NEPHROLOGY

Section I - Introduction to Nephrology

I. Basic Principles

A. Primary functions of the kidneys

1. Removal of waste products (drugs, urea, etc.)
2. Electrolyte homeostasis
3. Acid-base regulation
4. Blood volume homeostasis
5. Regulation of erythropoiesis
6. Regulation of blood pressure
7. Regulation of bone health (vitamin D, calcium, and phosphorous)

II. Fluid Compartments

A. Distribution of water

1. The total body water (TBW) comprises 60% of body weight.
2. The intracellular space comprises 40% of body weight (⅔ of TBW).
3. The extracellular space comprises 20% of body weight (⅓ of TBW).

B. The measured volume of fluid compartments

1. Tritiated water can be used to measure TBW, because it is disbursed in all body compartments.
2. Mannitol can be used to measure the extracellular compartment, because the large size prevents it from crossing cellular membranes.
3. Evans blue can be used to measure the plasma volume, because it tightly binds to albumin.
4. A known mass of one of these substances can be injected into a patient, allowed to equilibrate, and then measured again to determine the volume of the compartment of interest using the following equation:

volume = amount / concentration

C. Redistribution of water between compartments

a) Osmolarity is the concentration of a solution.

b) NaCl, potassium, urea, and glucose are major physiologic contributors to osmolarity.

c) NaCl cannot cross the cellular membrane.

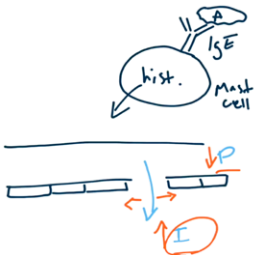
d) Water freely shifts between the compartments in response to changes in osmolarity.

e) The osmolarity of the extracellular fluid (ECF) is normally equal to the osmolarity of the intracellular fluid (ICF).

REVIEW QUESTIONS

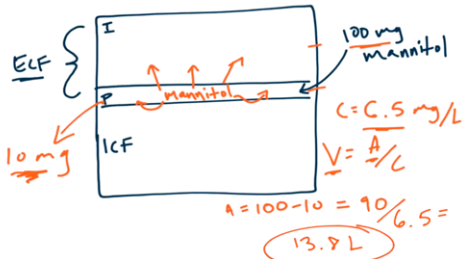
1. How would anaphylaxis alter the volume in the intracellular and extracellular compartments?

   - **Anaphylaxis is a severe allergic reaction → antigen binds to IgE which activates mast cell to release histamine**
   - **Histamine dilates smooth muscle cells of arterioles → vasodilation. Also causes contraction of pericytes**
   - **↓ plasma volume, ↑ interstitial volume, unchanged extracellular fluid compartment volume**



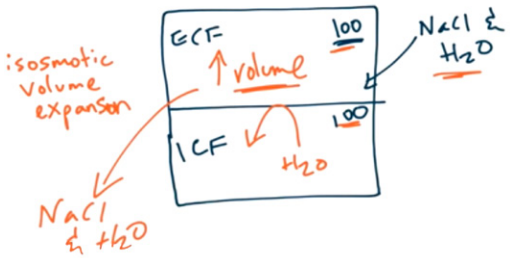
2. How would the redistribution of water be altered in the intracellular and extracellular fluid compartments in a patient who has been given an IV bolus of normal saline?

   - **↑ volume of the extracellular fluid compartment, but osmolarity is unchanged → no redistribution of water (isosmotic volume expansion)**



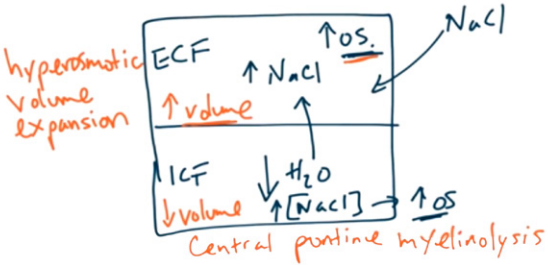
3. How would the redistribution of water be altered in the intracellular and extracellular fluid compartments in a patient who has been given an IV highly concentrated NaCl?

   - **↑ NaCl in the ECF → ↑ ECF osmolarity → water moves from the ICF to the ECF until the osmolarity has equilibrated → net ↓ ICF volume and ↑ ECF volume (hyperosmotic volume expansion)**



4. What neurological pathology is associated with hyperosmotic volume expansion?

   - **Central pontine myelinolysis**



5. How would the redistribution of water be altered in the intracellular and extracellular fluid compartments in a patient who has been sweating during a long hike?

   - **In sweat, water loss is greater than NaCl loss → ↓ free water from ECF → ↑ ECF osmolarity → water moves from ICF to ECF → net ↓ ECF and ICF volume (hyperosmotic volume contraction)**