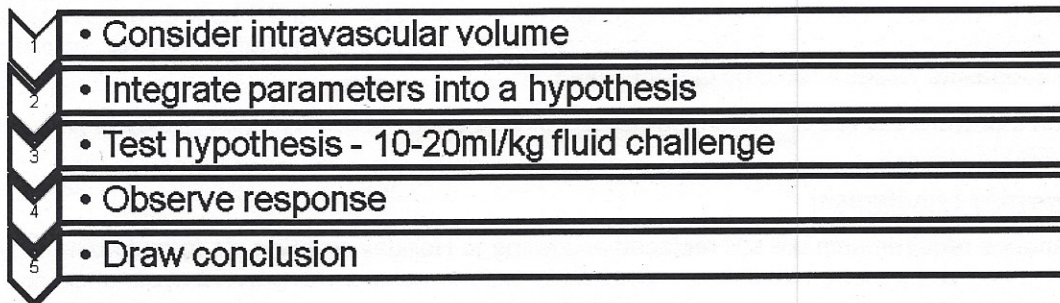


sense that a procedure such as laparotomy for necrotising enterocolitis could require an additional 50 ml/kg/hr.

Over zealous fluid administration should be avoided as hypervolaemia in itself can drive fluid shift and even increase capillary permeability through damage of the endothelial glycocalyx. Fluid replacement should start with isotonic crystalloid but after 20 - 30 ml/kg a suitable colloid must be considered.

Assessment of intravascular volume could be challenging as heart rate, blood pressure and capillary refill could be influenced by pain, anaesthesia and temperature. One should start with a knowledge of age-related norms and look at all haemodynamic parameters in combination and it's variability with surgical stimulation. Cotè et al suggests:



Blood loss – in brief

Estimated blood volume

| | |
|--------------------|---------------|
| Premature neonates | 100 ml/kg |
| Term neonates | 90 ml/kg |
| Infants | 80 ml/kg |
| Older children | 70 - 80 ml/kg |

Table 3

Blood loss must be replaced by either:

| | |
|------------------|---------------------------------|
| Crystalloids | 3 ml for every 1 ml bloodloss |
| Colloids | 1 ml for every 1 ml bloodloss |
| Blood products | 1 ml for every 1 ml bloodloss |
| Whole blood | 8 ml/kg raises Hb by 1 g/dl |
| Red packed cells | 4 ml/kg raises Hb by 1 g |
| Platelets | 10 ml/kg raises count by 50 000 |

Leucocyte depleted red cell concentrate

(Filtration of red cell concentrate, < 5 x 10 leucocytes per unit)

- Intrauterine transfusions and all infants under 1 year of age
- Recurrent febrile haemolytic transfusion reactions
- Cardiac patients and critically ill patients (although this is not common practise)

Washed red cells

(Washing red cell concentrate – 80% leucocyte and plasma removal)

- Transfusion of neonates with T-cell activation due to NEC

Irradiated blood

- Immune suppressed patients
- Pre- and post bone marrow transplantation
- Exchange transfusions, neonates

Transfusion triggers

| | |
|---|--------------|
| Healthy child | 7 g/dl |
| Healthy neonates | 10 g/dl |
| Respiratory or cardiac disease | 9 g/dl |
| Neonate with cardio respiratory disease | 12 - 13 g/dl |
| Lacroix et al - stable, critically ill | 7 g/dl |

Table 4

Postoperative fluid replacement

Paediatric patients are at high risk of developing postoperative hyponatraemia due to indiscriminate use of hypotonic maintenance fluid postoperatively. Neonates and infants are at even higher risk due to the inability of kidneys to get rid of a large water load as discussed previously. Postoperative patients are subjected to high levels of ADH secondary to the stress of surgery, pain, nausea, opiate use and other possible pathological conditions. Patients may also have ongoing isotonic losses such as blood, wound exudates and gastrointestinal fluid. Hyponatraemia can lead to catastrophic cerebral oedema. Children are more vulnerable to adverse outcome with hyponatraemia as they have a larger brain to intracranial volume ratio than adults. Symptoms of hyponatraemia - including lethargy, nausea, vomiting and headaches - are often picked up too late or ascribed to other causes.

Recent case reports of paediatric deaths in the UK secondary to hyponatraemia have led to a patient safety alert by the National Patient Safety Agency (NHS). This alert prescribes the removal of all hypotonic fluids from general wards. 0.18% NaCl with dextrose as maintenance is prohibited. All postoperative patients should receive isotonic solutions such as 0.9% NaCl or Ringer's lactate with or without dextrose. Electrolytes should be monitored where there are ongoing losses. 0.45% NaCl may be used for maintenance in otherwise healthy children that are not postoperative.

7. CONTROVERSIES IN PAEDIATRIC FLUID MANAGEMENT

Colloid vs. Crystalloid

Still a dearth of evidence in the paediatric population. We still extrapolate from adult data.

We currently use a combination of crystalloid and colloid, with most clinicians considering the use of colloid after 20 ml/kg of crystalloid has been given.

Which colloid?

The choice of colloid should be based on patient factors such as the disease process, estimated capillary permeability, clotting profile, renal function, allergy profile and volume need. Colloid characteristics that should be considered include effects (time in circulation, volume expansion), side effects (coagulation, renal function, anaphylaxis, pruritis) and cost. The Association of Paediatric Anaesthetists of Great Britain and Ireland favour the use of gelatines; the Association of French speaking Paediatric Anaesthetists favours hetastarch and in the United States 5% albumin remains the first choice. + Australia.

3rd space loss and fluid shift

As discussed in an earlier section. Although the existence of a 3rd space has been refuted by adult research, most paediatric texts and guidelines acknowledge increased fluid shift with major procedures and in critically ill patients. Intuitive estimation of capillary permeability due to trauma or inflammatory processes as well as haemodynamic parameters should guide the volume as well as the type of fluid administered. A well-chosen colloid solution could aid in reducing fluid shift from permeable capillaries.

Intraoperative dextrose

As discussed previously. The use of 5% Dextrose should be discouraged. 1% - 2% solutions are adequate in patients at risk of hypoglycaemia such as neonates, young infants, and patients with liver or endocrine disorders and after prolonged starvation. A new isotonic fluid, Ringer's lactate with 1% Dextrose, has been developed and is in widespread use in Europe. It is known as polyionique B66.

Children
27% ↑ brain
↑ brain skull
↑ brain skull
(↑ CSF)

what are you
losing?

How much
capillary leak
do you have?

How much
do you
need to
give to
fill space?

NB:
Molecular
weights
etc...

Post Hypo Na: • Elec loss
or • ADH ↑ CO+V / Pain (stress) Hypovol. Opioids.
• Hypotonic fluids

No proven benefit of either over the other
Make educated decision!

Cheap. No capillary leak
eff.