Objectives

- Identify the layers and functions of pericardium.
- Describe the Heart in regard to (position, chambers and valves).
- Describe the blood supply of the heart.
- Describe the blood return of the heart.
- Describe innervation of the heart.
- Know the most clinical significances of the heart.
Resources

Essential of Human Anatomy and Physiology
By Elaine Marieb and Suzanne Keller

Atlas of Human Anatomy
By Frank Netter

Gray’s Anatomy
By Richard Drake, Wayne Vogl & Adam Mitchell

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Introduction

- The pericardium is a tough double-walled sac containing the heart and the roots of the great vessels.
- There are two layers to the pericardial sac:
  - the outermost fibrous pericardium.
  - the inner serous pericardium.
- The space between the two layers of serous pericardium, the pericardial cavity, is filled with serous fluid which protects the heart from any kind of external shock.
Classification

- **FIBROUS PERICARDIUM**
  - The tough and external layer of the pericardium.
  - It is made up of dense and loose connective tissue to protect the heart and preventing it from overfilling with blood.

- **SEROUS PERICARDIUM**
  - The thin internal layer of pericardium.
  - Divided into two layers:
    - **Parietal pericardium**, which is inseparable from the fibrous pericardium
    - **Visceral pericardium**, which is part of the epicardium.
  - Both are made of single sheet of epithelial cells.
  - Between two layers, the pericardial cavity, which contains a small amount of lubricating serous fluid.
  - Both of two layers function in lubricating the heart to prevent friction during heart activity.
Functions

- **Protects** the heart from infections coming from other organs like the lungs.
- **Lubricates** the heart.
- **Prevents** excessive overfilling of the heart in cases of acute volume overload.
- **Fixes** the heart in mediastinum and limits its motion.
Fibrous pericardium and the parietal layer of serous pericardium are supplied by **phrenic nerves**.

The visceral layer of serous pericardium has different innervations than the parietal layer.

It is innervated by branches of **sympathetic** trunks and **parasympathetic** (vagus nerves).
Pericarditis

- It is the **inflammation** of the pericardium, and the chest pain is involved.
- The causes of pericarditis includes:
  - Infections of the pericardium by viruses or bacteria.
  - Idiopathic causes (unknown cause).
  - Post-infarction pericarditis.
  - Dressler's syndrome.
    - it is a secondary form of pericarditis that occurs in the setting of injury to the heart or the pericardium.
    - it consists of fever, pleuritic pain, pericarditis and/or a pericardial effusion.
The Heart
Introduction

- The human heart is an organ that **pumps** blood throughout the body via the circulatory system.
- The **blood** carries oxygen, nutrients, cell wastes, hormones and many other substances vital for body homeostasis.
- The heart provides **forces** to move the blood around the body by the beating Heart.
It is a **hollow**, cone shaped muscular pump that keeps circulation going on.

It is the size of hand’s **fist** of the same person.

It has:
- Apex
- Base
- Surfaces:
  - Diaphragmatic & Sternumcostal
- Borders:
  - Right, Left, Inferior.
Location

- It is located in the thoracic cavity in a place known as the **Middle Mediastinum** between the two pleural sacs.
- Enclosed by a double sac of serous membrane (**Pericardium**).
- 2/3 of the heart lies to the **left** of median plane.
- The outer wall of the heart is made up of **three** layers:
  - Epicardium.
  - Myocardium (muscle of the heart).
  - Endocardium.
Walls

- The **epicardium** is a thin layer of connective tissue and fat and serves as an additional layer of protection for the heart, under the pericardium.
- The **myocardium** is the muscle tissue of the heart, composed of cardiac muscle cells called cardiomyocytes, which contract like other muscle cells.
- The **endocardium** is composed of endothelial cells which provide a smooth, non-adherent surface for blood collection and pumping and help regulate contractility.
Atria

- They are two (Right & Left).
- Superior in position.
- They are the **receiving** chambers.
- They have **thin** walls.
- The Right Atrium receives the **venous** blood coming to the heart.
- Left Atrium receives **arterial** blood coming from the lungs.
Ventricles

- The inferior chambers.
- They are two (right & left).
- They have thick walls.
- They are the **discharging** chambers (actual pumps).
- Their contraction propels blood out of the heart into the circulation.
Valves

- Heart has **four** valves
  - Two **Atrio-Ventricular** valves.
  - One **Aortic Semilunar** valve.
  - One **Pulmonary Semilunar** valve.
Atrioventricular Valves

- Valves between atria & ventricles.
- They allow the blood to flow in **one direction** from the atria to the ventricles.
- Right AVV (**Tricuspid**).
- Left AVV (**Bicuspid**).
Semilunar Valves

- Between the right and left ventricles and the great arteries leaving the heart.
  - Aortic Semilunar Valve
  - Pulmonary Semilunar Valve
- They allow the flow of blood from the ventricles to these arteries.
Blood Supply

- Coronary Circulation
- It is comprised of arteries, arterioles, capillaries, venules and veins.
Coronary Arteries

- The heart has its own unique blood supply known as the coronary circulation.
- The aorta branches off into two main coronary arteries.
- The right coronary artery supplies blood mainly to the right side of the heart.
- The left coronary artery supplies blood to the left side of the heart.
- The left side of the heart is larger and more muscular because it pumps blood to the rest of the body.
Coronary Veins

