

BSCI202 EXAM REVIEW 2

CARDIOVASCULAR SYSTEM

The Cardiovascular System

- The function of the cardiovascular system is to deliver oxygen and nutrients and to remove carbon dioxide and other waste products
- Transport of substances such as:
 - Oxygen & nutrients to cells
 - Wastes from cells to liver & kidneys
 - Hormones, immune cells, clotting proteins to specific target cells
- A closed system of the heart and blood vessels
 - The heart pumps blood
 - Blood vessels allow blood to circulate to all parts of the body
- Blood is used for delivery

Overview of the Cardiovascular System

- The heart
 - Located in thoracic cavity
 - Diaphragm separates abdominal cavity from thoracic cavity
 - Size of fist
 - Weights about 250-350 grams
 - Valves present for unidirectional bloodflow
 - 4 chambers: 2 atria and 2 ventricles
- blood vessels
- blood

The heart

- location is in the thorax between the lungs in the inferior mediastinum
- orientation
 - pointed apex directed toward left tip
 - base points toward right shoulder

Properties of Cardiac Muscle

- Intercalated Discs
 - Gap junctions: so heart contracts as a unit
 - Desmosomes: resist stress
- Aerobic muscle
- No cell division after infancy-growth by hypertrophy
- 99% contractile cells
- 1% autorhythmic cells

The Heart's Covering: The Pericardium

- pericardium is a double-walled membranous sac surrounding heart
 - fibrous pericardium is loose and superficial
 - serous pericardium is deep to the fibrous pericardium and composed of 2 layers
 - visceral pericardium: next to heart; also known as epicardium
 - parietal pericardium: outside layer that lines the inner surface of the fibrous pericardium
 - serous fluid fills the space between the layers of pericardium
 - lubricates heart decreasing friction
 - pericarditis: inflammation of pericardium

Walls of the Heart

- 3 layers
 - 1. Epicardium
 - outside layer
 - this layer is the visceral pericardium
 - connective tissue layer
 - 2. Myocardium

- middle layer
- mostly cardiac muscle
- 3. Endocardium
 - inner layer
 - endothelium
- walls of ventricles thicker than walls of atria
- wall of left ventricle thicker than wall of right ventricle

The Heart: 4 chambers

- right and left side act as separate pumps
- septa: separates chambers
- interventricular septum
 - separates the 2 ventricles
- interatrial septum
 - separates the 2 atria
- 4 chambers
 - atria are receiving chambers
 - right atrium
 - left atrium
 - ventricles are discharging chambers
 - right ventricle
 - left ventricle

The Heart: Valves

- allow blood to flow in only one direction to prevent backflow
- 4 valves:
 - atrioventricular (AV) valves are between atria and ventricles
 - Bicuspid (mitral) valve (left side of heart)
 - Tricuspid valve (right side of heart)
- Semilunar valves are between ventricle and artery
 - Pulmonary semilunar valve
 - Aortic semilunar valve
- AV valves
 - Anchored in place by chordae tendineae ("heart strings")
 - Open during heart relaxation and closed during ventricular contraction
- These valves operate opposite of one another to force a one-way path of blood through the heart

Valves and Unidirectional Blood Flow

- Pressure within chambers of heart vary with heartbeat cycle
- Pressure difference drives blood flow: high pressure to low pressure
- Normal direction of flow
 - Veins to atria
 - Atria to ventricles
 - Ventricles to arteries
- Valves prevent backward flow of blood
- All valves open passively based on pressure gradient

AV Valves Open

- Operation of the AV valves
 - 1. Blood returning to the atria, puts pressure against AV valves; the AV valves are forced open
 - 2. As the ventricles fill, AV valve flaps hang limply into ventricles
 - 3. Atria contract, forcing additional blood into ventricles

AV Valves Closed

- 1. Ventricles contract, forcing blood against AV valve flaps
- 2. AV valves close
- 3. Chordae tendineae tighten, preventing valve flaps from everting into atria

Semilunar Valves

- operation of semilunar valves
 - as ventricles contract and intraventricular pressure rises, blood is pushed up against semilunar valves, forcing them open
 - as ventricles relax, and intraventricular pressure falls, blood flows back from arteries, filling the leaflets of semilunar valves and forcing them to close

Blood Vessels: Vasculature

- heart → arteries → arterioles → capillaries → venules → veins
- arteries are relatively large, branching vessels that conduct blood away from the heart
- arterioles are small branching vessels with high resistance
- capillaries are the site of exchange between blood and tissue
- venules are small converging vessels
- veins are relatively large converging vessels that conduct blood to the heart
- closed system
- pressure drives blood flow

Series Flow Through the Cardiovascular System

- parallel flow within the systemic or pulmonary circuit
 - pulmonary circuit
 - supplied by right heart
 - blood vessels from heart to lungs and lungs to heart
 - systemic circuit
 - supplied by left heart
 - blood vessels from heart to systemic tissues and tissues to heart
- cardiovascular system = closed system
- left ventricle → aorta → systemic circuit → venae cavae → right atrium → right ventricle → pulmonary artery → pulmonary circuit → pulmonary veins → left atrium → left ventricle

Oxygenation of Blood

- exchange between blood and tissue takes place in capillaries
- ___ capillaries
 - blood entering lungs = deoxygenated blood
 - oxygen diffuses from tissue to blood
 - blood leaving lungs = oxygenated blood
- ___ capillaries
 - blood entering tissues = oxygenated blood
 - oxygen diffuses from blood to tissue
 - blood leaving tissues = deoxygenated blood

Blood Flow Through the Heart

- superior and inferior venae cavae lead blood into the right atrium
- from right atrium, through the tricuspid valve, blood travels to the right ventricle
- from the right ventricle, blood leaves the heart as it passed through the pulmonary semilunar valve into the pulmonary trunk
- pulmonary trunk splits into right and left pulmonary arteries that carry blood to the lungs
- oxygen is picked up and carbon dioxide is dropped off by blood in lungs
- oxygen-rich blood returns to the heart through the 4 pulmonary veins
- blood enters the left atrium and travels through the bicuspid valve into the left ventricle
- from the left ventricle, blood leaves the heart via the aortic semilunar valve and aorta

Coronary Circulation

- intrinsic conduction system (nodal system): heart muscle cells contract, without nerve impulses, in a regular, continuous way
- blood in the heart chambers does not nourish the myocardium
- the heart has its own nourishing circulatory system consisting of:
 - coronary arteries branch from the aorta to supply the heart muscle with oxygenated blood
 - cardiac veins drain the myocardium of blood