Fluid and Electrolyte Imbalances
Acid Base Imbalances

Unit XI

Lemone and Burke Chapter 10

Objectives

- Discuss factors affecting fluid and electrolyte balance
- Discuss specific lab data and their implications as they relate to fluid and electrolyte balances.
- Explain pathophysiology, manifestations, nursing diagnoses and interventions of imbalances of the following electrolytes:
  - a. Sodium
  - b. Potassium
- Develop and implement a plan of care for a client with fluid and electrolyte imbalance

Homeostasis

- Body's attempt to maintain state of physiologic balance in presence of constantly changing conditions
- Necessary for body to function optimally at a cellular level and as a total organism

Basic Metabolic Panel

- BUN – 5-25 mg/dL
- Creat – 0.5-1.5 mg/dL
- Na – 135-145 mEq/L
- Cl – 95-105 mEq/L
- K - 3.5-5.0 mEq/dL
- Glu – 70-110 mg/dL
- CO_2 – 22-28 mEq/L

Urine pH and Specific Gravity

- pH – 4.5-8
- Specific gravity – 1.005 – 1.030

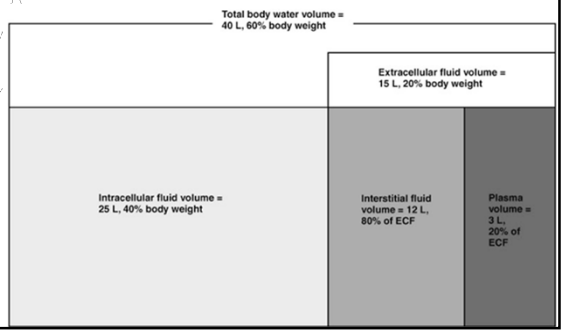
Body Fluid Composition

- Water – primary component
  - Medium for transport
  - Medium for metabolic reaction within cell
  - Helps regulates body temperature
  - Provides insulation
  - Provides form, structure, and shock absorption
  - Acts as a lubricant
  - Contribute to enzyme reactions
  - Essential for neuromuscular activity

Body Fluid Composition

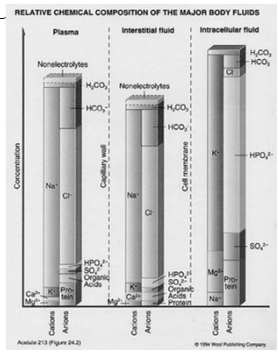
- Electrolytes
  - Charged particles called ions
  - Anions and cations
  - Assist in regulating water balance
  - Help regulate and maintain acid-base balance
  - Contribute to enzyme reaction
  - Essential for neuromuscular activity

Body Fluid Composition



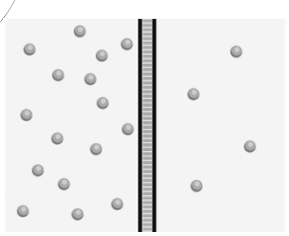
Body Fluid Composition

- Plasma and interstitial fluid similar in electrolyte composition but intracellular differs significantly



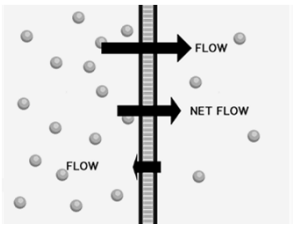
Body Fluid Movement

- **Osmosis** (Fig. 10-3)
  - **Water** moving through a semi-permeable membrane from lower to higher solute concentration
  - **(<- Water moves right to left)**



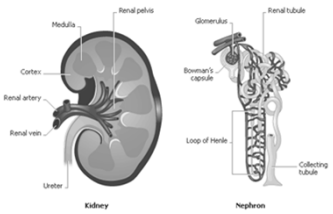
Body Fluid Movement

- **Diffusion** (Fig. 10-5)
  - **Solute** molecules moving from high concentration to low concentration to become evenly distributed
  - Arrows show movement of solutes

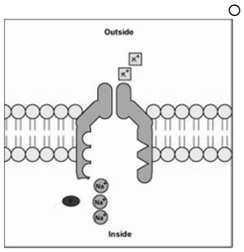


Body Fluid Movement

- **Filtration** (Fig. 10-6)
  - Water and solutes move from high hydrostatic pressure to low hydrostatic pressure



