IV Fluids And Acid Base Disorder

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Body fluid compartments:

- Water:
  - constitute 50-70% of lean body weight depending on age and gender (80% in newborn babies, which they lose after one week).
  - Total body water content is higher in men.
  - Concentrated in skeletal muscles
  - Declines steadily with age
- Intracellular fluids constitutes 40% of body weight.
- Extracellular fluids constitutes 20% of body weight and formed of
  - Plasma or intravascular compartment: 5%, e.g. for a 70kg adult male, 3.5kg is plasma.
  - Interstitial compartment 15% .
- Na+ is the principal extracellular cation .
- Cl-and HCO3 are the principal extracellular anions .
- K+ and Mg+2 are the principal intracellular anions.
- Phosphates and negatively charged proteins are the principal intracellular anions .
- Osmolality is concerned with the concentration of electrolytes in fluid.
- Fluid balance is achieved by:
  - daily requirement.
  - replacement of ongoing loss
  - correction of abnormalities

Types of I.V fluids:

A-Crystalloids (محلول مائي)
B-Colloids (has blood or blood products)

Crystalloids

- Crystalloids are aqueous solutions of mineral salts or other water soluble molecules.

A. **Ringer's Lactate (Ringer's Acetate)**: (Isotonic)
   - often used for large volume fluid replacement.
   - conains:
     - ✓ Dixtrose
     - ✓ Lactate
     - ✓ Na with concentration=130 m.mol/L
     - ✓ Cl with concentration=109 m.mol/L
     - ✓ Ca with concentration= 2 m.mol/L
     - ✓ K with concentration= 4 m.mol/L

B. Saline:

- Normal saline: (Isotonic) contains: "most commonly used"
  - ✓ Na with concentration =154 m.mol/L.
  - ✓ Cl with concentration= 154 m.mol/L.

NOTE:
- ✓ Concentration of NaCl= 0.9
- ✓ there is no potassium (k).

- 1/2 Normal saline: (hypotonic) it means it has half of the NaCl concentration in the normal saline.
  - ✓ Na concentration= 75-77 m.mol/L.
  - ✓ Cl concentration= 75-77 nm.mol/L.

- 1/4 Normal saline

C. **Regular water with no salt.**

D. **Some hypertonic solutions:**
that have NaCl concentration= 4, 5, 7 > 0.9 (not usually used, but can be used in cases of hyponatremia for example for rapid correction)

Colloids:

(have high oncotic pressure)

- colloids contain larger insoluble molecule such as
  - ✓ gelatin
  - ✓ fresh frozen plasma
  - ✓ blood
  - ✓ packed RBCs
  - ✓ Albumin
  - ✓ Coagulation factors

- When patient loses blood:

  - When giving him Crystalloide we should give 3 times the normal amount he lost because only 1/3 of what we give goes into the intravascular compartment and 2/3 is extravascular, but if we give him more than x3 his blood will be diluted.
  - When giving him Colloids we give the same amount lost (1:1) (but we don't always give blood because of the blood borne infections).

NOTE:
- ✓ we give I.V fluids to pre-operation patients because they are NPO (Nell Per Oss) so we have to give them something since they cant eat so they won't go into a shock.
- ✓ the choice of fluid may also depend on the chemical properties of the medications being given.

- We measure the amount of I.V. fluid intake depending on weight as the following:

  - for giving the daily requirement of fluid (that keeps us alive and doing our daily activities) there are three ways:

1)Give:
- ✓ 35 cc/kg/**day** (the easiest way)

2)Give:
- ✓ for the first 10 kg.s → 100 cc/kg/**day**
- ✓ for the second 10 kg.s → 50 cc/kg/**day**
- ✓ for each kg. after that → 10 cc/kg/**day**

3)Give:
- ✓ for the first 10 kg.s → 4 cc/kg/**hour**
- ✓ for the second 10 kg.s → 2 cc/kg/**hour**
- ✓ for each kg. after that → 1 cc/kg/**hour**

for example:
a patient weighing 70 kg.s we give:
- ✓ for first 10 kg.s → 40 cc.
- ✓ for second 10 kg.s → 20 cc.
- ✓ for the remaining 5o kg.s → 50 cc.

