I. Body Water
   a. Compartments
      i. Total body water (TBW): 60%
         1. Intracellular body water (ICW): 40%
         2. Extracellular body water (EBW): 20%
            a. Plasma/intravascular fluid
            b. Interstitial/extravascular fluid
            c. Transcellular fluid
      ii. Body water over the years
      iii. Composition of body water
      iv. Plasma = serum and clotting factor
II. Electrolyte Balance
   a. Electrolytes
      i. Ionized salts dissolved in water
      ii. Clinically important: Na, K, Ca, Mg, Cl, bicarbonate, phosphate
   b. Regulation
   c. Regulatory Na/K pump 3Na out, 2 K in
      i. Electrolyte concentration in plasma is different than concentration in cell: concentrations must be normal and balanced for body to function
      ii. Electrolyte regulation is dynamic
         1. 4 processes work together to maintain normal limits: electrolyte intake, absorption, distribution and excretion
         2. If intake increases, excretion must increase to normalize quantities
         3. If intake decreases, electrolytes must be redistributes into the plasma to maintain normal plasma levels
III. Water and Electrolytes
   a. Regulation
      i. Distal = out at tube and into urine
      ii. Glucose, amino acids, sodium
      iii. Will go into more detail with this later…
IV. Body Fluids → low blood volume means low BP
   a. Sensed by baroreceptors, sympathetic system… vasoconstriction
      i. Less blood to the kidney
   b. Function
      i. Surrounds and permeates cells
      ii. Lubricant and solvent for metabolic chemical reactions
      iii. Transport: oxygen, nutrients, chemical messengers, waste products
      iv. Regulates body temperature
   c. Fluid homeostasis: dynamic process involving the interplay of 4 subprocesses: fluid intake, absorption, distribution, excretion
   d. Regulation
      i. ECW osmolarity and volume is regulated by
         1. Hypothalamus
         2. RAAS

3. Natriuretic peptides

ii. Hypothalamus
    1. Neuron stimulation of water-output area in hypothalamus will cause thirst sensation
    2. Stimulate ADH production in hypothalamus and release from posterior pituitary
    3. ADH induces water absorption in kidney
    4. Reduce water output: hypertonic urine

iii. RAAS → this is a major important concept
    1. Neurohormonal regulation to increase water volume and sodium reabsorption
    2. Rening: proteolytic enzyme made by kidney, converts angiotensinogen to angiotensin I in liver
    3. Angiotensin I converts to angiotensin II in lung

iv. Natriuretic peptides
    1. Reciprocal effects to the RAAS
    2. Atrial natriuretic peptide (ANP)
    3. Brain natriuretic peptide (BNP)
    4. C-type natriuretic peptide (CNP)

e. Abnormalities
    i. Abnormalities in
        1. Volume
        2. Concentration
        3. Electrolyte composition
    ii. Due to many different pathophysiological conditions
    iii. Results in clinical disorders or death

V. Water Balance Disorders

a. Due to
    i. Water intake and output imbalance
    ii. Sodium intake and output imbalance

b. Results in
    i. Dehydration
    ii. Overhydration

c. Dehydration
    i. Thirsty, dry, no sweat/tears
    ii. Glassy eyes, can't swallow
    iii. Decreased skin tugor
    iv. Can be caused by
        1. Kidney disease → too much H2) retained by ADH
        2. Increased sweating
        3. Hyperventilation
        4. Diarrhea
    v. Due to water deficit → simple dehydration
    vi. Hypernatremic dehydration = hyperosmolar dehydration
    vii. Normonatremic dehydration = isomolar dehydration
    viii. Hyponatremic dehydration = hyposmolar dehydration

d. Overyhydration
    i. Due to
        1. Excess water intake (water intoxication): high TBW, normal total body Na
        2. Excess water and Na retention

VI. Electrolyte Balance Disorders

a. Sodium
    i. Normal total body Na: 55 mmol/kg body weight, mostly found in ECW
    ii. Abnormalities in body Na:
        1. Na excess → including blood, extracellular fluid, intracellular fluid
        2. Na depletion
    iii. Abnormalities in plasma Na
        1. Hyponatremia: low plasma Na
        2. Hypernatremia: high plasma Na
            a. Inside blood only
    iv. Pitting edema
    v. Heart failure… RAAS activated increase of sodium in the body
b. Potassium
    i. Increased potassium in acidosis
    ii. Decreased in alkalosis
c. Normal total body K: 50 mmol/kg body weight, 98% found in ICW
d. Abnormalities of body K
    i. K excess
    ii. K depletion
e. Abnormalities of plasma K
    i. Hypokalemia: low plasma K
    ii. Hyperkalemia: high plasma K