

Perioperative Intravenous Fluids in Children

National Patient Safety Agency
Recommendations

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NPSA

- Special Health Authority
- Helps NHS learn from patient safety incidents
- Collect reports nationally (NRLS)
- Initiate preventative measures
- Also encompasses hospital design, cleanliness & food, research (COREC), performance of medical staff (NCAS), and managing the 3 confidential enquiries

National Patient Safety Agency

‘Reducing the risk of harm when
administering intravenous fluids to
children’

Definitions

- **Hyponatraemia** – sodium less than 130 mmols/L
- **Osmolality** – osmoles of solute per kg of solvent
= number of particles in solution
- **Tonicity** – effective osmolality in relation to a semi-permeable membrane, i.e. solute that exerts an osmotic force

Background

- More than 50 reported cases of child death or neurological injury from hospital-acquired hyponatraemia in past decade worldwide
- Associated with hypotonic intravenous solutions

Background cont.

- 4 deaths and 1 'near miss' reported in UK since 2000
- Postoperative & ward-based cases
- Phenomenon not well recognised & probably greatly underreported

Factors contributing to hyponatraemia

- Wide use of hypotonic IV solutions for hydration therapy
- Most prescriptions written by trainees, with inadequate training & supervision
- Children inadequately monitored (e.g. bodyweight & electrolytes)
- Poorly designed fluid prescription & balance charts
- Inadequate audit of process

NPSA Action

- Safety alert published at end of 2005 with 5 main recommendations
- Circulated for wide stakeholder consultation (Jan-March 2006)
- Plan to publish final recommendations later in 2006
- Discussion group established on NPSA website

NPSA Recommendations

1. 'Immediately remove *Sodium chloride 0.18% with glucose 4%* intravenous infusion from use and restrict access to critical care and specialist ward areas for example, renal or cardiac units.'

Background to Recommendation 1

- All children at risk of hyponatraemia from use of hypotonic solutions
- 4 deaths and one 'near miss' since 2000 in UK literature associated with the use 0.18% NaCl 4% glu
- Removed from ward stock in 2 cases and no further reported cases since

Background to Recommendation 1

- Discussed by MHRA, CSM and JMC of RCPCH/Neonatal & Paediatric Pharmacists Group
- Statement issued by RCA in November 2003 at request of RCPCH, warning of dangers of water overload and hyponatraemia with use of 0.18% NaCl 4% glu
- Recent survey shows this is not well recognised

Perioperative fluid therapy in children: a survey of current prescribing practice

- Questionnaire-based study
- 477 Consultants – 43% (203) replies from those with paediatric practice
- 67.7% without local departmental policy for fluid prescription
- 58.1% unaware of concerns of RCPCH
- 60.1% administered hypotonic D/S in intraoperative period
- 72.5% prescribed it in postop period

Way C et al. BJA 2006; 97: 371-9

Perioperative fluid therapy in children: a survey of current prescribing practice

- Specialist Paediatric Anaesthetists 5x more likely to administer isotonic fluids intraoperatively
- All prescribed hypotonic fluids postoperatively
- 81.8% based calculations on Holliday & Segar formula
- 5.9% anaesthetists restrict fluids in postop period
- SPAs 13x more likely to restrict fluids postop

Holliday and Segar Formula for IV Fluids

Body weight (kg)	Average maintenance allowance for fluid	
	ml/day	ml/hr
0-10	100 ml/kg	4 ml/kg
10-20	1000ml + 50ml/kg for each kg more than 10 kg	40ml + 2 ml/kg for each kg more than 10 kg
20+	1500 ml + 20 ml/kg for each kg more than 20 kg	60 ml + 1 ml/kg for each kg more than 20 kg

Features of commonly used IV fluids

Solution	Osmolarity	Sodium	Osmolality vs. plasma	Tonicity
Sodium chloride 0.9%	308	154	Isosmolar	Isotonic
Sodium chloride .45%	154	77	Hyposmolar	Hypotonic
SC 0.45% & glu 5%	432	75	Hyperosmolar	Hypotonic
Glucose 5%	278	-	Isosmolar	Hypotonic
Glucose 10%	555	-	Hyperosmolar	Hypotonic
SC 0.9% & glu 5%	586	150	Hyperosmolar	Isotonic
SC 0.45% & glu 2.5%	293	75	Isosmolar	Hypotonic
SC 0.18% & glu 4%	284	31	Isosmolar	Hypotonic
Hartmann's	278	131	Isosmolar	Isotonic
HAS 4.5%	275	Variable	Isosmolar	Isotonic

NPSA Recommendations

2. 'Produce and disseminate [clinical guidelines](#) for the fluid management of paediatric patients which give clear recommendations for fluid selection and clinical and laboratory monitoring.'

