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Lec.2

cardiovascular system

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The cardiovascular system is vital for transporting blood, oxygen, and nutrients to the cells while removing carbon dioxide and metabolic waste.

Physiology of the Heart

Heart Anatomy and Basic Functions

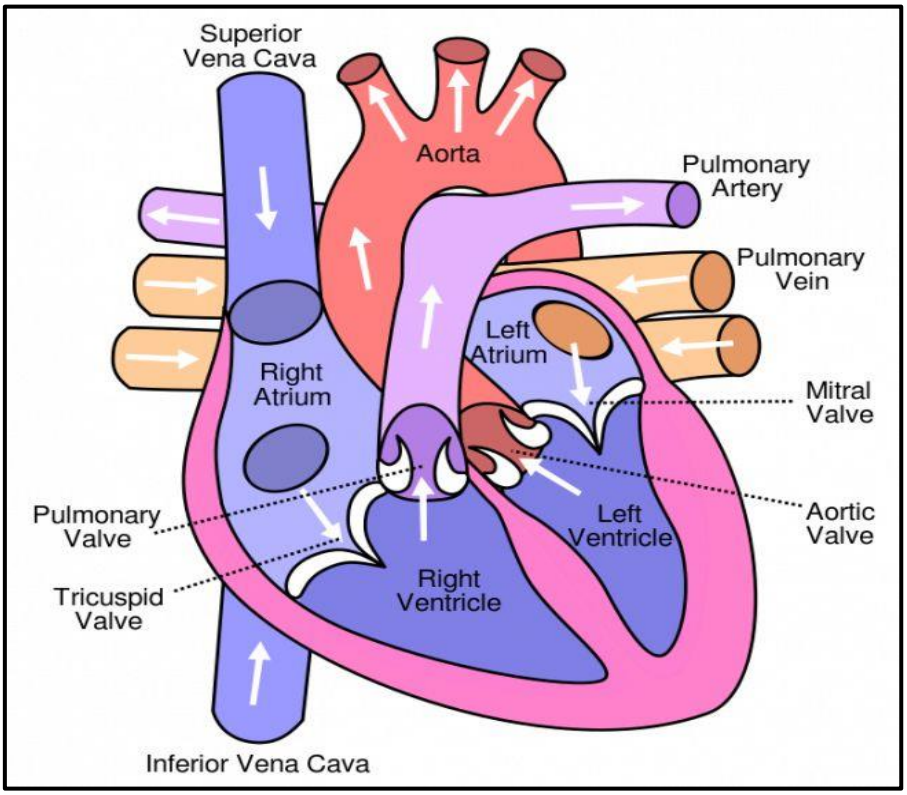
The heart is a muscular organ divided into four chambers:

1. **Right Atrium:** Receives deoxygenated blood from the body via the superior and inferior vena cava.
2. **Right Ventricle:** Pumps deoxygenated blood to the lungs through the pulmonary artery.
3. **Left Atrium**: Receives oxygenated blood from the lungs via the pulmonary veins.
4. **Left Ventricle**: Pumps oxygenated blood to the body through the aorta.

The Cardiac Cycle

The cardiac cycle includes two main phases:

1. **Systole**: Contraction of the ventricles to eject blood.
2. **Diastole**: Relaxation of the ventricles to allow filling with blood.



Electrical Conduction System

The rhythmic contractions of the heart are regulated by its intrinsic electrical conduction system:

1. **Sinoatrial Node (SA Node):** The natural pacemaker that generates electrical impulses.
2. **Atrioventricular Node (AV Node):** Delays impulses, allowing complete atrial emptying before ventricular contraction.
3. **Bundle of His and Purkinje Fibers:** Distribute electrical signals across the ventricles for coordinated contraction.

Neural and Hormonal Regulation

1. **Sympathetic Nervous System:** Increases heart rate and contraction strength.
2. **Parasympathetic Nervous System:** Slows down the heart rate.
3. **Hormonal Influence:** Adrenaline and other hormones enhance cardiac activity during stress.

Coronary Circulation

Coronary arteries supply oxygenated blood to the heart muscle itself.

Blockages in coronary circulation can lead to angina or myocardial infarction (heart attack).

Physiology of Blood Vessels

1. Types of Blood Vessels and Their Functions

Arteries: Carry oxygenated blood away from the heart (except pulmonary arteries) and sustain high pressure.

Veins: Return deoxygenated blood to the heart and have valves to prevent backflow.

Capillaries: Facilitate exchange of gases, nutrients, and waste between blood and tissues.

2. Hemodynamics

Blood Pressure: The force exerted by circulating blood on the walls of blood vessels, regulated by the heart and arterioles.

Resistance: Depends on vessel diameter, length, and blood viscosity.

