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ROYAL HOBART HOSPITAL
HOBART TASMANIA AUSTRALIA

POTASSIUM **GUIDELINES** **(ADULT)**

PRESCRIBING AND
ADMINISTRATION
January 2003

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These guidelines were produced by the Pharmacy Department, Royal Hobart Hospital in consultation with Associate Professor Anthony Bell and Associate Professor Janet Vial.

Further copies of these guidelines may be obtained from the Drug Information Centre 03 6222 8737.

Comments relating to these guidelines should be forwarded to Sarah Herd via email: sarah.herd@dhhs.tas.gov.au

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Potassium is the major positive ion in intracellular fluid and is essential for maintenance of:

- Electropotential gradient of the cell membrane
- Isotonicity
- Acid-base balance

The kidney has a major role in potassium homeostasis.

The reference range for serum potassium is **3.5 – 5.0mmol/L**.

Section 1: Hypokalaemia

Clinical Signs of Potassium Deficit

Signs and symptoms of potassium deficit are late and non-specific including:

- Apathy
- Weakness
- Cramping
- Paraesthesia
- Heart rhythm disturbance (common) - ECG showing sagging ST segments, depression of T waves and elevated U waves
- Muscle paralysis (late sign)

Considerations in Potassium Replacement

- Hypokalaemia may be corrected either orally or parenterally.
- **Oral** is the preferred route of administration for potassium replacement, as it is easy to administer and readily absorbed from the GI tract.
- Replacement fluid volume is a major issue during parenteral potassium replacement (as one litre per hour IV fluid is not appropriate in the usual clinical setting).
- Assess the fluid balance if large volumes of potassium replacement are given via the peripheral route.
- Use extreme caution when replacing potassium in low bodyweight patients.

Magnitude of Potassium Deficit

Use serum potassium plus ongoing losses to calculate the magnitude of the total body potassium deficit as detailed in the following tables:

Serum Potassium (mmol/L)	Potassium Deficit (mmol)
3	200
2.5	300
2	400
1.5 (near lethal)	400+

+

Ongoing Loss	Amount of Potassium per litre of loss
Urine	20mmol/L (minimum)
Diuretics	75-100mmol/L of urine
Alkalosis	75-100mmol/L of urine
Gut loss (diarrhoea/vomiting)	40mmol/L of GIT loss
Pancreatic or small bowel fistula	100mmol/L of fluid loss

= TOTAL BODY POTASSIUM DEFICIT

Methods and Rate of Potassium Replacement

Calculate **Total Body Potassium Deficit** as above, then:

Replace 50 –75% of total body deficit in 24 hrs.

Aim to replace 25% of the total body deficit in the first 6 hours.

GUIDELINES FOR POTASSIUM REPLACEMENT

<p>CRITICAL DEFICIT</p> <p>(>400 mmol deficit)</p> <p>Serum K⁺ < 2.0 mmol/L</p>	<p>Critical emergency - Admit to ICU/HDU/CCU Administer potassium under continuous ECG monitoring. Use IV and oral replacement (if oral route possible):</p> <p>IV: 40mmol K⁺ ion (usually chloride) in 100mL IV fluid over 1 hour via central vein (<i>in an emergency, a large cubital fossa vein may be used until a central line can be placed</i>)</p> <p>Oral: 28 – 42 mmol K⁺ (if possible) every 2 to 4 hours if tolerated (dissolved in 100-150mL water) Continue to measure serum potassium every 1 to 2 hours and replace until K⁺ > 2.8 mmol/L</p>
<p>SEVERE DEFICIT</p> <p>(400 mmol deficit)</p> <p>Serum K⁺ 2.0 – 2.5 mmol/L</p>	<p>Consider ICU/HDU Admission IV and oral replacement</p> <p>IV: 20 - 30mmol K⁺ ion (chloride) in 100mL IV fluid over 1 hour via central vein (<i>may use fast flowing cubital fossa vein, when K⁺ concentration is 20mmol/100mL</i>)</p> <p>Continue to measure serum potassium every 1 to 2 hours until K⁺ > 2.8 mmol/L</p> <p>Oral: Two Chlorvescent[®] tablets (28mmol K⁺) per hour if tolerated (dissolved in 100-150mL water)</p>
<p>MODERATE DEFICIT</p> <p>(200-300 mmol deficit)</p> <p>Serum K⁺ 2.5 - 3.0 mmol/L</p>	<p>Oral (preferred) or IV replacement</p> <p>Oral: Two Chlorvescent[®] tablets (28mmol K⁺) three times a day (dissolved in 100-150mL water)</p> <p>IV: 30mmol K⁺/litre IV premixed bag at rate of 5-10mmol per hour. Repeat until serum potassium >3.2mmol/L</p>
<p>MILD DEFICIT</p> <p>(150mmol deficit)</p> <p>Serum K⁺ 3.0 - 3.5 mmol/L</p>	<p>Oral: Two Chlorvescent[®] tablets (28mmol K⁺) three times a day (dissolved in 100-150mL water)</p>

