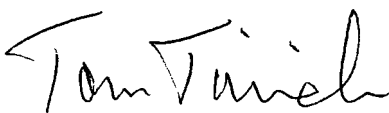
Guidelines for the Treatment of Hyperkalaemia in Adults

These guidelines have been published by the Guidelines & Audit Implementation Network (GAIN), which is a team of health care professionals established under the auspices of the Department of Health, Social Services & Public Safety in 2008.

The aim of GAIN is to promote quality in the Health Service in Northern Ireland, through audit and guidelines, while ensuring the highest possible standard of clinical practice is maintained.

This guideline is a review of the CREST January 2006 guideline and was produced by a sub-group of health care professionals from varied backgrounds and was chaired by Professor Gary McVeigh, Professor of Cardiovascular Medicine.

GAIN wishes to thank all those who contributed in any way to the development of these guidelines.



Dr T Trinick

Chairman of GAIN



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FOREWORD

The reported incidence of hyperkalaemia in hospitalised patients is between 1% and 10%. It is the most serious of all electrolyte abnormalities as the symptoms can be non-specific or absent, even in severe hyperkalaemia, before causing cardiac arrest. Most cases are associated with medicines that inhibit the renin-angiotensin system or interfere with renal function; especially in the setting of pre-existing renal compromise.



This guideline updates the previous January 2006 CREST Guideline for the Treatment of Hyperkalaemia in Adults. The major change in the updated guidance is the recommendation to use a customised kit to treat hyperkalaemia. The instructions accompanying the kit provide clear and concise information that will enable physicians to safely and effectively manage patients presenting with hyperkalaemia. In particular, the safe and effective use of insulin / glucose in the treatment of hyperkalaemia is highlighted with emphasis placed on the requirement to always use an insulin syringe and have a check of volume by a senior nurse before insulin is administered to the patient.

I would like to thank Miss Sharon O'Donnell, Medicines Governance Pharmacist and Professor Peter Maxwell, Consultant Nephrologist for their help in producing this updated guidance.

A handwritten signature in black ink that reads "Gary McVeigh". The signature is written in a cursive style with a horizontal line under the first name.

Professor G McVeigh

Professor in Cardiovascular Medicine



The reported incidence of hyperkalaemia in hospitalised patients is between 1 and 10%. **The vast majority of cases are related to patients prescribed angiotensin converting enzyme inhibitors (ACE) or angiotensin II receptor blockers (ARBs) in conjunction with spironolactone with pre-existing or new renal failure.** Most other cases are related to potassium supplementation and prescription of diuretics/medicines with potassium-sparing properties.

AETIOLOGY OF HYPERKALAEMIA

Renal Causes

- Acute or chronic renal failure
- Hyperkalaemic renal tubular acidosis (type IV)
- Mineralocorticoid deficiency (hypoaldosteronism states)
- Medicines that interfere with potassium excretion (amiloride, spironolactone)
- Medicines that interfere with the renin-angiotensin system (angiotensin converting enzyme inhibitors, angiotensin II receptor blockade, nonsteroidal anti-inflammatory agents, heparin)

Transcellular shift (intracellular to extracellular compartment)

- Acidosis (including diabetic ketoacidosis)
- Medicines (digoxin poisoning, suxamethonium, beta-blockade)

Increase circulating potassium - Exogenous or Endogenous

- Exogenous (potassium supplementation)
- Endogenous (tumour lysis syndrome, rhabdomyolysis, trauma, burns)

Pseudohyperkalaemia

- Prolonged tourniquet time
- Test tube haemolysis
- Marked leucocytosis and thrombocytosis (measure plasma not serum concentration in these disease states)
- Sample taken from a limb infused with IV fluids containing potassium



ASSESSMENT OF THE PATIENT

Is this “true” hyperkalaemia?

A repeat serum potassium should be ordered urgently, especially if hyperkalaemia is an unexpected or isolated finding and there are no ECG signs of hyperkalaemia, to exclude pseudohyperkalaemia.

How severe is the hyperkalaemia?

