

CELLULAR HOMEOSTASIS
Courie~Naini

NUR 401
Course~Num5er

COURSE DESCRIPTION

This unit serves as the foundation for all theoretical and clinical components. Discussion is directed at areas of normal fluid and electrolyte concentrations and their role as well as normal acid-base balance. It expands from normal to abnormal in terms of edema formation, dehydration, electrolyte imbalance, and acid-base disturbances.

Methods of nursing intervention and management are related to the pathological conditions.

A practice session of hypothetical situations on assessment of fluid and electrolyte balance and interpretation of acid-base disturbances is provided. Intravenous equipment and therapy as well as central venous pressure line maintenance and measurement is incorporated.

TERMINAL COURSE OBJECTIVES:

Utilizing the Nursing Process in the management of the critically ill patient, the critical care nurse will:

- a) systematically assess the functions of all body systems;
- b) incorporate knowledge of the inter-relatedness of all body systems;
- c) recognize the clinical presentation and related diagnostic findings of various pathological conditions;
- d) provide the essential elements of nursing care that will meet the needs of patients with multiple problems;
- e) anticipate potential complications of patients with multi-system problems;
- f) adapt nursing care according to phases of growth and development;
- g) adjust nursing care in accordance to the psychological manifestations of the patient;
- h) justify the nursing diagnosis, plan treatment modalities and interventions required;
- i) administer and evaluate patients' response to nutritional, fluid and electrolyte therapy;

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- j) appropriately administer and evaluate patient response to pharmacological agents?
- k) assist in the maintenance of optimal airway patency and circulation integrity;
- l) ensure the operation and effectiveness of machines and specialized equipment;
- m) provide the appropriate care for patients on continuous ventilatory or circulatory support systems;
- n) perform essential nursing care related to the patient with invasive monitoring;
- o) report accurately and record assessment data, changes in patient status and responses to therapy in accordance with policies of the employing agency;
- ^ Pp) communicate effectively with patients, families, and members of the health care team;
- q) participate in the design and implementation of patient and family education;
- r) evaluate the impact of the critical care environment on patients, family members and staff;
- s) collaborate with patient, family and other members of the health care team in planning care from admission through to rehabilitation;
- t) assume the responsibility for creating an environment of safe practice;
- u) comply with legislation and regulations governing nursing practice;

It is the responsibility of each nurse to maintain nursing competencies by continuously assessing his/her skills and knowledge by participating in formal and informal learning activities, when appropriate.

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Course Objectives

A) The Cell

- 1) The Cell Membrane
- 2) Cellular Properties and Functions
- 3) Na-K (sodium-potassium)
- 4) Action Potential
- 5) Energy Metabolism
 - aerobic
 - anaerobic
 - protein and fat

describe the normal structure and function of the cell membrane

discuss the Na-K pump mechanism in relationship to action potential

outline each of the methods of energy metabolism

B) Body Fluids

- * 1) IC and EC compartments
- * 2) IC and EC electrolytes

identify the major fluid compartments and the electrolyte concentrations found in each

C) Transport Mechanisms

- 1) Osmosis
- 2) Diffusion - simple
 - facilitated
- 3) Active Transport

explain each of the transport objectives

D) Solutions

- 1) Isotonic
- 2) Hypertonic
- 3) Hypotonic
- 4) Def* Osmolality

differentiate between isotonic, hypertonic and hypotonic solutions in order to safely administer
define osmolality

E) IC-EC Fluid Shift

- 1) Swelling, Shrinking of Cells

utilizing the knowledge of solutions, explain the fluid shifts that occur to result in the swelling or shrinking of cells