Considerations for Parenteral Potassium Administration

- Potassium salts **MUST NEVER** be given IM or as an IV push.
- Rapid intravenous administration of potassium is **NOT** recommended. (this can cause a high extracellular K⁺ level and in the presence of a low intracellular K⁺ level, the large change in the cellular electrochemical gradient can lead to death).

WARD SITUATION

- Rate of IV potassium should never exceed **30mmol K⁺/hour** without continuous ECG monitoring.
See Guidelines for Potassium Replacement

INTENSIVE CARE/HIGH DEPENDENCY SETTING

- Rate of IV potassium should not exceed **40mmol K⁺/hour** in ICU/HDU with continuous ECG monitoring, except in exceptional circumstances.

Safe Preparation of Parenteral Potassium Solutions

If preparing an IV infusion by adding potassium chloride or any other salt of potassium, the resultant solution should be mixed well.

The bag should be fully inverted 10 times to ensure adequate mixing.

DO NOT add potassium to hanging IV bags.

Compatible Fluids: Dextrose 5%, dextrose 10%, sodium chloride 0.9%, sodium chloride 3%, sodium chloride 0.45% and dextrose 5%, Hartmann's, Dextran 70 in sodium chloride or 5% dextrose

Incompatible Drugs: Adrenaline, Amoxicillin, Amphotericin B, Atropine Sulphate, Cephalothin, Chloramphenicol, Chlorpromazine, Diazepam, Mannitol, Methylprednisolone, Phenytoin, Promethazine, Suxamethonium, Thiopentone

Recommended Parenteral Concentration:

- Potassium salts **must be diluted** prior to use.
- Peripheral veins are damaged by a **potassium concentration of greater than 30mmol/L** (3mmol/100mL).
- *In an emergency situation a large cubital fossa vein may be used with higher concentration until a central line can be placed.*
- Intravenous potassium solutions **MUST** be administered via a volumetric pump.

Potassium Preparations Available at RHH

ORAL POTASSIUM PREPARATIONS	Amount of Potassium contained in Each Unit Dose
Potassium Chloride 600mg (Slow K [®] , KSR [®] , Span K [®])	8 mmol K ⁺ per tablet
Potassium Chloride Effervescent (Chlorvescent [®])	14 mmol K ⁺ per tablet

PARENTERAL POTASSIUM PREPARATIONS	Amount of Potassium contained in Each Unit Dose
PREMIXED INTRAVENOUS BAGS	
Potassium Chloride 30mmol in 1L 0.9% sodium chloride	30mmol K ⁺ in 1 Litre
Potassium Chloride 30mmol in 1L 5% dextrose	30mmol K ⁺ in 1 Litre
Potassium Chloride 30mmol in 1L 4% dextrose & 0.18% sodium chloride	30mmol K ⁺ in 1 Litre
POTASSIUM INJECTIONS	
Potassium Chloride 7.5% (1mmol/mL), 10mL injection	10mmol K ⁺ in 10mL
Potassium Chloride 15% (2mmol/mL), 10mL injection (Pharmacy Stock Only)	20mmol K ⁺ in 10mL Pharmacy Stock Only
Potassium Dihydrogen Phosphate 1mmol/mL, 10mL injection (Note: 10mmol phosphate ion per 10mL)	10mmol K ⁺ in 10mL
Potassium Dihydrogen/Di potassium phosphate 2.5mmol/mL 10mL injection (Note: 14.5mmol phosphate ion per 10mL)	25mmol K ⁺ in 10mL

Phosphate Replacement:

- Parenteral phosphate preparations often contain significant amounts of potassium ions.
- **CHECK** amount of potassium contained in phosphate replacement solution - Rate of infusion for phosphate replacement will be determined by the amount of potassium in the solution.

