Whittington Health NHS

Intravenous fluid management of paediatric patients

Subject:	Intravenous fluid management of paediatric patients
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Policy Executive Owner:	Dr Neeta Patel
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Name of Assurance Committee:	As above
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Target Audience:	All staff involved in intravenous fluid admin-istration to paediatric patients (1 month – 16 years)
Key Words:	Intravenous fluids, hyponatraemia

Version Control Sheet

Version	Date	Author	Status	Comment
1.0	March 2008	Dr N Patel	Off line	New guideline approved at CGC
2.0	March 2010	As above	Off line	Reviewed with minor amendment
3.0	July 2014	As above	Off line	Reviewed as part of Paediatric speciality guideline review. No change required other than transposing into current template.
4.0	June 2016	Dr Sakaria Ali Dr Neeta Patel	LIVE	Reviewed and updated in line with current NICE guidance New chart for infants aged less than 3 months

➢ Criteria for use

- Previously well children aged 1 month -16 years who require intravenous fluids

  See exclusion section below

➢ Exclusion criteria

- This guideline is NOT for use on children with renal, cardiac or endocrinological (including diabetic ketoacidosis) conditions **or neonates**.

- For infants and children with the above conditions intravenous fluid management should be discussed with a paediatric consultant.

  Note: There is a separate guideline for the management of hypernatraemic dehydration in breast- fed infants and for diabetic ketoacidosis

➢ Background

- The development of hyponatraemia is an uncommon but well recognised complication of incorrect fluid prescribing and is often due to excessive fluids being prescribed as well as the prescribing of hypotonic solutions (e.g. 0.18% saline + dextrose).

- Though rare, there are reports of fatalities in children following neurological injury from fluid induced hyponatraemia.

- This guideline gives recommendations for the volume and type of fluid that should be used, and clinical and laboratory monitoring

➢ Important points

- These guidelines only apply to children who cannot receive enteral fluids. Wherever possible the enteral route should be used.
- The safe use of intravenous fluid requires accurate prescribing and monitoring
- Always check prescriptions that you have written and double check prescriptions written by other staff when you take over a child's care
- Incorrectly prescribed fluids are potentially very dangerous.

➢ General principles of intravenous fluid replacement

Intravenous fluid therapy will involve the replacement of 1 or more of the following:

- Fluid maintenance
- Fluid deficit
- Ongoing losses

➢ Fluid maintenance

A. In well children

Well children with normal hydration but no oral intake require an amount of fluid called 'maintenance' fluid. This is the volume of daily fluid needed to replace insensible losses and allow excretion of the daily production of excess solute load (urea, creatinine, electrolytes) in a volume of urine that has a similar osmolarity to plasma.

The following calculation gives the approximate maintenance volume required for well children with normal insensible and urinary losses.

Patient weight	mls/day	mls/hour
3 to 10kg	100 x wt	4 x wt
10 - 20kg	1000 plus 50 x (wt-10)	40 plus 2 x (wt-10)
>20kg	1500 plus 20 x (wt-20)	60 plus 1 x (wt-20)

100mls/hour (2500mls/day) is the normal maximum amount

B. In unwell children

Maintenance fluid volumes may need to be adjusted in unwell children

They may need less maintenance if:

- Inactive (e.g. lying in a hospital bed)
- There is excessive secretion of ADH (eg pneumonia, meningitis, bronchiolitis, head injury, post-operative)

They may need more maintenance if:

- They have a persistent high fever
- They are unable to concentrate urine (diabetes insipidus, sickle cell disease and some renal conditions)

Which maintenance fluid to use?

If children need routine maintenance fluids use Isotonic solution such as 0.9% sodium chloride with 5% glucose +/- 20mmol KCL/1Litre bag

- Measure plasma electrolytes when starting iv fluids for routine maintenance (except before most elective surgery), and at least every 24 hours thereafter.
- Base any subsequent iv fluid prescriptions on the plasma electrolytes and blood glucose measurements.
- Weigh before starting iv fluids and daily while continuing on iv fluids.
- Document accurate fluid balance daily.
- Stop fluids and check plasma electrolytes if clinical signs suggestive of hyponatraemia develop. These features include **nausea, vomiting, headache, irritability, altered level of consciousness, seizure and apnoea.**

Call for senior help

Glucose replacement

Maintenance fluids for children should include glucose. Less or no added glucose may be appropriate in children with high blood glucose levels which may occur with certain stresses e.g. severe infection, brain injury.

