

Peri - operative Fluid & Electrolyte Management

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2. Paediatric fasting guidelines for elective procedures under general anaesthesia, regional anaesthesia and sedation (monitored anaesthesia)

2.1 Introduction:-

Fasting should not be too long in children as it can increase crying, discomfort and ketosis. These guidelines are made according to the American Society of Anaesthesiologist's (ASA) Fasting Guidelines:-

Material ingested	Minimum fasting
Clear fluids	2hrs
Beast milk	4hrs
Formula milk	6hrs
Non human milk	6hrs
Solids	6hrs

- Fasting times apply to all ages
- Examples: for clear fluids are water, fruit juice without pulp, clear tea , coffee
- Fried food may prolong gastric emptying time. Both amount and type of food must be considered. The guidelines recommend no routine use of gastrointestinal stimulants, gastric acid secretion blockers or oral antacids.

2 2. Time of the last feed has to be decided according to the scheduled time of the surgery

2.21 Procedures scheduled in the morning list at 8am:-

- No solids after midnight
- Formula milk / non human milk allowed until 2am
- Breast milk allowed until 4am
- Clear fluids until 6am (water with glucose/ plain tea etc.)

2.2.2 Procedures scheduled in the afternoon list at 2pm:-

- Early light meal is allowed before 8am (a toast or few biscuits with clear fluid)
- Formula milk / non human milk after 8.00 a.m.
- Breast milk until 10am
- Clear fluid until 12 noon

3. Guidelines on peri-operative Fluid & Electrolyte management

3.1 Introduction

ECF volume has a key role to play in the maintenance of perfusion of vital organs in the peri operative period

Optimization of peri operative fluid balance therefore reduces the risk of peri operative morbidity and mortality in patients undergoing surgery

Guidelines provide an overview on the assessment of fluid status and directions for fluid therapy in the peri operative period

3.2 Aims of peri-operative fluid management

- To identify and replace fluid deficits
- To provide maintenance fluid requirements
- To identify and replace ongoing losses
- To prevent peri-operative fluid instability

3.3 Principles of peri- operative fluid management

- Assessment of peri-operative fluid status
- Fluid therapy to replace
 - Existing deficits (eg: ECF, blood)
 - Obligatory losses (eg: insensible losses via skin / respiratory tract, urine) (maintenance fluids)
 - Ongoing losses (eg: blood, intestinal fluids, evaporative and 3rd space losses)

* Ideally ALL deficits / losses should be replaced with fluids of **similar composition and volume**

3.4 Assessment of peri-operative fluid Status

3.4.1 Clinical assessment by monitoring-

- **vital signs** (heart rate, pulse volume, blood pressure)
Tachycardia, low pulse volume, low blood pressure & pulse pressure Suggest depletion of ECF volume
- **capillary refill time** of > 2 seconds suggests hypovolaemia
- **colour / warmth of extremities**
Cold, clammy & pale extremities

- **state of mucous membranes & elasticity of skin**
dry mucous membranes with loss of skin turgor
- **hourly urine output**
< 0.5 to 1.0 ml/kg/hour suggests hypovolaemia
- **period of fasting**
Period of fasting in excess of 6-8 hours may incur significant fluid deficits especially in extremes of age
- **trends in CVP**, if available: values to be interpreted in the light of underlying clinical setting

Investigations

- **urine:**
Specific gravity > 1.035
osmolality > 1200 mosm/kg
Urinary Na⁺ < 20 mmol/l

- **blood:**
Packed cell volume (PCV) > 45%

3.5 Fluid therapy in patients with no significant peri operative fluid deficit or loss

Majority of patients undergoing **minor, elective surgery** will not require fluid therapy in the peri operative period. Those undergoing prolonged surgery or having a delay in establishing oral feeds will require maintenance fluids.