Body Fluid Movement



- **Active Transport**
  (Fig. 10-7)
  - Allows molecules to move across cell membranes and epithelial membranes against a concentration gradient

Body Fluid Regulation

- Thirst
- Kidneys
- Renin-Angiotensin-Aldosterone System
- Antidiuretic Hormone (ADH)
- Atrial Natriuretic Peptide (ANP)

Fluid Volume Deficit (FVD)

- **Causes**
  - Excessive fluid loss
  - Insufficient fluid intake
  - Failure of regulatory system
  - Third spacing

Manifestations - FVD

- Dry mucous membranes
- Decreased urinary output
- Fatigue
- Altered mental status, anxiety, restlessness
- Dry skin, pale, cool extremities
- Tachycardia,
- Decreased blood pressure
- Increased body temperature
- Thirst
- Weight loss
- Skin turgor poor

Diagnosing - FVD

- Serum electrolytes
- Serum osmolality
- Hemoglobin and hematocrit
- Urine specific gravity

Management - FVD

- Rehydration
  - Water for mild fluid deficit
  - Sports drink for moderate FVD
  - IV fluid for severe fluid deficit involving electrolyte imbalance

Intervention

- Assess
  - I & O
  - Vital signs
  - Skin turgor
- Administer oral and/or IV fluids
- Monitor lab values
- Monitor LOC
- Institute safety precautions
- Provide adequate skin care
- Instruct patient

Health Promotion and Assessment

- Instruct on adequate fluid intake
- Sports drinks for outside activities or exercise – esp in hot weather
- Fluid intake should include 2500ml/day
- Collect health history
- Physical assessment
  - Older adults

Nursing diagnosis - FVD

- Deficient Fluid Volume
- Ineffective Tissue Perfusion
- Risk for Injury

Fluid Volume Excess

- Both water and sodium are retained in the body
- Fluid overload

Manifestations and Complications

- Weight Gain (>5% in a short period)
- Full bounding pulse
- Distended neck and peripheral veins
- Dyspnea with cough
  - Moist crackles, pulmonary edema
- Polyuria
- Ascites
- Peripheral edema, if severe - anasarca

Management – Fluid Volume Excess

- Medications
  - Loop diuretics
  - Thiazide-type diuretics
  - Potassium sparing diuretics
- Fluid Management
  - Restriction
- Dietary Management
  - Decreased sodium intake

Interventions - Fluid Volume Excess

- Low sodium diet & fluid restriction
- Assess
  - vital signs
  - Weight daily
  - I & O
  - skin
- Elevate lower extremities
- Oral hygiene
- Diuretics
- Reposition Q 2 hours
- Monitor O2 saturation

Health Promotion and Assessment

- Eval risk factors
- Eval education needs
  - Disease process
  - Low sodium diet
  - Other management
- Health history
- Physical assessment

Nursing Diagnosis –

- Fluid Volume Excess
- Impaired gas exchange
- Risk for impaired skin integrity

Electrolytes

- Na – 135 – 145 mEq/L
- K – 3.5 – 5.0 mEq/L
- Ca – 8.5 – 10.0 mEq/dL
- Phos – 2.5 – 4.5 mg/dL
- Magnesium – 1.6- 2.6 mEq/dL

Sodium Imbalance

- Most plentiful electrolyte in ECF
- Normal range 135-145 mEq/L
- Primary regulator of volume, osmolality and distribution of ECF.
- Most of the body's sodium comes from diet
- The kidney excretes/conserves sodium in response to changes in vascular volume

Hyponatremia

- Lab Values
  - Serum sodium <135 mEq/L (Critical <120 mEq/L)
  - Serum osmolality <280 mOsm/kg
- Causes
  - Excess sodium loss (kidneys, GI tract, skin)
  - Water gains r/t renal disease, heart failure, liver failure
  - SIADH
  - Excessive hypotonic IV fluids (NS 0.45%)

Manifestation - Hyponatremia

- Anorexia
- Nausea, Vomiting
- Diarrhea, abdominal cramping
- Headache
- Altered mental status
- Muscle cramps, weakness, tremors
- Seizure and coma
- Decreased serum sodium and osmolality