Consider using a sodium based phosphate replacement solution

Storage and Availability of Potassium

For information regarding Storage and Availability of Potassium Injection refer to RHH Policy and Procedure.

Premixed IV Bags

Premixed IV bags containing 30mmol Potassium Chloride in 1L infusion fluid (0.9% sodium chloride, 5% dextrose or 4% dextrose and 0.18% normal saline) are stocked on the imprest of most wards in the hospital.

The premixed potassium bags are easily distinguished from other IV fluids, as they are packaged in a pink outer bag, with labelling in red writing.

The premixed potassium IV bags must be stored separately from other types of IV fluid stocked on the ward.

NO ADDITIVES (including extra potassium) are permitted into premixed solutions.

Potassium Injections

Potassium Chloride 7.5% (10mmol K⁺/10mL) injection is permitted on the imprest of selected wards only. Refer to RHH Procedure for a list of wards permitted to stock potassium chloride 7.5% injection.

Potassium Chloride 7.5% ampoules stocked on wards will be stored in the following manner:

- Physically separated from Water for Injection and 0.9% Sodium Chloride ampoules in all working areas;
- Stored in a labelled locked box, with the label stating:

Potassium Injection: Concentrated Solution. Dilute Before Use

The Pharmacy Department will supply potassium chloride injection for concentrations other than the premixed bags during the normal working hours. A patient specific prescription must be supplied to Pharmacy.

For supply after hours, the requesting ward must obtain the potassium chloride concentrated injection through the After Hours Nurse Supervisor.

Treatment of Severe Hyperkalaemia

Treatment of hyperkalaemia is directed at the underlying cause.

Section 2: Hyperkalaemia

Hyperkalaemia may be defined as a serum potassium of **greater than 5.0 mmol/L**.

Causes of Hyperkalaemia

- Artfactual (sampling errors)
- Excessive intake
- Severe tissue damage
- Decreased excretion (caused by renal failure or by drugs, for example; ACE Inhibitors, AT-II antagonists, spironolactone)
- Body fluid compartment shift (for example, acidosis)

Clinical features of Hyperkalaemia

- Tingling
- Paraesthesia
- Weakness
- Hypotension
- Bradycardia
- ECG Changes

ECG Changes with Hyperkalaemia

- Severity of hyperkalaemia determined by the presence of ECG changes.
- The characteristic ECG effects include:
 - Serum K^+ 5.5 – 7.0 mmol/L - tall peak T waves
 - Serum K^+ > 7.0 mmol/L - widening QRS complex, P waves disappear
 - Serum K^+ > 8.0 mmol/L – sine wave rhythm

Treatment of Hyperkalaemia

(Severity of hyperkalaemia determined by the presence of ECG changes)

SEVERE HYPERKALAEMIA

**Serum K^+
> 5.0 mmol/L**

with

ECG Changes

ECG changes include:

- Serum K^+ 5.5 – 7.0 mmol/L - tall peak T waves
- Serum K^+ > 7.0 mmol/L - widening QRS complex, P waves disappear
- Serum K^+ > 8.0 mmol/L – sine wave rhythm

Emergency Treatment [Temporary Measures Only - Do Not Delay Definitive Treatments]*

1. **Insulin:** Administer IV 10 units of soluble insulin (Actrapid®) in 50mL of 50% dextrose over 15 minutes. (*Onset: 20-30 minutes*)
2. **CaCl₂:** Initiate IV calcium chloride 5ml of 10% (3.4 mmol) as an IV push over 2-3 mins into a large vein, in attempt to prevent arrest. Repeat until ECG improves and consider transfer to ICU/HDU. (*Onset: <5 minutes, duration: 30-60 minutes*)
3. **If acidotic:** Administer IV sodium bicarbonate 25 - 50 mmol (25-50ml of 8.4% sodium bicarbonate) over 15 minutes. (*Onset: <5 minutes, duration: 15-30 minutes*)

Definitive Treatments

1. **Diuretics:** Administer a loop diuretic (frusemide) IV at a dose appropriate for the renal function. (*Onset: 1 hour*)
2. **Dialysis:** The excess total body potassium must be removed by either the intrinsic renal function or dialysis. **Do not delay – other methods of control are temporary.**

*Resonium is not appropriate therapy for severe hyperkalaemia

Resonium A[®] (Sodium polystyrene sulphonate)

Place in Therapy

- **The role of Resonium A[®] in the emergency setting is limited as the biochemical effects take several hours.**
- It is advised that Resonium A[®] **NOT** be used to treat symptomatic hyperkalaemia. Use should be limited to treatment of asymptomatic hyperkalaemia in the chronic setting e.g. chronic renal failure.

