RESP-1320: ACID-BASE AND HEMODYNAMICS

Cuyahoga Community College

Viewing: RESP-1320 : Acid-Base and Hemodynamics

Board of Trustees:
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Academic Term:
Fall 2020

Subject Code
RESP - Respiratory Care

Course Number:
1320

Title:
Acid-Base and Hemodynamics

Catalog Description:
Overview of acid-base regulation, integrating physiologic functions of renal and respiratory systems. Emphasis on body buffer systems, oxygen and carbon dioxide transport systems, basic chemistry and circulating blood forces through the body. Patient analysis and principles of equipment used in analysis of acid base, oxygenation status, cardiac output and cardiac blood pressures addressed.

Credit Hour(s):
2

Lecture Hour(s):
2

Lab Hour(s):
0

Other Hour(s):
0

Requisites

Prerequisite and Corequisite
RESP-1300 Respiratory Care Equipment, and RESP-1310 Cardiopulmonary Physiology.

Outcomes

Course Outcome(s):
Explain acid-base regulatory functions including the respective buffer systems, the respiratory and metabolic system components, and the oxygen and carbon dioxide transport systems.

Essential Learning Outcome Mapping:
Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):
1. List the general functions performed by kidneys.
2. Define processes involved in urine formation.
3. List normal ranges for body electrolytes.
4. Recognize the effect on acid base balance of out of range body electrolytes.
5. Discuss causes and treatment of kidney disease.
6. Calculate pH using the Henderson-Hasselbalch equation.
7. Demonstrate an understanding of body buffers role in acid-base balance.
8. Discuss how various substances affect the dissociation curve and tissue oxygenation.

Course Outcome(s):

Analyze acid-base states and propose possible causes of each respective disorder and also describe any compensatory functions acting to normalize the acid-base status.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. State causes and compensatory mechanisms of acute acid base imbalances.
2. Analyze arterial blood gas results.

Course Outcome(s):

Summarize the equipment used in the analysis of acid-base, oxygenation and hemodynamic status including the operational principles, quality assurance, and clinical application.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. State the function of blood gas electrodes.
2. Troubleshoot issues with blood gas electrodes.
3. Describe principle of operation and application of transcutaneous O2 and CO2 analyzers.
4. Describe operation and application of a cooximeter.
5. Describe the operation, application and limitations of a pulse-oximeter.
6. Explain the operation and application of a capnograph.

Course Outcome(s):

Discriminate normal cardiovascular pressures from abnormal and determine/propose possible causes and treatment.

Essential Learning Outcome Mapping:

Not Applicable: No Essential Learning Outcomes mapped. This course does not require application-level assignments that demonstrate mastery in any of the Essential Learning Outcomes.

Objective(s):

1. Discuss the indications, operation, hazards, and capabilities of a flow directed catheter.
2. List normal ranges for hemodynamic parameters.
3. Given a set of hemodynamic parameters determine possible clinical cause(s).
4. Propose treatment for a patient with abnormal hemodynamic values given a scenario.

Methods of Evaluation:

1. Quizzes
2. Tests
3. Comprehensive exam

Course Content Outline:

1. Basics of acid-base regulation
    a. Fundamental chemistry
        i. bases
        ii. acids
            1. volatile
            2. non-volatile
        iii. neutralization
        iv. relationship of hydrogen ion concentration to pH
            1. dissociation constant
            2. ionization constant
            3. pH
            4. Henderson-Hasselbach equation

5. acidosis
6. alkalosis

b. Body buffer systems
   i. regulation of blood acids
      1. dietary acids
      2. lactic acids
      3. keto acids
   ii. chemical buffers
      1. chemical buffers
      2. acid-base buffer pair
   iii. bicarbonate buffer system
      1. buffer strength
      2. organs involved
   iv. protein buffer system
      1. plasma proteins
      2. hemoglobin
         a. chemistry of hemoglobin
         b. oxygen affinity
         c. oxygen transport
         d. carbon dioxide transport
         e. chloride shift
         f. Haldane effect
         g. Bohr effect
   v. limitations of buffers

