Anatomy of the Cardiovascular system

Learning objectives:

After this lecture, student should be able to:

-Know the components &functions of CVS.

- Know the type of arteries and anastomosis

-Describe the differences between arteries and veins.

-Know systemic, pulmonary and portal circulations.

- Know the component of the lymphatic system

The cardiovascular system is a closed system composed of the heart and blood vessels .

-Function of the cardiovascular system:

1-Deliver oxygen and nutrients to the body tissues.

2-Remove carbon dioxide and other waste products from the tissues back to the circulation.

Heart

The heart is a conical hollow muscular pump inside the pericardium occupying a major part of the chest. It is formed of four chambers two atria (right and left) and two ventricles (right and left).

The heart has an apex, a base and two surfaces. The surfaces are the sternocostal and diaphragmatic. The borders are right, left, upper and lower border

Apex

It is formed only by the left ventricle and is directed downward, forward and to the left. Pulsations of the apex can be felt bellow nipple of the left breast, in the left 5^{th} intercostal space.

Base :

It is formed mainly by the left atrium and the back of the right atrium. It is directed backwards and to the right.

Sternocostal surface:

It is directed forwards, upwards and to the left. It is divided by coronary groove into:

1. Atrial Portion: It is formed mainly by the right auricle and small part of the left atrium.

2. Ventricular Portion: One third of this surface is formed by left ventricle and two thirds by the right ventricle.

Diaphragmatic surface

It is directed downwards and slightly backward. It is formed by the two ventricles, two thirds by the left ventricle and one third by the right ventricle.

Upper border: it is formed by the two atria, mainly the left.

Right border: It is formed only by right atrium.

Lower border: It is formed by the right ventricle and the apical part of left ventricle.

Left border: It is formed mainly by the left ventricle and partly by the left atrium.

Right Atrium

It is separated from the left atrium by the inter atrial septum. The right atrium is composed of two main parts, a smooth posterior portion and a rough walled anterior portion. In the large smooth part the following orifices are present:

1. The superior vena cava: Opens into the upper posterior part. It brings blood from head, neck, upper limbs and thorax.

2. The inferior vena cava: Opens into the lower posterior part. It brings from the lower limbs and abdomen to the right atrium.

3. The coronary sinus: It conveys venous blood from the heart wall to the right atrium.

Note: ***Tricuspid valve connects the right atrium with the right ventricle. It is guarded by three cups*****.**

Left Atrium

The left atrium forms the greater part of the base of the heart. It interior presents a smooth surface except for view rough part. The left atrium shows the following orifices:

1. The four pulmonary veins, two from each lung.

Note: ***The mitral valve connects the left atrium with the left ventricle.***

Right ventricle

It is separated from the left ventricle by interventricular septum. Its wall is muscular and is more thicker than the atrial wall. The pulmonary trunk arises from the right ventricle and divides into two pulmonary arteries one to each lung. There are three papillary muscles attached to the wall of the ventricle. From the apices papillary muscles, fibrous cords (chorda tendinae) pass to the cusps of the tricuspid valve.

Left ventricle:

The left ventricle is longer than the right ventricle and forms the apex of the heart. Its wall is nearly three times thicker than the right . The ascending aorta arises from it. **The ascending aorta gives two coronary arteries which supply the heart**. Then it curves forming the arch of the aorta and then descends downwards as the descending aorta. The arch of aorta gives three branches which supply the head, neck and upper limbs. The descending aorta supplies the rest of the body. Its cavity presents two papillary muscles which are attached to the two cusps of the mitral valve by chord tendinae.