Background to Recommendation 2

- Audit showed weight & baseline U+E assessment often omitted
- If child received IV fluids for more than 24 hours, 12% did not have any U+Es taken & 73% did not have it checked daily

Background to Recommendation 2 cont.

- 44% respondents did not check fluid balance charts
- Very few weighed patients
- Departmental policy in only 1/3rd cases

Additional Recommendations

1. Prescribing of fluids afforded same consideration as other drugs
2. Prescribing of fluids individualised
3. *Resuscitation*: Use boluses of 0.9% saline

Additional Recommendation cont.

4. *Deficit:* Replace with similar solution & usually isotonic (0.9% saline \pm glucose, Hartmanns)
5. *Maintenance:* **Don't use 0.18% NaCl with 4% glucose** - 0.45% NaCl with dextrose generally OK

Additional Recommendation cont.

6. High-risk patients should only receive isotonic fluids, e.g. dehydrated, perioperative, hypotensive, CNS infection, head injury, bronchiolitis, sepsis & Na <135
7. Perioperative fluids should contain glucose, otherwise monitor levels

Additional Recommendation cont.

8. *Monitoring:* weigh before commencing therapy & daily thereafter; monitor fluid balance
9. Measure U+Es at baseline & at least daily; 4-6 hrly if abnormal, Na <130, or child symptomatic (headache, N&V, depressed conscious level, seizures)

Acute Hyponatraemic Encephalopathy

- Medical emergency
- Requires senior medical supervision
- Administer hypertonic fluids
- Never manage with fluid restriction alone

NPSA Recommendations

3. 'Provide adequate training and supervision for all staff involved in the prescribing, administration and monitoring of intravenous infusions to children.'

Background to Recommendation 3

- Doctors in training responsible for prescribing 80-90% fluids on general wards
- Junior doctors often feel confident to prescribe IV fluids, but significant gaps in knowledge often present
- 1/3rd trainees felt inadequately trained in fluid prescribing

Background to Recommendation 3 cont.

- Need to improve this skill in trainees & increase supervision
- Consultant surgeons feel present perioperative fluid prescribing unsatisfactory
- Need for improved education & guidelines

Background to Recommendation 3 cont.

- 1999 NCEPOD report – 20% patients had poorly documented fluid balance or unrecognised/untreated fluid imbalance
- Could contribute to serious postoperative morbidity/mortality
- Fluid prescription should be afforded same status as drug prescription

NPSA Recommendations

4. 'Review and improve the design of existing intravenous fluid prescriptions and fluid balance charts to reinforce safer practice.'

Background to Recommendation 4

- Design of IV prescription & fluid balance charts can reinforce safe practice
- Include guidelines on IV fluid selection & methods of calculating requirements
- Include essential monitoring data, such as weight & electrolyte levels
- Template designed by NPSA

NPSA Recommendations

5. 'Promote the reporting of hospital acquired hyponatraemia incidents via local risk management reporting systems and implement a programme of audit to ensure that local systems and practices are safe.'

Background to Recommendation 5

- Increasing body of evidence in literature of hyponatraemia episodes
- Difficult to quantify global incidence and effect
- All episodes should be reported through local risk management systems
- National Reporting and Learning System will aid with data collection

Background to Recommendation 5

- IV therapy practice needs to be included in local audit programmes
- Should include:
 - Compliance with guidelines
 - provision & uptake of training
 - Incident reporting

Comments

- Should all hypotonic fluids be avoided in the postoperative period?
- Is 0.45% SC a suitable alternative to 0.18% SC?
- Will liberal use of 0.9% SC cause its own problems?
- Are routine U&Es justified in most patients on IV fluids?
- No recommendations on fluid restriction in patients with potential SIADH
- Isotonic solutions with dextrose not readily available in UK
- Has the consultation exercise engaged a sufficient body of medical opinion?

What happens now?

- Consultation responses collated
- Reference group had further meeting
- Changes agreed and incorporated
- Approval of DOH sought
- ? Nov 06 to Jan 07 for definitive recommendations

Useful links

- Forum on NPSA website:

<http://www.saferhealthcare.org.uk/ihi/forums>

- Contact at NPSA:

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- Responses to draft document:

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