BAPTIST SCHOOL OF NURSING  
NSG. 4037: ADULT NURSING III  

PHYSIOLOGIC INTEGRITY AND THERAPEUTIC NURSING INTERVENTIONS  
FOR PATIENTS WITH FLUID AND ELECTROLYTE DISTURBANCES  
2006

READING ASSIGNMENT:
St. Louis: Elsevier Saunders. Unit 3 (p 196); Ch 13-14 (p 205-245)

LECTURE OBJECTIVES:

1. Define intracellular fluid (ICF), extracellular fluid (ECF), intravascular fluid, interstitial fluid, hypertonic, hypotonic (hyposmolar), diffusion, osmolality, and osmolarity.

2. Describe fluid movement by diffusion and osmosis.

3. Apply the nursing process to extracellular fluid volume deficit (dehydration) and extracellular fluid volume excess: assessment, analyze, plan, implement and evaluate.

4. Distinguish the etiology, pathophysiology, clinical manifestation, and medical management of extracellular fluid volume deficit and excess.

5. Differentiate the hypotonic, isotonic and hypertonic intravenous water and electrolyte solutions.

6. Outline situations in which hypotonic, isotonic and hypertonic intravenous water and electrolyte solutions are used.

7. Discuss aspects of care that may be appropriately delegated to unlicensed assistant personnel and family members in the management of fluid volume deficit.

8. Analyze the modifications of management of fluid volume excess in elderly clients.


10. Apply the nursing process to extracellular fluid volume shift (third spacing); assessment, analyze, plan, implement, and evaluate.

11. Identify the etiology, pathophysiology, clinical manifestations, and medical management of extracellular fluid volume shift.

12. Formulate a nursing care plan for the client with extracellular fluid volume deficit or excess, intracellular fluid volume excess, and extracellular fluid volume shift.

13. Identify normal serum ranges for electrolyte: sodium, chloride, potassium, calcium, phosphorus, magnesium, and calcium.

14. Formulate a diet for imbalances of sodium, potassium, and calcium.
15. Compare electrolyte imbalances in terms of etiology, risk factors, clinical manifestations, and pathophysiology then apply the nursing process to such imbalances.

A. Hyponatremia
B. Hypernatremia
C. Hypokalemia
D. Hyperkalemia
E. Hypocalcemia
F. Hypercalcemia
G. Hypophosphatemia
H. Hyperphosphatemia
I. Hypomagnesemia
J. Hypermagnesemia
LECTURE OUTLINE:

FLUID IMBALANCES- Chapter 13

I. Physiology Review
   A. Normal body fluid function
      1. Intracellular (ICF): fluid within the cells- 2/3 of total
      2. Extracellular (ECF): fluid outside the cells- 1/3 of total
         a. Interstitial: third spaces around the cells
         b. Intravascular: in the bloodstream
      3. Hydrostatic pressure: pressure within the capillaries
      4. Osmotic (oncotic) pressure: pressure resulting from the presence of plasma proteins (albumin) that draws fluid back into the vessel

   B. Fluid Movement
      1. Diffusion - movement of fluids or substances across a membrane because of differences in concentration
      2. Osmolality and osmolarity - measured by the number of dissolved particles per kg. of water
         a. Sodium used to measure osmolality
         b. Normal osmolality is 275 - 295 mOsm/kg.
         c. Hyperosmolar (hypertonic) state that is the result of osmolality > 295
         d. Hyposmolar (hypotonic) state that results when osmolality is < 275

II. Extracellular Fluid Volume Deficit: Dehydration
   A. Average daily fluid intake 1500 to 2000 ml.
   B. Etiology
      1. Lack of fluid intake
      2. Excess fluid loss
      3. Alteration in the balance regulators
         a. Thirst
         b. Hormones
         c. Lymphatic system
         d. Kidneys
   C. Degrees of Dehydration
      1. Mild - 1 to 2 L of water loss (2% body wt.)
      2. Moderate - 3 to 5 L water loss (5% body wt.)
      3. Severe - 5 to 10 L water loss (8% body wt.)
   D. Lack of Fluid Intake - Causes
1. Cognitive and physical impairments reduce fluid intake
2. Impaired thirst mechanisms
3. Hyperosmolarity conditions

E. Excess Fluid Losses - potential causes of excess fluid loss
1. Unmonitored use of diuretics
2. Severe vomiting and diarrhea
3. Fever and diaphoresis
4. GI suction and fistula drainage
5. Blood loss and burns
6. Third spacing of fluids

