Applied physiology

Physiology of The Heart

Lecture 2

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Pathway of blood through the heart

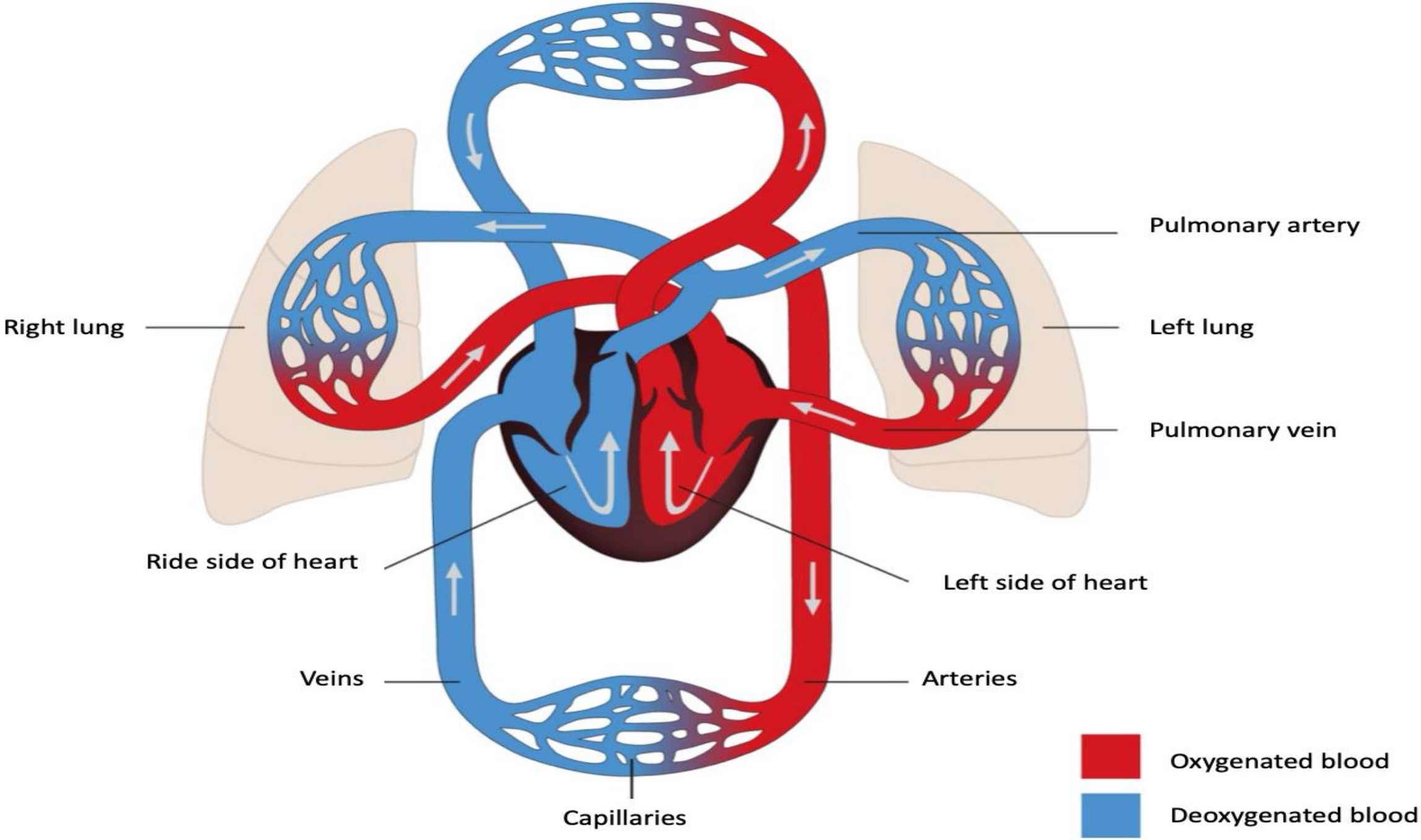
- The heart has two pumps, one on the right and one on the left, working simultaneously. Blood flows from the right atrium to the right ventricle and then is pumped to the lungs to receive oxygen. From the lungs, the blood flows to the left atrium and then to the left ventricle; from there, it is pumped to the systemic circulation.