- **Calculation of maintenance fluid volume:** 1 – 2 ml/kg/hour
- **Types of replacement fluids:** crystalloids - 0.9% saline, Hartmann's solution

* Maintenance fluid volume may need to be restricted in elderly and those with underlying severe cardio respiratory diseases

3.6. Fluid therapy in patients with significant peri operative fluid deficits

3.6.1 Fluid deficits due to prolonged fasting

These patients may or may not show any clinical evidence of their fluid deficits. However if they are to undergo prolonged surgery or any anticipated delay in establishing oral feeds, additional fluids are indicated to replace the deficits incurred as a result of prolonged fasting

3.6.2 Calculation of fluid volume deficit:

Maintenance fluids (1 – 2 ml/kg/hour) x
number of hours of fast

3.6.3 Types of replacement fluids:

Crystalloids - 0.9% saline, Hartmann's solution

3.6.4. Fluid deficits due to the loss of ECF / ICF fluids (dehydration)

The loss of ECF / ICF fluids over a period of time will give rise to various degrees of dehydration

eg: - losses from the GIT – vomitus, diarrhoea, nasogastric aspirate, via fistulae, fluids collected in the intestinal lumen

- losses from the body surfaces – evaporation of sweat etc. losses via kidneys – polyuria

3.7 Estimation of the Severity of Dehydration

Signs & Symptoms	mild dehydration	moderate dehydration	severe dehydration
thirst	may not be present	mild to moderate thirst	severe thirst
mucous membranes	may not appear dry	dry	cracked
skin elasticity	normal	reduced elasticity	markedly reduced elasticity
pulse volume	normal	normal / low	thready
heart rate	normal	slightly increased	markedly increased
respiratory rate	normal	increased	significantly increased
blood pressure	normal	normal / low	low
urine out put	normal ≥ 0.5 ml/kg/hour	reduced ≤ 0.5 ml/kg/hour	markedly reduced
central venous pressure (CVP)	normal	reduced	markedly reduced

3.7.1 Calculation of fluid volume deficit:

Degree of dehydration	Estimated fluid volume deficit (as a % of total body weight)
mild	4 % volume deficit calculation: 4 x body weight in kg x 10 mls
moderate	6 % volume deficit calculation: 6 x body weight in kg x 10 mls
severe	8 % volume deficit calculation: 8 x body weight in kg x 10 mls

3.7.2 Types of replacement fluids:

Crystalloids: 0.9% saline, Hartmann's solution

Colloids: gelatin, starch preparations colloids are preferred to crystalloids in those with **severe dehydration & underlying cardiovascular instability**

* In patients with **severe dehydration**, colloids (20 mls / kg) to be given initially to correct hypotension followed by crystalloids

3.7.3 Time frame for fluid replacement

50% of the calculated fluid deficit to be replaced with in the first hour of treatment. Half of the remaining fluids to be given over the next hour. Fluids left over to be given at a rate based on the volume status. Fluid therapy and the assessment of the volume status should go hand in hand to prevent over or under hydration.

3.7. Fluid deficits due to the loss of intravascular volume (blood)

Estimation of intra vascular volume deficit is difficult unless the losses are revealed. However the monitoring of clinical parameters and the results of relevant investigations shall guide the fluid therapy.

3.9 Estimation of Severity of Hypovolaemia:

Signs	20% blood loss	20-30% blood loss	More than 30% loss
Pallor	Present	Significant	Markedly pale
Level of consciousness	Oriented	Lethargy	Obtunded
Capillary refill	2 secs	2-4 secs	>4 secs
Pulse volume	Normal	Low volume	Thready
Pulse rate	Slight rise	Significant rise (>100/min)	Markedly tachycardic (>120)
Blood pressure	Normal	Slight reduction	Significantly reduced
CVP	Reduced	Reduced	Reduced
Respiratory rate	Normal	Tachypnoeic (20-30)	Significantly increased (>30)
Urine output	May be normal	<0.5ml/kg	Markedly reduced

