Medical Physiology of the Cardiovascular System
HAPS Institute Graduate Credit Course
offered in conjunction with Alverno College
April 20 to June 20, 2021

Instructor:
Patrick Eggena, M.D.
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Class size: 3-7
Graduate Credits: 3
Prerequisite: Human Physiology

Description of the course:

This course in Medical Physiology of the Cardiovascular System is primarily for HAPS professors who teach pre-medical, medical, or nurse practitioner students. It is a self-study course where participants attend 13 hours of live video-lectures by Dr. Eggena in cardiovascular physiology and read pertinent information related to the lectures.

After the lecture series students follow Dr. Eggena on his 16-hour night tour at a hospital where they apply the physiology learned in class to patient care in the emergency room and at the patient’s bedside.

Participants taking the course for graduate credits are given a 2-hour proctored examination with 60 true/false and 4 graphic essay questions.

Syllabus

A. Watch: *Lectures in Cardiovascular Physiology* by Patrick Eggena M.D. on a HAPS website.

B. Read: *Medical Physiology of the Heart-Lung-Kidney* by Patrick Eggena, M.D. provided for free by the author.

Instructions

1. (1) Watch:
Cardiac Electrophysiology: In this 1-hour video-lecture Dr. Eggena gives an overview of the cardiovascular system and considers cardiac action potentials.

(2) Read:
   a. Basic Structure and Function of the Heart
   b. Cardiac Action Potential

2. (1) Watch:
   Introduction to Electrocardiography: In this 46-minute video-lecture Dr. Eggena discusses depolarization and repolarization of the heart and considers cardiac vectors, waves, and intervals.
   (2) Read:
   a. Depolarization and Repolarization of Cardiac Muscle
   b. Cardiac Vectors, Waves, and Intervals

3. (1) Watch:
   The Leads, Hypertrophy, and Axis: In this 52-minute video-lecture Dr. Eggena discusses the leads of the EKG, myocardial hypertrophy, and the mean electrical axis of the heart.
   (2) Read:
   a. EKG leads
   b. Cardiac Hypertrophy
   c. Mean QRS Axis

4. (1) Watch:
   Myocardial Infarction and Cardiac Rhythms: In this 40-minute video-lecture Dr. Eggena considers EKG changes in Myocardial Infarction and discusses regular, irregular, and fast rhythms.
   (2) Read:
   a. Myocardial Infarction
   b. Regular Rhythms
   c. Irregular Rhythms

5. (1) Watch:
   Fast Rhythms and Disturbances in Conduction: In this 45-minute video-lecture Dr. Eggena considers fast rhythms arising above the ventricles, AV blocks and Potassium Imbalance.
   (2) Read:
   a. Fast Rhythms
   b. SA and AV Nodal Blocks
   c. Bundle Branch and Fascicular Blocks
   d. Aberrant Conduction
   e. The EKG and Potassium Imbalance

6. (1) Watch:
Cardiac Muscle: In this 46-minute video-lecture Dr. Eggena discusses the structure of the myocardium, the sliding filament hypothesis, excitation-contraction coupling and force-velocity relationship of cardiac muscle.

(2) Read:
- a. Structure of Myocardial Cells
- b. Sliding Filament Hypothesis of Muscle Contraction
- c. Excitation-ContrACTION Coupling
- d. Myocardial Muscle Relaxation
- e. Papillary Muscle Contraction

7. (1) Watch:
Ventricular Function: In this 49-minute video-lecture Dr. Eggena discusses the LaPlace equation, ventricular compliance, the Frank-Starling law of the heart, homeometric regulation of cardiac contraction, volume-pressure changes during the cardiac cycle, and preload and afterload.

(2) Read:
- a. LaPlace Equation
- b. Ventricular Compliance
- c. Ventricular Contraction
- d. Volumes and Pressures during the Cardiac Cycle
- e. Regulation of Stroke Volume
- f. Work of the Heart
- g. Cardiac Metabolism

8. (1) Watch:
The Cardiac Cycle: In this 41-minute video-lecture Dr. Eggena discusses cardiac output, hemodynamic monitoring in the ICU, and pressure changes during the cardiac cycle.