Circulatory pathways

Blood vessels of the body are functionally divided into two circuits: (pulmonary circuit and systemic circuit)

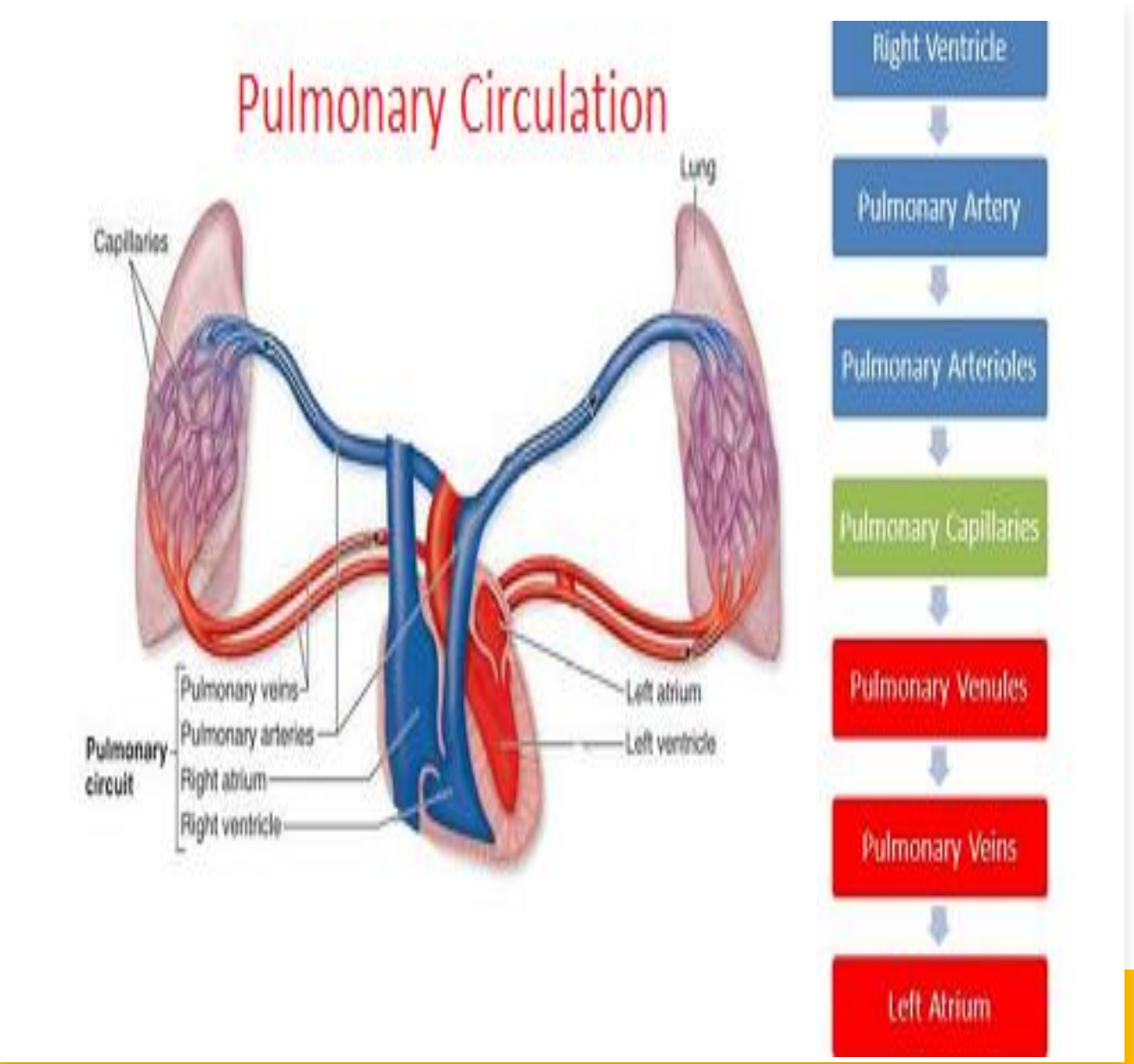
The pump for the pulmonary circuit, which circulates blood through the lungs, is the right ventricle.

The left ventricle is the pump for the systemic circuit which provides the blood supply for the tissue cells of the body.


