

# Theoretical Physiology

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## **Lecture 6**

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### **First Stage**

**\*Cardiovascular system**



## Lec 1

# Introduction

**The Cardiovascular System(C.V.S) also called circulatory system** is transport system of body.

The system supplies nutrients to and remove waste products from various tissue of body

## Function of Cardiovascular System

- \*Transport nutrients ,hormones
- \*Remove waste products
- \*Gaseous exchange
- \*Immunity
- \* Blood vessels transport blood

# COMPONENTS OF CARDIOVASCULAR SYSTEM

1.Blood 2.Heart 3.Blood Vessels

## **The Heart**

Heart is a four chambered, hollow muscular organ that pumps blood during the circulatory system, it is located in the thoracic cavity between the lungs this area is called mediastinum.

There are two normal heart sounds, often described as a **lub** and **dub** occur in sequence with each heartbeat

\***first heart sound s1** produced by the closing of **tricuspid valve** and **mitral valve**.

\***second heart sound s2** produced by the closing of **aortic valve** and **pulmonary valve**.

# Structure of the heart

## Right side of the heart

Right side of the heart has two chambers, **right atrium** and **right ventricle**

\***Right atrium** is receive deoxygenated blood from tissues of the whole body via two large veins:

1. **Superior vena cava** that carries blood from the head, and upper limbs
2. **Inferior vena cava** that carries blood from **lower parts of the body**.

This blood passes into the right ventricle across the **right atrioventricular hole** which is guarded by tricuspid valve.

\***Right ventricle** is receive blood from the right atrium and passes the blood into the pulmonary artery, which sends it to the lungs to pick up oxygen.

