LRI Children's Hospital

Ward 27 - Children's Haematology/Oncology – Intravenous Electrolyte Correction

Staff relevant to:	Medical and Nursing staff caring for children with low potassium, magnesium and phosphate on ward 27
Approval date:	November 2024
Revision due:	November 2026
Written by: Reviewed by:	Ahmed Kamal (Cons) Emmanuel Oyewole (SpR), Ghazala Javid (Pharm)
Version:	1
Trust Ref:	C78/2024

1. Introduction and who this guideline applies to

This guideline is for use in children, teenager and young adults (TYA) on ward 27 who have been identified as having low potassium, magnesium and phosphate that are either unsuitable for correction with oral supplements, have failed with oral supplements or are unsuitable and/or have failed with normal intravenous fluid.

Related Documents:

This guideline should be used in conjunction with Fluid and Electrolyte Management UHL Childrens Hospital Guideline **C6/2015**

Exclusions:

Non-oncology patients admitted under General Paediatrics

2. Guideline Standards and Procedures

Children and TYA patients needing potassium, magnesium and phosphate whose needs cannot be met with oral supplements or from pre-made infusion fluids will use the following policy which is for use on **ward 27 only at the Leicester Royal Infirmary.**

Contents

1. Introduction and who this guideline applies to 1
Related Documents: 1
2. Guideline Standards and Procedures 1
3. Potassium 3
IMPORTANT NOTE 4
Dilution 4
Monitoring 5
Dose and administration 5
4. Magnesium 6
Dilution 6
Monitoring 7
Dose and administration 7
5. Phosphate 8
Dilution 8
Monitoring 9
Central dose and administration of Phosphate Polyfusor 9
Peripheral dose and administration 9
6. Education and Training 10
7. Monitoring Compliance 10
8. Supporting References 10
9. Key Words 11
Contact and review details 11

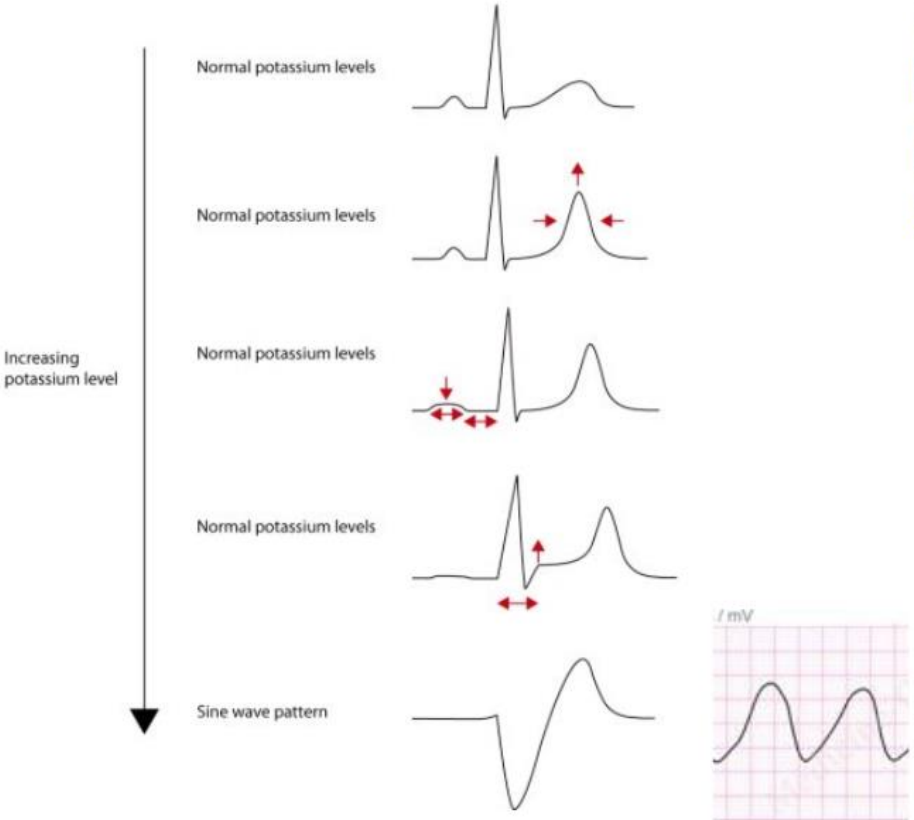
3. Potassium

Children and TYA patients on chemotherapy specifically on platinum containing regimes are likely to need higher levels of potassium to correct low potassium. Any additional insult such as diarrhoea, vomiting and inter-current illnesses is likely to need higher doses of potassium.

