



Department of Anesthesia Techniques
Title of the lec1: Cardiovascular system



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LEARNING OBJECTIVES

By the end of this section, you will be able to understand :

- **The functions of Cardiovascular system**
- **The structure of cardiac muscle and contractile cardiomyocytes**
- **Conducting system that distributes electrical impulses through the heart.**

✚ **Cardiovascular physiology** is the study of the functions of the heart, blood vessels.

✚ **The cardiovascular system consists of the heart, blood vessels, and blood.**

✚ **Its primary function** is to transport nutrients and oxygen-rich blood to all parts of the body and to carry deoxygenated blood back to the lungs.

✚ **Cardiovascular system consists of the following organs and tissues:**

- **The heart:** A muscular pump that forces blood around the body.
- **A closed system of blood vessels** include:
 - **Arteries:** Vessels that carry blood away from the heart.
 - **Veins:** Vessels that bring blood back to the heart.
 - **Capillaries:** Tiny vessels that branch off from arteries to deliver blood to all body tissues

Structure of the heart

The heart consists of four chambers **two on either side**:

Two **receiving chambers** “**atria**” and two **pumping chambers** “**ventricles**.” A wall or “**septum**” separates the atria and ventricles. **Valves** control the flow of blood in the heart.

1. **The right atrium** receives the blood returning from the body tissues. This blood is low in oxygen, carried by veins
2. **The right ventricle** pumps the blood received from the right atrium and sends it to the lungs.
3. **The left atrium receives** blood which is high in oxygen as it returns from the lungs.
4. **The left ventricle**, which has the **thickest walls of all**, pumps oxygenated blood to all parts of the body through the arteries.

The Heart Valves: The human heart contains four valves:

A. Two atrioventricular valves (AV)

between atria and ventricles:

- ☐ **Tricuspid valve** : allows blood flowing one way from right atrium to right ventricle.
- ☐ **Mitral valve:** from left atria to left ventricle.

The function of AV valves is to prevent backflow of blood into the atria during ventricular contraction.

B. Two semilunar valves

- ☐ **Aortic valve:** allows blood flowing one way from left ventricle to aorta (transport oxygenated blood to the body).
- ☐ **Pulmonary valve:** from right ventricle to pulmonary artery (Transport deoxygenated blood to lung)

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✚ **There are two blood circulatory systems in the body.**

1. **The systemic circulatory system.** This is the main blood circulatory system that transports blood to the organs, tissues, and cells throughout the body.
2. **The pulmonary circulatory system.** This circulatory system moves blood between the heart and lungs

✚ **Cardiac cells**

There are **two** major types of cardiac cells:

Contractile cells (99%) and **Conducting cells**.

A. Myocardial contractile cells (99%) called Cardiomyocytes:

Cardiac muscle cells or cardiomyocytes are the muscle cells that make up the heart muscle. Cardiomyocytes go through a contraction-relaxation cycle that enables cardiac muscles to pump blood throughout the body.

Its characteristics :