So we give total of (40+20+50)= 110 cc./hour.

NOTE:
the daily requirement differs from a person to another
for e.g: a working or resting so we to compensate for other losses like sweating

Volume disorders :

1-Hypervolemia :

❖ Causes:

1-Parenteral overhydration: Iatrogenic(from doctors):
most common cause. Mistake by doctor in giving an overload of IV fluid.

2-cardiac failure:
because In these patients the heart is not pumping well so when we give fluids the fluid goes to the interstial space (edema) and we think the patient isn't resuscitated yet.

3-renal failure:
because there is no urine output and when we see that there is no output, we give more fluid thinking that he hasn't been resuscitated yet while the problem is not in the resuscitation but in kidney function.

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❖ Clinical findings:

- ✓ weight gain
- ✓ pedal, sacral or pulmonary edema.
- ✓ modest elevation of central venous pressure (CVP)
- ✓ Chest x-ray findings.

❖ Treatmet:

- ✓ water restriction.
- ✓ diuretics.
- ✓ sodium restriction.

2-Hypovolemia :

❖ Four types:

- ✓ Mild: 4% loss of TBW, 15% of blood .
- ✓ Moderate: 6% TBW, 15-30% of blood .
- ✓ Severe: 8% TBW, 30-45% of blood .
- ✓ Shock: > 8% TBW, >45% of blood .

❖ Signs and Symptoms:

- ✓ Mental status changes.
- ✓ tachycardia
- ✓ dryness of tissue, e.g: skin, tongue.

- Management of nonacute (elective) cases: (not in emergencies)

- replacement of ongoing loss (fluid turnover):
  - ✓ GIT (including vomiting and diarrhea): 6000-9000 cc/day = 6-9 L/day. (but not all are lost because a lot is reabsorbed again).
  - ✓ Renal: 1000-1500 cc/day = 0.5-1 cc/kg/hour = normal urine output.
  - ✓ Insensible loss (sweating, breathing ..etc): 600-800 cc/day.
- Basal requirement:
  the ways that were mentioned earlier.
- fluid deficit, e.g gastroenteritis.

- Management of acute conditions (shock) in hypovolemia:

NOTE:
in case of emergencies we don't calculate by weight like what was previously mentioned)

1-we start by giving two liters of normal saline (we always start with normal slaine orRinger's lactate (both are isotonic) through an IV line in each arm, squeeze it right away to raise the pressure as soon as possible.

- ✓ don't use 1/2 normal saline because it's hypotonic.

2- If there is no significant response, give another two liters until the pressure and heart rate approach normal.
3- If that still didn't work switch to giving two units of blood prducts i.e. colloids. (each unit of packed RBCs= 300-400 cc.)
4- we give again 2 liters of normal saline if patient still didn't get better.
5- If still didn't get better we continue alternating between crystalloids and colloids.

- start to calculate for maintenance.
- sometimes it may lead to overload, which is treated by furosemide (lasix).
- The central line (into internal jugular vein, subclavian or femoral artery, about 17cm line) is preferred because it is more stable then the peripheral one.
- The amount of body fluid lost is replaced by ratio 3:1 by crystalloids but in ratio 1:1 by colloids.
- in children's case, give 20 cc/kg instead of a total two liters.

NOTE:
the best indication of rehydration is evaluation of urine output.☝

Acid-Base balance : (ما ذكرهم الدكتور في المحاضرة)

- ✓ . Enzymatic balance.
- ✓ Three primary systems:

1.Buffer system: RBCs, proteins, phosphate.
2.Respiratory system .
3.Renal system .

Metabolic acidosis :

- ✓ . Overproduction or underexcretion of acid.
- ✓ . Anion gap = Na+ - (Cl- + HCO3).
- ✓ Normal anion gap (RTA,diarrhea).
- ✓ Wide anion gap (DKA, RF,toxins).

