1. **Fluid and Electrolyte Imbalances**  
   **Acid Base Imbalances**  
   Unit III—  
   Lemone and Burke Chapter 10

2. **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

3. **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

4. **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

5. **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

6. **Body Fluid Composition**  
7. **Body Fluid Composition**  
   - Plasma and interstitial fluid similar in electrolyte composition but intracellular differs significantly

8. **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)

9. **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

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

Diagnosing - FVD
- Serum electrolytes
- Serum osmolality
- Hemoglobin and hematocrit
- Urine specific gravity
16  **Management - FVD**

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

17  **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

18  **Nursing diagnosis - FVD**

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

19  **Intervention**

- Assess intake and output
- Vital signs
- Administer oral and/or IV fluids
- Monitor lab values
- Monitor LOC
- Institute safety precautions
- Provide adequate skin care
- Instruct patient

20  **Fluid Volume Excess**

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

21  **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

22  **Management – Fluid Volume Excess**

- Medications
  - Loop diuretics
  - Thiazide-type diuretics
Potassium sparing diuretics

Fluid Management
- Restriction

Dietary Management
- Decreased sodium intake

Health Promotion and Assessment
- Eval risk factors
- Low sodium diet
- Health history
- Physical assessment

Interventions - Fluid Volume Excess
- Low sodium diet
- Assess vital signs
- Elevate lower extremities
- Daily weight
- Intake and output
- Oral hygiene
- Diuretics
- Assess skin
- Reposition Q 2 hours
- Monitor O2 saturation

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
- IVs
- 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

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

36 **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

37 **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

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

39 **Hypokalemia**
○ Potassium < 3.5 mEq/L
○ Causes
  ● Excess GI losses: vomiting, diarrhea, ileostomy drainage
  ● Renal losses: diuretics, hyperaldosteronism
  ● Inadequate intake
  ● Alkalosis,
- Insulin Therapy
  
40  **Manifestation - Hypokalemia**
  - Cardiovascular
    - Dysrhythmias
    - ECG changes
  - Gastrointestinal
    - Nausea, vomiting
    - Anorexia
    - Decreased bowel sounds
  - Neuromuscular
    - Muscle weakness
    - Leg cramps

41  **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

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

43  **Interventions - Hypokalemia**
  - Monitor K+
  - VS
  - Assess Pulses
  - Assess muscle tone
  - Monitor respirations
  - I+O
  - Bowel sounds

44  **Nursing Diagnosis - Hypokalemia**
  - Decreased Cardiac Output
    - Activity Intolerance
    - Risk for Imbalanced Fluid Volume
  - Risk for injury
  - Risk for ineffective health maintenance

45  **Hyperkalemia**
High serum potassium >5.0 mEq/L

Causes:
- Renal failure
- Potassium sparing diuretics
- Adrenal insufficiency
- Excess potassium intake
- Aged blood
- Acidosis

Manifestations - Hyperkalemia
- Cardiovascular
  - Tall, peaked T waves, widened QRS
  - Dysrhythmias
  - Cardiac Arrest
- Gastrointestinal
  - Nausea and vomiting
  - Abdominal cramping and diarrhea
- Neuromuscular
  - Muscle twitching 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

Health Promotion Hyperkalemia
- Teaching – K supplement use
- Diet – what foods to avoid

Assessment:
- Health history –
- Physical assessment

Intervention
- Monitor ECG pattern
- Monitor lab values
- Accurate I&O
- Monitor for edema

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 240

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
- HCO3 low
- Resp system attempts compensation

**Metabolic Alkalosis**
- pH > 7.45
- High HCO3
- Resp system attempts compensation

**Nursing diagnosis**
- Risk for impaired gas exchange
- 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
- OBE - -2

**Sample ABG**
- pH – 7.51
- PCO2 - 38
- PO2 - 88
- HCO3 – 32 mEq/L
- OBE - +3

**Sample ABG**
- pH – 7.50
- PCO2 – 18 mm Hg
- PO2 – 84 mm Hg
- HCO3 – 25 mEq/L
- OBE - -2
pH – 7.30
PCO2 – 36 mm Hg
PO2 – 84 mm Hg
HCO3 – 15 mEq/L
BE - -2