FLUID AND ELECTROLYTE BALANCE

BODY FLUIDS

A. Major locations
    a. Inside cells as (ICF)
    b. Outside of cells in extracellular fluid (ECF)
    c. Between cells as interstitial fluid (IF)
    d. In blood vessels as plasma
B. Total body fluid is approximately 50 to 60% of body weight in a healthy body
C. Variation in total body water is related to:
    a. Total body weight
        i. More a person weighs, the more water the body contains
    b. Fat content of the body
        i. The more fat present, the less total water content per unit of weight (fat is mostly water free)
    c. Sex
        i. Proportion of body weight represented by water is about 10% less in women than in men
    d. Age
        i. In newborn infant water may account for 80% of total body weight

MECHANISMS THAT MAIINTAIN FLUID BALANCE

A. Fluid output, mainly urine volume adjusts to fluid intake
    a. ADH from posterior pituitary gland acts to increase kidney tubule reabsorption of sodium and water from tubular urine into blood
    b. Tends to increase ECF and total body fluid by decreasing urine volume
B. ECF electrolyte concentration (mainly Na^+ concentration) influences ECF volume
    a. An increase in ECF Na^+ tends to increase ECF volume by increasing movement of water out of ICF and by increasing ADH secretion
    b. This decreases urine volume and, in turn, increases ECF volume
C. Capillary blood pressure pushes water out of blood, into IF, blood protein concentration pulls water into blood from IF; hence these two forces regulate plasma and IF voumes under usual conditions
D. Importance of electrolytes in body fluids
    a. Non electrolytes—organic substances that do not break up or dissociate when placed in water solution (for example: glucose)

b. Electrolytes—compounds that break up or dissociate in water solution into separate particles called ions (for example: ordinary table salt of sodium chloride)
c. Ions—the dissociated particles of an electrolyte that carry an electrical charge (for example: the sodium ion—Na^+)
d. Positively charged ions (for example: potassium K^+ or sodium Na^+
e. Negatively charged particles (ions) such as chloride Cl^- or bicarbonate HCO_3^-
f. Electrolyte composition of blood plasma
g. Sodium—most abundant and important positively charged ion of plasma
    i. Normal plasma level 142 mEq/L
    ii. Average daily intake diet = 100 mEq
    iii. Chief method of regulation = kidney
    iv. Aldosterone increases $Na^?$ reabsorption in kidney tubules
    v. Sodium contain internal secretions

E. Capillary blood pressure and blood proteins

FLUID IMBALANCES

A. Dehydration: total volume of body fluids smaller than normal
    a. IF volume shrinks first
    b. Then, if treatment is not given ICF volume and plasma volume decrease
    c. Dehydration occurs when fluid output exceeds intake for an extended period
B. Overhydration: total volume of body fluids larger than normal
    a. Various factors may cause this, such as givng excessive amounts of intravenous fluids or fiving them too rapidly
    b. Intake exceeds output

NEW WORDS

Dissociate extracellular fluid interstitital fluid (IF) ions
electrolyte (ECF) intracellular fluid (ICF)

DISEASES AND OTHER LINICAL TERMS

Dehydration diuretic edema
overhydration

ACID-BASE BALANCE

pH OF BODY FLUID

A. Definition of pH: a number that indicates the hydrogen ion ($H^?$) concentration of a fluid
    a. pH 7 indicates neutrality
        i. higher than 7 indicates alkalinity
        ii. less than 7 indicates acidity
B. normal arterial blood pH is about 7.45
C. normal venous blood pH is about 7,35

MECHANISMS THAT CONTROL PH OF BODY FLUIDS

A. buffers
    a. definition: substances that prevent a sharp change in the pH of a fluid when an acid or base is added to it
    b. "fixed" acids are buffered mainly by sodium bicarbonate ($NaHCO_3$)
    c. Changes in blood produced by buffering of "fixed" acids in the tissue capillaries
        i. Amount of carbonic acid (H_2CO_3) in blood increases slightly
        ii. Amount of $NaHCO_3$ in blood decreses
            1. Ration of amount of $NaHCO_3$ does not normally change
            2. Normal ratio is 20:1
        iii. H^+ concentration of blood increases slightly
        iv. Blood pH decreases slightly below arterial level
B. Respiratory mechanism of pH control
    a. Respirations removed some CO_2 from the blood as blood flows through lung capillaries
        i. The amount of H_2CO_3 in blood is decreased and thereby its H^+ concentration is decreased
        ii. Thus in turn there is an increase in blood pH from its venous to its arterial blood levels
C. Urinary mechanism of pH control
    a. The body's most efficient regulator of blood pH
        i. Kidneys usually acidify urine by the distal tubules secreting hydrogen ions and ammonia (NH_3) into the urine from blood in exchange for $NaHCO_3$ being reabsorbed into the blood

pH IMBALANCES

A. Acidosis and alkalosis are the two kind of pH or acid base imbalances

B. Disturbances in acid-base balance depend on relative quantities of $NaHCO_3$ and H_2CO_3 in the blood
C. Body can regulate both of the components of the $NaHCO_3$- H_2CO_3 buffer system
    a. Blood levels of $NaHCO_3$ regulated by the kidneys
    b. H_2CO_3 levels regulated by the lungs
D. Two basis types of pH disturbance, metabolic and respiratory, can alter the normal 20:1 ratio of $NaHCO_3$ to H_2CO_3 in the blood
    a. Metabolic disturbances affect the $NaHCO_3$ levels in the blood
    b. Respiratory disturbances affect the H_2CO_3 levels in the blood
E. Types of pH or acid-base imbalances
    a. Metabolic disturbances
        i. Metabolic acidosis-bicarbonate $NaHCO_3$ deficit
        ii. Metabolic alkalosis-bicarbonate $NaHCO_3$ excess, complication of severe vomiting
    b. Respiratory disturbances
        i. Respiratory acidosis (H_2CO_3 excess)
        ii. Respiratory alkalosis (H_2CO_3 deficit)
F. Uncompensated metabolic acidosis – the normal ratio of $NaHCO_3$ to H_2CO_3 is changed
    a. In compensated metabolic acidosis, the ration remains at 20:1 but the total amount of $NaHCO_3$ and H_2CO_3 changes

NEW WORDS

Acid solution	bicarbonate loading	buffer pairs	ketone bodies
Alkaline solution	buffer	carbonic anhydrase	normal saline
Base			pH

DISEASES AND OTHER CLINICAL TERMS

Diabetic ketoacidosis	respiratory acidosis	metabolic alkalosis	respiratory alkalosis
Metabolic acidosis			