Pulmonary artery
Right lung
Left lung
Pulmonary vein
Ride side of heart
Left side of heart
Veins
Arteries
Capillaries
Oxygenated blood
Deoxygenated blood

Pulmonary circuit

Pulmonary circulation transports oxygen-poor blood from the right ventricle to the lungs, creating a new blood supply. Then, it returns the oxygen-rich blood to the left atrium.



Systemic circulation

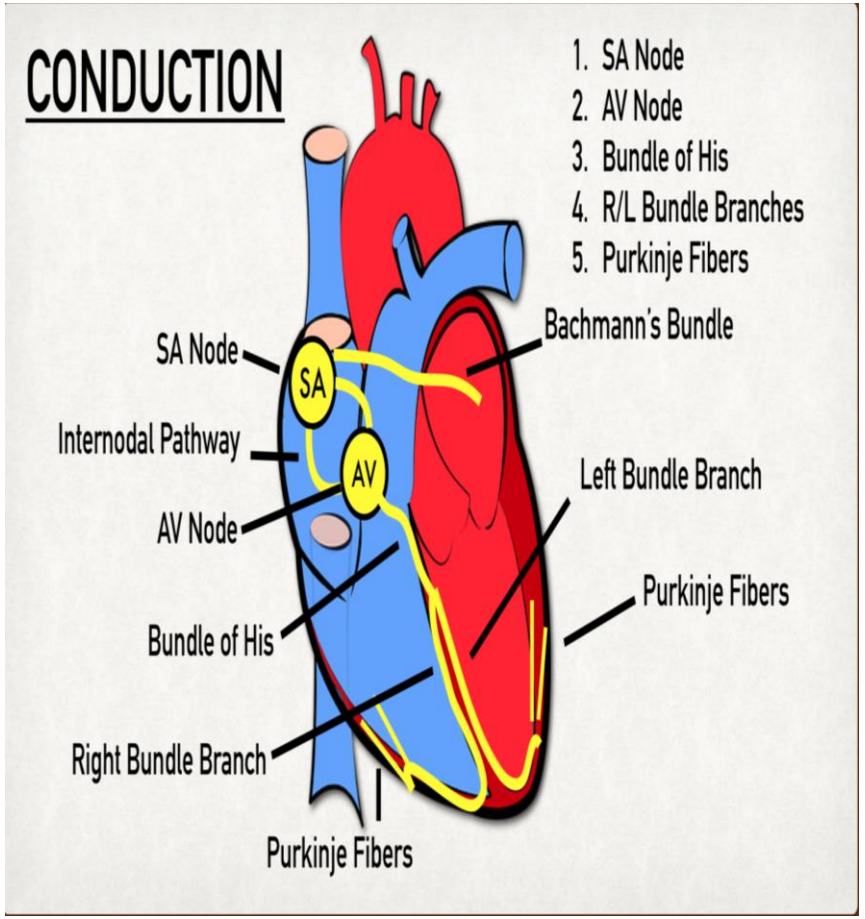
- Systemic circulation provides the functional blood supply to all body tissues. It carries oxygen and nutrients to the cells and picks up carbon dioxide and waste products.
- Systemic circulation carries oxygenated blood from the left ventricle through the arteries to the capillaries in the body's tissues. Deoxygenated blood returns From the tissue capillaries through a system of veins to the heart's right atrium.