3.9.1 Fluid therapy in hypovolaemic patients:

- Hypotension is treated with colloid 20ml/kg bolus
- Start Crystalloid using a large bore cannula.
- Rapid infusion is recommended in moderately and severely affected patients (up to 1.5-2 l)
- Blood is given when the blood is available or O Negative
- All fluids should be warm to prevent hypothermia
- Use other measures such as elevation of limbs
- Treat the cause

3.10 Fluid therapy in patients with on going fluid losses

- Fluid losses during surgery include the loss of blood, intestinal fluids apart from
- 3rd space and evaporative losses incurred during major surgery of body cavities.
- These losses need to be replaced with fluids of appropriate composition and volume to prevent cardio vascular instability

3.11 Fluid deficits due to loss of blood

Blood loss may be easy to estimate where it is revealed (eg: suction apparatus, blood soaked towels / swabs) but difficult when the loss is concealed (eg: blood in drapes / floor, pelvic & long bone fractures)

3.11.1 Estimation of revealed blood loss

- blood volume in *suction apparatus*
(volume of *irrigation fluids* / *intestinal fluids* in suction bottle to be noted)
- blood volume in *swabs* - fully soaked \approx 10 mls
- blood volume in *towels* - fully soaked \approx 100 mls

** *weighing* of swabs / towels
(more accurate than the visual estimation)
(soaked – dry = wt in gms = blood volume in mls)

3.11.2 Estimation of concealed blood loss

- extra 10% of volume to be added to account for the blood in drapes & on the floor
- 2 – 4L of extra volume to be added in pelvic fractures
- 0.5 – 1L of extra volume to be added in long bone fractures

3.11.3 Type / volume of fluids for replacement of blood loss

- **Blood loss of < 30% of the total blood volume**

Volume replacement depends on the **type of fluids** to be used

Replacement with crystalloids:

volume of *crystalloids* \Rightarrow 3 x blood volume lost
(0.9% saline, Hartman's solution)

Replacement with colloids:

volume of *colloids* \Rightarrow equal to the
volume of blood lost
(gelatin, starch preparations)

** Colloids are indicated when there is
a risk of volume overload with crystalloids

Replacement with blood:

- Blood is indicated to maintain Hb level above 6 g/dl, in patients with low pre operative Hb levels.
- In patients with ischaemic heart disease, recommended level of Hb in the peri operative period is \geq 10 g/dl
- **blood loss of > 30% of total blood volume**
- Blood loss is replaced with *colloids* of equal volumes until the blood is available
- Replacement with *blood* is indicated to maintain Hb above 6 g/dl, in healthy individuals
- Whole blood or packed cells may be used for this purpose

** 1 unit of packed cells \Rightarrow Hb \uparrow by 1 g / dl
PCV \uparrow by 2-3% in adults

3.12 Goals of therapy in hypovlaemia

The idea is to achieve an effective intravascular volume status,, normal left ventricular filling pressure, normal cardiac output and to achieve adequate O2 delivery.

- Improvement in level of consciousness
- Reduction in pulse rate is the first response to fluid
- Systolic blood pressure above 90 mmhg
- Normal urine output
- Hb% more than 8 with PCV 20-39%

3.13 Fluid deficits due to losses from GIT

3.13.1 Fluid deficits due to loss of NG fluids

Replace the deficit with equal volumes of Hartmann's or 0.9% saline

3.13.2 Fluid deficits due to loss of fluids into the intestinal lumen

Replace the deficit with isotonic fluids

3.13.3 Fluid deficits due to the evaporation from exposed surfaces

- **Estimation of evaporative losses**

Evaporative fluid loss μ surface area exposed
duration of exposure

Fluid loss is approximately 200-250 mls / hour with exposed body cavities.

Fluid deficits are replaced with 0.9% saline and 5% DW

- **Fluid deficits due to the 3rd space losses**

3rd space loss occurs with extensive tissue damage & inflammation.

Massive fluid shifts, from ICF & ECF into undefined 3rd spaces occur as a result.