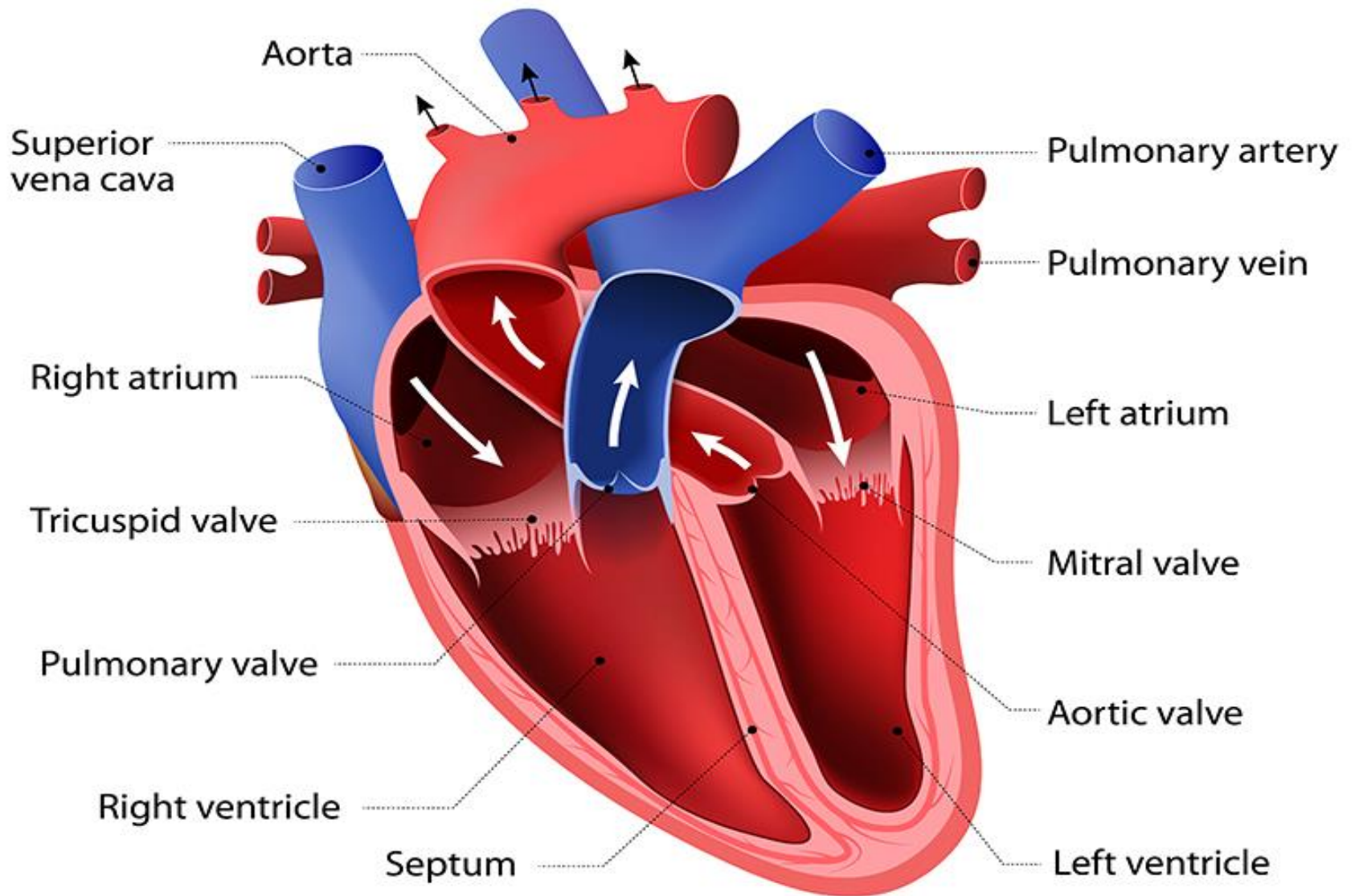
### **Left side of the heart**

Left side of the heart has two chambers, left atrium and left ventricle

•**Left atrium** is receive oxygenated blood from the lungs through the four pulmonary veins, This blood passes into left ventricle through the **left atrioventricular hole** which is guarded by the **mitral valve**.

•**Left ventricle** is receive blood from the left atrium and pumps out into systemic circulation through the aorta.

# Heart Anatomy



## Septa of the Heart

Right and left atria are separated from one another by a fibrous septum called it **atrial septum**.

Right and left ventricles are separated from one another by **interventricular septum**.

The upper part of this septum is a membranous structure, whereas the lower part of it is muscular in nature.