- **Great Cardiac Vein** begins at the apex of the heart and ascends along with the IV branch of the left coronary artery.
- **Middle Cardiac Vein** begins at the apex of the heart and ascends in the posterior IV groove, accompanying the posterior IV branch of the right coronary artery.
- **Small Cardiac Vein** runs along the right margin of the heart in company with the marginal artery and then posteriorly in the coronary sulcus to end in the right end of the coronary sinus.
Coronary Sinus

- The largest vein draining the heart and lies in the coronary sulcus, which separates the atria from the ventricles.
- Opens into the right atrium between the opening of the IVC and the AV opening.
- Has a one-cusp valve at the right margin of its aperture.
- Receives blood from:
  - the great, middle, and small cardiac veins.
  - the oblique vein of the left atrium.
  - the posterior vein of the left ventricle.
Coronary Circulation

- Aorta
- Left coronary artery (behind pulmonary trunk)
- Superior vena cava
- Left atrium
- Circumflex artery
- Right coronary artery
- Right atrium
- Right ventricle
- Marginal artery
- Marginal artery
- Anastomosis (junction of vessels)
- Posterior interventricular artery
- Anterior interventricular artery
- Small cardiac vein
- Coronary sinus
- Middle cardiac vein
- Great cardiac vein
- Anterior cardiac vein
Innervation

- **Visceral Sensory** Fibers given off by the branches of phrenic nerve, innervate the fibrous pericardium as well as the parietal layer of serous pericardium. These fibers generally carry the sensation of pain.

- **Parasympathetic** Fibers responsible for slowing down of the heart rate, arise as branches of the vagus nerve in the neck and thorax and innervate the visceral layer of serous pericardium.

- **Sympathetic** Fibers increase the rate and force of contraction travel to the heart from the cervical and upper thoracic sympathetic chain of ganglia and innervate the visceral layer of serous pericardium just like the sympathetic fibers.
Blood

- Blood is the actual **carrier** of the oxygen and nutrients into arteries.
- Blood is made mostly of **plasma**, which is a yellowish liquid that is 90% water.
- Plasma contains also salts, glucose and other substances.
- Most important, plasma contains **proteins** that carry important nutrients to the body’s cells and strengthen the body’s immune system.
- Blood has main 3 types of blood cells that circulate with the plasma.
Heart Diseases

- Heart disease is a major cause of death, accounting for an average of 30% of all deaths in 2008, globally.
- **Obesity**, **high blood pressure**, and **high cholesterol** can all increase the risk of developing heart disease.
- Coronary artery disease and atherosclerotic disease are the most common form of heart disease.
- The common causes of heart failure are heart attacks, valve disorders and high blood pressure.
- This happens when the heart is pumping insufficiently and cannot meet the body's blood flow demands.
Angina Pectoris

- **Angina pectoris** is the medical term used to describe the temporary chest pain that occurs when the heart is **not** getting enough blood.

- It presents as a severe steady pain and constriction around the heart, typically radiating from the chest to the left shoulder and down the left arm, creating a feeling of pressure in the chest.

- The patient will often be very pale and will experience **dyspnea** and have a variable raised blood pressure.

- An attack of angina pectoris will last a few seconds to a few minutes.

- It is relieved by removing the stressor and/or taking sublingual nitroglycerin.
Congestive Cardiac Failure

- **Congestive cardiac failure** (CCF) is a condition in which the heart cannot pump enough blood, and consequently enough oxygen around the body.

- It can result from **coronary artery disease** such as stenosis, scarring from a previous myocardial infarction, hypertension, damaged heart valves, cardiomyopathy or an infection such as endocarditis.

- The failing heart keeps working but not as **efficiently** as it should.

- People with CCF cannot exert themselves because they become fatigued and short of breath very easily.

- Diagnosis is by clinical examination, **electrocardiogram**, **echocardiogram** and **blood tests**.

- Treatment includes **reduction** of salt and fluid intake, medications such as **diuretics**, and a **cocktail** of cardiac specific medications.
Coronary Artery Disease

- **Coronary Artery Disease** (CAD) occurs when the arteries that supply blood to heart muscle (the coronary arteries) become hardened and narrowed.
- This is due to **atherosclerosis** which is the buildup of cholesterol-rich plaque, on the inner walls of the vessels.
- Over time, this plaque hardens and may rupture.
- Hardened plaque narrows the coronary arteries and reduces the flow of oxygen-rich blood to the heart.
- This reduced blood supply to the heart muscle is called **ischemia**.
- When the heart muscle doesn’t get enough blood, chest pain known as angina may occur.
Endocarditis

- **Endocarditis** is a **bacterial** infection of the endocardium resulting in valvular deformity.
- It most commonly occurs in **susceptible** patients whose circulatory system has been breached in some way such as through insertion of a central venous line, recent dental work, drug injections, or previous cardiac surgery.
- Long-term intravenous antibiotics are required, and replacement of heart valves may be necessary.
Heart Attack

- Heart attack occurs when blood flow to a part of the heart is blocked by a blood clot.
- If this clot cuts off the blood flow completely, the part of the heart muscle supplied by that artery begins to die.
- Most people survive their first heart attack and return to their normal lives to enjoy many more years of productive activity.
Other heart Diseases

- **Hemorrhagic Stroke**
  - Occurs when a blood vessel within the brain bursts. The most likely cause is uncontrolled hypertension.

- **Heart Failure**
  - It means the heart isn't pumping blood as well as it should. The heart keeps working, but the body's need for blood and oxygen isn't being met.

- **Arrhythmia**
  - This is an abnormal rhythm of the heart. The heart can beat too slow, too fast or irregularly.

- **Heart Valve Problems**
  - When heart valves don't open enough to allow the blood to flow through as it should.