RESP-1310: CARDIOPULMONARY PHYSIOLOGY

Cuyahoga Community College

Viewing: RESP-1310 : Cardiopulmonary Physiology

Board of Trustees:
May 2019

Academic Term:
Fall 2019

Subject Code
RESP - Respiratory Care

Course Number:
1310

Title:
Cardiopulmonary Physiology

Catalog Description:
Physiology of cardiovascular and pulmonary systems with emphasis on electrophysiology of the heart, electrocardiography interpretation, blood flow characteristics and hemodynamics. Pulmonary system emphasis on lung volumes, dynamics of ventilation, pulmonary function tests, diffusion, ventilation to perfusion characteristics, gas transport, oxygenation studies and control of ventilation.

Credit Hour(s):
3

Lecture Hour(s):
3

Lab Hour(s):
0

Other Hour(s):
0

Requisites

Prerequisite and Corequisite
Departmental approval.

Outcomes

Course Outcome(s):
Relate the anatomic structures of the cardiovascular system to their respective physiologic function.

Objective(s):
1. Categorize the clinical significance of the components of the blood
2. Diagram and label the mechanical and electrical structures of the heart.
3. Differentiate capacitance and resistance vessels.
4. Relate the terms depolarization and repolarization to the electrical and mechanical actions of the heart.
5. Differentiate the results of sympathetic and parasympathetic innervation on the heart and blood vessels.

Course Outcome(s):
Compare and contrast factors that affect blood pressure and blood flow through the cardiovascular system.

Objective(s):

1. Compare the relationship of preload, afterload and contractility on stroke volume and cardiac output.
2. Interpret the interrelationship of contractility, flow, pressure, and resistance to changes in systemic and/or pulmonary vascular resistance.
3. Predict the effect on blood pressure when any of the following factors are changed: blood volume, venous return, ventricular end-diastolic pressure (VEDP), ventricular end-diastolic volume (VEDV), stroke volume (SV), cardiac output (CO), heart rate, contractility, peripheral resistance, and vessel constriction and/or dilation.
4. Differentiate the types of pressures affecting blood vessels.
5. Compare the systemic and pulmonary vascular systems.
6. Relate the effect of gravity on blood flow to various regions of the lung.

Course Outcome(s):

Compare normal and abnormal conduction (arrhythmias) to heart function.

Objective(s):

1. Relate the phases of the action potential to the conduction of a normal heart beat.
2. Compare the effects of repolarization and depolarization of the heart chambers to the waveforms seen on the electrocardiogram (ECG).
3. Calculate the heart rate given an ECG strip.
4. Analyze ECG rhythm strips.
5. Predict the physiologic events that are occurring given an electrocardiogram (normal or abnormal).

Course Outcome(s):

Relate the anatomic structure of the respiratory system to the respective physiologic function.

Objective(s):

1. Associate principles of gas flow, resistance and compliance to the anatomical structures regulating the dynamic principles of ventilation.
2. Gain an understanding of the principles of gas diffusion and its limiting factors within the pulmonary circulation.
3. Differentiate the processes of ventilation, gas distribution, gas flow, diffusion and respiration and identify the structures that accommodate these functions.
4. Compare the stimulus of ventilation between the central and peripheral chemoreceptors.
5. Integrate the structural and physiologic effects of spinal injuries on the process of ventilation.

Course Outcome(s):

Categorize pulmonary function test results as measuring flow, volume, diffusion or resistance.

Objective(s):

1. Diagram and label a spirometry tracing and flow-volume loop.
2. Interpret pulmonary function test results as normal, obstructive or restrictive.
3. Compare actual and percent of predicted values.
4. Identify airflow and lung volume abnormalities given a pulmonary function report (tracing and numerical values).

Course Outcome(s):

Associate principles of gas flow, resistance and compliance to the anatomical structures regulating the principles of ventilation.

Objective(s):

1. Compare pressure gradients during inspiration and expiration across the lung.
2. Evaluate the clinical changes seen with changes in lung compliance.
3. Calculate minute ventilation, alveolar ventilation, tidal volume and frequency given a clinical scenario.
4. Predict how changes in the variables of Poiseuille's Law affect airway resistance.
5. Classify clinical scenarios as presenting normal, shunting, deadspace relationships.
6. Predict how changes in surfactant levels could alter alveolar distending pressures and lung compliance in newborns and adults.
7. Categorize how changes in gas flow, volume, pressure, and/or resistance could alter work of breathing.

Course Outcome(s):

Illustrate the relationship of gas diffusion and gas transport to cellular respiration.

Objective(s):

1. Calculate the alveolar air equation given clinical scenarios and relate results to diffusion gradients in the lung under normal and abnormal conditions.
2. Differentiate the methods of gas transport for oxygen and carbon dioxide.
3. Categorize clinical factors that could shift the position of the oxygen and carbon dioxide dissociation curves.
4. Calculate oxygen content related equations.
5. Contrast the Bohr and Haldane Effects in achieving deliver of O2 to tissues and CO2 to the lung.
6. Predict changes in the rate of gas diffusion at the alveolar capillary membrane using Fick's Law given a clinical scenario.