- ❖ short and have small diameter
- ❖ involuntary contraction
- ❖ striated

These striations are caused by

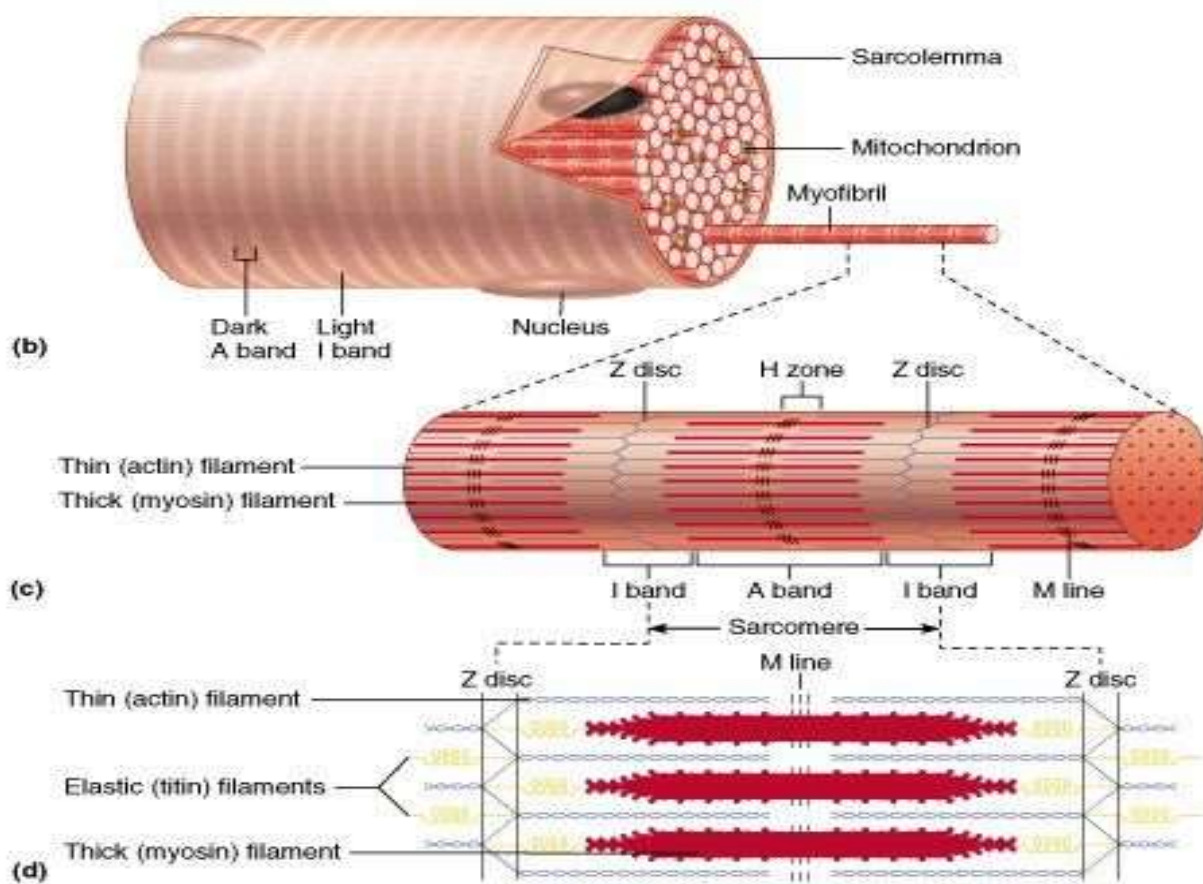
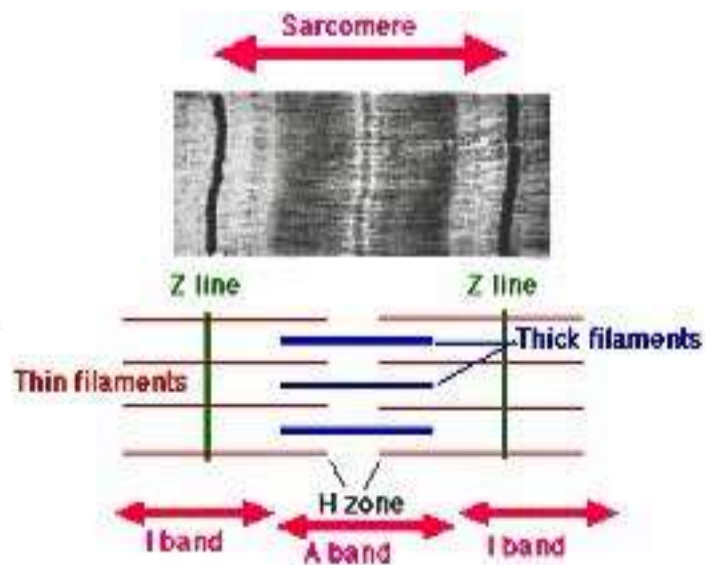
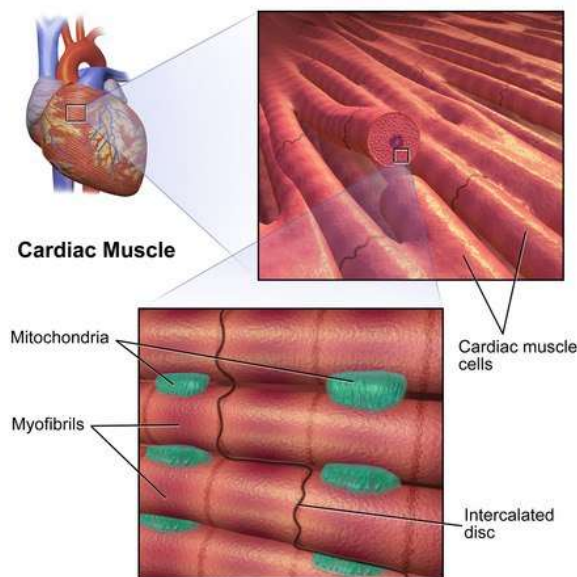
- lighter I bands (actin)
- darker A bands (myosin).

