Paediatric Intensive Care Unit

PICU fluid management UHL policy

Staff relevant to:	Medical and Nursing staff caring for children in the PICU
Approval date:	March 2023
Version:	V.3
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Related Guidelines and Policies:	
C6/2015	Fluid and electrolyte management
C97/2016	Metabolic disease; http://www.bimdg.org.uk/site/guidelines.asp
C103/2016	Diabetic ketoacidosis; https://www.bsped.org.uk/media/1381/dkaguideline.pdf
C159/2016	Pyloric stenosis
C120/2008	UHL policy for infant feeding
C150/2016	Admission to Paediatric Intensive Care Unit Following Cardiac Surgery
	Guideline for Management of Fluids in Children and Young People with known Renal Disorders http://www.emeesykidney.nhs.uk/professional-area/individual-guidelines

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1. Introduction

This guideline is intended for use in children and young people aged up to 16 years who are cared for in the PICU/CICU UHL Children's Hospital and East Midlands Congenital Heart Centre requiring fluid replacement and specifies use of PlasmaLyte 148 with or without 5% glucose.

2. Fluid replacement management within PICU, CICU & EMCH

MAINTENANCE IV FLUID PICU/CICU
Check electrolytes & glucose level daily

NEONATE
(doesn't include VLBW neonates)

Day 1: 60 ml/kg/d

Day 2: 90 ml/kg/d

Day 3: 120 ml/kg/d

Day 4 - 28: 120 ml/kg/d

1 month - 16 years of age

Holiday - Segar formula:
100 ml/kg/d for the first 10kg of weight
50 ml/kg/d for the second 10kg of weight
20ml/kg/d for the remaining weight
Max 2500ml for male; 2000ml for female
Alternatively:
4 ml/kg/h for the first 10kg of weight
2 ml/kg/h for the second 10kg of weight
1 ml/kg/h for the remaining weight
Max 100ml/h for male; 80ml/h for female

For oliguric/anuric patient use (e.g. weaning from CRRT):

Body surface: 300 - 400ml/m2 (insensible losses) + urinary output

If the risk of water retention
(non-osmotic ADH secretion: critical illness, general anaesthesia, surgery)
RESTRICT to 50 - 80% of IV maintenance
For post cardiac surgery patients see C150/2016, Appendix A

If postnatal adaptation phase (RDS, HIE) use 5 or 10% glucose, add Na based on U&E (0.45 or 0.9% Sodium chloride)

0.9% Sodium chloride with 5 or 10% glucose

HYPERKALAEMIA
renal impairment → 0.9%Sodium chloride +5%glucose (the need for sodium may vary)

HYPOCHLORAEMIA
pyloric stenosis, large NG losses → 0.9%Sodium chloride+5%glucose

METABOLIC DISEASE → www.bimdg.org.uk/site/guidelines.asp

GLUCOSE FREE DIET
(ketogenic diet) → PlasmaLyte 148 without glucose

ANY OTHER PATIENT > 1 month old → **PLASMALYTE with 5% GLUCOSE**

Title: PICU fluid management
V:3 Approved by: UHL Children's Quality & Safety Board : March 2023 Next Review: March 2026
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Recommended resuscitation and maintenance fluid:

Patient - condition	Resuscitation fluid	Maintenance fluid
Possible hyperkalemia (eg.renal impairment)	0.9% Sodium Chloride	0.9% Sodium chloride with 5% glucose See also: http://www.emeesykidney.nhs.uk/professional-area/individual-guidelines
Hypochloraemia (see Pyloric stenosis)	0.9% Sodium Chloride	0.9% Sodium chloride with 5% glucose
Metabolic disease	0.9% Sodium Chloride	**http://www.bimdg.org.uk/site/guidelines.asp**
Glucose free diet (Ketogenic diet)	PlasmaLyte 148	PlasmaLyte 148
<1 month of age (except term neonates in postnatal adaptation/preterm neonates)*	PlasmaLyte 148	0.9% Sodium chloride with 5% Or 10% glucose
Any other patients	PlasmaLyte 148	PlasmaLyte 148 + 5% glucose

* If term neonates need IV fluids for routine maintenance, initially use 0.9% Saline with 5-10% glucose. Only for term neonates in critical postnatal adaptation phase (for example, term neonates with respiratory distress syndrome, meconium aspiration, hypoxic ischaemic encephalopathy), give no or minimal sodium until postnatal diuresis with weight loss occurs. Preterm neonates (by Corrected Gestational Age) should be started on 10% Dextrose and add sodium as required, based on U&Es.

What is PlasmaLyte 148?