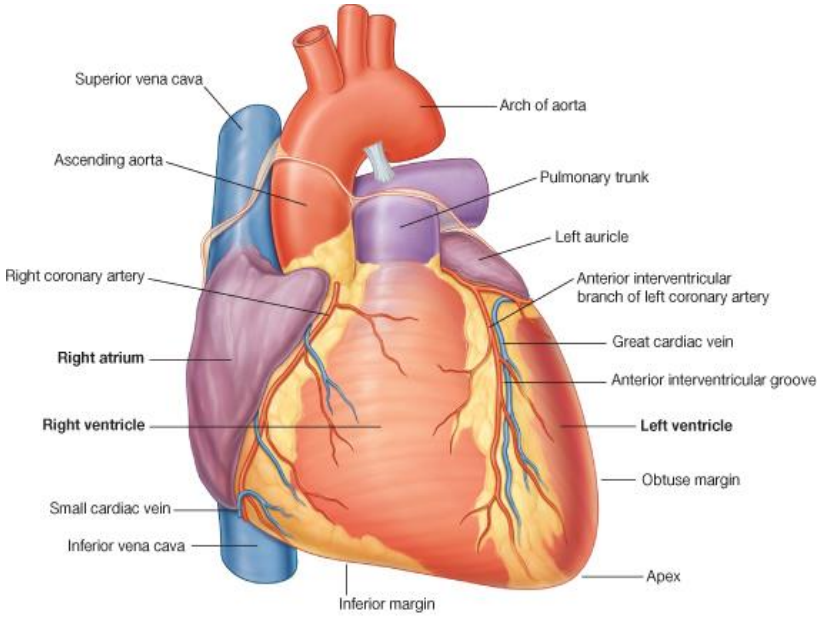


Fig. 1: Sternocostal surface

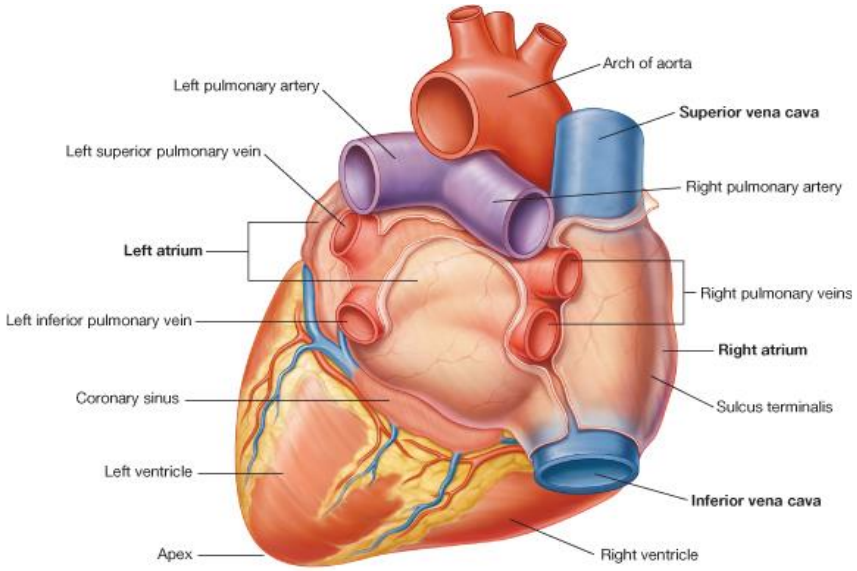


Fig.2: Diaphragmatic surface

Pericardium

The pericardium is a **fibro-serous sac** that encloses the heart and the roots of the great vessels

It consists of an outer fibrous sac lined with an inner serous sac. The serous pericardium has a visceral layer covering the heart and a parietal layer lining the fibrous pericardium.

Its function is to restrict excessive movements of the heart as a whole and to serve as a lubricated container in which the different parts of the heart can contract.

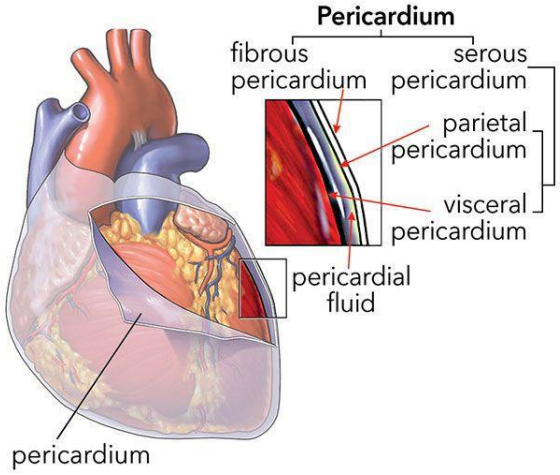


Fig.3 : It shows the Pericardium

Conducting system of the Heart:

The conducting system of the heart consists of modified cardiac muscle fibers which are responsible for initiation and maintenance of cardiac rhythm. The conducting system is formed of:

1. Sino-atrial nod (SAN)

2. Atrioventricular node (AVN)

3. Atrioventricular bundle (AVB)

AVB is a slender bundle, which extends from the A-V node .Then divided into right and left branches.