Most patients will only need IV fluids with potassium chloride at maintenance rate to maintain a potassium level > 3.5mmol/L. However there will be some patients who will need additional potassium to help maintain their homeostasis.

The threshold potassium level for patients is 3.5mmol/L, or as specified by the treating clinician. Treatment should be commenced if the potassium level falls below the target level.

ECG changes can occur as a result of low or high potassium and can also occur during potassium corrections (if over corrections occurs).



7.4 ECG changes in hyperkalaemia (image from www.ecgwaves.com)

- Tall peaked t-waves
- QRS widens
- Wide-complex tachycardia (severe hyperkalaemia)
- Sine wave formation (severe hyperkalaemia)

7.6. ECG changes in hypokalaemia (www.my-ekg.com)

Moderate Hypokalemia:
ST depression, T waves flattening (red arrows), prominent U waves (orange arrows).

Severe Hypokalemia:
ST depression, negative T waves (red arrows), prominent U waves (orange arrows).

- ST depression
- Negative T-waves (flattened at first)
- Prominent U-waves

IMPORTANT NOTE

High strength Potassium corrections on ward 27 can be given during normal working hours (0900-1700) on Monday-Friday following discussion with service week Paediatric Oncology/Haematology Consultant.

If decision is made to give potassium chloride correction out of hours this must be discussed with on-call Paediatric Oncology/Haematology Consultant and nursing staff.

High strength continuous potassium infusions on ward 27 are not first-line at correcting low potassium levels.

Dilution

Use ready-made bag only: 20 mmol in 100mls of potassium chloride bags made in 0.9% saline are stocked on PICU and ward 27.

Monitoring

Patients receiving higher strength potassium with a Potassium level of 2.5-3.0 mmol/L should be attached to a **3-lead ECG monitor** (please see ECG changes above).

Please ensure that all other potassium containing fluids are stopped during the correction.

In any 24hour period a child requiring high strength potassium will be given an initial dose of **0.4mmol/kg (maximum dose 20mmols)** over **2 hours**

Potassium will then be checked after 2 hours (Blood gas and lab to confirm). If it is still low, a second dose of **0.4mmol/kg (maximum dose 20mmols)** over **2 hours** can be given.

If potassium is still not corrected following 2 doses of 0.4mmol/kg please discuss with Children's Intensive Care for admission. Higher rates and concentration can be used on Children's Intensive Care.

If there are ECG changes on 3-lead monitor that are concerning please inform medical staff immediately and stop the infusion.

Dose and administration

Infusion of 0.4mmol/kg (max dose 20mmols) should be given **CENTRALLY** over **2 hours**

The maximum rate of potassium should not exceed **0.5mmol/kg/hour**

Example prescription:
A child who weighs 15kg needs a potassium correction.

PRESCIPTIONS FOR INTRAVENOUS INFUSIONS FOR CHILDREN									
DATE	TIME	INFUSION FLUID	ADDITIVES & AMOUNT (BATCH/BLOOD BAF NO.)	VOLUME	RATE(mls/hour)	EQUIVA-LENT DOSE	TIME/DATE REASSES	PRESCRIBER'S SIGNATURE	PRINT NAME
23/08/22	**1300**	**POTASSIUM CHLORIDE PRE-MADE BAG (20mmols in 100mls of 0.9% Sodium Chloride)**		**30mls = 6 mmols**	**15ml/hr (For 2 hours)**			(insert signature)	A.Kamal

4. Magnesium

Magnesium is another electrolyte that often needs correcting in both Paediatrics and TYA Haematology/Oncology. These patients often require additional intravenous supplementation of Magnesium to maintain homeostasis.

Normal range of magnesium is between 0.7-1.0 mmol/L. **Magnesium < 0.5 mmol/L** should be treated as detailed below.

It is important to consider the aetiology when thinking about management of low Magnesium in these patients. The table below shows common causes of hypomagnesaemia in these patients.

Aetiology	Causes and Consequences
Dietary deficiency of magnesium	Starvation, protein-calorie malnutrition, total parenteral nutrition, enteral feeding with inadequate magnesium
Magnesium redistribution	Blood transfusions, acute pancreatitis, refeeding syndrome
Gastrointestinal losses	Diarrhoea, vomiting, malabsorption secondary to mucositis, gastrointestinal fistulae, bowel resection, drug related (*e.g.*, PPIs, calcineurin inhibitors such as tacrolimus and ciclosporin)
Kidney losses	Ketoacidosis, hypercalcemia, hypoparathyroidism, hyperaldosteronism, hypervitaminosis D, **chemotherapeutic agents (*e.g.*, cisplatin and carboplatin), calcineurin inhibitors (Tacrolimus, Ciclosporin)**
Transdermal losses	Burns, excess sweating, persistent fevers.