Mechanism of Action

- Sodium ions are exchanged for potassium ions and the exchanged resin is excreted via the faeces
- 15g of Resonium A[®] lowers serum potassium by ~ 0.1mmol/L.

Administration

- **Oral:** 15g up to four times a day dispersed in water (50-100mL).
- **Rectal:** 30g up to every six hours dispersed in water to 100ml. The enema should be retained for as long as possible (ie. 6 to 9 hours).

Following retention of rectal Resonium A[®], a colonic irrigation with a non-sodium, non-potassium containing solution is advised to ensure adequate removal of the resin, for example, 5% dextrose 100mL.

Adverse Effects

- Anorexia
- Nausea
- Vomiting
- Constipation
- Colonic necrosis (rectal administration)

Availability

- Prepacks of Resonium A[®] for oral or rectal administration are available from Pharmacy on prescription.
- Oral and Rectal Prepacks are also available in the After Hours Pharmacy (Refer to After Hours Nurse Manager for access).

Section 3: References

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- Saggar-Malik AK, Cappuccio FP. Potassium supplements and potassium-sparing diuretics. A review and guide to appropriate use. Drugs 1993; 46 (6): 986-1008
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ROYAL HOBART HOSPITAL
HOBART TASMANIA AUSTRALIA

Subject: Intravenous Administration of Potassium Chloride

Effective Date: Date when procedure is implemented

Review Date: Date when procedure is up for review e.g. Two Yearly

Approved by: Royal Hobart Hospital Management Committee or
Continuum of Care

Primary Responsibilities: Nursing, Pharmacy and Medical Staff

Procedure:

(1) Premixed Intravenous Bags

Premixed IV bags containing 30mmol Potassium Chloride in 1 litre infusion fluid (0.9% sodium chloride, 5% dextrose or 4% dextrose and 0.18% sodium chloride) are imprested on most wards in the hospital.

Wards stocking the premixed potassium intravenous bags must physically separate these bags from other intravenous fluids. The premixed potassium bags are easily distinguished from other IV fluids, as they are packaged in a pink outer bag, with labelling in red print.

(2) Potassium Chloride 7.5% (10mmol K⁺/10ml) Injection

The following wards ONLY are permitted to stock Potassium Chloride 7.5% injection:

- Department of Critical Care Medicine (ICU and HDU)
- Cardiothoracic Intensive Care Unit (CT-ICU)
- Neurosurgical High Dependency Unit (NSU HDU)
- Cardiothoracic Unit (2DS)
- Oncology (1BS)
- Paediatrics (3A)
- Neonatal Intensive Care (NICU)
- Department of Emergency Medicine (DEM)
- Operating Theatre
- Ward 2BS
- General Surgical (6A)

In all other areas, if concentrated potassium chloride injection is required, it must be obtained from Pharmacy during normal working hours or via the After Hours Nurse Supervisor. It will only be supplied by Pharmacy on receipt of a copy of the administration order for the potassium chloride infusion.

(3) Storage of Potassium Chloride 7.5% (10mmol K⁺/10ml) Injection:

Potassium Chloride 7.5% concentrated injection must be stored as follows:

- In the preparation/work room of the ward
- Locked in a receptacle with a label stating:
“**Potassium Injection: Concentrated Solution. Dilute before Use**”
- Physically separated from Water for Injection and 0.9% sodium chloride ampoules

(4) Preparation of Parenteral Potassium Solutions

Potassium chloride concentrated injections should only be added to a bag of infusion fluid if a premixed solution is not clinically appropriate.

If preparing an IV infusion by adding potassium chloride concentrated injection or any other salt of potassium, the following are essential:

- The IV bag should be fully inverted at least 10 times to ensure adequate mixing, The resultant solution must be mixed well before connection to the infusion pump;
- Never add concentrated potassium injection to a hanging bag.
- NO ADDITIVES (including extra potassium) are permitted to premixed potassium solutions;
- All potassium infusions must be administered via a volumetric infusion pump.

(5) Prescribing and Administration Guidelines

The Pharmacy Department be responsible for coordinating the periodic review, updating and production of the Guidelines.

FOR FURTHER INFORMATION CONTACT
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