* 1) intracellular and extracellular

* 2) intracellular and extracellular

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F) Fluid Pressures

- 1) Capillary Hydrostatic Pressure
- 2) Plasma Oncotic Pressure
- 3) ISF Oncotic Pressure
- 4) Interstitial Fluid Pressure

explain the four fluid pressures that relate to capillary fluid shifting

G) Capillary Fluid Dynamics

- 1) Starling's Law

H) Water Balance

- 1) Intake-Output
- 2) Daily Weight
- 3) Infant and Adult

outline methods of determining fluid balance and of accurate recording

I) Regulation of Water Balance

- 1) Hormonal
 - Antidiuretic Hormone
 - Aldosterone
 - Renin Angiotensin System
- 2) Nervous
- 3) Renal
- 4) Effect of Diuretics

discuss the renin-angiotensin system and its role in relation to ADH and aldosterone in the regulation of arterial blood pressure
explain the effect of major diuretics

J) Electrolytes

- 1) Amount, Distribution, Function and Regulation of Na⁺, K⁺, Ca⁺⁺, Mg⁺⁺, Cl⁻, HCO₃⁻, Proteins

describe the regulation of each of the major cations and anions

K) Acid-Base Balance

- 1) Definition of Terms Acidosis, Alkalosis, Hypoxemia, Hypoxiar pH, pCo₂, HCO₃⁻, BE, PO₂, O₂ Sat
- 2) Sources of Acids
 - fixed volatile

define the major terminology in acid-base interpretation

Course Content**Course Objectives**

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| <ul style="list-style-type: none"> 3) Buffer Systems <ul style="list-style-type: none"> - Carbonic Acid Buffering System - Phosphate - Proteins 4) Regulation - Lungs <ul style="list-style-type: none"> - Kidneys | <p>describe three buffer systems employed to maintain acid-base balance</p> <p>differentiate between renal and respiratory regulation of acid-base balance</p> |
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L) Formation of Edema Due To

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| <ul style="list-style-type: none"> 1) Increased Capillary Hydrostatic Pressure 2) Changes in Capillary Membrane Permeability 3) Low Blood Protein 4) Lymphatic Blockage | <p>discuss the factors that influence the formation of edema</p> <p>state the appropriate nursing interventions for the patient with edema</p> |
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M) Dehydration

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| <ul style="list-style-type: none"> 1) Causes 2) Signs and Symptoms | <p>list the signs and symptoms of overload and dehydration and relate to the underlying pathophysiology</p> |
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N) Overload

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| <ul style="list-style-type: none"> 1) Causes 2) Signs and Symptoms | <p>develop a nursing care plan to assist in the care of the patient with dehydration</p> |
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O) C.V.P. Lines and Measurement (Central Venous Pressure)

discuss the use of C.V.P. measurements to determine an indication of venous return to the right heart

P) Electrolyte Imbalances

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| <ul style="list-style-type: none"> 1) Hypernatremia <ul style="list-style-type: none"> - Hemo-concentration - Na⁺ Excess 2) Hyponatremia <ul style="list-style-type: none"> - Hemodilution - Na⁺ Deficit 3) Hyperkalemia, Hypokalemia | <p>describe each of the electrolyte imbalances with reference to etiology, pathophysiology</p> <p>diagnostic studies, clinical presentation and management</p> <p>formulate a plan for nursing intervention to assist in the maintenance</p> |
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- 4) Hypercalcemia,
Hypocalcemia
- 5) Hypermagnesium,
Hypomagnesium
- 6) Protein Excess and
Deficit

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of electrolyte balance
discuss the psychological support
required for a patient with an
electrolyte disturbance

Q) Acid-Base Imbalances

- 1) Causes, Clinical
Presentation and Inter-
pretation of the
following:
 - Respiratory Acidosis
 - Respiratory Alkalosis
 - Metabolic Acidosis
 - Metabolic Alkalosis

state the major causes of each of the
four imbalances
list the clinical findings of acidosis
and alkalosis
differentiate between correction and
compensation
interpret acid-base imbalances in
relation to disease

METHOD OF ASSESSMENT (GRADING METHOD);

- 1) Test #1 (worth 40% of final mark)

The Cell
Body Fluids
Transport Mechanisms
Solutions
IC-EC Fluid Shift

Fluid Pressures
Capillary Fluid Dynamics
Water Balance
Regulation of Water Balance

- 2) Test #2 (worth 60% of final mark)

- Electrolytes
Electrolyte Imbalances
Acid-Base Balance
- Acid-Base Imbalances

Formation of Edema
Dehydration
Overload
- C*V.P.

