

Lecture Outline for Integrated Basic Health Sciences for Pharmacy

Physiology Component of Module : Cardiovascular

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Heart Physiology (pp. 676–687; Figs. 18.13–18.22)

- A. Electrical Events (pp. 676–680; Figs. 18.13–18.18)
1. The intrinsic conduction system is made up of specialized cardiac cells that initiate and distribute impulses, ensuring that the heart depolarizes in an orderly fashion.
 2. The autorhythmic cells have an unstable resting potential, called pacemaker potentials, that continuously depolarizes.
 3. Impulses pass through the autorhythmic cardiac cells in the following order: sinoatrial node, atrioventricular node, atrioventricular bundle, right and left bundle branches, and Purkinje fibers.
 4. The autonomic nervous system modifies the heartbeat: the sympathetic center increases rate and depth of the heartbeat, and the parasympathetic center slows the heartbeat.
 5. An electrocardiograph monitors and amplifies the electrical signals of the heart and records it as an electrocardiogram (ECG).
- B. Heart Sounds (p. 681; Fig. 18.19)
1. Normal
 - a. The first heart sound, lub, corresponds to closure of the AV valves, and occurs during ventricular systole.
 - b. The second heart sound, dup, corresponds to the closure of the aortic and pulmonary valves, and occurs during ventricular diastole.
 2. Abnormal
 - a. Heart murmurs are extraneous heart sounds due to turbulent backflow of blood through a valve that does not close tightly.
- C. Mechanical Events: The Cardiac Cycle (p. 682; Fig. 18.20)
1. Systole is the contractile phase of the cardiac cycle and diastole is the relaxation phase of the cardiac cycle.
 2. A cardiac cycle consists of a series of pressure and volume changes in the heart during one heartbeat.

- a. Ventricular filling occurs during mid-to-late ventricular diastole, when the AV valves are open, semilunar valves are closed, and blood is flowing passively into the ventricles.
 - b. The atria contract during the end of ventricular diastole, propelling the final volume of blood into the ventricles.
 - c. The atria relax and the ventricles contract during ventricular systole, causing closure of the AV valves and opening of the semilunar valves, as blood is ejected from the ventricles to the great arteries.
 - d. Isovolumetric relaxation occurs during early diastole, resulting in a rapid drop in ventricular pressure, which then causes closure of the semilunar valves and opening of the AV valves.
- D. Cardiac Output (pp. 682–687; Figs. 18.21–18.23)
1. Cardiac output is defined as the amount of blood pumped out of a ventricle per beat, and is calculated as the product of stroke volume and heart rate.
 2. Regulation of Stroke Volume
 - a. Preload: the Frank-Starling law of the heart states that the critical factor controlling stroke volume is the degree of stretch of cardiac muscle cells immediately before they contract.
 - b. Contractility: contractile strength increases if there is an increase in cytoplasmic calcium ion concentration.
 - c. Afterload: ventricular pressure that must be overcome before blood can be ejected from the heart.
 3. Regulation of Heart Rate
 - a. Sympathetic stimulation of pacemaker cells increases heart rate and contractility, while parasympathetic inhibition of cardiac pacemaker cells decreases heart rate.
 - b. Epinephrine, thyroxine, and calcium influence heart rate.
 - c. Age, gender, exercise, and body temperature all influence heart rate.
 4. Homeostatic Imbalance of Cardiac Output
 - a. Congestive heart failure occurs when the pumping efficiency of the heart is so low that blood circulation cannot meet tissue needs.
 - b. Pulmonary congestion occurs when one side of the heart fails, resulting in pulmonary edema.

END OF OUTLINE

References

Marieb, E. N. & Hoehn K (2010). Human Anatomy and Physiology. 8th Edition, Pearson, Benjamin Cummings.