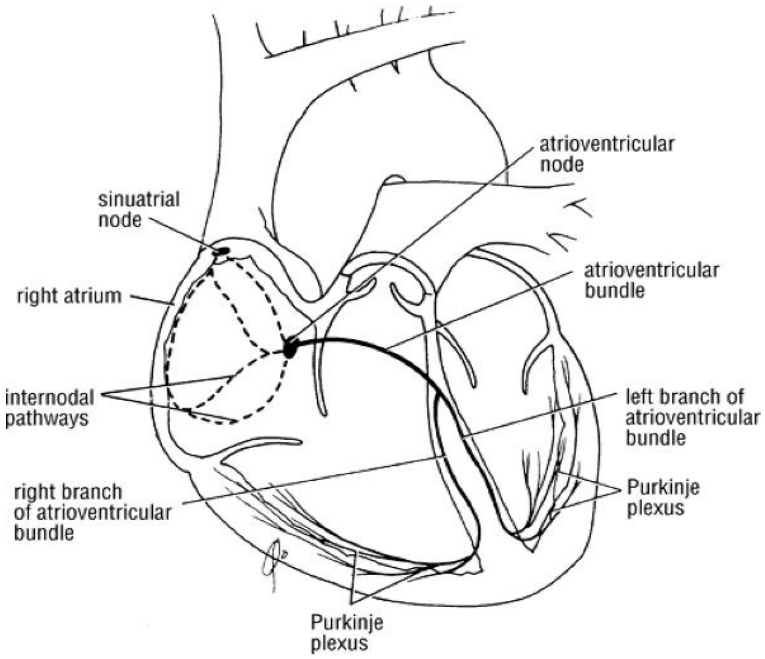


Fig. 4 : Conducting system of the heart

Arteries:

Muscular, thick walled, elastic blood vessels

-Carry oxygenated blood **away** from the heart to body cells, tissue & organs ***Except*** for pulmonary artery.

Arterioles: Small terminal branches of arteries connect arteries to capillaries

Types of arteries:

1-Large elastic arteries: e.g Aorta, pulmonary artery.
2-Medium muscular arteries: e.g brachial artery.
3-Small arteries
4-Tortous arteries: e.g coronary arteries, uterine arteries
5-End arteries:
These are artries that is the only source of oxygenated blood to an organ. They do not anastomose with their neighbours

A-Anatomical end artries: there is no anastomosis between its branches. So interruption of their blood flow end in serious complication, e.g central artery of the retina, pulmonary artery.

B-Functional end arteries : arteries with inefficient anastomosis supply kidney, liver, brain, heart.

Arterial pulsation: The wall of the artery pulsates with each cardiac beat. This can be felt in artries upon rigid bones

Capillaries: Very small blood vessels connect arterioles to venules

Venules :

Small veins connect capillaries to larger veins

Veins :

-Thin walled, wide lumen blood vessels. They Carry deoxygenated blood to the heart from body cells, tissue & organs except for pulmonary vein
-They have one-way valves which prevent blood from flowing backwards.

Anastomosis

1-It is a connection between many arteries to maintain arterial supply if the main artery is occluded.
-It may be:
a- arterio-arterial anastomosis between arteries e.g, coronary arteries
b- veno-venous anastomosis between veins e.g alternate drainage of organs
c- arterio-venou anastomosis between an artery and a vein. Their walls are surrounded by Sphenicters control blood to organs e.g fingers. Skin of nose & Lips

Types of circulation of blood

In a human body, there are three types of circulation of blood:

Systemic (greater) circulation:
The blood flows from the left ventricle, through various parts of the body, to the right atrium, i.e. from the left to the right side of the heart . This circulation is responsible for keeping the body tissues alive by supplying a continuous stream of blood to them.
Pulmonary (lesser) circulation:
-The blood flows from the right ventricle, through the lungs, to the left atrium, i.e. from the right to the left side of the heart. -This circulation is responsible for oxygenation of blood.

