Perioperative Fluid Therapy

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TOTAL BODY WATER

* Approx. 60% Body weight
* Varies with age, gender and body habitus 50% BW in females
* 80% BW in infants
* Less in obese : fat contain little water

Body Water Compartments

* Intracellular volume : 2/3 of TBW
* Extracellular volume : 1/3 of TBW - Intravascular : Plasma volume (1/4) - Extravascular: Interstitial fluid and others(3/4)

Preoperative Evaluation of Fluid Status

* Mental status
* H/O intake and output
* Blood pressure: supine and standing
* Heart rate
* Skin turgor
* Urinary output
* CVP

Perioperative fluid strategy

* Compensatory intravascular volume expansion
* Deficits
* Maintenance
* Blood loss

* Compensatory intravascular volume expansion-
* Intravascular fluid vol must usually be supplemented to compensate for venodilation and cardiac depression caused by anesthesia(normally, 5-7ml/kg of balanced salt solution is used)

* Deficits:
* Preop npo (hrly maintenance x duration)
* Preop blood loss (trauma) or fluid loss(burns) Typically replaced over 1st 2-4 hrs

* Maintenance:
* (4-2-1 rule)
* 4ml/kg/hr for 1st 10kg of body wt
* 2ml/kg/hr for 2nd 10kg of body wt
* 1ml/kg/hr for each kg of b wt above 20kg
* Based on water loss from burning calories- from Holiday and Segar

Replacing Third Space Losses

* Refers to fluid losses into spaces that are not visible such as bowel lumen or retroperitoneum.
* Superficial surgery: 1-2ml/kg/hr
* Surgeries like hysterectomy, hernia, head neck surgery, knee surgery where third space loss is not significant, 4-5 ml/kg/hr fluid should be given
* Major surgery: 8-10 ml/kg/hr (or more) - AAA repair, nehprectomy

* Replace blood loss:
* 2-10ml/kg/hr
* 3:1 of crystalloid
* 1:1 of blood or colloid

Crystalloids

* Clear fluids made up of water and electrolyte solutions;
* Will cross a semi-permeable membrane Grouped as isotonic, hypertonic, and hypotonic
* Normal saline 0.9%,3 %
* Dextrose solutions 5 %,10%,20%,25%
* DNS
* Ringer's lactate
* Isolyte P

Colloids

* The colloid solutions contain particles which do not readily cross semi-permeable membranes such as the capillary membrane.
* Thus the volume infused stays (initially) almost entirely within the intravascular space .
* Stay intravascular for a prolonged period compared to crystalloids.
* However they leak out of the intravascular space when the capillary permeability significantly changes e.g. Severe trauma or sepsis. and interfere with fibrinolysis and coagulation factors (factor VIII) – thus they can cause significant coagulopathy in large volumes.
* Natural : Albumin
* Artificial : GeBecause of their gelatinous properties they cause platelet dysfunction gelatin and Dextran , HES

Balanced salt Solutions

* Are made to physiological pH.
* Contains Na, K, Cl, Mg, Ca and acetate as a buffer instead of lactate.
* Kabilyte is an example.

0.9% Normal Saline

* Contains: Na+ 154 mmol/l, Cl- - 154 mmol/l
* Osm : 308mosm/l, pH 6.0
* IsoOsmolar compared to normal plasma.
* Indication : Intravascular resuscitation and replacement of salt loss e.g. diarrhoea and vomiting.
* Also for diluting packed RBCs prior to transfusion
* Used for diluting Drugs
* Complications: When given in large volume can produces Hyperchloremic metabolic acidosis because of high Na+ and Cl- content

Ringer Lactate

* Most physiological solution
* Electrolyte composition similar to ECF
* One litre of lactated Ringer's solution contains: Sodium ion= 130 mmol/L. Chloride ion = 109 mmol/L.
* Lactate = 28 mmol/L.
* Potassium ion = 4 mmol/L.
* Calcium ion = 1.5 mmol/L
* Osmolarity of 273 , pH of 6.5

