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Cardiovascular System

- Cardiovascular system is the *transport system* of the body, through which the nutrients are conveyed to places where these are utilized, and the metabolites (waste products) are conveyed to appropriate places from where these are expelled.
- The conveying medium is a liquid tissue, the blood, which flows in tubular channels called *blood vessels*. The circulation is maintained by the central pumping organ called the *heart*.

COMPONENTS

Cardiovascular system is a closed system of tubes made up of the following parts based on their structural and topographical characteristics (Fig. 5.1).

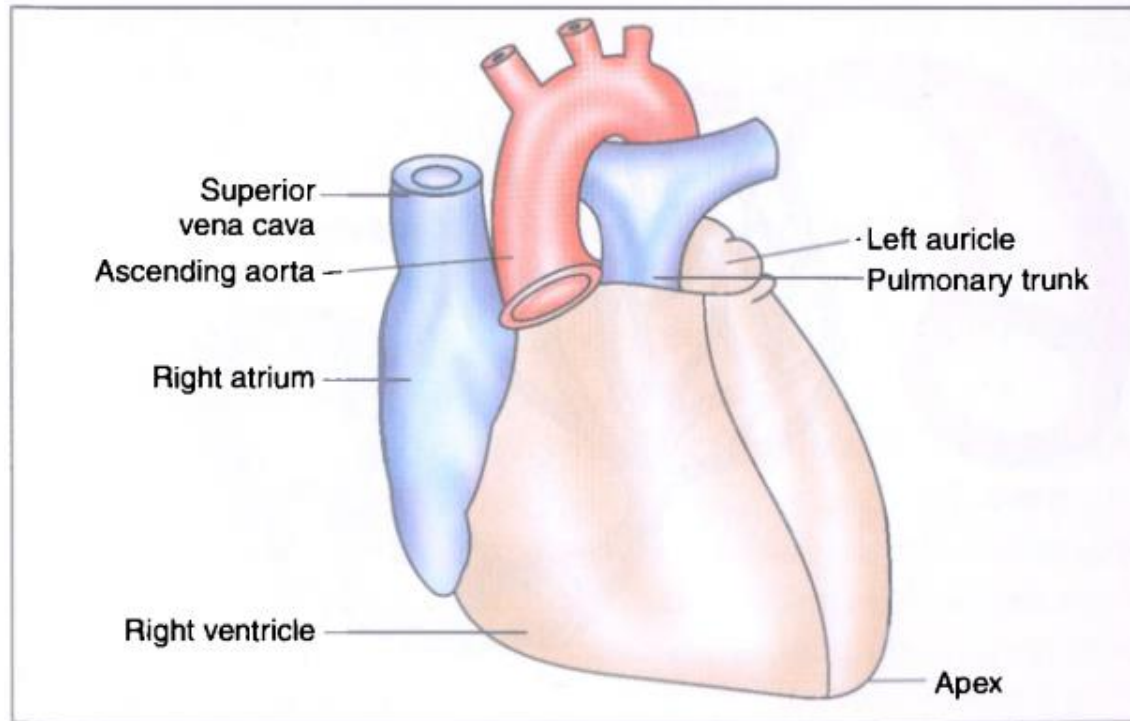
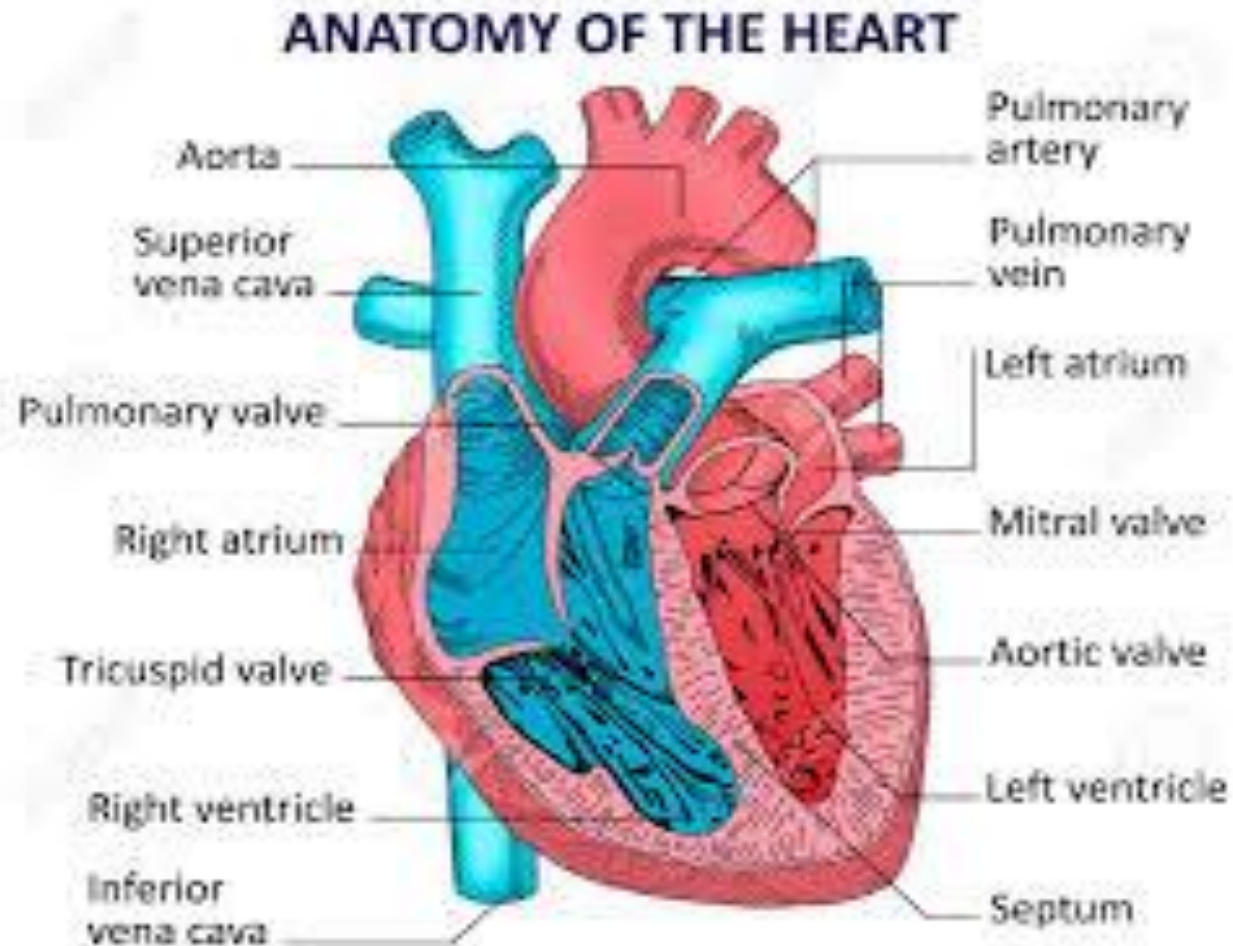