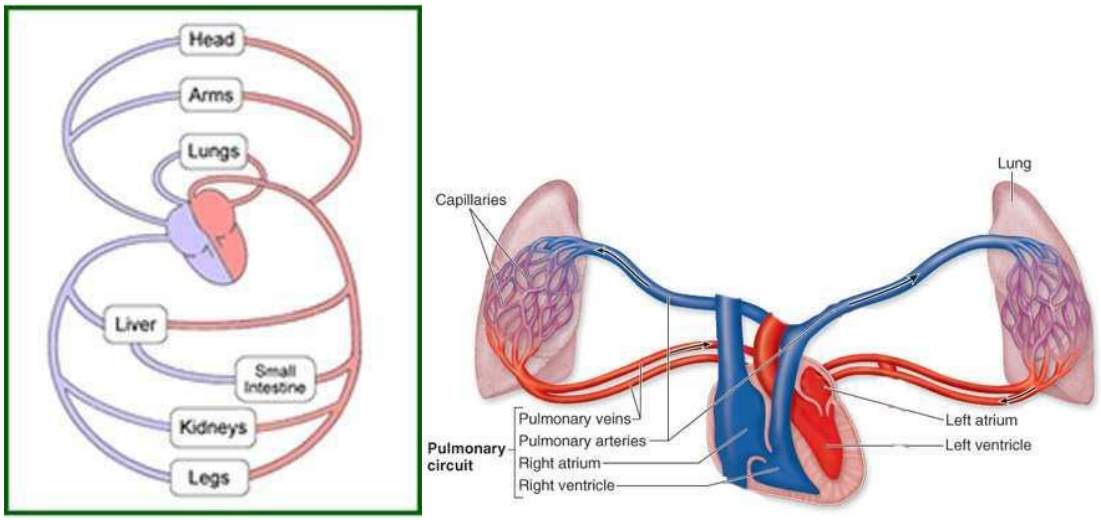
Portal circulation:

-It is a part of systemic circulation, which has the following characteristics:

1-The blood passes through two sets of capillaries before draining into a systemic vein.

2-The vein draining the first capillary network is known as ***portal vein*** which branches like an artery to form the second set of capillaries or sinusoids.

Examples: hepatic portal circulation, hypothalamo hypophyseal portal circulation and renal portal circulation.



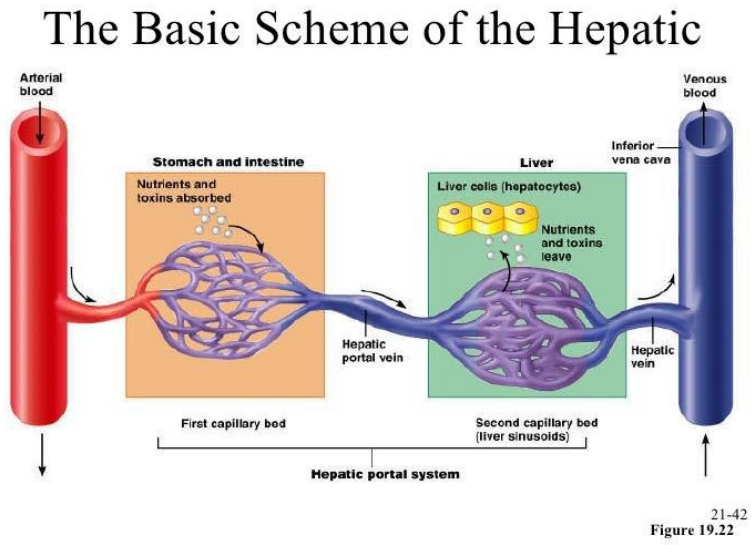


Fig.5: Types of circulation of blood

Lymphatic system

Lymphatic system is a drainage system that assists the cardiovascular system in removal of tissue fluid from the tissue spaces of the body.
-**It consists of lymph, lymphatic tissues and lymphatic vessels**.