Management - Hyponatremia

- Fluid and dietary management
  - Isotonic saline (NaCl 0.9%) or Lactated Ringer sol.
    - 3% saline may be given cautiously for severe sodium loss.
  - Loop diuretics (Lasix)
  - Increase foods high in sodium (box 10-4)

Interventions - Hyponatremia

- I+O
- Isotonic solutions
- Fluid restriction
- Daily weight
- Monitor labs
- Assess for neuro changes
- Assess muscle strength and tone

Nursing Diagnosis - Hyponatremia

- Risk for Fluid Volume Deficit
- Risk for Ineffective Cerebral Tissue Perfusion

Hypernatremia

Labs:

- Serum sodium level > 145 mEq/L
- Osmolality > 295 mOsm/kg
- Sodium gain
- Water loss
- Excess sodium in ECF stimulates release of ADH -more water retained
- The thirst mechanism stimulated to increase intake of water
- Hypernatremia almost never occurs in people with intact thirst mechanism

Causes - Hypernatremia

- Altered thirst mechanism
- Profuse sweating
- Diarrhea
- Diabetes Insipidus
- Oral electrolyte solutions
- Excess IV fluids such as NS, 3% or 5% NaCl
- Inability to respond to thirst sensation or obtain water

Manifestation - Hypernatremia

- Thirst
- Increased temperature
- Dry, sticky mucous membranes
- Restlessness
- Weakness
- Altered mental status
  - Decreased level of consciousness
  - Muscle twitching
- Seizures

Management - Hypernatremia

- Oral or Intravenous fluid intake
- Hypotonic solution 0.45% NaCl
- 5% dextrose in water (provides pure water when the glucose is metabolized)
- Diuretics to increase sodium excretion

Nursing Diagnosis - Hypernatremia

- **Risk for injury**
  - mental status and brain function is
  - affected by elevated Na, - brain swells

Intervention:

Assess neuro function
LOC, N+V

Monitor labs
Na and osmolality

Potassium Imbalance

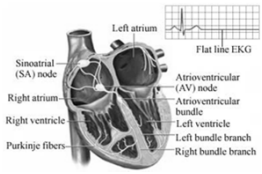
- Normal Value 3.5 – 5.0 mEq/L
- Hypokalemia
  - <3.5 mEq/L Critical value: <2.5 mEq/L
- Hyperkalemia
  - > 5.0mEq/L Critical value: >6.5 mEq/L
- Kidneys are principle organ for eliminating potassium
- Most potassium intake is acquired through diet

.Hypokalemia

- Potassium < 3.5 mEq/L
- Causes
  - Excess GI losses: vomiting, diarrhea, ileostomy drainage
  - Renal losses: diuretics, hyperaldosteronism
  - Inadequate intake
  - Alkalosis,
  - Insulin Therapy

Manifestation - Hypokalemia

- Cardiovascular
  - Dysrythmias
  - ECG changes
- Gastrointestinal
  - Nausea, vomiting
  - Anorexia
  - Decreased bowel sounds
- Neuromuscular
  - Muscle weakness
  - Leg cramps



Management - Hypokalemia

- Potassium supplements (see box pg 221)
  - Potassium chloride- treatment of choice
  - KCL 40 mEq daily
  - Orally dilute with juice and food
  - Intravenously, administer slowly and diluted in IV solution to prevent burning
- Dietary Intake
  - High in potassium rich foods

Health Promotion and Assessment

- Discuss use of sports drinks to replace fluid loss – esp athletes
- Diet teaching
- Medication teaching
- Health history
- Physical assessment

Interventions - Hypokalemia

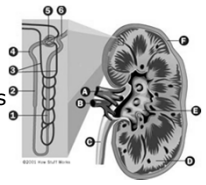
- Monitor K+
- VS
- Assess Pulses
- Cardiac monitoring
- Assess muscle tone
- Monitor respirations
- I+O
- Bowel sounds

Nursing Diagnosis - Hypokalemia

- Decreased Cardiac Output
- Activity Intolerance
- Risk for Imbalanced Fluid Volume
- Risk for injury
- Risk for ineffective health maintenance