Fig. 5.1: Heart

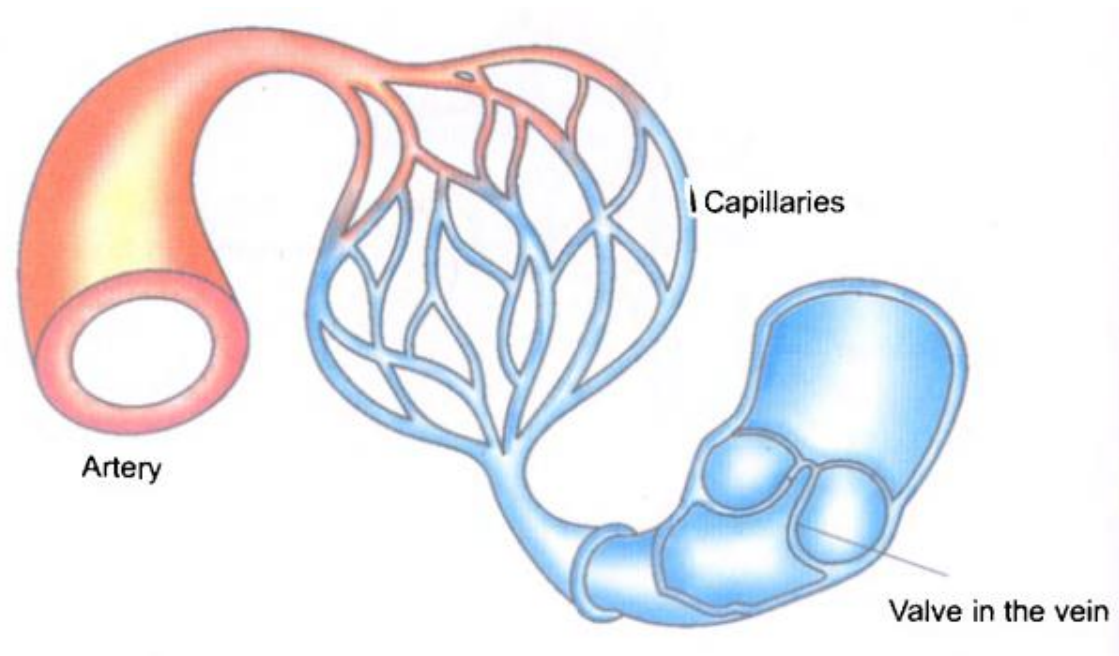
- **Heart:** It is a four-chambered muscular organ which pumps blood to various parts of the body. Each half of the heart has a receiving chamber called *atrium*, and a pumping chamber called *ventricle*.