A minimum achievement level of 70% is required.

HOURS

7 Weeks (Total of 21 Hours - 3 hours per week)

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TEXTBOOKS;

- 1) Burke, Shirley, The Composition and Function of Body Fluids The C-V. Mosby Co., Toronto, 1980.
- 2) Weldy, Norma Jean, Body Fluids and Electrolytes The C.V. Mosby Co., Toronto, 1984.

CLASS SCHEDULE!

Week #1

Reading Assignments

The Cell
Body Fluids
Transport Mechanisms
Solutions
IC-EC Fluid Shift

Part 1 (Weldy)
Chapters 1, 3, 4, 10, pp 173-179
(Burke)

Week #2

Fluid Pressures
Capillary Fluid Dynamics
Water Balance
Regulation of Water Balance

Part 1 (Weldy)
Chapters 1, 3, 6 (Burke)

Week #3

Test #1 (1 1/2 hours)
Electrolytes

Test #1 (Content A-I)
Part 1 (Weldy)
Chapter 5 (Burke)

Week #4

Electrolytes
Electrolyte Imbalances

Part 1, 4 (Weldy)
Chapter 5 (Burke)

Week #5

Acid-Base Balance
Acid-Base Imbalances

Part 2 (Weldy)
Chapters 8, 9 (Burke)
Articles "Interpreting ABG's"
(On Reserve in Library)

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Week #6

Reading Assignments

Formation of Edema
Dehydration
Overload
C.V.P.

Part 3 (Weldy)
Chapters 2, 3, 10 (Burke)

Week #7

Test #2

Test #2 (Content J-Q)

REFERENCE LIST

Burke, Shirley, The Composition and Function of Body Fluids. The C.V. Mosby Co., Toronto, 1980.

Goldberger, Emanuel, A Primer of Water, Electrolyte and Acid-Base Syndromes* Lea and Febiger Co., New York, 1980.

Guyton, Arthur, Human Physiology and Mechanisms of Disease, 3rd Ed., W-B. Saunders Co., Philadelphia, 1982.

Hamilton, Helen, Monitoring Fluid and Electrolytes Precisely. Intermed Communications, Inc., Pennsylvania, 1979.

Hudak, C-, Lohr, T., and Gallo, B., Critical Care Nursing. J.B. Lippincott Co., Philadelphia, 1982.

Kee, Joyce, Fluids and Electrolytes with Clinical Applications. John Wiley & Sons, Inc., New York, 1978.

Kenner, C, Guzzetta, C, and Dossey, B., Critical Care Nursing Body, Mind, Spirit. Little, Brown and Co., Boston, 1985.

Keyes, Jack, Fluid Electrolyte and Acid-Base Regulation. Wadsworth Health Sciences Division, Inc., California, 1985.

Meyer, Nancy, Nursing the Critically Ill Adult, Applying Nursing Diagnosis. Addison-Wesley Publishing Co., California, 1984.

Reed, G,, and Sheppard, V., The Regulation of Fluid and Electrolyte Balance. W.B. Saunders Co., Philadelphia, 1977.

Stolar, Vera, Human Acid-Base Chemistry. The American Journal of Nursing Co., New York, 1973.

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Urrowsr Susan, The Nursing Clinics of North America. W.B. Saunders Co., Philadelphia, 1980.

Weldy, Norma Jean, Body Fluids and Electrolytes. The C.V- Mosby Co., Toronto, 1984.