F. Pathophysiology of Fluid Deficit
1. Fluids that are lost from the intravascular spaces contribute to the following compensatory mechanism:
   a. Interstitial fluids move to restore volume
   b. Antidiuretic hormone and aldosterone secretion causes the reabsorption of sodium and water
   c. Baroreceptors are stimulated, leading to vasoconstriction and an increased HR
   d. Osmoreceptors signal the thirst mechanism
2. Fluid deficit (dehydration) occurs when compensation fails to restore blood volume

G. Types of Extracellular Fluid Volume Deficit
1. Hyperosmolar or hypertonic deficit
   a. Water loss is greater than electrolyte (sodium) loss
2. Iso-osmolar or isotonic deficit
   a. Water and electrolyte (sodium) losses are equal
3. Hypotonic deficit
   a. Electrolyte loss is greater than fluid loss

H. Clinical Manifestations of a Fluid Deficit
1. Loss of body weight
   a. Daily weight most accurate measure of fluid loss
   b. May not occur d/t trapped fluid in third space
2. Changes in intake and output
   a. Thirst, decreased uop, concentrated urine
3. Changes in vital signs
   a. Decrease in blood pressure, central venous pressure (CVP), etc
   b. Increased heart rate and temperature
4. Other: dry mucous membranes, decreased skin turgor - tenting of skin not diagnostic in elderly
I. Diagnostic Findings During a Fluid Deficit
   1. Indicators of hemoco ncentration
      a. Osmolality above 295 mOsm/kg (rough estimate - 2 x Na = osmolality)
      b. Plasma sodium > 145mEq/L
      c. BUN > 25 mg/dl
      d. Glucose > 120 mg/dl
      e. Hematocrit > 55%
      f. Urine specific gravity > 1.030

J. Outcome Management of Fluid Deficit
   1. Fluid Restoration
      a. Oral rehydration
         i. Used if loss is mild and pt. can drink - oral glucose and electrolyte solutions
      b. IV rehydration
         i. Used in severe situations - volume calculated on wt. And presence of co-morbidities
   2. Monitor for complications
   3. Correct the underlying problem
   4. Nursing Management
      a. Assessments
         i. Vital signs
         ii. Peripheral vein filling
         iii. Intake, output, and daily weights
         iv. Lab values
         v. Oral cavity
         vi. Skin turgor
      b. Restore fluids
      c. Control underlying problem
      d. Monitor for complications

K. Diagnosis and Outcomes for Fluid Deficits
   1. Nursing Diagnosis: Deficient Fluid Volume R/T insufficient fluid intake, diarrhea, hemorrhage, or third-space fluid loss
   2. Outcomes: return of levels of body fluids
      a. Oral intake 1500 - 2500 ml/24 hours
      b. Urine output > 0.5 ml/kg/hr
      c. Stable blood pressure and pulse
d. Increase body weight by 0.5-1 pound/day

e. Absence of crackles

f. Moist tongue and mucus membranes

g. Lab values within normal ranges in 48-72 hours

L. Diagnosis, Outcomes, and Interventions for Fluid Deficits
1. Nursing Diagnosis: Impaired Oral Mucous Membranes R/T lack of oral intake or other causes
   a. Outcomes: mucous membranes are restored
      i. Lips, tongue, and gums are moist
      ii. Lips, tongue, and gums are free of dried mucus
   b. Interventions
      i. Assessments
      ii. Oral care every 2-4 hours

M. Diagnosis, Outcomes and Interventions for Fluid Deficits (cont)
1. Nursing Diagnosis: Risk for injury
   a. Outcomes
      i. Client will remain free of injury
   b. Interventions
      i. Provide safety in position changes
      ii. Place bed alarms if confused

N. Interventions for Fluid Deficits
1. Teach
   a. Appropriate fluid replacement
   b. Exercise with adequate fluid replacement
      i. Cool water before exercise
      ii. 150-200 ml q 15 min. during exercise
   c. Do not decrease fluid intake for incontinence
   d. Drink fluids even in the absence of thirst

2. Evaluation: volume deficits usually resolve in 8-24 hours

III. Intracellular Fluid Volume Deficit
A. Caused by severe dehydration

B. Rare in healthy adults - occurs often in elderly and in conditions resulting from acute water loss

C. Compensatory mechanisms similar to ECFVD

D. Manifestations: Fever, CNS changes

E. Outcome management: Restoration of fluid volume via IV replacement

IV. Extracellular Fluid Volume Excess: Fluid Overload
A. Fluid overload or overhydration-
   1. Hypervolemia
      a. Excess fluids in the vascular system
2. Third-spacing
   a. Excess fluids in the interstitial spaces

