

FLUID GUIDELINES IN CHILDREN

PERIOPERATIVE FLUIDS

Intravenous fluids are administered perioperatively to maintain homeostasis during this period. Water and electrolytes are required to correct deficits and ensure adequate intravascular volume. Calories in the form of dextrose may be needed to prevent hypoglycaemia.

Unless fasted for a long period of time, most children undergoing minor procedures which allow them to resume feeding soon after surgery do not need intra-operative intravenous fluids.

Children undergoing major surgery, or those who have incurred fluid deficits, and/ or are required to remain nil by mouth post-operatively will require intravenous (IV) fluids. Fluids may be given for:

- Resuscitation - to correct pre-existing hypovolaemia or dehydration
- Maintenance - to provide water, electrolytes and glucose during the starvation period.
- Replacement of ongoing losses

Assessment of Extent of Dehydration

Sign	Child 3-6% Infant 5-10%	Child 6-10% Infant 10-20%	Child >10% Infant >20%
Pulse (rate/strength)	Normal/ normal	Increased /weak	Greatly increased/ feeble
Blood pressure	Normal	Normal to low	Reduced and orthostatic
Respiration	Normal	Deep	Deep and rapid
Mucous membrane	Moist	Dry	Very dry
Anterior fontanelle	Normal	Sunken	Markedly sunken
Eyes	Normal	Sunken	Markedly sunken
Skin turgor sunken	Normal	Decreased	Markedly decreased

Sensorium	Normal/ thirsty/ restless	Thirsty/ lethargic but arousable	obtunded
Urine output	<2 ml/kg	<1 ml/kg	<0.5ml/kg

Resuscitation

Hypovolaemia (losses from the intravascular space) should be replaced initially with 10- 20 ml/kg boluses of isotonic solutions like Plasma-Lyte® A/ Ringer Lactate. In children with hypochloremia such as those with severe gastroenteritis or vomiting, the use of isotonic normal saline can be considered. Blood should be considered if the haemoglobin is low, or there is ongoing bleeding, or more than 40 ml/kg of fluid is required. Colloids are associated with more adverse drug reactions than balanced salt solutions but can be used in volumes of 5-10 mls /kg (up to 20 ml/kg) where crystalloids alone are not sufficiently effective and blood products are not indicated.

To assess fluid responsiveness,

- an autotransfusion manoeuvre like pressure on the liver or passive leg raising can be performed.
- Blood pressure curve variations over the breathing cycle (systolic blood pressure variation, pulse pressure variation)
- the perfusion index or pleth variability index calculated based on pulse oximetry
- echocardiographic measurements are additional aids to assess fluid responsiveness.

Maintenance

The simplest and most commonly used formula is the one devised by Holliday and Segar (modified by Oh).

Body weight	Holliday and Segar	Oh
1-10kg	4ml/kg/hour	4ml/kg/hour
10-20kg	40 ml/hour+2 ml/kg/hour above 10 kg	20 + (2x weight in kg) ml/kg/h
>20kg	60 ml/hour+1 ml/kg/hour above 20 kg	40 + weight in kg ml/kg/h

For f insensible loss -minimal tissue trauma may range from 0-2 ml/kg/hr,
 - moderate surgery 2-4ml/kg/hr
 - up to 10ml/kg/hr for severe tissue trauma/ major surgery.

A background infusion rate of 10ml/kg/hr can be initiated and then adjusted to actual fluid requirements during the course of the surgery.

To maintain normal glucose concentrations and avoid lipolysis, hyponatremia and hypochloremia, adding 1-2.5% glucose can be considered as a background infusion especially in infants, liver disease and metabolic diseases. Add 20mls of Dextrose 50% solution under

aseptic technique into 500-1000mls of isotonic balanced salt solution. In children at risk of hypoglycaemia and those undergoing long surgeries, check blood glucose levels regularly.

Fluids in the Operating theatre

In the OT, the default fluid used for patients will be Ringer Lactate or Plasma-Lyte® A solution except in:

- Neonates- Use Dextrose 5% or Dextrose 10% as maintenance drip, and use Plasma-Lyte® A, Normal Saline or Albumin 5%/ blood /blood products for volume resuscitation / replacement as appropriate to the clinical situation.
- Neurosurgical cases- Normal Saline or Plasma-Lyte® A
- Child on total parenteral nutrition (TPN)- continue TPN during surgery. Do not disrupt the sterility of the line used to administer TPN.

The composition of some commonly used crystalloids and colloids are given below.

Fluid Type	Osmolarity (mOsm)	Na (mmol/L)	Osmolality	Tonicity	Others
0.9% saline	308	154	isosmolar	isotonic	
D5% / 0.9% saline	586	150	hyperosmolar	isotonic	
4.5% albumin	275	100-160	isosmolar	isotonic	
Hartmann's solution	278	131	Slightly hyposmolar	Slight hypotonic	K/Ca/ lactate
0.45% saline	154	77	hyposmolar	hypotonic	
D5% / 0.45% saline	432	75	hyposmolar	hypotonic	
D5%	278	0	isosmolar	hypotonic	
D10%	555	0	hyperosmolar	hypotonic	

PAEDIATRIC ANAESTHESIA

Sterofundin	309	145	isosmolar	isotonic	K/Ca/Mg/acetate/ malate
Plasmalyte A	294	140	isosmolar	isotonic	Na/K//Mg/acetate/ gluconate

References:

1. Holliday MA, Segar WE. The maintenance need for water in parenteral fluid therapy. Paediatrics 1957;19:823-832
2. Oh TH. Formulas for calculating fluid maintenance requirements. Anesthesiology 1980; 53:351
3. Sümpelmann R, Becke K, Brenner S et al. Perioperative intravenous fluid therapy in children: guidelines from the association of the Scientific Medical Societies in Germany
4. Infopedia/KKH/Departments/Paediatrics/ PAME clinical guidelines aka Baby Bear Book. Appendix V: Fluids and electrolytes