IV magnesium adverse effects: Arrhythmias; coma; confusion; drowsiness; flushing of skin, Hypermagnesaemia associated side-effects (such as hypotension; loss of tendon reflexes; muscle weakness; nausea; respiratory depression; thirst; vomiting)

Dilution

The maximum concentration allowed is 100mg/ml (0.4mmol/ml). UHL stocks two strengths of Magnesium sulphate and both these infusions MUST be diluted before

use. Suitable diluents include 5% glucose, 10% Glucose, 0.45% Sodium Chloride and 0.9% Sodium Chloride, 0.9% sodium chloride/5% Glucose solutions.

1. Magnesium Sulfate 20% solution: 200mg/ml = 0.8 mmol/ml. **Please dilute with the same volume of diluent.**

2. Magnesium Sulfate 50% solution: 500mg/ml = 2 mmol/ml. **Please dilute with at least 5 times the volume of diluent.**

Monitoring

Blood pressure and respiratory rate should be monitored during infusion. 3-Lead ECG monitoring should be started if the patient requires a rapid infusion ((i.e over 20 minutes)

For compatibility, see medusa.

Potential adverse effects during infusion:-

Arrhythmias; coma; confusion; drowsiness; flushing of skin Hypermagnesaemia associated side-effects; hypotension; loss of tendon reflexes; muscle weakness; nausea; respiratory depression; thirst; vomiting

Dose and administration

IV infusion dose of **0.4mmol/kg = 100mg/kg (max dose 20mmols = 5 grams)** should be given **CENTRALLY**

It is recommended to give at a slower rate of infusion in order for better magnesium retention. Therefore, infusions should ideally be given over 3-6 hours.

If needed to be given quickly (i.e over 20 minutes), it is recommended that 3-Lead ECG monitoring is commenced during the infusion.

Infusion rate should not exceed **10mg/kg/min (0.04mmol/kg/min)**
For peripheral administration/concentration please refer to other children's hospital guidelines.

Example: for a 40kg child aged 13 years old

PRESCIPTIONS FOR INTRAVENOUS INFUSIONS FOR CHILDREN

DATE	TIME	INFUSION FLUID	ADDITIVES & AMOUNT (BATCH/BLOOD BAF NO.)	VOLUME	RATE(mls/hour)	EQUIVA-LENT DOSE	TIME/DATE REASSES	PRESCRIBER'S SIGNATURE	PRINT NAME
Example with Mg 20%	**1300**	**0.9% Sodium Chloride**	**Magnesium sulphate 20%**	**40mls**	**Over 4 hours (10ml/hr)**	16mmol		(insert signature)	A.Kamal
Example Mg 50%	**1300**	**0.9% Sodium Chloride**	**Magnesium sulphate 50%**	**40mls**	**Over 4 hours (10ml/hr)**	16mmol		(insert signature)	A.Kamal

5. Phosphate

Phosphate is another electrolyte that often needs correcting in both Paediatric and TYA Haematology and Oncology patients. Please consider the aetiology of hypophosphataemia prior to commencing IV correction including suitability for oral replacement and efficacy of oral replacement.

Etiology	Causes and Consequences
Decreased Gastrointestinal Absorption	Chronic Diarrhoea, Medications such as Proton Pump Inhinibitors (PPIs), Phosphate Binders, Vitamin D Deficiency
Transcellular shift of phosphate	Refeeding Syndrome, Respiratory alkalosis
Kidney losses (non-medication)	Primary hyperparathyroidism, Vitamin D deficiency, Fanconi syndrome, Osteomalacia, CAR-T cell therapy
Kidney losses (Medication)	Ifosfamide, Cisplatin/Carboplatin, Imatinib, Bevacizumab, Irinotecan, Most tyrosine Kinase Inhibitors (Imatinib, Dasatinib), ALK inhibitor, MTOR inhibitor (Everolimus), Azacitidine.