B. Etiology
1. Simple overloading of fluids
2. Failure to excrete fluids
   a. Renal failure
   b. Edema

C. Pathophysiology
1. Hydrostatic pressure increases, pushing fluids into the interstitial spaces
2. Peripheral vascular resistance increases
3. Pulmonary and/or peripheral edema and heart failure develop

D. Clinical Manifestations of Fluid Excess
1. Respiratory and cardiovascular
   a. Cough, dyspnea, crackles, pallor, etc.
   b. Bounding pulse, elevated B/P, increased CVP
   c. JVD
2. Other
   a. Peripheral edema
   b. Weight gain
   c. Confusion, seizure, coma
3. Indicators of hemodilution
   a. Osmolality < 275 mOsm/kg
   b. Sodium < 135 mEq/l
   c. Hematocrit, 45%
   d. Urine specific gravity < 1.010
   e. BUN < 8 mg/dl

E. Outcome Management of Fluid Excess
1. Restrict dietary sodium
   a. Mild- 4-5 gm Na
   b. Moderate- 2 gm Na
   c. Severe- 0.5 gm Na
2. Restrict fluid
3. Promote urine output
   a. Diuretics - usually combination of potassium sparing and potassium wasting diuretics
4. Improve myocardial function
a. Digitalis

b. Angiotensin - converting enzyme (ACE) inhibitors and beta-blockers

5. Nursing management
   a. Assessments
      i. Vital signs, lung sounds
      ii. Edema
      iii. Intake and output
      iv. Lab values - plasma osmolality, sodium level, hematocrit, urine specific gravity
      v. Observe for changes in level of consciousness

F. Diagnosis and Outcomes for Fluid Volume Excess
1. Nursing Diagnosis - Excess Fluid Volume R/T specific cause

2. Outcomes: return of normal levels of body fluids
   a. Stable blood pressure and pulse
   b. Decrease body weight of .05 -1 lb./ day
   c. Absence of confusion, coughing, crackles, edema
   d. Lab values, normal levels in 48-72 hours

G. Interventions for Fluid Volume Excess
1. Reduce sodium and fluid intake
2. Mobilize fluids
   a. Turning, positioning
3. Prevent complications
   a. Elevate head of bed
   b. Monitor lab values
   c. Provide skin care
4. Teach
   a. Low-sodium diet
   b. Use of alternative seasonings
   c. Fluid restriction
   d. Daily weights

H. Modifications for Older Patients
1. Response time to treatment is slower
2. Increased risk for side effects
   a. Decreased renal and liver function
   b. Drug interactions
c. Some lab studies not as accurate in this age group
   i. Creatinine levels more accurate at assessment of renal function than BUN

V. Intracellular Fluid Volume Excess: Water Intoxication

A. Etiology
   1. Water excess or solute (sodium) deficit
      a. Excessive administration or intake of hypo-osmolar fluids (especially 5% dextrose or 0.45% saline)

B. Pathophysiology
   1. Hypo-osmolar fluids in the ECF compartment move by osmosis to the region of higher sodium concentration in the cells (ICF compartment) to equalize concentration of Na

C. Clinical Manifestations of a Fluid Volume Excess: Water Intoxication
   1. Neurologic
      a. Increased intracranial pressure
      b. Altered level of consciousness
      c. Pupillary changes
   2. Lab indicators of hemodilution
      a. Plasma sodium less than 125 mEq/L
      b. Decreased hematocrit

D. Outcome Management of Fluid Volume Excess: Water Intoxication
   1. Medical management
      a. First priority is to reduce intracranial pressure
   2. Nursing management
      a. Frequent vital signs, neuro check
      b. Hourly I&O, daily weights
      c. Prevent increased intracranial pressure
      d. Provide safety
      e. Monitor IV fluids-sodium rich solutions

VI. Extracellular Fluid Volume of ECF between the intravascular and interstitial spaces

A. Etiology
   1. Increased capillary permeability
   2. Decreased serum protein levels
   3. Obstructed lymphatic drainage

B. Pathophysiology
   1. Tissue injury (burns) or protein malnutrition leading to fluid shift

C. Clinical Manifestations of Fluid Volume Shift: Third-Spacing
   1. Cardiovascular
      a. Weak pulse, hypotension, pallor, cool limbs
2. Other
   a. Oliguria
   b. Decreased level of consciousness
   c. Elevated BUN, hematocrit, and urine specific gravity
   d. Weight doesn’t change - fluid has only shifted
   e. Fluid may obstruct an organ nerve, or blood vessel causing additional symptoms

D. Outcome Management for a Fluid Volume Shift: Third-Spacing
   1. Identity underlying cause
   2. Replace fluids
   3. Stabilize other problems
   4. Nursing management
      a. Assessments
      b. Prevent skin breakdown
      c. Monitor for signs of fluid overload with fluid replacement

ELECTROLYTE IMBALANCES- Chapter 14

I. Electrolytes

A. Chemicals that carry a positive or negative charge
   1. Impact the electrical impulses in nerves and muscles.
   2. Imbalance is present whenever there is an excess or deficit in the serum.