Hyperkalaemia is classified as –

- mild (K^+ 5.5 - 6.0 mmol/L)
- moderate (K^+ 6.1 - 6.9 mmol/L) or
- severe ($K^+ \geq 7.0$ mmol/L) **or** if ECG changes or symptoms (muscle weakness or flaccid paralysis palpitations, paresthesias) occurring at **ANY** level of serum potassium ≥ 5.5 mmol/L especially if associated with hypoxia

Situations associated with a rapid rise in potassium (acute renal failure, rhabdomyolysis) **and hypoxia of any cause** are more strongly associated with the development of cardiac conduction disturbances.

Mild hyperkalaemia is common and often well tolerated in patients with chronic renal failure.

Is urgent treatment required?

Urgent treatment is required if the serum potassium is ≥ 7 mmol/L OR hyperkalaemia is accompanied by **ECG changes or above symptoms - even in the presence of mild hyperkalaemia (K^+ 5.5 - 6.0 mmol/L).**

Why has the patient got hyperkalaemia?

A thorough medical history focussing on a history of renal disease and determination of the medications or fluids prescribed will often reveal the cause of the hyperkalaemia. Examine for bladder distension and prostatic hypertrophy. Catheterise if appropriate.



MONITORING THE PATIENT

- A 12-lead ECG is mandatory. Cardiac monitoring should be:
 - considered if hyperkalaemia is mild (serum K^+ >5.5-6.0 mmol/L)
 - thought of as good practice if moderate (serum K^+ 6.1-6.9 mmol/L)
 - mandatory if severe (serum K^+ \geq 7.0 mmol/L)
- The ECG does not always demonstrate changes, even in the presence of severe hyperkalaemia, so a normal ECG does not obviate the need for therapy. However, the presence of ECG findings should be a strong impetus for urgent action
- The most worrying findings are decreased or absent P-waves, PR prolongation, QRS widening, sine wave QRST, AV dissociation or asystole. It is often difficult to judge if T waves are truly peaked and this finding on its own should not be an automatic indication for urgent therapy

Monitor urea, electrolytes and glucose at regular intervals. Additional blood work including creatinine kinase and blood gas analysis are performed if appropriate.



TREATMENT OF HYPERKALAEMIA

Stop further potassium accumulation

Stop all potentially offending medicines immediately. These include ACE inhibitors, angiotensin receptor blockers, potassium retaining diuretics e.g. spironolactone, amiloride – (in co-amilofruse), NSAIDs and potassium containing laxatives (Movicol[®], Klean-Prep[®], Fybogel[®]). Beta-blockers and digoxin should also be stopped as they prevent intracellular buffering of potassium and reduce the effectiveness of insulin-glucose and beta-2 agonists.

Place the patient on a low potassium diet. It is imperative that whilst waiting for this diet that the patient does not consume fruit juice, fruits, chocolate, fruit gums, biscuits, coffee or potatoes.

Use the Hyperkalaemia Kit

Information on how to use the kit is contained in Appendix 1. The kit contains:

- 10 x 10ml calcium gluconate 10% ampoules
- 2 x 50ml glucose 50% Minijet[®]
- 1 x 50ml glucose 50% vial
- 20 x salbutamol 2.5mg nebulas
- 2 x insulin syringes

NB Actrapid[®] insulin is stored in the pharmaceutical refrigerator.

Protect the cardiac membrane

Give 10ml of calcium gluconate 10% intravenously over 2 minutes (The hyperkalaemia kit contains a box of 10 x 10ml calcium gluconate 10% ampoules)

- This intervention will not lower the potassium, but if ECG changes are present, there should be improvement seen within 1 to 3 minutes



- If improvement does not occur a further 10ml of calcium gluconate 10% can be given intravenously every 10 minutes until the ECG normalises (patients may require up to 50ml). The effect of this intervention is transient (approximately 30-60 minutes)
- It is important to note that if the patient is taking digoxin and the decision is made that calcium gluconate is required, it should be given slowly over 20 minutes mixed in 100ml of glucose 5% as rapid calcium administration may precipitate myocardial digoxin toxicity
- Digoxin toxicity can cause hyperkalaemia and arrhythmias and urgent haemodialysis or the administration of digoxin antibody (Fab) fragments may represent the preferred approach. Consult with senior colleagues