Normal Serum phosphate is >0.8mmols/L (Adults and TYA) and > 1.2 mmol/L (children) but IV treatment may be required only if **<0.8mmol/l.**

IV phosphate infusion adverse effects of: Hypotension, tachycardia, oedema (including pulmonary), hypocalcaemia, tetany, thrombophlebitis, hyperkalaemia, hypernatraemia, hyperphosphataemia

Dilution

Use Phosphate Polyfusor as first line; Phosphate polyfusor has 50mmol of phosphate in 500mL

Dilution is not required for central or peripheral infusion. It is available as a stock item on ward 27.

If Potassium Acid Phosphate is required please refer to separate children's hospital guideline. Potassium Acid Phosphate has to be ordered by pharmacy and is not available as a stock item.

Monitoring

Do not infuse with any other medicines, especially those with calcium or magnesium Monitor electrolyte levels (especially phosphate, calcium, potassium) Monitor renal function: caution if function deranged

Central dose and administration of Phosphate Polyfusor

Dose : <2 yrs 0.7 mmol (phosphate)/kg adjusted to response

≥2yrs 0.4 mmol (phosphate)/kg adjusted to response

Maximum rate should not exceed 0.5mmol/kg/hour when infused centrally.

Maximum single dose should not exceed 50mmols.

Adverse Effects: Hypotension, tachycardia, oedema (including pulmonary), hypocalcaemia, tetany, thrombophlebitis, hyperkalaemia, hypernatraemia, hyperphosphataemia

Peripheral dose and administration

Use Phosphate Polyfusor with similar doses as above however **peripheral maximum rate** should not exceed 0.05mmol/kg/hour

Maximum single dose should not exceed 50mmols.

Example 1 for a 10kg child age 1y/o
Example 2 for a 40kg child aged 13y/o

PRESCIPTIONS FOR INTRAVENOUS INFUSIONS FOR CHILDREN

DATE	TIME	INFUSION FLUID	ADDITIVES & AMOUNT (BATCH/BLOOD BAF NO.)	VOLUME	RATE(mls/hour)	EQUIVA-LENT DOSE	TIME/DATE REASSES	PRESCRIBER'S SIGNATURE	PRINT NAME
Example 1	1300	Phosphate polyfusor		70ml	5ml/hr (over 14hrs)	7mmol		(insert signature)	A.Kamal
Example 2	1300	Phosphate polufusor		160ml	20ml/hr (over 8hrs)	16mmol		(insert signature)	A.Kamal

6. Education and Training

All relevant staff (nursing and medical) on ward 27 will need to attend/watch presentation on ECG changes due to Hypokalaemia and Hyperkalaemia.

7. Monitoring Compliance

What will be measured to monitor compliance	How will compliance be monitored	Monitoring Lead	Frequency	Reporting arrangements
Patients who are prescribed IV potassium, magnesium and phosphate correction have correct prescriptions and are given appropriate volume and at appropriate rate.	Audit	Ahmed Kamal	3 yearly	

8. Supporting References

1) BNF for Chlidren 2020-2021

2) Medusa Injectable Medicines Guide: accessed via https://medusa.wales.nhs.uk/Local%20files/UHLP/IV%20Monograph%20POTASSIUM%20CHLORIDE%20vs2-%20PICU%202020.pdf on 18/02/2022
3) Micromedex Drug Database:
4) Birmingham Children's Hospital Injectable Medicine Guide POTASSIUM CHLORIDE for IV INFUSION Version 1.03
5) Workeneh BT, Uppal NN, Jhaveri KD, Rondon-Berrios H. Hypomagnesemia in the Cancer Patient. Kidney360. 2020 Nov 11;2(1):154-166. doi: 10.34067/KID.0005622020. PMID: 35368816; PMCID: PMC8785729
6) Adhikari S, Mamlouk O, Rondon-Berrios H, Workeneh BT. Hypophosphatemia in cancer patients. Clin Kidney J. 2021 Apr 15;14(11):2304-2315. doi: 10.1093/ckj/sfab078. PMID: 34754427; PMCID: PMC8572986.

9. Key Words

Potassium Chloride, Electrolytes, Magnesium sulphate, Phosphate Polyfusor, Ward 27.

The Trust recognises the diversity of the local community it serves. Our aim therefore is to provide a safe environment free from discrimination and treat all individuals fairly with dignity and appropriately according to their needs.
As part of its development, this policy and its impact on equality have been reviewed and no detriment was identified.

Contact and review details	
Guideline Lead (Name and Title) Ahmed Muaz Bin Mustafa Kamal	**Executive Lead** Chief Medical Officer
Details of Changes made during review: New Document	