B. Plasma ranges for electrolytes

C. Electrolyte imbalances
   1. Etiology and risk factors
      a. Decreased intake and availability or increased loss of an electrolyte
      b. Increased intake and retention or decreased excretion of an electrolyte
   2. Diagnosis of imbalance
      a. Through plasma levels in lab studies
      b. Through clinical manifestations

D. Related Nursing Diagnosis
   1. No direct nursing diagnoses for electrolyte imbalances
   2. Indirect diagnoses
      a. Risk for injury
   3. Collaborative problems
4. Nursing activities developed for collaborative problems

II. Sodium Imbalances: Hyponatremia - Sodium < 135 mEq/L

A. Etiology and risk factors
   1. Increased loss: diuretics, vomiting, diarrhea, excessive perspiration, etc.
   2. Inadequate intake

B. Pathophysiology
   1. Intracellular edema due to fluid shifts

C. Clinical Manifestations: Hyponatremia
   1. Sodium < 125 mEq/L
      a. Neurologic: headache, confusion
      b. Cardiovascular: decreased BP, tachycardia, thready pulse
      c. Pulmonary: crackles, dyspnea
      d. Gastrointestinal: nausea, vomiting
      e. Other: dry skin and mucous membranes

D. Outcome Management: Hyponatremia
   1. Medical and nursing management
      a. Restore sodium levels: replacement
      b. Reduce sodium loss: prevent vomiting and diarrhea
      c. Restore sodium balance
   2. Outcomes
      a. The nurse will monitor sodium and chloride levels and for clinical manifestations of hyponatremia

III. Sodium Imbalances: Hypernatremia - Sodium > 145 mEq/L

A. Etiology and risk factors
   1. Excess fluid loss or sodium intake
   2. Inadequate water intake

B. Pathophysiology
   1. Fluid shift causing cellular dehydration
   2. Increased myocardial depolarization

C. Clinical Manifestations: Hypernatremia
   1. Early symptoms - Na > 145 mEq/L
      a. Polyuria followed by oliguria, anorexia, N&V, weakness, restlessness
   2. Late symptoms - Na > 155 mEq/L
      a. Confusion, seizures, coma, tremors, muscle twitching, rigid paralysis

D. Outcome Management: Hypernatremia
   1. Medical/nursing outcome management
      a. Goal is correction of the body water osmolality with restoration of cell volume, by decreasing
the ratio of sodium to water in the ECF

b. Replace fluid loss-slow IV administration of hyposmolar electrolyte solutions (0.2% or 0.45% NaCl or 5% dextrose in water)

c. Sodium restriction - know high and low Na foods and teach accordingly

2. Outcomes
   a. The nurse will monitor plasma sodium and chloride levels and for clinical manifestations of hypernatremia

E. Diagnosis, Outcomes, Interventions
   1. Diagnosis
      a. Impaired or oral mucous membranes R/T lack of body water

   2. Outcomes
      a. Maintain moist oral mucous membranes

   3. Interventions
      a. Oral care
      b. Offer low-acid juices

IV. Potassium Imbalances: Hypokalemia - Potassium < 3.5 mEq/L
   A. Etiology and risk factors
      1. Inadequate intake of potassium
      2. Excess output of potassium
      3. Medications linked to potassium loss (especially diuretics)

   B. Pathophysiology
      1. Increased excitability of nerves and muscles

   C. Clinical Manifestations: Hypokalemia
      1. Cardiovascular
         a. Electrocardiogram (EKG) changes, dysrhythmias, arrest, decreased myocardial contraction
      2. Gastrointestinal
         a. Anorexia, abdominal distention
      3. Musculoskeletal
         a. Muscle weaknesses, leg cramps, paralysis
      4. Neurological
         a. Fatigue, hyporeflexia, confusion, convulsions, coma

   D. Outcome Management: Hypokalemia
      1. Medical/nursing management
         a. Restore potassium levels
            i. Mild or moderate hypokalemia - Administer foods high in potassium or oral potassium supplements (give with juice or food to decrease irritation or gastric mucosa)
            ii. Severe hypokalemia - IV replacement - NEVER GIVE POTASSIUM IV PUSH (must dilute and give slowly)

         b. Ongoing assessments
E. Diagnosis, Outcomes, Interventions

1. Diagnosis - Risk for injury R/T muscle weakness, hypotension, seizures
   a. Outcome
      i. Client will not sustain injury
   b. Interventions
      i. Implement safety precautions

