Intravenous Fluid Therapy

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Why use intravenousous fluids?

- If the gut works use it!
- Think about why you are ordering IVF.
  - NPO.
  - Significant volume deficit.
  - On going losses.
  - Specific goal to fluid therapy. (e.g. hydration prior to contrast dye.)
- Consider appropriateness of IVF daily in each patient.
- Do not use IVF if they are unnecessary. There are potential complications:
  - Fluid overload.
  - Dangerous electrolyte derangements.
  - Line infections.
Distribution of Total Body Water

- Total Body Water (TBW):
  - Wt (Kg) x .6 (m) .5 (f) = TBW in liters.
  - 70 x .6 = 42 L

- Next, consider the different fluid compartments within the body.
  - “2/3, 1/3” rule.
Fluid Compartments

TBW

- Intracellular Fluid
  - 2/3 of TBW

- Extracellular Fluid
  - 1/3 of TBW

  - Interstitial Fluid
    - 2/3 of ECF

  - Intravascular Fluid
    - 1/3 of ECF
Fluid Compartments

- 70 kg male:
  - TBW = 42 L
  - Intracellular volume = 0.66 x 42 = 28 L
  - Extracellular volume = 0.34 x 42 = 14 L
    - Interstitial volume = 0.66 x 14 = 9 L
    - Intravascular volume = 0.34 x 14 = 5 L
Fluid Compartments

TBW 42 L

Intracellular Fluid
2/3 of TBW
28 L

Extracellular Fluid
1/3 of TBW
14 L

Interstitial Fluid
2/3 of ECF
9 L

Intravascular Fluid
1/3 of ECF
5 L
Fluid Requirements

- Normal adult requires approximately 35cc/kg/d.
  - IBW = 50 (m) 45.5 (f) + (2.3 per in. > 5 ft.)

- This assumes normal fluid loss.
  - Urine
  - Stool
  - Insensible

- Watch I/O carefully and be aware of other losses.
  - Fever increases insensible loss by 200cc/day for each degree (C).
  - Monitor abnormal GI loss e.g. NGT suctioning.
“4,2,1” Rule
- First 10 kg = 4cc/kg/hr
- Second 10 kg = 2cc/kg/hr
- 1cc/kg/hr thereafter

In adults remember IVF rate = wt (kg) + 40.
- 70 + 40 = 110cc/hr
- Assumes no significant renal or cardiac disease and NPO.

This is the maintenance IVF rate, it must be adjusted for any dehydration or ongoing fluid loss.

Conversely, if the pt is taking some PO, the IVF rate must be decreased accordingly.

Daily lytes, BUN, Cr, I/O, and if possible, weight should be monitored in patients receiving significant IVF.
Electrolyte Requirements

- Na: 1-3 meq/kg/day
- 70 kg male requires 70-210 meq NaCl, 2600 cc fluid per day.
- 0.45% saline contains 77 meq NaCl per liter.
  - $2.6 \times 77 = 200$ meq
- Thus, 0.45% saline is usually used as MIVF assuming no other volume or electrolyte issues.
Electrolyte Requirements

- Potassium: 1 meq/kg/day
- K can be added to IV fluids. Remember this increases osm load.
- 20 meq/L is a common IVF additive.
  - This will supply basal needs in most pts who are NPO.
- If significantly hypokalemic, order separate K supplementation.
  - Oral potassium supplementation is always preferred when feasible.
Intravenous Fluids

- **0.9 % Saline**
  - Na: 154  Cl: 154  Osm: 308

- **0.45 % Saline**
  - Na: 77  Cl: 77  Osm: 154

- **LR**

- **D5**
  - Adds 50 gm glucose per liter, 170 kcal, 250 Osm

- **3 % Saline**
  - Na: 512  Cl: 512  Osm: 1024
Which fluid to Choose?

1: What is your goal for therapy?
- Maintenance
- Rehydration
- Volume resuscitation

2: Any baseline electrolyte abnormalities?
- ALWAYS look at basic chemistry prior to ordering fluids.

3: Where is the fluid going to go?
Which Fluid to Choose?

- **Hypovolemia**: primary goal is volume expansion.
  - Use the fluid that will put the most volume into the intravascular space. NS or LR.