Electrolyte disorders

A. Hyponatremia :

❖ Three types:

1) Hypotonic:
   - ✓ Hypovolemic: Loss of isotonic fluids or replacement with inadequate volume of excessively hypotonic fluids.
   - ✓ Hypervolemic: Fluid retaining .
   - ✓ Isovolemic: SIADH (Syndrome of inappropriate ADH secretion).
2) Isotonic:
   - ✓ Pseudohyponatremia.
3) Hypertonic:
   - ✓ through non-sodium osmotic substances. e.g.100 mg/dl glucose increases serum Na+ concentration by 3 meq/L.

❖ Clinical features:

- ✓ Extra salivation and lacrimation.
- ✓ confudion nausea, vomiting, headache and malaise.
- ✓ and diminished reflexes
- ✓ convulsions, stupor or coma.

❖ Treatment :

- ✓ . Underlying disorder .
- ✓ Water restriction .
- ✓ Loop diuretics .
- ✓ Rate of infusion .

NOTE:

- ✓ do not correct hyponatremia quickly because this may lead to central demyelination (also central pontile myelinolysis). ☝

B-**Hypernatremia :**

Water loss greater than salt loss .

- ❖ Three types:

1.Hypovolemic:

- ✓ for every liter of water deficit, serum Na raises 3 meq above the normal value of 140 mEq/L.

2.Isovolemic:

- ✓ Diabetes insipidus .

3.Hypervolemic:

- ✓ iatrogenic, endocrine.

- ❖ Clinical features:
  - ✓ dryness and thick oral mucosa
  - ✓ lethargy, weakness, irritability, and edema.
  - ✓ seizures and coma.

- ❖ Treatment :
  - ✓ Underlying disorder.
  - ✓ Modest water deficit is treated orally or by IV 5% dextrose in water.
  - ✓ mEq change in serum Na = TBW x (140-serum Na)
  - ✓ TBW= 0.6 x body weight per kg.
  - ✓ Water deficit=(0.6 x kg weight) (serum Na+/140-1).
  - ✓ Slow replacement because rapid replacement my lead to osmotic shifts, which can produce cellular edema that may affect the brain i.e. causing cerebral edema. ☝

C-**Hypokalemia :**

- ❖ Normal Serum potassium level = 3.5 - 5 mEq/L.

- ❖ Causes:

1.Redistributional :shifts fom extracellular to intracellular compartments, e.g. insulin administration, alkalosis.

2.Depletion by: GI loss, renal loss.

3. decrease in the uptake of food with potassium.

4. not giving enough supply of potassium.

- ❖ Clinical features

(rarely significant until serum potassium decreases to less than 3 mEq/L):

- ✓ ECG changes:

1- inverted T-wave

2- wide QRS-complex

- ✓ weakness, fatigue
- ✓ paralytic ileus and abdominal destention.☝

- Treatment :
  - ✓ Adequate renal function .
  - ✓ Enteral replacement .
  - ✓ Parenteral replacement .
  - ✓ Treat alkalosis.

Hyperkalemia:

- A serum potassium level is greater than 5 mEq/L. It is much more dangerous than hypokalemia.
- Causes:
  1)Redistributional: acidosis, tissue necrosis.
  2)Renal failure, excessive intake, spironolactone (because will cause accumulation of K+ in body).
  3)excessive intake.
  4)Drugs, e.g. spironolactone.
- Leukocytosis, hemolysis, thrombocytosis.
- Clinical features:
  - ✓ Nausea, vomiting, diarrhea , colic.
  - ✓ ECG changes:
    1-peaked T-wave
    2-narrow QRS-complex .
  - ✓ Cardiac arrest.
- Treatment :
  - ✓ Remove exogenous source and stop ongoing K+ IV.
  - ✓ If serum level is > 7.5 mEq/L., it's an emergency, which is treated by:

1-Calcium gluconate (to protect the heart, by blocking muscle fibers but doesn't effect K+ levels)
2-Insulin with glucose 50% (D50W), insulin causes entry of K+ with glucose into the cells
3-loop diuretics (lasix).
4-put the patient on a heart monitor and call a nephrologists for an emergency heamodialysis (cause usually these patients have renal failure).

Done By Surgery Queens