-The lymph:
-It is a clear colorless fluid formed at tissue spaces. The tissue fluid once it enters a lymphatic vessel is known as lymph. It is composed of blood plasma, proteins & lymphocytes.
-lymphatic tissues are formed of lymphatic aggregations (spleen & lymph nodes) & lymph nodes

The lymphatic vessels:
-Lymphatic capillaries drain lymph from tissue spaces. They unite to form small lymphatic vessels which unite to form larger vessels.
-Lymphatic vessels either superficial or deep to the deep fascia.
-Lymphatic vessel that carry lymph to the lymph nodes is called **Afferent vessels**, while those which transport lymph from the node is called **Efferent vessels.**

-Lymph reach the blood stream at the root of the neck by two large vessels. They are **right lymphatic duct** on the right side drain the right 1/4 of the body and **the thoracic duct** on the left side drain the rest of the body.
The thoracic duct is largest lymphatic vessel in the body. It starts from cisterna chyli in abdomen and empties into the angle between the left internal jugular and left subclavian veins.

Some structures in the body are rich in lymphatics and others are poor in lymphatics

Sites without lymphatics	Sites rich in lymphatics
1- central nervous system 2- Bone marrow 3-Spleen 4-Epidermis,hair,nail ,cornea& articular	1-Dermis 2-Mucous membrane 3- Serous membrane 4-Glands

Clinical notes:
-Lymph nodes may become enlarged & painful if they receive infected lymph.
-Certain types of cancer may spread by lymphatics

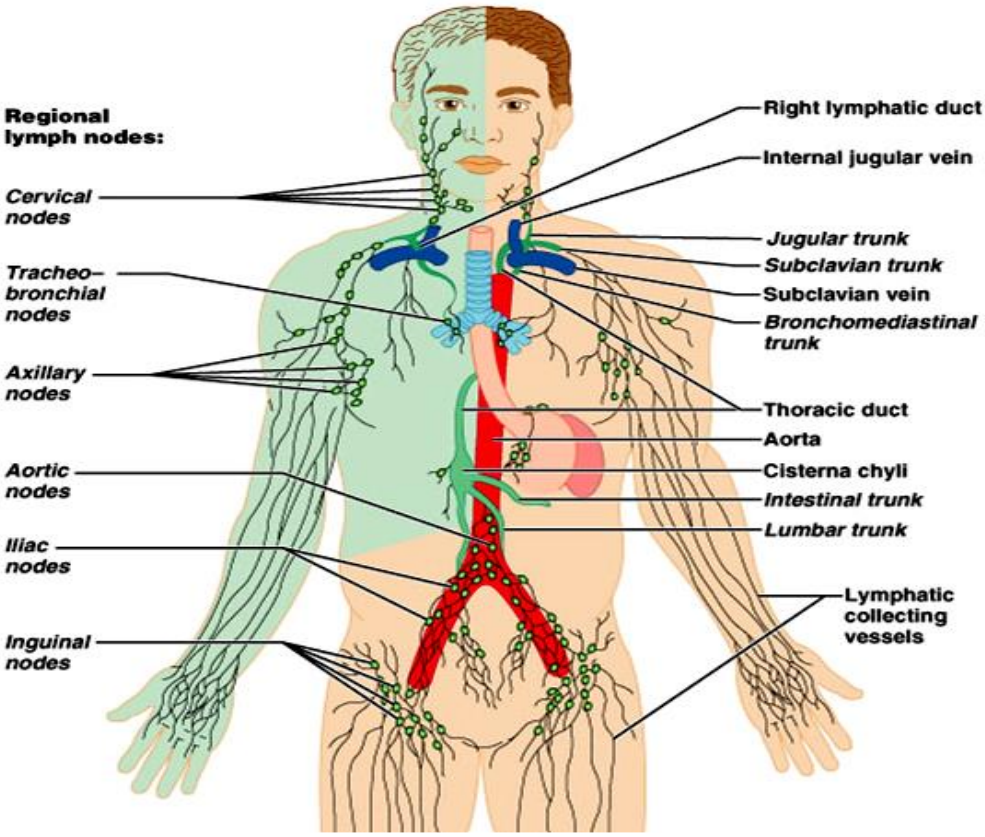


Fig.6: Lymphatic system