- **Dehydration (= hyperosmolality)**: primary goal is free water replacement. Note that this is not synonymous with hypovolemia.
  - Use a hypotonic fluid usually 0.45% saline or D5W.
Which Fluid to Choose?

Post-operative patients:

- Pain and narcotics can be powerful stimulants of inappropriate ADH secretion (SIADH).
- Giving hypotonic fluids in this setting can (but usually does not) cause dangerous hyponatremia.
- This makes 0.9% saline a safer fluid but realize that it will also deliver free water in the setting of SIADH. (stay tuned for a future lecture)
Why NS for volume expansion?

- How much volume expansion per liter of fluid.

- Concepts:
  - Free water is distributed evenly throughout the TBW “compartment”
  - Essentially 100% of sodium if confined to the extracellular space
  - Normal saline contains essentially no free water.
Remember where the fluids you are ordering are going

- TBW
  - Intracellular Fluid: 2/3 of TBW
  - Extracellular Fluid: 1/3 of TBW
    - Interstitial Fluid: 2/3 of ECF
    - Intravascular Fluid: 1/3 of ECF
1000cc D5W:

- 2/3 to intracellular space = 660cc
- 1/3 to extracellular space = 330cc
  - 2/3 to interstitial space = 220cc
  - 1/3 to intravascular space = 110cc
- 110/1000 = 11 %
1000 cc 0.45% saline

- 500 cc free water throughout TBW
  - 55 cc intravascular space
- 500 cc to ECV
  - 2/3 to interstitial space = 330 cc
  - 1/3 to intravascular space = 170 cc
- 225 cc into the intravascular space
1000 cc 0.9% saline:

- Essentially all confined to extracellular compartment
- 2/3 to interstitial space = 660 cc
- 1/3 to intravascular space = 340 cc
- Approximately 33 %
Examples

35 y/o female NPO for elective lap chole. Afebrile HR 72 BP 120/80 Wt 85 kg. Na 140 K 4.0. Fluid Orders:

- D5 0.45% saline with 20meq KCl @ 125 cc/hr.
Examples

- 40 y/o with idiopathic cardiomyopathy. EF = 15%. Crackles ½ up both lung fields to auscultation and 3+ edema of both lower extremities, JVP elevated. Na: 130, K: 5.1, Cr: 2.3. IVF?

- This pt is both water (hyponatremia) and salt (edema) overloaded and will require diuresis.

- Heparin lock.
55 y/o male. In ED for fever and rigors. T 39.0, HR 120, BP 70/40 RR 35 WBC: 25,000; UA: 500 WBC/hpf, many bacteria.

Fluid orders:

- 0.9% saline wide open.
- This means a bag of saline in a pressure device through a large bore iv, probably two in this case.
- Reassess for clinical response.
Examples

- 89 y/o nursing home pt. admitted for diverticulitis. T 38.0 HR 90 BP 145/85. wt 70 kg Na: 140, K: 3.7. Not eating. Fluid Orders:
  - Basal needs 70 + 40 = 110cc/hr
  - Additional loss from fever = approx. 10 cc/hr
  - Total rate = 120 cc/hr: IVF?
  - (D5) 0.45% saline with 20 meq KCl
Examples

- 50 y/o with massive hematemesis, SBP 80 HR 130 IVF?
- 0.9% saline WIDE OPEN through two large bore IVs.
- O neg STAT
- Type and cross 6 units PRBC STAT.
Examples

- 65 y/o male hospitalized with pneumonia. Temp 38.5, HR 72, BP 125/72. Wt 75 kg. Na:165 K: 4.0. Orders:
  - Basal needs 115 cc/hr + 12 cc/hr for fever. Also:
  - Free water deficit of (.6)(75)[(165/140) – 1] = 7.6 liters.
  - IV # 1: 0.45% saline @ 130 cc/hr.
  - IV # 2: D5W @ 150cc/hr for 50 hrs.
Examples

- 30 y/o male admitted for ITP. Platelets 6, T 37.0, HR 72, BP 120/80, Wt 80 kg. Eating well. IVF orders:
Remember……..

- Your fluid orders are incomplete until you have ordered monitoring labs (lytes, Cr, etc), I/O, daily weights.
- IVF orders are often more art than science.
  - There may be several reasonable rates to order—be sure that you have thought your orders out.
  - The basic fluid, i.e. isotonic, hypotonic, hypertonic, should be clear.