# Valves of Heart:

There are four valves in human heart involve

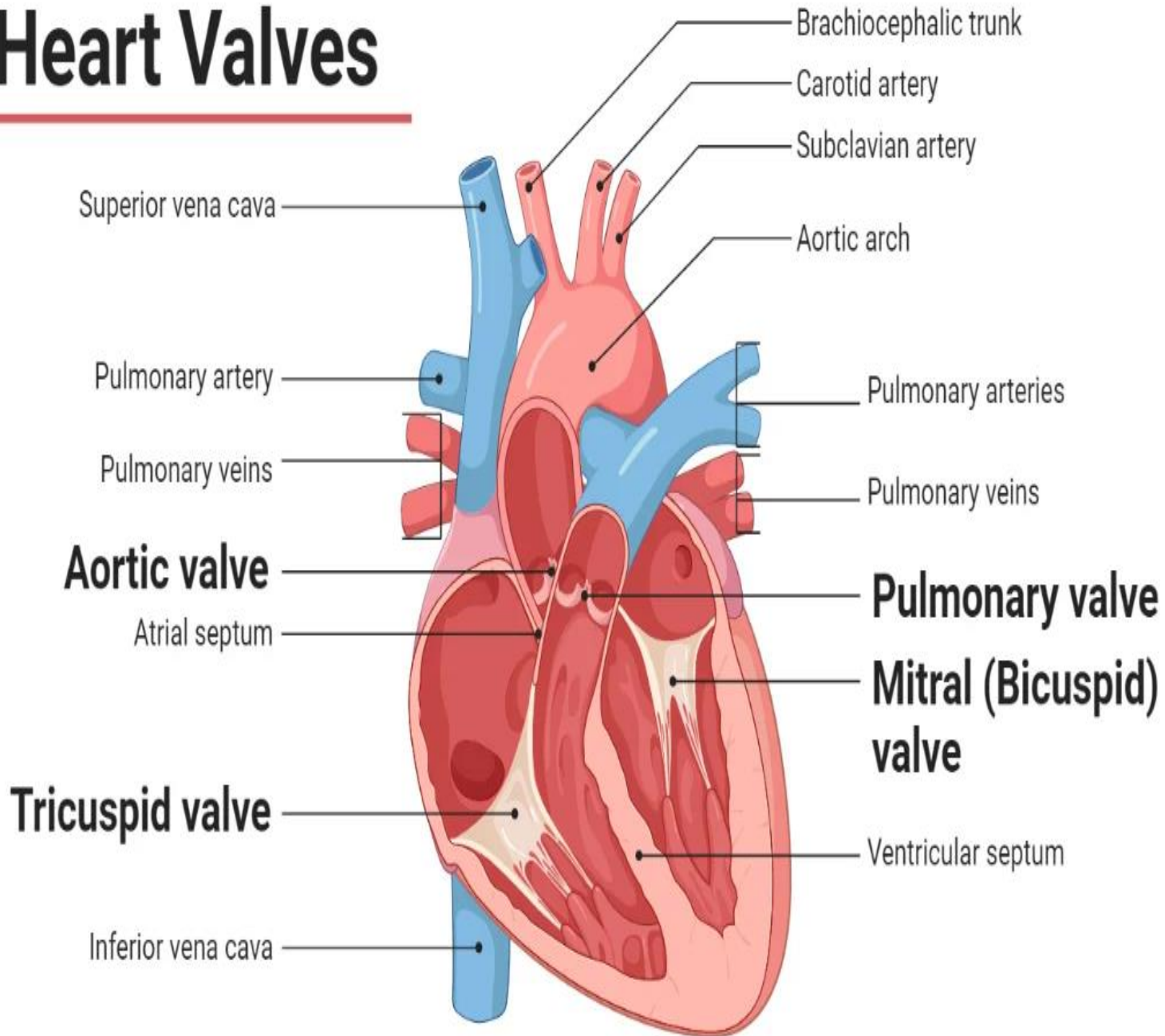
**1. Tricuspid valve:** located between the right atrium and the right ventricle. It opens to allow blood to flow from the right atrium to the right ventricle and prevents the back flow of blood from the right ventricle to the right atrium.

**2. Mitral valve or bicuspid valve:** located between the left atrium and the left ventricle. It opens to allow blood to flow from the left atrium to the left ventricle and prevents the back flow of blood from the left ventricle to the left atrium.

**3. Aortic valve :** It separates the left ventricle from the aorta. It opens to allow blood to leave the heart from the left ventricle through the aorta and the body and prevents the backflow of blood .