- Balanced, crystalloid iv fluid
- Osmolality and electrolyte concentration including chloride is very similar to blood plasma
- It is used as resuscitation fluid and in combination with glucose as maintenance fluid

The reason for the replacement of 0.9% Sodium chloride with Plasmalyte is hyperchloraemic metabolic acidosis which is a side effect of 0.9% Sodium chloride administration. This causes a reduction in glomerular filtration due to decrease in renal artery flow rate which results in deterioration in renal function and postoperative mortality. (1-7)

Advantage of PlasmaLyte 148:

- Diminished hyperchloremic metabolic acidosis (10)
- Quicker resolution of acid-base disturbances (11)
- Better than other balanced crystalloids such as as Hartmanns and has been shown to decrease mortality in postoperative patients compare to group treated with 0.9% sodium chloride or lactated Ringer's solution (9,12,13)

- In paediatrics, in patients with gastroenteritis, rehydration and normalisation of bicarbonate levels are reached more quickly and less abdominal pain was also noted (14,15)

Limitations of PlasmaLyte use:

Patients at risk of hyperkalaemia e.g. Tumour Lysis syndrome, Rhabdomyolysis, renal impairment. Myasthenia gravis (Mg content).

	Blood	0.9%Sodium Chloride	PlasmaLyte148	PlasmaLyte148 with 5% glucose
Sodium (mmol/l)	140	150	140	140
Potassium (mmol/l)	4.5	0	5	5
Chloride (mmol/l)	99	150	98	98
Magnesium (mmol/l)	1.2	0	1.5	1.5
Glucose %	5	0	0	5
pH	7.4	5.5	7.4	7.4
Osmolality (mOsm/l)	290	300	294	572

Specific areas:

A. Renal patients with separate sodium requirements:
http://www.emeesykidney.nhs.uk/professional-area/individual-guidelines
B. Metabolic patients: http://www.bimdg.org.uk/site/index.asp

Risks:

a) **Care must be taken with specific patients who may not tolerate some elements of this fluid**, especially the potassium component - only available with standard 5 mmol/l of potassium. Patients needing less potassium than this would need 0.9% Sodium chloride with glucose (or 0.45% Sodium chloride depends on sodium requirement).
b) **PlasmaLyte 148 and PlasmaLyte 148+5% dextrose** have similar names and fluid bag looks similar – needs attention!
c) **Compatibility:** Basically, from 87 tested drugs used at PICU relatively frequently Y-site incompatible are: **Amiodarone, Cyclosporin, Mycophenolate mofetil, Propofol.** (For further information please see the attachment)

Monitoring and recording

The child's fluid requirements should be calculated and recorded on a daily basis bearing in mind that critically ill children have decreased ability to excrete free water and insensible losses are reduced on humidified invasive ventilation, so "fluid restriction" is often required. Exceptions could be children with burns and metabolic disease. (For fluid requirement post cardiac surgery see the guideline "Admission to Paediatric Intensive Care Unit Following Cardiac Surgery" C150/2016)

Every child on intravenous fluids should have:

- regularly reviewed their fluid status and iv fluid requirement
- documented input, on-going losses, urine output and calculated fluid balance
- checked electrolytes and glucose daily
- regularly checked their weight

Summary of the role of Plasma-Lyte 148 in PICU/CICU

- Maintenance fluids with or without 5% dextrose
- Replacement of GI losses
- Bolus administration (without dextrose)
- Priming CRRT/ECMO circuits

3. Education and Training

Training and raising awareness are on-going processes. On-going awareness is promoted through the induction and continuous bedside teaching. Training is provided for medical staff during lunchtime teaching (Wednesdays) and other sessions, and at junior doctors' induction training. Nursing education is supported by the Practice Development teams, and nursing educators.

4. Monitoring Compliance

What will be measured to monitor compliance	How will compliance be monitored	Monitoring Lead	Frequency	Reporting arrangements
Treatment algorithm followed and documented	Audit	PICU Consultant	As required	Clinical practice group

5. Supporting References

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6. Key Words

Plasmalyte, maintenance fluid, hyperchloremic acidosis, renal failure, compatibility Plasmalyte

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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 **Julia Vujcikova - Consultant**	**Executive Lead** **Chief Medical Officer**

Details of Changes made during review:

Pg. 2 Flow chart fluid volume changes –
Day 1: changed from 50ml/kg/d to **60ml/kg/d**
Day 2: changed from 75ml/kg/d to **90ml/kg/d**
Day 3: changed from 100ml/kg/d to **120ml/kg/d**

Pg. 3 What is Plasmalyte?
Added to reasoning - The reason for the replacement of 0.9% Sodium chloride **with Plasmalyte** is hyperchloraemic metabolic acidosis **which is a side effect of 0.9% Sodium chloride administration. This causes a** reduction in glomerular filtration due to decrease in renal artery flow rate which results in deterioration in renal function and postoperative mortality. (1-7)

Pg. 4 Risks
Amended-

d) **Compatibility:** Basically, from 87 tested drugs used at PICU relatively frequently Y-site incompatible are: **Amiodarone, Cyclosporin, Mycophenolate mofetil, Propofol.** (For further information please see the attachment ~~contact pharmacy regarding Y-site compatibility of intravenous drugs with PlasmaLyte 148~~)

Guideline name changed from Plasmalyte use in PICU/CICU to **PICU fluid management**