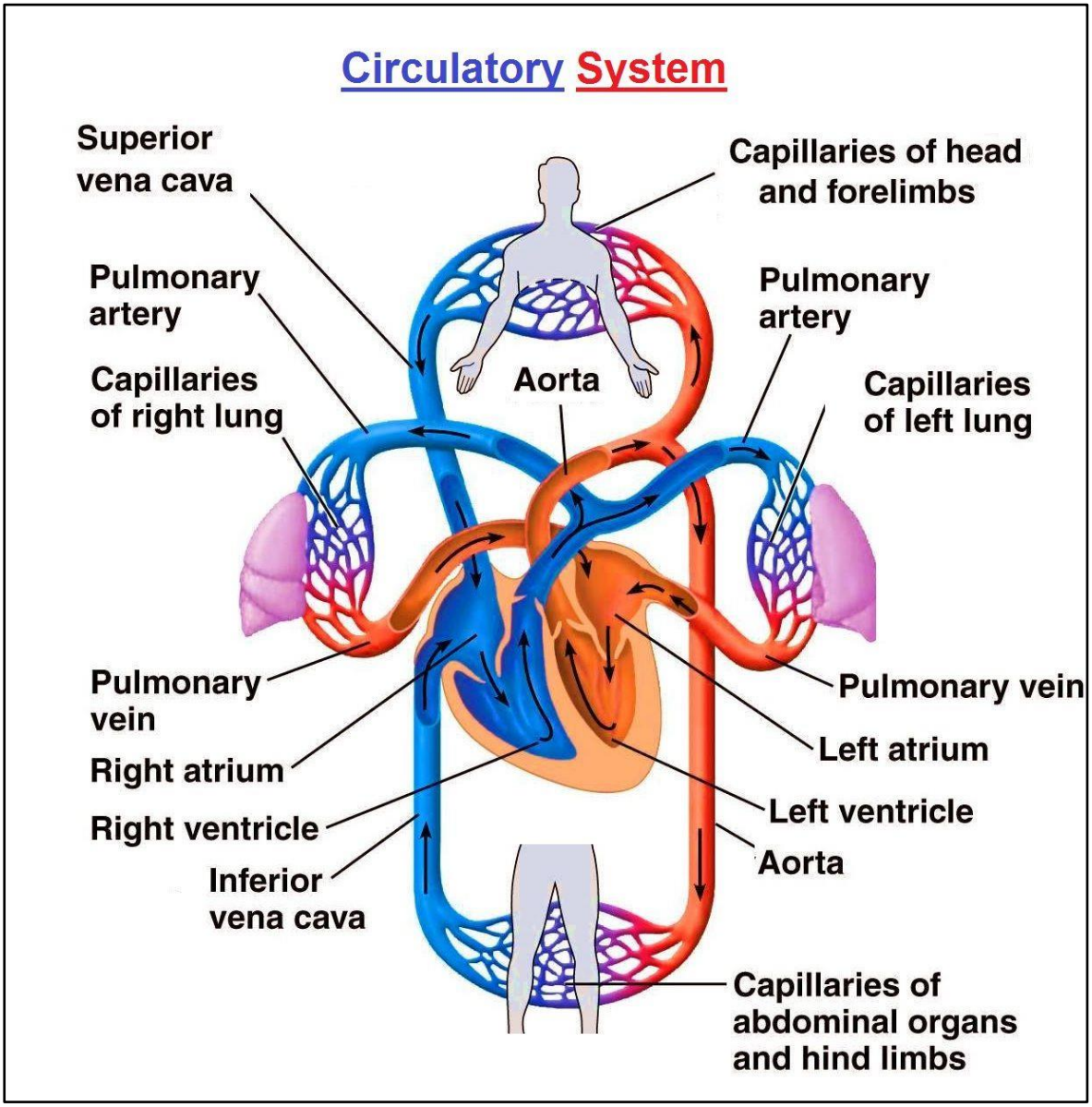
Blood Flow: Governed by Poiseuille's Law, which highlights the role of pressure and resistance in determining flow rates.

3. Regulation of Blood Flow

Autoregulation: Small vessels adjust blood flow based on tissue needs.

Neural Regulation: Controlled by the autonomic nervous system.

Hormonal Regulation: Hormones like aldosterone regulate blood volume and vessel tone.



Roles of the Cardiovascular System

1. **Oxygen and Nutrient Supply:**

Ensures oxygenated blood reaches all tissues for cellular function.

2. **Waste Removal:**

Removes carbon dioxide and metabolic byproducts via the lungs, liver, and kidneys.

3. **Thermoregulation:**

Distributes heat to maintain body temperature.

4. **Immune Defense:**

Transports white blood cells and antibodies to fight infections.

Disorders of the Cardiovascular System

1. **Hypertension (High Blood Pressure):**

Increases strain on the heart and blood vessels.

2. **Coronary Artery Disease:**

Results from the narrowing or blockage of coronary arteries due to atherosclerosis.

3. **Heart Failure:**

The heart's inability to pump blood efficiently.

4. **Thrombosis:**

Blood clots that can obstruct vessels, leading to strokes or pulmonary embolisms.

The heart and blood vessels are central to sustaining life. Understanding their physiology helps in the prevention and management of cardiovascular diseases. A healthy lifestyle—including regular exercise, a balanced diet, and avoiding smoking—is key to maintaining cardiovascular health.