# Heart Valves

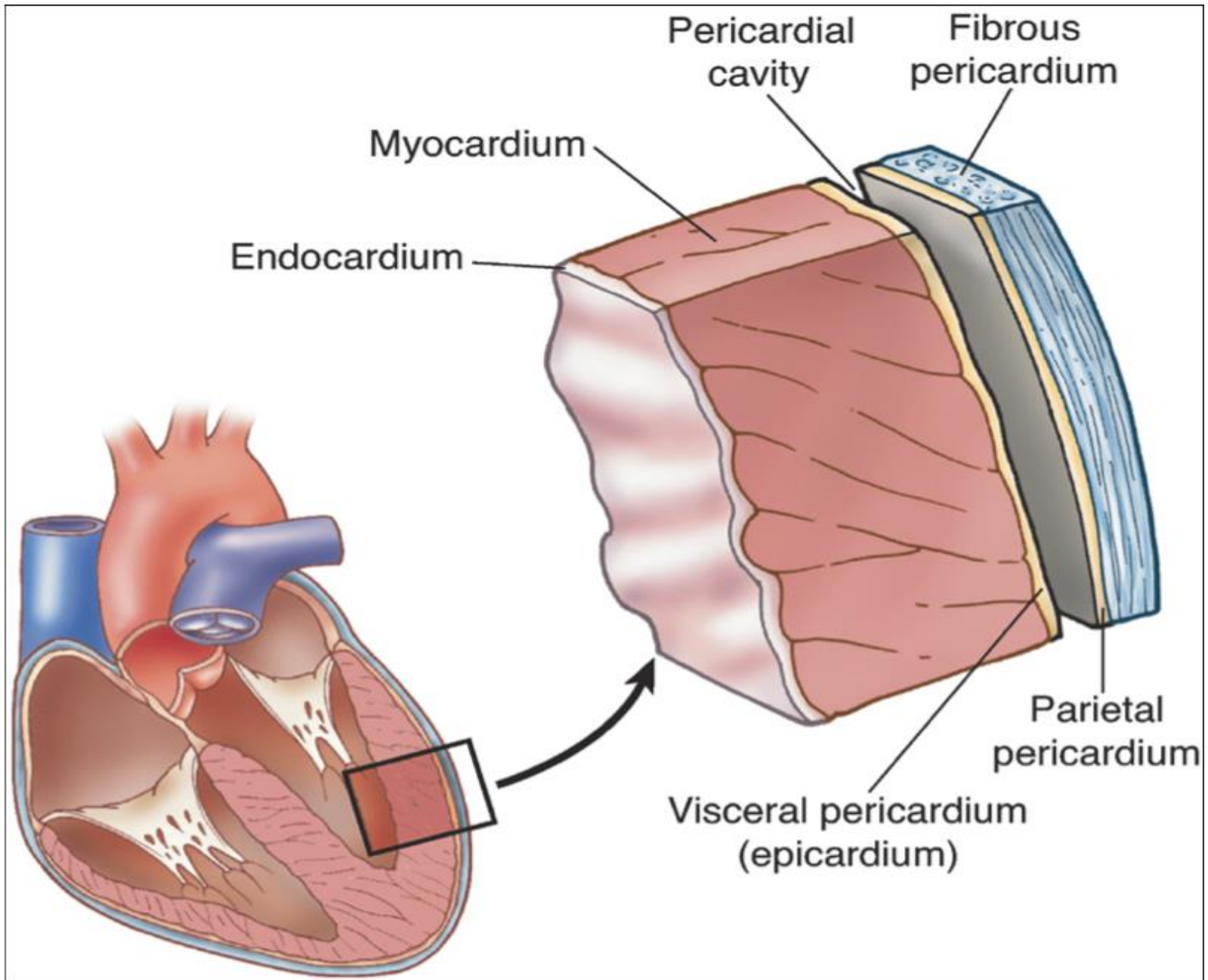


**4. Pulmonary valve:** It separates the right ventricle from the pulmonary artery. It opens to allow blood to be pumped from the right ventricle to the lungs (through the pulmonary artery) where it will receive oxygen and prevents the back flow of blood.

### **Layers of wall Heart**

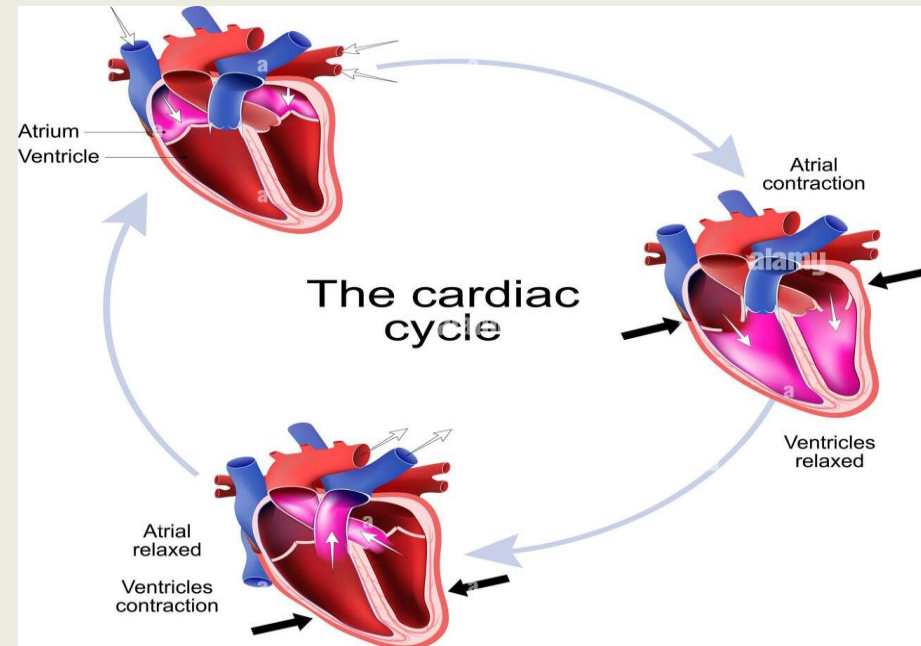
composed of three layers:

1. **The endocardium** is the inner layer of the heart lining the heart chambers. It is a very smooth.
2. **The myocardium** is the thick, muscular middle layer of the heart
3. **The epicardium** is the outer layer of the heart. The heart is enclosed within a double-layered pleural sac, called the pericardium.