2. Components of acid-base regulation
   a. Metabolic component
      i. renal regulations of acids and bases
      ii. renal compensation
      iii. laboratory assessment
         1. actual bicarbonate
         2. standard bicarbonate
         3. total carbon dioxide
         4. base excess/deficit
   b. Respiratory component
      i. ventilation
         1. alveolar ventilation
         2. deadspace ventilation
      ii. relation of carbon dioxide tension to pH level
         1. carbon dioxide solubility
         2. body fluid pH levels related to ventilation
            a. peripheral chemoreceptors
            b. central chemoreceptors
      iii. compensatory limitations
      iv. respiratory failure
         1. central nervous system insufficiency
         2. lung parenchymal disorders
         3. mechanical disorders
      v. laboratory assessment
3. Abnormal acid-base states
   a. Characteristics of acid-base disturbances
      i. acidosis
         1. metabolic acidosis
            a. causes
            b. buffer mechanisms
            c. acute vs. chronic
            d. treatment
         2. respiratory acidosis
            a. possible causes
            b. buffer mechanisms

c. acute vs. chronic
d. treatment

ii. alkalosis
1. metabolic alkalosis
a. possible cause
b. buffer mechanisms
c. acute vs. chronic
d. treatment
2. respiratory alkalosis
3. possible cause
4. buffer mechanisms
5. acute vs. chronic
6. treatment

b. Clinical acid-base interpretation
i. criteria for interpretation
1. evaluate pH
a. normal
b. acidotic
c. alkalotic
2. evaluate carbon dioxide tension
a. normal
b. increased
c. decreased
3. evaluate bicarbonate level
a. normal
b. increased
c. decreased
4. evaluate base excess/deficit
5. evaluate oxygenation
a. normal
b. hypoxemia

ii. combined acid-base disorders
1. combined acidosis
2. combined alkalosis
3. combined acidosis and alkalosis
a. naturally occurring
b. iatrogenically induced
4. superimposed

4. Mechanical analysis of acid-base and oxygenation status
a. Arterial blood gas analyzers
i. pH electrode (Sanz Electrode)
1. calibration/quality assurance
2. trouble shooting

ii. PC02 electrode (Severinghause Electrode)
1. calibration/quality assurance
2. trouble shooting

iii. P02 electrode (Clark Electrode)
1. calibration/quality assurance
2. trouble shooting

b. Transcutaneous analyzers
i. P02 electrode
1. structure
2. principle of operation
3. calibration/quality assurance
4. clinical application
5. limitations

ii. PC02 electrode
1. structure
2. principle of operation
3. calibration/quality assurance

4. clinical application
5. limitations

c. Cooximetry
   i. principle of operation
   ii. measurable parameters
   iii. calibration/quality assurance
   iv. clinical application
   v. limitations

d. Oximetry
   i. principle of operation
   ii. measurable parameters
   iii. clinical application
   iv. sampling protocols
   v. calibration/quality assurance
   vi. limitations

e. Capnography
   i. principle of operation
   ii. measurable parameters
   iii. clinical application
   iv. sampling protocols
   v. calibration/quality assurance
   vi. limitations

5. Components of hemodynamic monitoring
   a. Arterial blood pressure
      i. diastolic pressure
      ii. systolic pressure
      iii. mean pressure
      iv. systemic vascular resistance (SVR)
   b. Stroke volume
   c. Preload
   d. Afterload
   e. Central venous pressure (CVP)
   f. Right ventricular
   g. Pulmonary artery
      i. catheter insertion
         1. indications
         2. hazards
         3. waveforms
         4. trouble-shooting errors
      ii. diastolic pressure
      iii. systolic pressure
      iv. mean pressure
      v. pulmonary vascular resistance (PVR)
      vi. pulmonary capillary wedge pressure (PCWP)
   h. Left atrial pressure
      i. diastolic pressure
      ii. systolic pressure
   i. Left ventricular pressure
      i. diastolic
      ii. systolic
   j. Cardiac output
   k. Cardiac index
6. Clinical hemodynamic interpretation
   a. Equipment calibration
   b. Equipment troubleshooting
   c. Evaluation for interpretation
      i. CVP
      ii. pulmonary artery pressure

iii. PVR
iv. PCWP
v. left heart pressures
vi. cardiac output
vii. SVR

d. Disorders
e. Treatment

Resources

Kacmarek, R., M., J. K. Stoller and A.J. Huer. *Egan's Fundamentals of Respiratory Care*. 11th ed. St. Louis: Elsevier, 2017.

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T. Des Jardins, George G. Burton. (2020) chapter 5 - Blood Gas Assessment. *cliinical Manifrstations and Assessment of Respiratory Diseases*, St. louis: Elsevier.

W. Beachey. (2018) Chapter 13-Clinical Assessment of Acid-Base and Oxygenation. *Respiratory Care Anatomy and Physioology*, St. Louis: Elsevier.

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