Fluid Therapy in Clinical Practice Pitfalls and Practical Guidelines

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ABSTRACT

Published on 29th March 2010

The correct knowledge about fluid balance is needed to understand the various disorders of fluid balance. A calculated and rationale approach to fluid infusion helps to make an accurate correction of fluid and electrolyte imbalance and saves many untoward situations. This article examines the various disorders in fluid balance and details the method of correction of the resultant defects.

Keywords: Fluid therapy, Dehydration, Over hydration, Electrolyte disorders.

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A calculated and rationale approach to fluid infusion helps to make an accurate correction of fluid and electrolyte imbalance and saves many untoward situations. In clinical practice, commonly encountered consequences in fluid therapy are due to any of the situations like: too rapid an infusion, inadequate fluid infusion, excessive fluid infusion, or a flow rate that is too slow or a wrong fluid pertaining to that situation. The common guidelines to regulate the rate of infusion are based on the following formulae;

15 drops =1 ml,
60 micro drops =1ml
Micro drop rate / minute=IV Infusion in ml/hour
Maximum rate of infusion = 500 ml/ hour
Drop rate per minute/10=IV Infusion in litre /day
Drop rate per minute X 4=IV Infusion volume in ml/ hour.

Too rapid a flow rate can result in conditions like pulmonary edema, Acute Bronchospasm, Cardiac Failure, Cardiac arrest, Hyperpyrexia and Delirium secondary to hyperpyrexia. However if the infusion is running too slow inadequate correction and persistence and prolongation of the basic disorder will continue. Review of the clinical status is hence mandatory.

Daily Fluid Balance

- Insensible fluid loss
  skin—500 ml
  lungs—400 ml
  stool—100 ml
  Total 1000ml
- Insensible fluid Input
  due to oxidation—300 ml
  Fluid loss(1000)— Fluid input(700)=700ml
  Daily Fluid Requirement : Measurable loss (Urine) +700 ml.
  Sodium and Potassium
  Sodium: 60 to 150 mEq/day
  6 Gr.NaCl/day
  Potassium: 40 to 60 mEq/ day
  2 gm.KCl /day

Glucose requirement / Day

- 100 grams of Dextrose per day
- It is necessary to:
  - Provides Calories
  - Prevent breakdown of endogenous protein and catabolism
  - Prevent depletion of Glycogen
  - Brain and RBCs need it for calories

2 The basic guidelines in the assessment of the desired volume are:

Loss of weight, if known, reflects the fluid deficit

- ECF deficit=0.2X lean body wt.X
  Current Haematocrit -1
  Normal Haemotocrit

Effective rate of replacement per hour=

- 50 to 200 ml+Urine output /hour
  + ongoing loss/hour
  (diarrhoea or RT drainage/hour)

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An excessive fluid infusion will result in circulatory overload, pulmonary edema, cellular dehydration, rise in intracranial tension and based on the distortion in osmolality, CNS demyelination may also occur. Too inadequate a fluid volume will proceed to further deterioration of the clinical status due to multiple imbalances in the electrolyte and acid-base level. When we plan for an infusion, what is the strategy?

- Maintenance of optimum body water
- Maintenance of the Electrolytes
- Supply of adequate calories

Table 1. Distribution of IV Fluids in body fluid compartments

Fluid distribution of 1000 ml	Intra vascular	Interstitial	ICC
5% Dextrose	83	250	666
Isotonic Saline 0.9 %	300	700	Nil
Colloids/Blood trans.	100	Nil	Nil

While evaluating and planning for fluid infusion, history of the case is most important. In a case of Vomiting or gastric outlet obstruction, Hypokalemia, Hypovolemia, Metabolic Alkalosis, Hyponatremia, and calorie deficit are the common sequalae. While in a case of Diarrhea— loss of water, sodium, potassium and acidosis are the possibilities. The symport-antiport mechanism operates to overcome the excess loss of Bicarbonate in exchange of Chloride from the gastric lumen as well as the chloride retention through the ileal and jejunal brush boarders which explains the acidosis.

In conditions like burns, loss of water, will be maximum with marked protein and sodium loss. But potassium being an intracellular cation, as in any tissue damage, comes out of the ICF compartment, elevating the serum potassium level.

Water and electrolyte loss will be of varying grade, in sweating and depends on the cause, extend of heat exposure, or exercise and duration, with moderate to severe sodium and water loss. In extreme and prolonged situations, shock also may result.

Water and electrolyte loss in an unmonitored diuretic therapy can result in Severe dehydration. The water loss depends on the potency of the diuretic. Sodium loss, most of the time will be a common feature, with potassium status varying, depending on the nature and site of action of the diuretic. Acetazolamide has influence on bicarbonate level, but ACE Inhibitors' specific influence is on the serum potassium level.

The extend and nature of the deficiency of fluids, and electrolytes contributes very much to the clinical picture.

- Thirst, dry tongue, low skin turgidity, restlessness, cold, clamy extremities, all reflect hypovolemia and generalized fluid loss.
- Low blood pressure, rapid pulse rate and tachycardia-suggest decreased circulatory (isotonic) volume which can be an impending feature of circulatory failure .

At this juncture, the urine flow rate gives a true reflection of tissue perfusion and hydration. Whereas a patient with: edema, basal rales and weight gain indicates water retention.