Course Outcome(s):

Differentiate the gas volume of the lung to pulmonary circulation and the physical characteristics which regulate ventilation to perfusion matching.

Objective(s):

1. Compare perfusion and diffusion limited gases and relate to pulmonary blood flow.
2. Calculate the overall ventilation-perfusion ratio given a clinical scenario.
3. Diagram ventilation-perfusion relationships seen in the zones of the lung in an upright position and compare to variations occurring with changes in body position.
4. Analyze how ventilation-perfusion ratios could change in the presence of shunting and /or deadspace.

Methods of Evaluation:

1. Examinations and quizzes
2. Class presentations in small learning groups
3. Participation in small group learning activities

Course Content Outline:

1. Cardiovascular system
   a. anatomy and physiology
      i. blood
      ii. vessels
      iii. heart
   b. Cardiac cycle
      i. blood flow through the heart chambers
      ii. cardiovascular pressures and volumes
      iii. cardiovascular control
   c. Electrophysiology of the heart
      i. action potential
      ii. conduction system of the heart
      iii. sequence of electrical activity of the cardiac cycle
      iv. interrelationship of electrical system and mechanical action of heart
      v. action potential related to conduction
   d. Hemodynamics of cardiovascular system
      i. interrelationships between flow, volume, resistance, and pressure
      ii. variables that determine/modify blood pressure
      iii. variables that determine/modify cardiac output
      iv. variables the determine/modify resistance to blood flow
      v. clinical measurements related to flow, volume, resistance, and pressure
   e. Normal and abnormal electrocardiogram
      i. waveform components of electrocardiogram and corresponding electrical and mechanical actions of the heart
      ii. calculate rate of electrocardiogram rhythms
      iii. interpret normal and abnormal electrocardiogram rhythms
      iv. abnormal cardiac rhythm impact on cardiac output
2. Respiratory system

a. anatomy and physiology
    i. upper and lower airways
    ii. respiratory exchange zone
    iii. lung divisions
    iv. thorax
    v. histology
b. control of ventilation
    i. normal ventilatory drive
    ii. abnormal ventilatory drive
    iii. ventilation mechanics
    iv. interrelationships between pressure, flow, volume, and resistance
    v. pulmonary pressure changes that result in inspiration and expiration
    vi. normal and abnormal lung compliance
    vii. variables effecting distending pressure of alveolus
    viii. variables effecting airway resistance
    ix. relationship of clinical measurements of tidal volume, respiratory rate, minute ventilation
c. pulmonary function tests
    i. spirometry
    ii. flow-volume loops
    iii. body plysmography
    iv. Diffusing capacity of the lungs for carbon monoxide (DLCO)
    v. characteristics of normal, obstructive, and restrictive studies
d. diffusion of pulmonary gases and transport of gases
    i. normal movement of gases across alveolar-capillary membrane
    ii. alveolar-air equation and related calculations
    iii. effect of variables of Fick's Law on rate of gas diffusion
    iv. methods of gas transport for oxygen and carbon dioxide
    v. oxygen content variables and related calculations
    vi. oxygen and carbon dioxide dissociation curves
    vii. optimizing gas transport utilizing Bohr and Haldane effect
e. ventilation-perfusion matching
    i. perfusion-limited and diffusion limited gases
    ii. calculate ventilation-perfusion matching
    iii. normal and abnormal ventilation-perfusion matching in the lung
    iv. pulmonary shunting and deadspace

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Resources

Des Jardins T. *Cardiopulmonary Anatomy and Physiology.* 6th ed. Clifton Park NY: Delmar, 2013.

Forster II, Robert E., and Arthur B. Dubois. *The Lung: Physiologic Basis of Pulmonary Function Tests.* 3rd ed. Chicago: Yearbook Medical Publishers, 1986.

West JB. *Respiratory Physiology - The Essentials*. 10th. Baltimore: Williams and Wilkins, 2015.

West JD. *Physiology & Pathophysiology*. 9th. Baltimore: Lippincot Williams & Wilkins, 2017.

Wilkins S, Stoller J, Scanlan D,. *Efan's Fundamentals of Respiratory Care*. 11th. St. Louis: Elsevier, 2017.

O'Keefe JH Jr, Hammill SC, Freed MS, Pogwizd SM. *The Complete Guide to ECGs*. 4th. Boston: Physician's Press, 2016.

Aehlert, B. *ECGs Made Easy*. 6th. Philadelphhia: Mosby, 2017.

Hess DR, MacIntyre NR, Mishoe SC, Galvin WF, Adams AB. *Respiratory Care-Principles and Practice*. 3rd. Burlington MA:Jones & Bartlett Learning, 2015.

Ruppel GL. *Manual of Pulmonary Function Testing*. 11th. St. Louis: Elsevier health Sciences, 2017.

Aaronson PI, Ward JPT, Connolly MJ. *The Cardiovascular System - at a glance.* 4th. Malden MA: John Wiley Sons, 2013.

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