Shift the potassium from the blood into the cell

- Withdraw 10 units of Actrapid® insulin using an INSULIN syringe. There are two insulin syringes in the hyperkalaemia kit.
- **Always** obtain a check of volume from a senior nurse before proceeding.
- Add to 50ml glucose 50% Minijet® as shown in the Standard Operating Procedure (SOP) in the hyperkalaemia kit (Appendix 1). Use of a Minijet® is the preferred method. If there are any difficulties using a Minijet®, use the 50ml glucose 50% vial in the kit.
- Administer by slow IV injection over 5 minutes
- The onset of the hypokalaemic action occurs within 15 minutes and lasts at least 60 minutes. The reduction in potassium observed ranges from 0.6 to 1.0mmol/L
- Monitor urea and electrolytes (U&Es) 30 minutes after each administration of insulin/glucose. If there is a good response, check U&Es 1-2 hours after last intervention.

- If the serum glucose is ≥ 15 mmol/L then administration of additional glucose with insulin is not required
- The effects of administering insulin/glucose are observed in 15 minutes and last 4-6 hours
- Monitor blood glucose 30 minutes after starting the infusion and then hourly up to six hours after completion of the infusion as delayed hypoglycaemia is commonly reported when less than 30g of glucose is administered with insulin
- In some circumstances (circulatory shock, diabetic ketoacidosis) capillary glucose testing with a glucometer may not provide an accurate or reliable measure of blood glucose. In these circumstances or if the glucose level measured by capillary testing does not correspond with the clinical picture a venous blood sample should be sent to the laboratory for analysis. A drop of blood from the venous sample can be tested using the glucometer to assess if a discrepancy exists with the capillary measurement. Comparison of the venous sample with the laboratory sample will confirm the glucometer is properly calibrated
- **Administer 10mg of nebulised salbutamol. (There is a box of 20 salbutamol 2.5mg nebulisers in the hyperkalaemia kit)**
- Salbutamol for nebulisation is normally 2.5mg/2.5ml strength and the nebuliser chamber will hold 10ml i.e. 10mg salbutamol. This will lower the potassium by 0.5 to 1.0mmol/L by 15-30 minutes with the effect lasting at least 2 hours
- 20mg of nebulised salbutamol may be more effective than a 10mg dose at 2 hours. The lower dose is preferable in patients with ischaemic heart disease. There is no difference in the maximum hypokalaemic effect when nebulised salbutamol is compared with salbutamol 500 micrograms administered intravenously



- Salbutamol may not lower potassium in all patients and some studies show that up to 40% of dialysis dependent patients are resistant to these agents. The hypokalaemic response is also weakened in patients taking beta-blockers and digoxin. Therefore salbutamol is not recommended as a single agent to treat hyperkalaemia
- There is evidence that the combination of nebulised salbutamol and insulin/glucose display additive effects in lowering the serum potassium, with a weakening of the hypoglycaemic action of insulin. These interventions buy time for more definitive therapy as they do not remove potassium from the body

Sodium bicarbonate - not recommended. While this has been a traditional treatment for hyperkalaemia, many studies show that sodium bicarbonate fails to lower the serum potassium. A reduction in potassium will not occur within 60 minutes of administration. There are also potential risks in giving sodium bicarbonate in terms of volume and sodium overload and tetany in patients with chronic renal failure and co-existent hypocalcaemia. The risks outweigh any potential benefit.



REMOVAL OF POTASSIUM FROM THE BODY

Haemodialysis

If despite the above measures the potassium remains greater than 7mmol/L or if pathological ECG changes/symptoms persist, the renal team should be contacted to arrange urgent dialysis if appropriate.

- This is the most effective and definitive but invasive method in treating hyperkalaemia. It is strongly considered if hyperkalaemia is severe (level debated but ≥ 7.0 mmol/L) and other first-line agents have been unsuccessful, or if there is ongoing tissue damage and continued release of intracellular potassium is expected
- It is important to enlist the help of nephrology at an early stage in these circumstances

Use the gut

- Calcium polystyrene sulphonate resin (Calcium Resonium[®]) 15g orally 4 times daily with regular lactulose will increase gut losses of potassium.
- The onset of action is slow (≥ 2 hours) and other measures should be employed in the interim to lower potassium levels. Do not add Calcium Resonium[®] to fruit juice which has a high potassium content
- Each gram of Calcium Resonium[®] removes approximately 1mmol/L potassium from the gut

Medicines administered for the treatment of hyperkalaemia must be prescribed on the Kardex. The term 'units' must not be abbreviated when prescribing insulin.