2. Diagnosis - Imbalanced Nutrition: Less than Body Requirements R/T insufficient intake of potassium-rich foods
   a. Outcomes
      i. Adequate intake of potassium-rich foods
   b. Interventions
      i. Educate patient regarding potassium-rich foods and supplements

V. Potassium Imbalances: Hyperkalemia - Potassium > 5.0 mEq/L

A. Etiology and risk factors
   1. Retention of potassium
   2. Excess intake of potassium
   3. Release from cells following trauma

B. Pathophysiology
   1. Altered excitability of nerves and muscles

C. Clinical Manifestations: Hyperkalemia
   1. Cardiopulmonary
      a. Hypertension, cardiac and respiratory arrest due to muscle paralysis
   2. Gastrointestinal
      a. Intestinal colic, diarrhea
   3. Musculoskeletal
      a. Paresthesias, muscle irritability

D. Outcome Management: Hyperkalemia
   1. Medical/nursing management
      a. Restore potassium balance
         i. Dietary restrictions
         ii. Administer fluids and encourage diuresis
         iii. Utilize cation exchange resin - Kayexalate
   2. Outcomes
      a. The nurse will monitor potassium levels and report abnormal findings and symptoms or hyperkalemia

VI. Calcium Imbalances: Hypocalcemia - Calcium < 4.5 mEq/L or 9 mg/dl

A. Etiology
   1. Inadequate intake of calcium or vitamin D
   2. Parathyroid disease or removal

B. Pathophysiology
   1. Increased neuromuscular excitability
C. Clinical Manifestations - Hypocalcemia
1. Neuromuscular
   a. Numbness and tingling of hands, toes, and lips; facial twitching, seizures; tetany- NEEDS IMMEDIATE ATTENTION

2. Cardiovascular
   a. Hypotension, dysrhythmias, weak pulse

3. Skeletal
   a. Spontaneous fractures

D. Outcome Management - Hypocalcemia
1. Medical/nursing management
   a. Restore calcium balance
      i. Replacement
   b. Educate regarding calcium-rich foods
   c. Move patient with caution
   d. Careful assessments

VII. Calcium Imbalances: Hypercalcemia - Calcium > 5.5 mEq/L or 11 mg/dl
A. Etiology and risk factors
   1. Metastatic malignancy, thiazide diuretic therapy, hyperparathyroidism

B. Pathophysiology
   1. Decreased neuromuscular excitability

C. Clinical Manifestations - Hypercalcemia
1. Urinary
   a. Polyuria related to an osmotic diuresis

2. Gastrointestinal
   a. Anorexia, constipation, nausea, abdominal distention

3. Neuromuscular
   a. Fatigue, depression, muscle weakness

D. Outcome Management: Hypercalcemia
1. Medical/nursing management
   a. Restore calcium balance
      i. IV hydration and diuretics
      ii. Avoid calcium-containing products and foods high in calcium
   b. Safety precautions
   c. Educate to avoid calcium intake

VIII. Phosphate Imbalances:
A. Hypophosphatemia - Level < 1.2 mEq/L
   1. Etiology and risk factors
      a. Excess loss or lack of intake
      b. Long-term use of antacids
   2. Clinical manifestations
      a. Decreased cardiac and respiratory function, weakness, confusion, etc.
3. Outcome management  
a. Restore phosphate balance

B. Hyperphosphatemia - Level > 3 mEq/L  
1. Etiology and risk factors  
a. Excessive intake

2. Clinical manifestations  
a. Early: tachycardia, palpitations  
b. Late: tetany, hyperreflexia

3. Outcome management  
a. Eliminate excess phosphate

IX. Magnesium Imbalances:  
A. Hypomagnesemia  
1. Level < 1.5 mEq/L or 1.8 mg/dl  
a. Related to less intake and absorption

2. Risk factors  
a. Alcoholism, malabsorption syndromes, medications, history of cocaine abuse

3. Clinical manifestations  
a. Myocardial irritability, convulsions, etc.

4. Outcome management  
a. Replacement

B. Hypermagnesemia  
1. Levels > 2.5 mEq/L or 3 mg/dl

2. Clinical manifestations  
a. Muscle weakness, sedation, areflexia (loss of deep tendon reflexes), respiratory paralysis

3. Outcome management  
a. IV hydration and diuretics