Physiology of circulation

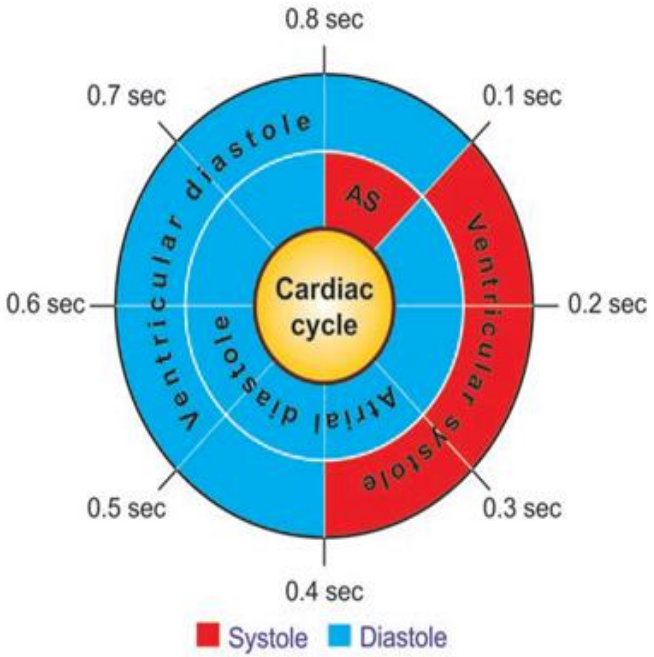
- In addition to forming the connection between the arteries and veins, capillaries play a vital role in exchanging gases, nutrients, and metabolic waste products between the blood and the tissue cells.
- Substances pass through the capillary wall by **diffusion, filtration and osmosis**.
- Oxygen and carbon dioxide move across the capillary wall by diffusion.
- A combination of hydrostatic and osmotic pressure determines fluid movement across the capillary wall. The net result of the capillary microcirculation created by hydrostatic and osmotic pressure is that substances leave the blood at one end of the capillary and return at the other.

Physiology of the heart

- The conduction system includes several components. The first part is the **sinoatrial node.** Without any neural stimulation, the sinoatrial node rhythmically initiates impulses 70 to 80 times per minute. Because it establishes the basic rhythm of the heartbeat, it is called the **pacemaker of the heart.**
- The other parts of the conduction system include the atrioventricular node, atrioventricular bundle, bundle branches, and conduction myofibers. These components coordinate the contraction and relaxation of the heart chambers.



Cardiac cycle



- The cardiac cycle refers to the alternating contraction and relaxation of the myocardium in the walls of the heart chambers coordinated by the conduction system during one heartbeat.
- 1. Systole is the contraction phase of the cardiac cycle (ventricular contraction) 1\3
- 2.diastole is the relaxation phase (ventricular filling). 2\3
- At a regular heart rate, one cardiac cycle lasts 0.8 seconds.

Heart sounds and rate

- The sounds associated with the heartbeat are due to **vibrations in the tissues and blood caused by the closure of the valves**; abnormal heart sounds are called murmurs.
- The sinoatrial node, acting alone, maintains a constant rhythmic heart rate. However, it relies on the atrioventricular node to either increase or decrease the heart rate, thereby adjusting the cardiac output to meet the body's changing needs.
- Most changes in heart rate are mediated through the cardiac centre in the **medulla oblongata** of the brain. The centre has both sympathetic and parasympathetic components that adjust the heart rate to meet the body's changing needs.
- Peripheral factors such as emotions, ion concentrations, and body temperature may affect heart rate; these are usually mediated through the cardiac centre.

Blood flow and Pressure

- Blood flow refers to blood movement through the vessels from arteries to capillaries and into the veins. Pressure measures the force the blood exerts against the vessel walls as it moves through the vessels. Like all fluids, blood flows from a high-pressure area to a lower-pressure region.
- Blood flows in the same direction as the decreasing pressure gradient: arteries, capillaries, and veins.
- The rate or velocity of blood flow varies inversely with the total cross-sectional area of the blood vessels; as the total cross-sectional area of the vessels increases, the flow velocity decreases.
- Blood flow is slowest in the capillaries, allowing time for exchanging gases and nutrients.

Pulse and Blood Pressure

- Pulse refers to the rhythmic expansion of an artery caused by the ejection of blood from the ventricles. It can be felt when an artery is close to the surface and rests on something firm.
- The term blood pressure refers to arterial blood pressure, the pressure in the aorta and its branches; systolic pressure is due to ventricular contraction, and diastolic pressure occurs during cardiac relaxation.
- Pulse pressure is the difference between systolic and diastolic pressure. Blood pressure is measured by a sphygmomanometer and recorded as the systolic pressure over the diastolic pressure.
- Remember….. pressure = force\area

- **Four major factors interact to affect blood pressure:**

1. cardiac output
2. blood volume
3. peripheral resistance
4. viscosity

- When these factors increase, blood pressure also increases.
- Arterial blood pressure is maintained within normal ranges by changes in cardiac output and peripheral resistance.

Thank you