Calculation of fluid loss due to *redistribution of body fluids* (3rd space losses)

3rd space fluid loss μ **extent of dissection / tissue injury, duration of surgery**

3rd space loss in relation to *degree of tissue injury*:

mild (hernia repair) \Rightarrow 0 - 2 mls /kg/ hour fluids

moderate (cholecystectomy) \Rightarrow 2 - 4 mls /kg/ hour fluids

severe (intestinal resection) \Rightarrow 5 -15 mls /kg/ hour fluids

Type of fluids for replacement of 3rd space losses

isotonic solutions

0.9% saline, Hartman's solution, colloids

into the **post operative period** to replace continuing deficits and losses.

Special attention to be paid in replacing fluids in the post operative period due to following reasons:

- Hormone mediated retention of fluids in response to surgery and trauma
- Redistribution of fluids lost into the 3rd spaces, back to intravascular compartment with the added risk of cardiovascular instability in susceptible individuals.

3.14.2 Assessment of adequacy of fluid replacement therapy in the peri operative period

- **vital signs**
heart rate, pulse volume, capillary refill time, BP
- **hourly UOP**
e" 0.5 to 1.0 ml/kg/hr
- **fluid input / output charts**
look for negative / positive balance
- **trends in CVP**
response to fluid challenges

4. Correction of electrolyte abnormalities

4.1 Potassium

Potassium should be corrected if the serum potassium is less than 3.5 mmol/l

$BW \times \text{Deficit} \times 1/5$. This is given over 2-4 hours in 250-500 ml of 5% Dextrose

4.2 Sodium –

Correction of sodium is more difficult than Potassium
Serum Na of <120 needs vigilant correction upto 130 mmol/l
 $BW \times \text{Deficit} \times 1/5$ is given at the rate of 1-2 mmol/hour
Hypertonic Saline or Sodium bicarbonate has to be used.

5. Fluid management in patients with Renal Failure

Introduction-

Renal failure is a condition with deranged fluid handling by the kidneys. The derangement with regard to fluids is based on the type (acute, chronic or acute on chronic renal failure) and the severity of underlying renal disease. Therefore due consideration should be given to the type and severity of renal failure in managing fluids in the peri-operative period

- Acute Renal failure is a condition with inability to excrete excess fluids via the kidneys with the risk of hypervolaemia. Therefore fluid restriction is required in such individuals until the patient recovers from the stage of acute renal failure. Fluid therapy in these patients should be guided by the volume status of the patient and the fluid lost from the patient over the preceding 24 hours.
- Patients with mild to moderate chronic renal failure do not have the ability to dilute or concentrate urine in states of over hydration or under hydration respectively and therefore run the risk of fluid retention and hypovolaemia in the peri-operative period. Therefore accurate fluid balancing is required in such patients guided by the volume status and the fluid input / output charts in the peri operative period to prevent the risk of over hydration and hypovolaemia.

Fluid management in the patients who are in end stage renal failure is solely dependent on the volume status of the patient which is in turn dependent on the efficiency of renal replacement therapy patient has had in the peri operative period.

6. Fluid management in Liver failure

6.1 Introduction

Liver failure is a multi systemic disorder with very high mortality. It could be primary or secondary as in sepsis or multi organ dysfunction. Usually the patients are hypovolaemic and hypoproteinaemic.

6.2 Treat the cause

6.3 Monitoring

- Non invasive : Pulse, BP, saturation, and ECG, temperature, urine output should be done
- Invasive : CVP, Intra-arterial BP, Cardiac output, Arterial blood gas should be done whenever possible

Investigations : Hb%, PCV, WBC/DC, Clotting screen, electrolytes, blood sugar, Blood urea etc should be done

6.4 Maintain euvolaemia

Use Normal Saline to maintain normovolaemia, preferably by checking the CVP. Correct sodium potassium, glucose and acid base status

6.5 Replace clotting factors

6.6 Prevent hepato-renal syndrome

Inotropes may be needed to maintain adequate blood pressure