* Lactate is converted to bicarbonate in liver
  Indications : Deficit ,Intraoperative fluid loss Severe hypovolemia
* Precautions: Severe metabolic acidosis (impaired lactate conversion)
*

DNS

* 0.9% saline & 5% dextrose
* Na+ 154, Cl- 154, 5 gm. Glucose
* Osm : 432 mosm/L
* Indication : Maintenance solution Correction of fluid deficit with supply of energy
*

ALBUMIN

* Principal natural colloid comprising of 50-60% of all plasma proteins.
* Synthesized only in liver and has a half life of app. 20 days.
* Used For emergency treatment of shock especially due to loss of plasma,
* acute management of burns
* fluid resuscitation in ICU
* Hypoalbumineamia.
* Side effects : pruritis, anaphylactoid reactions and coagulation abnormalities as compared to synthetic colloids.
* Disadvantages cost effectiveness , volume overload (in septic shock pt albumin add to interstitial edema)

DEXTRAN

* Highly branched polysaccharide molecules Produced by synthesis using the bacterial enzyme dextran sucrase from the bacterium Leuconostoc mesenteroids.
* Most widely used are 6%(dextran 70) and 10%(dextran 40) soln.
* Excreted via kidney primarily.
* Both lead to a higher vol expansion as compared to HES and 5% albumin.
* Used mainly to improve microcirculatory flow in microsurgical re-implantation .
* Also used in extracorporeal circulation during cardiopulmnary bypass.
* Side effects: Anaphylactic reactions, Coagulation abn, Interference with cross match, Ppt of ARF.

GELATINS

* Large mol. wt. proteins formed from hydrolysis of collagen. Produced by thermal degradation of cattle-bone gelatin.
* Indication : Rapid expansion of intravascular volume and correction of hypotension Advantage : cost effectiveness and no effect of renal impairment ,does not affect coagulation
* Disadvantage : Hypersenstivity Anaphylactoid reactions

STARCHES

* HYDROXYETHYL STARCHES Derivatives of amylopectin, which is a highly branched compound of starch. Advantage Cost effective: cheaper and comparable vol of expansion to albumin.
* Disadvantage: assoc. with 1st & 2nd generation HES - Coagulation abn - Accumulation - Anaphylactoid reactions - Renal impairment - Increase in amylase level
* TETRASTARCH:3RD GEN. HES Newer starch based plasma expander . Minimal effect on coagulation process and platelet function , Less accumulation and tissue storage , No effects on renal function

Colloid or Crystalloid Resuscitation Recommendations:

* Colloid should NOT be used as the sole fluid replacement in resuscitation ,volumes infused should be limited because of side effects and lack of evidence for their continued use in the acutely ill.
* In severely ill patients – principally use crystalloid and blood products;
* Colloid may be used in limited volume to reduce volume of fluids required or until blood products are available.
* In elective surgical patients Replace fluid loss with 'physiological Ringer's solutions. Blood products and colloid may be needed to replace intravascular volume acutely

Risk of Excess fluids

* Interstitial edema
* Impaired cellular metabolism
* Poor wound healing
* Decreased pulmonary compliance
* Heart failure-overload
* Delayed return of bowel function Hemodilution

Fasting guidelines in Paediatric patients

* Children should not be starved for prolonged periods before
  surgery, and oral fluids should be given wherever possible
* type of food/fluid — minimum fasting time
  clear liquids — 2hr
  Breast milk — 4hr
  Infant formula — 4 (<3 months old)
  6 (> 3 months old)
  Non-human milk/ Light meal — 6
* Maintenance Fluid is calculated by 4-2-1 rule

* he majority of healthy children undergoing minor surgery will re-establish oral intake in the early postoperative phase
  and will not need routine intravenous fluids.
  • Hypovolaemia should be corrected by rapid infusion of isotonic fluid while dehydration is corrected more slowly over 14-72 hours as appropriate. Ongoing losses should be measured and replaced
* During surgery the majority of children over 1 month of age will maintain a normal blood glucose if isotonic, non-dextrose containing fluids are given.