# Cardiac Cycle

The period of time that begins with contraction of the atria and ends with ventricular relaxation is known as the **cardiac cycle**. It consists of **two periods**, the period of contraction that the heart undergoes while it pumps blood into circulation is called systole and the period of relaxation that occurs as the chambers fill with blood is called diastole.



# \*The Cardiac Conductive System:(Conductive of Electrical Activity)

**1.Sinoatrial (SA)Node:**A collection of specialized cells (pacemaker cells),located in the upper wall of the right atrium.These pacemaker cells can generate electrical impulses.

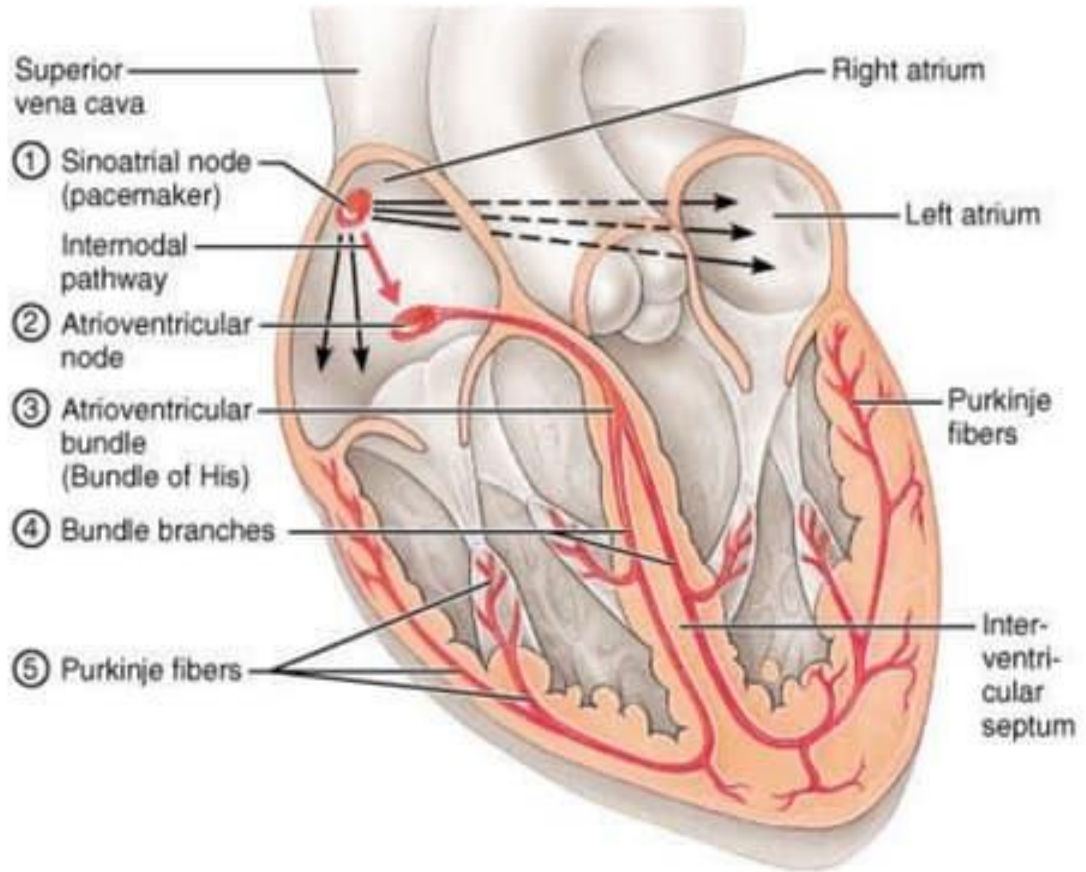
**2.Atrioventricular (AV) Node:** After the electrical impulses spread across the atria, they converge at the atrioventricular node-located within the atrioventricular septum, near the opening of the coronary sinus.

