How is hypokalaemia treated in adults?

Prepared by UK Medicines Information (UKMi) pharmacists for NHS healthcare professionals

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Background

There are no national guidelines for the treatment of hypokalaemia and practice varies across hospitals. Following a thorough search of the literature this guidance has been prepared and adopted in Leeds Teaching Hospitals NHS Trust (LTHT). Reference ranges vary between organisations. For the purposes of this document, the reference range for serum potassium is 3.5 - 5.3 mmol/L and hypokalaemia is defined as a serum potassium concentration of less than 3.5 mmol/L.

Low serum potassium is an electrolyte abnormality commonly encountered in clinical practice (1,2). Hypokalaemia is found in over 20% of hospitalised patients and is usually asymptomatic unless serum potassium concentrations fall below 3.0 mmol/L (1-3).

Hypokalaemia is usually well tolerated in otherwise healthy people but can be life threatening when severe. Even mild or moderate hypokalaemia increases the risk of morbidity and mortality in patients with cardiovascular disease. As a result, when hypokalaemia is identified, the underlying cause should be identified and treated (1,2).

True hypokalaemia is almost always the result of potassium depletion due to renal losses (frequently due to metabolic alkalosis) or intestinal losses (due to diarrhoea)(1,2,4). Occasionally, medicines are responsible, including (1,2,5,6):

- Thiazide diuretics (e.g. bendroflumethiazide) and loop diuretics (e.g. furosemide)
- Amphotericin, cisplatin, foscarnet
- Aminoglycosides (e.g. amikacin, gentamicin)
- Beta-agonists (e.g. salbutamol, terbutaline)
- Insulin treatment (e.g. in the treatment of diabetic ketoacidosis)
- Corticosteroids (e.g. fludrocortisone, hydrocortisone)
- Caffeine, theophylline
- Adrenaline, pseudoephedrine
- High dose penicillins

Table 1:
Clinical symptoms of hypokalaemia and corresponding serum potassium concentrations (1-3,6):

Serum potassium concentration	**Potential symptoms**
3.0-3.5 mmol/L	Usually no symptoms, *arrhythmias
2.5-2.9 mmol/L	Generalised weakness, lassitude and constipation, *arrhythmias
2.0-2.4 mmol/L	Muscle weakness and necrosis, *arrhythmias
Less than 2.0 mmol/L	Paralysis and impairment of respiratory function, *arrhythmias
* In patients with ischaemic heart disease, heart failure, or left ventricular hypertrophy, even mild hypokalaemia increases the likelihood of arrhythmias.	

Answer

Due to the risk of morbidity and mortality, the underlying cause of clinical hypokalaemia should be identified and treated. Maintenance of normal potassium levels is particularly important for (2,6):

- Patients taking digoxin or other anti-arrhythmic drugs; hypokalaemia increases the risk of digoxin toxicity and its arrhythmogenic potential
- Patients with hypoaldosteronism secondary to renal artery stenosis, liver cirrhosis, nephrotic syndrome and severe heart failure
- Patients with excessive loss of potassium in the faeces e.g. chronic diarrhoea
- Patients who are nil by mouth or those receiving total parenteral nutrition

Chronic hypokalaemia indicates a profound deficit in total body potassium and replacement may take several days (8). Failure to correct hypokalaemia despite appropriate treatment may be due to underlying hypomagnesaemia (1-3).

At LTHT replacement therapy is prescribed for patients with a serum potassium concentration of <3.5 mmol/L (9). Although this document offers guidance, the dose of potassium to treat hypokalaemia should be determined on an individual patient basis (3,5).

Oral potassium replacement

AT LTHT, Sando-K® is used as first line therapy in asymptomatic patients with a serum potassium concentration of 2.5 - 3.5 mmol/L (8). Each effervescent Sando-K® tablet contains 12 mmol potassium and 8 mmol chloride. Other oral supplements are commercially available (6).

Table 2: Suggested doses for oral replacement therapy (8):

Serum potassium concentrations	Suggested oral replacement	Suggested monitoring
3.0 - 3.5 mmol/L (mild hypokalaemia)	Sando-K® 2 tablets twice a day	Monitor serum potassium at least twice weekly until stable or >4.5 mmol/L, then re-assess
2.5 - 2.9 mmol/L (moderate hypokalaemia)	Sando-K® 2 tablets three times a day	Monitor serum potassium daily until >2.9 mmol/L then manage as for mild hypokalaemia (above).

Dose and duration of treatment depends on the existing potassium deficit and whether there are continuing losses (1). Larger doses may be required in patients with digitoxicity or diabetic ketoacidosis and specialist advice should be sought in such situations (8).

Parenteral potassium replacement

Intravenous (IV) therapy is indicated in the following situations (7):

- Patients with serum potassium concentration of less than 2.5 mmol/L
- Patients with symptoms of hypokalaemia
- Patients who are nil by mouth
- Patients who are unable to tolerate oral administration
- Patients who are unlikely to absorb oral potassium

The dose and rate of infusion of potassium is dependent on the patient's serum potassium concentration and clinical picture, renal function and whether the cause for hypokalaemia has been addressed. As a guide, adult patients should receive 40 - 80 mmol potassium a day to meet normal maintenance requirements (5-7). Concentrated potassium preparations must be diluted before slow IV infusion (5,9-11). Ready-made potassium infusions should be used where available.

