

Clinical Guidance

Paediatric Critical Care: Electrolyte Emergencies

Summary

This guidance offers advice for staff treating children in critical care with severe electrolyte derangement until their electrolytes normalise. The advice is for all non-arrest situations and additional advice is included where there is an arrest situation.

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Relevant external law, regulation, standards	
<p>This clinical guideline was produced by the South Thames Retrieval Service (STRS) at Evelina London for nurses, doctors and ambulance staff to refer to in the emergency care of critically ill children.</p> <p>This guideline represents the views of STRS and was produced after careful consideration of available evidence in conjunction with clinical expertise and experience. The guideline does not override the individual responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient.</p>	

Change History		
Date	Change details, since approval	Approved by
14 Feb 2018	Inserted 2 new references (Effe & Webster 2017; and Batterink et al 2015). Deleted 2 old references (Blumberg 1992 & 1988)	Evelina Patient Safety & Quality Committee

HYPERKALAEMIA (Potassium (K) > 5.5mmol/L +/- ECG changes)

High risk situations:

Tissue destruction (e.g. necrotising fasciitis).
Succinylcholine with tissue destruction or myopathy.
Impaired K excretion: e.g. acute renal failure or drugs.
Acute haemolysis; massive blood transfusion.

Clinical signs:

ECG changes - simultaneous/progressive: T waves >5mm tall; long PR; flutter/absent P waves; widened QRS; bradycardia/ventricular fibrillation (VF).
Other: muscle weakness; ileus.

Management:

STEP 1: Monitoring & medication

Stop red blood cell infusion and other medications & fluids that contain or increase K.
Continuous ECG monitoring. If ECG changes present treat. Do not wait for lab result.
Recheck gas K every 30mins & obtain laboratory confirmation. If any doubt, repeat gas potassium before treating.

STEP 2: Calcium Gluconate 10% (CaGlu)

Onset: < 2mins.
ONLY give if ECG changes.
If no ECG changes go to STEP 3.
Adverse effects: tissue injury if extravasates.

Calcium Gluconate 10% (CaGlu):

0.5mL/kg IV (max 20mL) over 5-10mins.
Central: neat.
Peripheral: dilute 1mL CaGlu in 4mL 0.9% Sodium Chloride (NaCl).
Repeat dose in 5mins if no ECG improvement.
IN ARREST: give immediately, neat, central or peripheral.
If patient on digoxin seek urgent toxicology advice BEFORE giving CaGlu.

STEP 3:

3a) Insulin & Glucose

Onset: 10-30mins.
Adverse effects: hypoglycaemia, hence 10% Glucose in sodium chloride infusion.

AND

3b) Beta₂ (β₂) stimulants

Salbutamol

Onset: 5-30mins (IV or nebulised).
Do NOT use as monotherapy as 50% unresponsive. AVOID with adrenaline as work on same β₂ receptors.

IN ARREST: Adrenaline: Onset: <1min.

Infusions of Insulin & Glucose:

Insulin at 0.05units/kg/h IV (2.5units/kg insulin in 50mL 0.9% NaCl at 1mL/h) & 10%Glucose in 0.9%NaCl at 5-10mL/kg/h IV. Give via the same IV cannula. Increase insulin to max. 0.2units/kg/h if required. Target blood glucose (BM) ≥6mmol/L with regular BM monitoring.
IN ARREST: first give IV bolus of 0.1units/kg insulin & of 10mL/kg 10% Glucose; and then the above infusions.

Salbutamol:

4micrograms/kg IV over 5mins.
Central: neat. Peripheral: dilute to 200micrograms/mL in 0.9%NaCl.
If self-ventilating: 2.5-5mg nebulised. Repeat PRN.

Adrenaline:

10micrograms/kg IV (0.1mL/kg 1:10 000) neat. Repeat PRN.

STEP 4: Dialysis Onset: 1h. If refractory, start continuous veno-venous haemofiltration (CVVH) / peritoneal dialysis (PD). Longer CPR appropriate to permit K correction.

HYPOKALAEMIA (K <3.0mmol/L +/- ECG changes)

Clinical signs:

ECG changes: U waves; flutter T waves; long QT; ventricular tachycardia / ventricular fibrillation (VF) / torsades de pointes (torsades).
Other signs: muscle weakness; ileus; rhabdomyolysis.

Management: Continuous ECG. Recheck gas K every 30mins. Correct low Mg; hypokalaemia refractory till Mg 0.7-1.0mmol/L.
Central potassium chloride (KCl) 1mmol/kg IV over 2h, diluted in 0.9% NaCl to 0.5mmol/mL. Repeat dose until K ≥ 3.0mmol.
ONLY IN ARREST: give KCl neat over 3-5mins, central (IV or intraosseous) or peripheral.

HYPERMAGNESAEMIA (Mg>2 mmol/L+/-ECG changes)

High risk situations: admin of Mg; rhabdomyolysis.
Clinical signs: weakness; coma; ↓BP, ↓HR, heart block.
Management: Bolus of CaGlu as above.
Ensure fluid replete (give 10-20mL/kg IV fluid bolus if necessary), then force diuresis with furosemide (1mg/kg IV, max 10mg) & target a neutral fluid balance.
If refractory dialyse. Check Mg level hourly.

HYPOMAGNESAEMIA (Mg <0.6mmol/L +/- ECG changes)

Clinical signs: seizures; ↑BP; arrhythmias (eg torsades).
Management: Magnesium Sulphate (MgSO₄) 50% 200mg/kg IV diluted to 200mg/mL in 0.9%NaCl over 30mins & after that at 20-50mg/kg/h.
If Torsades: MgSO₄ 50% 50mg/kg IV (max 2g) immediately & neat.
Check Mg level hourly. Target Mg 0.7-1.0mmol/L.

HYPERCALCAEMIA (iCa >3mmol/L +/- ECG changes)

High Risk Situations: Malignancy, post rhabdomyolysis.
Clinical signs: coma; polyuria; ↑BP; tachyarrhythmias.
Management:
Ensure fluid replete (give 10-20mL/kg IV fluid bolus if necessary), then force diuresis with furosemide (1mg/kg IV, max 10mg) & target a neutral fluid balance.
If refractory dialyse (CVVH more effective than PD).
Check ionised calcium (iCa) every 30-60mins.

HYPOCALCAEMIA (iCa <0.8mmol/L +/- ECG changes)

Clinical signs: seizures; ↓BP, long QT, pulseless electrical activity (PEA) / VF.
Management: 1st Correct Mg (hypocalcaemia refractory till Mg 0.7-1.0mmol/L); 2nd flush well to avoid precipitation; 3rd if phosphate (PO₄) ≥2mmol/L dialyse; 4th when PO₄ <2mmol/L, give CaGlu as above BUT over 1h, preferably central.
IN ARREST: immediately give CaGlu 10% as above.
Check ionised calcium (iCa) every 30-60mins. Repeat dose till iCa 1.0-1.4mmol/L.