Each cardiomyocyte contains chain of sarcomeres which are composed of long proteins that organize into thick and thin filaments, called myofilaments.

Thin myofilaments contain the protein **actin**.

Thick myofilaments contain the protein **myosin**.

The myofilaments slide past each other as the muscle contracts and relaxes.

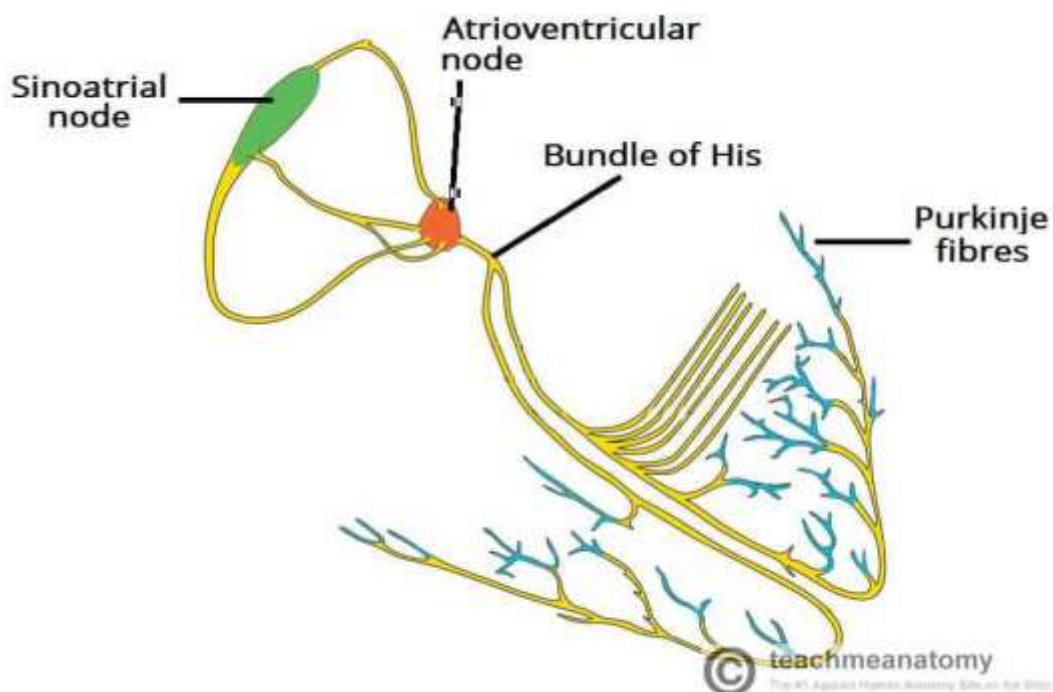


B. Myocardial conducting cells, Pacemaker cells:

Specialized modified cardiomyocytes known as pacemaker cells has the ability to initiate an electrical potential at a fixed rate that spreads rapidly from cell to cell to trigger the contractile mechanism. This property is known as **autorhythmicity**

Pacemaker cells carry the impulses that are responsible for the beating of the heart.

- the highest concentration of pacemaker cells is in the **sinoatrial (SA) node**, the natural and primary pacemaker, and the resultant rhythm is a **sinus rhythm**.



✚ Conducting System of the Heart

The heartbeat originates in a specialized cardiac muscle cells (cardiac conducting system) and spreads via this system to all parts of the myocardium.

Parts of conducting system:

1. Sinoatrial (SA) node is located in the right atrium
2. Atrioventricular (AV) node
3. Bundle of His: located in the interventricular septum and divided into right and left branches.
4. Purkinje fibers

A heart block refers to an interruption in the normal conduction pathway.

Heart Conduction System