Administering potassium intravenously carries a significant clinical risk. Follow local procedures for the administration of intravenous potassium, including ECG monitoring, maximum rates and concentration. Potassium must not be given intramuscularly (5-7).

Table 3: Suggested initial doses for intravenous replacement therapy (8):

Serum potassium concentrations	Suggested IV replacement	Suggested monitoring
2.5-3.4 mmol/L (e.g. if patient unable to take potassium orally)	20 - 40 mmol potassium chloride in 1 litre sodium chloride 0.9% over at least 8 hours.	Monitor serum potassium after 24 hours and review accordingly. Repeat infusion if appropriate. Switch to oral management as soon as practical.
< 2.5 mmol/L and/or patient symptomatic	40 mmol potassium chloride in 1 litre sodium chloride 0.9% over 6 hours.	Monitor serum potassium concentration after 6 hours and repeat infusion if appropriate.

Initial potassium replacement therapy should not involve glucose infusions, because glucose may cause a further decrease in the plasma-potassium concentration (7,9,10).

Low concentrations of potassium may also be administered subcutaneously, for example, to long term fluid dependent patients with no venous access; for further information, refer to UKMI Q&A 45.7 (12).

Adverse Drug Reactions

Excessive doses of potassium may lead to the development of hyperkalaemia, particularly in patients with renal impairment. Symptoms include (3,5-7,9,10):

- paraesthesia of the extremities
- muscle weakness
- paralysis
- confusion
- cardiac arrhythmias*
- heart block*
- cardiac arrest*

(*cardiac toxicity is of particular concern after IV dosage)

Other adverse reactions include (3,5-7,9,10):

- Pain, phlebitis or serious injury following intravenous administration via peripheral veins, particularly at higher concentrations
- Nausea, vomiting, diarrhoea, and abdominal cramps (with oral therapy)

Interactions

Potassium supplements should be used with caution in patients receiving drugs that increase serum potassium concentrations. These include (3,5-7,9,13):

- potassium-sparing diuretics (e.g. spironolactone, amiloride, triamterene, co-amilofruse, co-amilozide)
- ACE inhibitors (ACEI) (e.g. ramipril, lisinopril)
- angiotensin II receptor antagonists (e.g. irbesartan, losartan, candesartan)
- tacrolimus
- ciclosporin
- drugs that contain potassium such as the potassium salts of penicillin

Cautions to potassium replacement therapy (3,5,6,7,9)

- Severe renal impairment (exercise extreme caution and monitor frequently)
- Renal insufficiency (lower doses of replacement therapy may be required for patients with renal disease)
- Concomitant ACEI or potassium-sparing diuretic therapy

Summary

- There are no national guidelines on the treatment of hypokalaemia and practice varies across hospitals. The guidance within this document reflects practice at Leeds Teaching Hospitals NHS Trust (LTHT).
- Hypokalaemia is defined as a serum potassium concentration of less than 3.5 mmol/L.
- It is usually well tolerated in otherwise healthy people but can be life threatening when severe.
- It increases the risk of morbidity and mortality in patients with cardiovascular disease; the underlying cause should always be identified and treated.
- Hypokalaemia increases the risk of digoxin toxicity and its arrhythmogenic potential.
- Hypokalaemia is usually asymptomatic unless serum potassium concentrations fall below 3.0 mmol/L. Symptoms worsen with the severity of hypokalaemia; they include arrhythmias, weakness, lassitude, constipation, muscle weakness and necrosis, paralysis and impaired respiratory function.
- Treatment is with potassium supplementation, usually orally or intravenously; suggested doses are given in tables 2 and 3. Subcutaneous administration has also been used.
- Concentrated potassium preparations must be diluted before slow IV infusion.
- Treatment should be used with caution in patients with renal impairment, those on concomitant ACEI or potassium sparing diuretics, or those on other medicines known to increase serum potassium concentrations.
- Excessive treatment doses may lead to hyperkalaemia, particularly in patients with renal impairment. Other adverse reactions include pain, phlebitis and injury following IV administration; nausea, vomiting, diarrhoea and abdominal cramps following oral administration.

Limitations

This document provides guidance for adult patients only and the dose of potassium to correct hypokalaemia must be established on an individual patient basis. Other replacement therapy products are commercially available. This guidance is not suitable for patients with re-feeding syndrome, digoxin toxicity or diabetic ketoacidosis.

References

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Search strategy

- Embase (via NHS Evidence): [exp*potassium/ OR exp*potassium chloride/ OR exp*hypokalaemia] AND exp drug administration/ limited to human and English language. Dates 2014-2017
- Medline (via NHS Evidence): [exp potassium chloride/ OR exp potassium/ OR hypokalaemia] AND exp drug therapy/limited to human and English language. Dates 2014-2017
- In-house database/resources.