The common situations of hypovolemia requiring immediate correction are: Severe diarrhea ,vomiting, renal disorders, diuretics, burns, and high grade fevers and the clinical scenario most often consist of thirst, concentrated urine, dizziness, weakness, oliguria, postural hypotension, confusion, stupor, tachycardia, rapid thin thready pulse, cold extremities and reduced skin turgor.

Assessment of the situation and calculation of the requirement in done by the formulae discussed previously. In a case of hypovolemia and minimal hypotension the fluid of choice is Isotonic saline, since it has osmolality identical with the plasma and 30% of the infused fluid remains in the intravascular compartment, and is ideal for volume expansion in mild to moderate hypovolemia, with impending danger of shock.

In a situation where hypovolemia is coexisting with hypoalbuminemia of a chronic nature, colloids are better preferred, since the full volume of the infusate remains in intravascular compartment and three to four multiples of the infusate volume is also drawn in. Additional advantage is the extra fluid drawn in, stabilizes the blood pressure and also brings about an osmotic diuresis.

While considering the rate of replacement, the primary aim is to get the patient out of danger and induce a positive balance. While infusing, the factors to be monitored areweight, skin turger, sensorium, urine output, pulse rate, blood pressure, haematocrit, blood urea, serum creatinine, urinary sodium, CVP or PAWP

Some common Conditions and Management Strategies

Fluid and Electrolyte Imbalance due to vomiting

- Hypovolumia
- Hypokalemia

- Dehydration
- Hypochloremia
- Metabolic Alkalosis (HCO3 absorption in proximal Tubules
- >Metabolic Alkalosis,

Paradoxical Aciduria
Sodium loss results in Aldosterone
Secretion, Na Exchange for potassium leading to Hypokalemia.
Increased H Secretion in exchange of potassium for its conservation leads on to Paradoxical Aciduria

Fluid of choice
- Isolyte G.
- Specific fluid for replacement of upper GIloss
- Ammonia 70 mEq/L; Cl- 154 Eq/L;
- K+ 17mEq/ L;Na+ 63mEq/L;
- Corrects metabolic alkalosis by directly providing H+ion

With Isotonic Saline(0.9% Saline)
- Volume correction
- Decreases aldosterone secretion
- Corrects metabolic alkalosis
- Prevents hypokalemia
- Corrects Hypochlorermia

Diarrhea-
- Evolution of clinical Scenario
- Isotonic dehydration,
- Hypovolumia
- Sodium Deficit,

(Hypertonic Dehydration, when water loss is in excess than sodium loss)

Diarrhea; Extreme Scenario
- Metabolic Acidosis
- Hypokalemia
- Hyperchloremia

Fluid of choice

- RINGER LACTATE, It contains:
- Adequate Sodium
- Adequate Bicarbonete
- Drawbacks: Inadequate Calories
  Inadequate potassium
  Isotonic Saline
- Correctshypovolumia
- Provides Sodium and water
- Patient may require additional:
- Potassium to correct hypokalemia
- NaHCO3 to correct Metabolic acidosis Vomiting and Diorrhea, Coexisting
- Normal Saline with necessary Potassium supplementation

Fluid of choice in Shock
- Isotonic Saline :
  Before Urine Output is established
- Ringer Lactate :
  After Urine output is established

Treatment Strategy in :
Hypovolemic Hyponatremia
Treatment: Salt and water Supplementation

Hyponatremia with edema Treatment
- Salt restriction
- Water restriction
- Loop Diuretics

Normovolemic Hyponatremia
Treatment: Water Restriction

Commonly used fluid for raising BP
- Albumin
- Haemaccel
- Hetastarch
- Lomodex

More effective Volume Expansion
Less Risk of Pulmonary Edema

When to use Blood?
- Continuous Bleeding
- Marked Anemia
- Haematocrit should not be raised above35%;

The increased viscositylead to stasis in capillaries, and further consequences

5% DEXTROSE is not ideal in volume/ BP correction
- Poor Expansion of IV Volume
  1000ml will raise:
  ECF volume— only by 330 ml
  Intra Vascular volume by 83ml.
  (What remains in the circulation)
- Increased Urine output by osmotic Diuresis by 25 gr. Of glucose in 5% Dextrose
  Hepatic Encephalopathy
- IV Fluid preferred is:
  - 20% Dextrose and
  - 10% Dextrose

(Impaired Glucose Production in Liver cell failure)

- Hypokalemia to be corrected by oral or parenteral potassium supplementation

In Hepatic Encephalopathy-Avoid:

- 5% Dextrose - it is hypotonic
- Ringer lactate-as it can lead to
- Alkalosis
- Lactic Acidosis

In Acute Pancreatitis

- Prevent Hypotension and Renal Failure
- Protect Microcirculation
- Fluid requirement :
- Upto 5 to 10 litres
- Isotonic Saline
- Colloid Solutions: if Serum Albumin Falls below 2 Gr.%
- Hemorrhagic Pancreatitis
- Packed cells
- Blood Transfusion
- Maintain Hematocrit at around 30%

END NOTE

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Conflict of Interest: None declared

Cite this article as: Jose John Kokat. Fluid Therapy in Clinical Practice Pitfalls and Practical Guidelines. Kerala Medical Journal. 2010 Mar 29;3(1):28-31

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