## **3.Atrioventricular (AV) Bundle (bundle of His):**

A continuation of the specialized tissue of the AV node, and serves to transmit the electrical impulse from the AV node to the Purkinje fibers of the ventricles.it dividing into two main bundles right bundle branch and left bundle branch.

# Conducting System

- Network of specialized tissue that stimulates contraction
- Modified cardiac myocytes
- The heart can contract without any innervation



**4. Purkinje fibers:** A network of specialized cells, located in the sub endocardial surface of the ventricular walls, and are able to rapidly transmit cardiac action potentials from the atrioventricular bundle to the myocardium of the ventricles.

## **Cardiac output**

Cardiac output is the amount of blood pumped from each ventricle per minute. Usually, it refers to left ventricular output through aorta.

Cardiac output is the most important factor in cardiovascular system, because rate of blood flow through different parts of the body depends upon cardiac output

Cardiac output depends on the heart rate (beats per minute) and the stroke volume (is the amount of blood pumped out by each ventricle per beat or per contraction).

Therefore, cardiac output (CO) can be calculated by multiplying the stroke volume (SV) by the heart rate (HR):

$$\mathbf{CO=SV \times HR}$$

Under normal conditions, the average heart rate is about 70 beats/min and stroke volume is about 80 ml and thus cardiac output is  $80 \times 70 = 5.6$  L. The cardiac output is expressed in liters per minute and normally varies from 5-6 L/min

During exercise, cardiac output can increase to 20 to 25 liters per minute, and outputs as high as 40 liters per minute have been recorded in trained athletes during heavy endurance-type exercise.

The difference between the cardiac output at rest and the maximum volume of blood the heart can pump per minute is called the cardiac reserve.



# The Electrocardiogram(ECG)

- Is a record of the electrical activity associated with the contraction of cardiac muscle. Or it is a tool for evaluating the electrical events within the heart.

Differences of potential are recorded between two points on the skin.

- The action potential of the cardiac muscle is like battery which cause current flow throughout the body fluids. These currents produce voltage differences at the body surface which can be detected by metal plate electrodes.

## • The uses of ECG is valuable for:

- 1-detect the anatomical orientation of the heart.
- 2-detect the size of the chambers.
- 3-detect the disturbances of rhythm and conduction.
- 4-detect the extent, location and progress of myocardial ischemia.
- 5-detect the effect of changed electrolyte concentration.

## \* Normal ECG

- \* P-wave= atrial depolarization
- \* Q-wave=depolarization of ventricular septum
- \* R-wave=depolarization of the ventricular free wall from endocardium to pericardium
- \* S-wave=depolarization of the base of the ventricles
- \*T-wave=repolarization of ventricles

Blood Vessels –a closed network of tubes

These includes: 1. Arteries 2. Capillaries 3. Veins

## **Blood vessels**

**1.Arteries** (Distributing channel)

\*Thick walled tubes \* Elastic Fibers \* Circular  
Smooth Muscle

**2.Capillaries**( microscopic vessels) \*One cell thick

\*Serves the Respiratory System

**3.Veins**( draining channel)

## **General structure**

1.Tunica intima 2.Tunica media 3.Tunica adventitia

# Classification of Blood Vessels

• Conducting Vessels • Distributing Vessels • Resistance Vessels • Exchange Vessels

**1. Capillaries** (5-8 micron) • The smallest blood vessels are capillaries and they connect the arteries and veins.

**2. Veins** • Blood vessels that carry blood back to the heart are called veins. • They have one-way valves which prevent blood from flowing backwards. • They carry blood that is high CO<sub>2</sub> known as deoxygenated blood (O<sub>2</sub> poor blood).

**3. Arterial** Blood vessels that carry blood away from the heart are called arteries. They are the thickest blood vessels and they carry blood high O<sub>2</sub> known as oxygenated blood (O<sub>2</sub> rich blood).

**Thank you**