(2) Read:
- a. Measuring Cardiac Output
- b. Hemodynamic Monitoring
- c. The Cardiac Cycle

9. (1) Watch:
Heart Sounds: In this 43-minute video-lecture Dr. Eggena discusses and listens to heart sounds and the murmurs of mitral and aortic stenosis and mitral and aortic insufficiency (adapted from Dr. Eggena’s Multimedia Authorware computer program).

(2) Read:
- a. Auscultation
- b. Splitting of Second Heart Sound
- c. Third and Fourth Heart Sounds
- d. Characterization of Murmurs
- e. Mitral Stenosis
- f. Mitral Insufficiency
- g. Aortic Stenosis
h. Aortic Insufficiency

10. (1) Watch:
Hemodynamics: In the 54-minute video-lecture Dr. Eggena discusses pressures and blood volumes in the circulation, laminar and turbulent blood flow, Poiseuille’s equation, resistance in the circulation, and measurement and determinants of blood pressure and pulse pressure.

(2) Read:
a. Anatomic Considerations
b. Distribution of Blood and Cardiac Output
c. Velocity of Blood Flow
d. Pressures in the Circulation
e. Types of Blood Flow
f. Blood Viscosity
g. Radius of Vessels
h. Resistance to Blood Flow
i. Measurement of Blood Pressure
j. Determinants of Blood Pressure
k. Pulse Pressure

11. (1) Watch: Regulation of the Circulation: In this 52-minute video-lecture Dr. Eggena discusses the Starling-Landis principle, autoregulation of blood flow and Raynaud’s disease, neural regulation, the baroreceptor reflex, orthostatic hypotension, and the Cushing phenomenon.

(2) Read:
a. Fluid Exchange across Capillaries
b. Autoregulation
c. Neural Regulation

12. (1) Watch:
Regulation of Blood Pressure: In this 44-minute video-lecture Dr. Eggena discusses hormonal regulation of blood pressure, vasopressin, aldosterone, and epinephrine secretion and action, hypertension, and physiological approaches in the treatment of hypertension.

(2) Read:
a. Hormonal Regulation
b. Hypertension

c. 13. (1) Watch:
Cardiac Output and Venous Return: In this 46-minute video-lecture Dr. Eggena discusses the regulation of cardiac output and venous return and the use of Guyton’s curves in the graphic analysis of altered states.

(2) Read:
a. Regulation of Cardiac Output
b. Regulation of Venous Return
c. Graphic Analysis of Cardiac Output and Venous Return
C. Apply: *Physiological Correlates of a Physician’s Diary* by Patrick Eggena, MD provided for free by the author.

**Instructions**

1. Read the case in the Diary Section of the Chapter.
2. Read the question, the answer, and the discussion in the Physiology Correlate Section of the Chapter.
3. Practice drawing your answer to the 16 graphic essay questions below. Four of these questions will be asked on the examination.

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<th>Answer Physiology Question #</th>
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D. Examination (2 hours)

1. True/False Questions
**Instructions:** Participants taking the course for graduate credits take a 2-hour exam which is proctored by the participant's chairperson or his/her assistant. The exam consists of 60 true/false questions. (Participants taking the course for professional development are not required to take this exam.)

**2. Graphic Essay Questions**

**Instructions:** Using a black ink pen and/or pencil, participants draw the answers to each of 4 graphic essay questions on separate sheets of paper. (Participants taking the course for professional development are not required to take this exam.)

Each participant is responsible for arranging a time and place with his/her Departmental Chairperson who has agreed to administer the exam and to email the results (in one folder) back to Dr. Eggena for grading. Should this not be possible (due to COVID 19) other arrangements will be made.

**E. Evaluation**

All HAPS-I courses follow grading policies on a "credit / no credit" basis. Like many progressive graduate programs, HAPS-I does not use letter grades in our courses. However, a "credit" grade is equivalent to a letter grade of B or better. A "credit" grade is earned by satisfactorily accomplishing a set of specific goals (at a "B" level or better) as outlined in this course syllabus and in the online course material as determined by the course faculty. (A letter grade will be provided upon request by Alverno College.)