The amount of glucose given in these circumstances must be guided by blood glucose levels.

Potassium replacement

Most infants and children on maintenance fluids will need potassium replacement.

Generally 20mmol potassium chloride per 1L bag will be adequate (although this may have to be adjusted according to U&E results)

➢ Fluid deficit

This is a single calculation /estimate of the amount of fluid lost before treatment has begun. (**excluding** any volume given to treat initial hypovolaemic shock)

It can be calculated by making a clinical estimation of the degree of dehydration as expressed as a percentage of body weight:

Example: Fluid deficit (L) = % dehydration X pre-illness weight (kg) /100

e.g: a 10kg child who is 5% dehydrated has a water deficit of 500mls

Or based on pre illness and current weight if available:

Example: Fluid deficit (L) = pre illness weight (kg) – current weight (kg)

Which fluid to use to replace deficit?

0.9% sodium chloride +/- 5% glucose

If both maintenance and deficit replacement is required use 0.9% sodium chloride with 5% glucose + KCL aim to rehydrate over 48hours.

Note: in surgical patients other isotonic solutions may be used e.g. Hartmann's solution

Note:

Replacement may be rapid in most cases of gastroenteritis (although usually this is best achieved by oral or nasogastric fluids), but should be slower in diabetic ketoacidosis and meningitis, and much slower in states of hypernatraemia (aim to rehydrate over 48 hours, the serum sodium should not fall by >1mmol/litre/hour).

➢ Ongoing losses

These are abnormal fluid losses that occur after treatment commences.

Certain children, in particular those who have acute surgical problems (e.g. paralytic ileus, bowel obstruction) will need accurate measurement and replacement of fluid losses. They should be measured 4 hourly and replaced ml for ml.

Which fluid to use?

Ideally fluid used should reflect the electrolyte composition of the fluid lost.

Generally 0.9% sodium chloride is used

Note: If both maintenance and replacement of ongoing losses is required use 0.9% sodium chloride with 5% glucose with KCL

➢ Monitoring

This is the most important aspect of intravenous fluid therapy.

- Plasma electrolytes should be measured before starting intravenous fluids and at least every 24 hours if intravenous fluids are continuing.
- If Na< 130mmol/l or >150mmol/l recheck in 4-6 hours. In both circumstances review the fluid prescription, fluid balance, urine output and make a clinical assessment.
- Urine Na can occasionally be useful if unsure clinically if child is hypovolaemic (e.g. children with nephrotic syndrome).
- Weigh before starting fluids (if possible) and twice daily while on intravenous fluids.
- Document accurate fluid balance daily. Assess urine output- oliguria may be due to inadequate fluid, SIADH, renal failure or obstruction.
- Stop fluid and check plasma electrolytes if clinical features suggestive of hyponatraemia develop. These features include nausea, vomiting, headache, irritability, altered level of consciousness, seizure and apnoea. Call for senior help.

Intravenous fluid guidelines for previously well children aged 3 month - 16 years

(excluding renal, cardiac, endocrinology, diabetic ketoacidosis and acute burns patients)

Hyponatraemia may develop as a complication of any fluid regime

If shock is present administer 20ml/kg 0.9% sodium chloride isotonic solution, (10ml/kg in the setting of trauma)

Repeat if necessary and call for senior help

Symptomatic hyponatraemia is a medical emergency

Check plasma electrolytes and blood glucose level

Consider the replacement of
A. Fluid deficit
B. Fluid maintenance
C. Ongoing fluid losses

Fluid Deficit

Estimate any fluid deficit and replace as isotonic solution e.g. 0.9% Sodium chloride +/- 5% glucose

Fluid Maintenance

0.9% Sodium chloride + 5% glucose + KCL 20mmol/L generally appropriate.

Ongoing fluid losses

0.9% Sodium Chloride +/- potassium chloride to replace ongoing losses.