CLINICAL PEARLS

- Always consult with the senior doctor responsible for the patient with hyperkalaemia
- Always stop medicines/food and fluids that exacerbate hyperkalaemia (ACE/ARBs, spironolactone, potassium sparing diuretics, digoxin, NSAIDs)
- Careful cardiac monitoring and repeated blood testing including glucose is mandatory
- A negative ECG does not negate the need for calcium gluconate and insulin/glucose in severe cases
- Digoxin toxicity (probable in renal failure) can increase serum potassium. Calcium gluconate MUST be administered slowly over 20 minutes mixed in 100ml glucose 5% to prevent myocardial digoxin toxicity. Alternatively, and perhaps safer, urgent dialysis and administration of digoxin antibody (Fab) fragments is preferred. Consult with senior colleagues
- Insulin can be administered as a single agent without 50ml glucose 50% if glucose >15mmol/l
- If doubts exist confirm the accuracy of capillary blood glucose values by using a sample of venous blood for glucometer testing and sending the remainder of the sample to the laboratory for analysis
- Beta-2 agonists may not lower serum potassium especially in dialysis patients or those taking beta-blockers or digoxin. Not recommended as a single agent
- Calcium gluconate/insulin/beta-2 agonists are not definitive therapies - they simply buy time for more definitive therapy



- Ensure that the patient is placed on a “low potassium diet” and ban the patient from consuming food with a high potassium content e.g. chocolate, fruit juices, until a dietetic assessment has been undertaken



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APPENDICES

APPENDIX 1

How to make up 10 units of Actrapid® (soluble) insulin in 50ml glucose 50% Miniject® using the hyperkalaemia kit

Protect the cardiac membrane: give 10ml of calcium gluconate 10% IV over 2 mins (NB If patient on digoxin, and calcium gluconate required, give slowly over 20 mins in 100ml of glucose 5%)

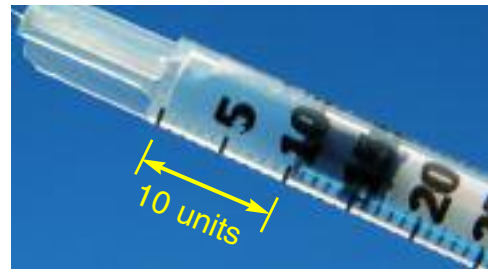
- 1 With the nurse in charge, obtain an Actrapid® vial from the pharmaceutical fridge.



- 2 Take the glucose 50% Miniject® glass vial from the kit. Remove its blue protective cap.



- 3 Measure 10 units of insulin using an insulin syringe from the kit:



- a. Draw the plunger back to the 10 unit mark on the insulin syringe. Check the 10 units of insulin obtained with the senior nurse in duty.
- b. Note 10 units of insulin is contained in 0.1ml
- c. Record administration of this and other medicines used to treat hyperkalaemia on the Kardex. Ensure both signatures for double check are documented on the Kardex.



- 4** Inject the 10 units of insulin through the blue stopper of the glucose 50% Miniject[®] glass vial.

- 5** Mix.

- 6** Remove the yellow protector cap from the Miniject[®] injector.



- 7** Thread the glucose 50% Miniject[®] glass vial into the Miniject[®] injector three half turns or until the needle penetrates the stopper.



- 8** Remove the yellow cap from the tip of the Miniject[®] injector and expel air.

- 9** Administer into a large vein by slow IV injection over 5 mins.

- 10** If difficulty in administering insulin/glucose using the Miniject[®] (preferred method), use the glucose 50% vial in the kit.

- 11** Monitor and document blood glucose 30 mins after administration of insulin/glucose and then hourly up to 6 hours after completion of administration.

- 12** Monitor U&Es 30 mins after each administration of insulin/glucose. If good response, check U&Es 1-2 hours after last intervention.



APPENDIX 2

Membership of the GAIN Sub-Group on the Treatment of Hyperkalaemia in Adults

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ISBN: 978-1-906805-02-9