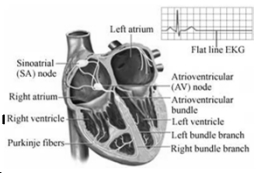
Hyperkalemia

- High serum potassium >5.0 mEq/L
- Causes:
  - Renal failure
  - Potassium sparing diuretics
  - Adrenal insufficiency
  - Excess potassium intake
  - Aged blood
  - Acidosis
  - Burns



Manifestations - Hyperkalemia

- Cardiovascular
  - Tall, peaked T waves, widened QRS
  - Dysrhythmias
  - Cardiac Arrest
- Gastrointestinal
  - Nausea and vomiting
  - Abdominal cramping and dia
- Neuromuscular
  - Muscle twitchng and tremors
  - Paresthesia
  - Flaccid paralysis



Management - Hyperkalemia

- Medications
  - Calcium gluconate
  - Insulin R and glucose 50% IV
  - Kayexalate
  - Diuretics if renal function is normal
- Dialysis
  - If renal function is severely limited
- Dietary
  - Decrease potassium rich foods

Intervention

- Assess
  - Pulses
  - ECG pattern
  - Muscle strength
  - Edema
  - Monitor lab values
- Accurate I&O
- Health history
- Teaching
  - Diet
  - K supplement

Nursing Diagnosis - Hyperkalemia

- Risk for Decreased Cardiac Output
- Risk for Activity Intolerance
  - Same as Hypokalemia
- Risk for Imbalanced Fluid Volume
- Ineffective health maintenance

Case Study

- 63 y/o female with hx of DM and ESRD
- Comes to ER c/o SOB and extreme weakness

Case Study

- 43 y/o male w Hx DM comes to ER w c/o flu for 3 days, not feeling good

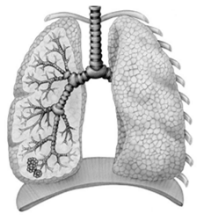
Acid-Base Disorders

- Homeostasis keeps hydrogen ion in body fluids in narrow range
- Hydrogen ions determine acidity of body fluids
- Relationship between hydrogen ion and pH is inverse

Buffer Systems

- Substances to prevent major changes in pH:
  - Bicarbonate/carbonic acid buffer
  - Phosphate buffer
  - Protein buffer

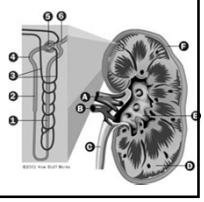
Respiratory System



- Regulates carbonic acid by retaining or eliminating CO2
- Works within minutes
- Alkalosis depresses respiratory center

Renal System

- Long term regulation of acid base balance
- Slow acting (hours to days)
- Alkalosis – kidneys retain hydrogen ions and excrete bicarb
- Acidosis – kidneys retain bicarb and excrete hydrogen ions



ABG – normal values

- pH – 7.35-7.45
- PaCO2 – 35-45 mm Hg
- PO2 – 80-100 mm Hg
- HCO3 – 22-26 mEq/L
- BE -3.0 to +3.0

- Table 10-10, pg 223

Respiratory Acidosis

- pH < 7.35
- PaCo2 is high
- Renal system attempts compensation - slow

Respiratory Alkalosis

- pH > 7.45
- PaCo2 is low
- Renal system attempts compensation - slow

Metabolic Acidosis

- pH < 7.35
- HCO_3 low
- Resp system attempts compensation

Metabolic Alkalosis

- pH > 7.45
- High HCO_3
- Resp system attempts compensation

Nursing diagnosis

- Risk for impaired gas exchange
- Risk for decreased CO
- Risk for excess/deficient fluid volume
- Risk for injury
- Ineffective airway clearance
- Ineffective breathing patterns

Sample ABG

- pH – 7.30
- PCO2 – 51 mm Hg
- PO2 – 84 mm Hg
- HCO3 – 25 mEq/L
- BE - -2

Sample ABG

- pH – 7.51
- PCO2 - 38
- PO2 - 88
- HCO3 – 32 mEq/L
- BE - +3

Sample ABG

- pH – 7.50
- PCO2 – 18 mm Hg
- PO2 – 84 mm Hg
- HCO3 – 25 mEq/L
- BE - -2

Sample ABG

- pH – 7.30
- PCO2 – 36 mm Hg
- PO2 – 84 mm Hg
- HCO3 – 15 mEq/L
- BE - -2

"Try to get some rest. I'll be in every few minutes to make sure you don't."