If child requires fluid maintenance + fluid deficit and/or ongoing losses replacement use *Isotonic solution* e.g. 0.9% Sodium chloride + glucose 5%+ KCL 20mmol/L

Volume of intravenous maintenance fluid

1.Child with normal insensible and urinary losses
Less than 10kg: 100ml/kg/day **or** 4ml/kg/hour
10-20kg: 1000ml plus 50ml/kg/day for each kg over 10kg
or 40ml/hour plus 2ml/kg/hour for each kg over 10kg
Over 20kg:1500ml plus 20ml/kg/day for each kg over 20kg **or** 60ml/hour plus 1ml/kg/hour for each kg over 20kg

Up to a maximum of 2500 ml/day in males and 2000ml in females

2. Acutely ill / perioperative children may need reduced maintenance (2/3 normal) because of raised ADH secretion

Volume of deficit replacement

Fluid deficit (L) = % dehydration **X** pre-illness weight (kg) /100

Monitoring

- Measure plasma electrolytes before starting iv fluids and every 24 hours if iv fluids are continuing
- If abnormal consider rechecking in 4-6 hours. If Na< 130 check in 4-6 hours. Review fluid prescription, fluid balance, + clinical state
- Weigh before starting fluids(if possible) and daily while on iv fluids
- Document accurate fluid balance daily.

Stop fluids and check plasma electrolytes if clinical features suggestive of hyponatraemia develop. These features include **nausea, vomiting, headache , irritablilty, altered level of consciousness, seizure and apnoea.**

Call for senior help

Intravenous fluid guidelines for infants aged less than 3 months

Assessment including hydration status

For newborns calculate routine iv maintenance fluids using the following formula:
Day 1: 60ml/kg/day
Day 2: 90ml/kg/day
Day 3: 120ml/kg/day
Day 4: 150ml/kg/day
Maximum rate at 150ml/kg/day aiming to titrate it down gradually.

- No sodium in the fluids until postnatal diuresis with weight loss; give **10% Dextrose bag** using above rate
- Base any subsequent iv fluid prescriptions on the plasma UEs and blood glucose measurements.

plasma Na < 135

- Discuss all babies with hyponatraemia with on call SpR
- Consider causes (including non-osmotic antidiuretic hormone secretion) and hydration status
- Seek immediate help if hyponatraemic symptoms seen - **headache, vomiting, irritability, altered consciousness, seizure and apnoea**

0.45% sodium chloride + 5% glucose + KCL 10mmol/500ml bag

- Initial volume should be at 100ml/kg/day
- If serum Na falls
  - restrict volume to 2/3 maintenance
  - replace the iv fluid with 0.9% sodium chloride with 5% glucose +/- KCL

plasma Na 135 - 145

0.45% sodium chloride + 5% glucose + KCL 10mmol/500ml bag

- Initial volume should be at 100ml/kg/day
- Consider enteral feeding and titrating down the amount of iv fluids being given

plasma Na >145

0.45% sodium chloride + 5% glucose + KCL 10mmol/500ml bag

- Initial volume should be at 100ml/kg/day
- If sodium rises or signs of dehydration change the iv fluids to 0.9% sodium chloride +/- water deficit replacement over 48 hours.

- Close monitoring of observations including daily weights
- Keep feeding chart and maintain strict fluid balance
- Monitor blood glucose level 12 hourly and urea electrolytes 4- 6 hourly for at least the initial 24 hours, then monitor according to treatment response
- If hypoglycaemic ensure more frequent blood glucose level checks and changing iv fluids
- If baby is not responding to iv fluids treatment consider reasons and discuss with the on call Paediatric Consultant
- Regular review of the need for iv fluids and consider enteral feeding as soon as deemed appropriate

➢ Further information

- Consultant paediatrician on call (via switch)
- Children's Acute Transport Service (CATS) Emergency referral/advice hotline 08000850003
- Use of strong potassium solutions.
  Whittington Hospital Clinical Guideline September 2007

➢ References (evidence upon which the guideline is based)

- Intravenous fluid therapy in children and young people in hospital, NICE guideline, Dec 2015 https://www.nice.org.uk/guidance/ng29
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  Reducing the risk of hyponatraemia when administering intravenous infusions to children
- Royal Children's Hospital, Melbourne, clinical practice guidelines 2010
- APA Consensus Guideline on perioperative fluid management in children September 2007