
Chapter 14: Cardiovascular System

Components of the Cardiovascular System:

- Heart = pumps oxygenated blood to body and deoxygenated blood to lungs
- Blood vessels = arteries, arterioles, capillaries, post-capillaries, venules, veins (pulmonary/systemic)
- Blood = plasma, RBC's and WBC's

Main Functions of the Cardiovascular System:

1. To transport materials throughout the body
2. To protect the body from infection and blood loss
3. To help the body maintain a constant temperature
4. To help maintain fluid balance

Pressure Differentials Direct Blood Flow:

- Pressure created by contracting muscles is transferred to blood
- Driving pressure is created by the ventricles
- If blood vessels dilate, blood pressure decreases
- If blood vessels constrict, blood pressure increases
- Volume changes affect blood pressure in cardiovascular system
- Flow through a tube is directly proportional to the pressure gradient (the higher the pressure gradient the greater the flow, must be positive)
 - Flow through a tube is inversely proportional to resistance (if resistance increases flow decreases)

Poiseuille's Law:

- Resistance is proportional to length (L) of the tube (blood vessel)
 - Resistance increases as length increases

- Resistance is proportional to viscosity (η), or thickness, of the fluid (blood)
 - Resistance increases as viscosity increases
- Resistance is inversely proportional to tube radius to the fourth power
 - Resistance decreases as radius increases

Resistance Opposes Flow:

- Small change in radius has a large effect on resistance to blood flow
 - Vasoconstriction is a decrease in blood vessel diameter/radius and decreases blood flow
 - Vasodilation is an increase in blood vessel diameter/radius and increases blood flow
- Flow = P/R
 - Flow of blood in the cardiovascular system is
 - Directly proportional to the pressure gradient
 - Inversely proportional to the resistance to flow

Cardiac Muscle:

- Myocardium = cardiac muscle
- The heart generates pressure when it contracts (systole) and pumps blood into the arterial or the circulation
 - Arteries act as a pressure reservoir during diastole
 - Mean arterial pressure = cardiac output - peripheral resistance

The Heart:

- Pericardium = tough membranous sac that encases the heart
- Chordae tendineae = attach flaps of valves to the walls of the ventricles
- Papillary muscle = extensions of ventricle muscle that hold the chordae in place
- Left ventricle = receives blood from left atrium, sends blood to body
- Right ventricle = receives blood from right atrium, sends blood to lungs
- Left atrium = receives blood from pulmonary veins, sends blood to left ventricle
- Right atrium = receives blood from vena cavae, sends blood to right ventricle
- Aorta = receives blood from left ventricle, sends blood to systemic arteries

- Superior/inferior vena cava = receives blood from systemic veins, sends to right atrium
- Pulmonary artery = receives blood from right ventricle, sends to lungs
- Pulmonary veins = receives blood from lungs, sends to left atrium
- Coronary artery/veins = surface blood vessels

Heart Valves:

- Two sets of heart valves ensure one-way flow
 - Atrioventricular valves
 - Between atria and ventricles
 - Tricuspid valve on the right side
 - Bicuspid valve, or mitral valve, on the left side
 - Semilunar valves
 - Between right ventricle and pulmonary trunk = Pulmonary valve
 - Between left ventricle and aorta = Aortic valve

Ventricular Contraction & Relaxation:

- During ventricular contraction, the AV valves remain closed to prevent blood flow backward into the atria
- The semilunar valves prevent blood that has entered the arteries from flowing back into the ventricles during ventricular relaxation

Cardiac Muscle:

- Contractile cells
 - Striated fibers organized into sarcomeres
- Autorhythmic cells, or pacemakers
 - Signal for contraction
 - Smaller and fewer contractile fibers compared to contractile cells
 - Do not have organized sarcomeres
- Myocardial muscle cells
 - are branched
 - have a single nucleus
 - are attached to each other by specialized junctions known as intercalated disks
- The spiral arrangement of ventricular muscle allows ventricular contraction to squeeze the blood upward from the apex of the heart