Anatomy and Physiology

Cardiovascular System

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Anatomy of Heart

The human heart is a muscular organ containing four chambers that is situated just to the left of the midline of the thoracic cavity.

The upper two chambers (**atria**) are divided by a wall like structure called the interatrial septum.

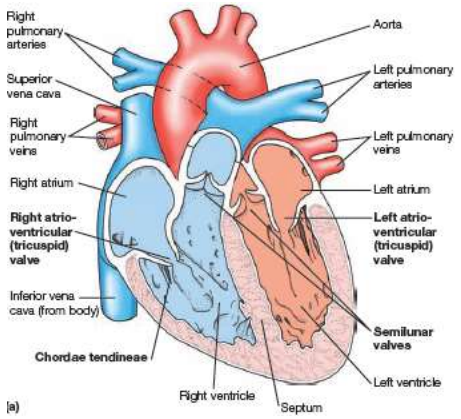
The lower two chambers (**ventricles**) are divided by a similar structure called the interventricular septum.

Functions of the Heart

1. Generating blood pressure
2. Routing blood Heart separates pulmonary and systemic circulations
3. Ensuring one-way blood flow: Heart valves ensure one-way flow
4. Regulating blood supply: Changes in contraction rate and force match blood delivery to changing metabolic needs

Structures of the Heart

- The heart lies inside the thoracic cavity, resting on the diaphragm.
- It is hollow and cone-shaped, varying in size.
- The heart is within the mediastinum in between the lungs.
- Its posterior border is near the vertebral column, and its anterior border is near the sternum.
- An average adult has a heart that is about 14 cm long by 9 cm wide.
- The *base* of the heart is actually the upper portion, where it is attached to several large blood vessels. This portion lies beneath the second rib.
- The distal end of the heart extends downward, to the left, ending in a blunt point called the *apex*, which is even with the fifth intercostal space.



Walls of the Heart

The three layers comprising the wall of the heart.

1. The outer **pericardium**: The pericardium consists of connective tissue and some deep adipose tissue, and it protects the heart by reducing friction.
2. Middle **myocardium**: The thick **myocardium** is mostly made of cardiac muscle tissue that is organized in planes and richly supplied by blood capillaries, lymph capillaries, and nerve fibers. It pumps blood out of the chambers of the heart
3. Inner **endocardium:** The **endocardium** is made up of epithelium and connective tissue with many elastic and collagenous fibers. It also contains blood vessels and specialized cardiac muscle fibers known as **Purkinje fibers**.

Inside of the Heart

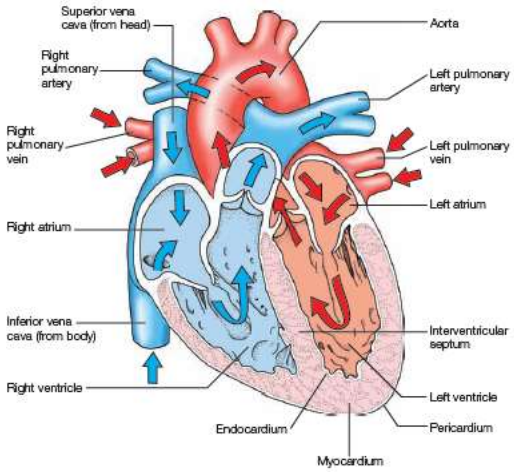
- The inside of the heart is divided into four hollow chambers, with two on the left and two on the right.
- The upper chambers are called **atria** and receive blood returning to the heart. They have *auricles,* which are small projections that extend anteriorly.
- The lower chambers are called **ventricles** and receive blood from the atria, which they pump out into the arteries
- The left atria and ventricle are separated from the right atria and ventricle by a solid wall-like structure called **septum**.
- The atrioventricular valve (AV valve), which consists of the **mitral valve** on the left and the **tricuspid valve** on the right, ensures one-way blood flow between the atria and ventricles.

Cardiac Muscle

- Elongated, branching cells containing 1-2 centrally located nuclei
- Contains actin and myosin myofilaments
- Intercalated disks: Specialized cell-cell contacts
- Desmosomes hold cells together and gap junctions allow action potentials
- Electrically, cardiac muscle behaves as single unit

Blood Circulation in the Heart

- The right atrium receives low-oxygen blood through the vena cava and coronary sinus.
- As the right atrium contracts, the blood passes through the tricuspid valve into the right ventricle.
- As the right ventricle contracts, the tricuspid valve closes. Blood moves through the pulmonary valve into the pulmonary trunk and pulmonary arteries.
- It then enters the capillaries of the alveoli of the lungs, where gas exchanges occur.
- This freshly oxygenated blood then returns to the heart through the pulmonary veins, into the left atrium.
- The left atrium contracts, moving blood through the mitral valve into the left ventricle.
- When the left ventricle contracts, the mitral valve closes. Blood moves through the aortic valve into the aorta and its branches.



Heart Valves

There are Four valves in the Heart

- Two Atrioventricular valves – between atria and ventricles
  1. Bicuspid valve (left)
  2. Tricuspid valve (right)
- Two Semilunar valves between ventricle and artery
  3. Pulmonary semilunar valve
  4. Aortic semilunar valve

Function of Valves

- Prevent blood from flowing back
- Valves open as blood is pumped through
- Held in place by chordae tendineae (“heart strings”)
- Close to prevent backflow