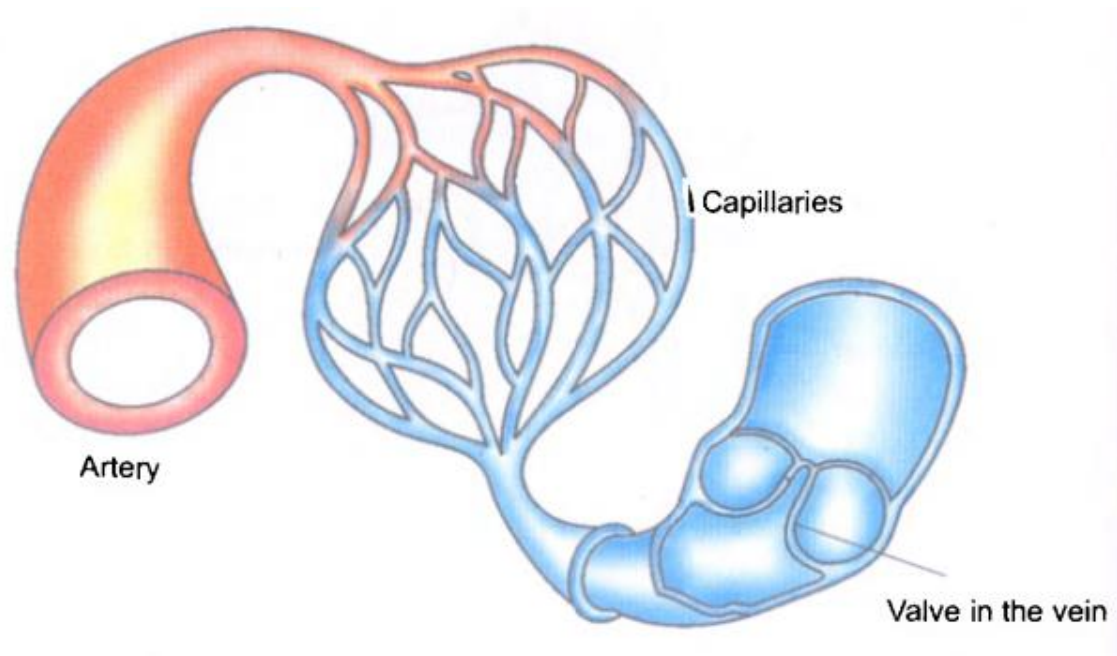
Arteries:

- **Arteries:** These are distributing channels which carry blood away from the heart.
 - (a) They branch like trees on their way to different parts of the body.
 - (b) The large arteries are rich in elastic tissue, but as branching progresses there is an ever-increasing amount of smooth muscle in their walls.
 - (c) The minute branches which are just visible to naked eye are called *arterioles*.
 - (d) *Angeion* is a Greek word, meaning a vessel (blood vessel or lymph vessel).

- **Veins:** These are draining channels which carry blood from different parts of the body back to the heart.
 - (a) Like rivers, the veins are formed by tributaries.
 - (b) The small veins (venules) join together to form larger veins, which in turn unite to form great veins called *venae cavae*



- **Capillaries:** These are networks of microscopic vessels which connect arterioles with the venules.
 - These come in intimate contact with the tissues for a free exchange of nutrients and metabolites across their walls between the blood and the tissue fluid



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.
- **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

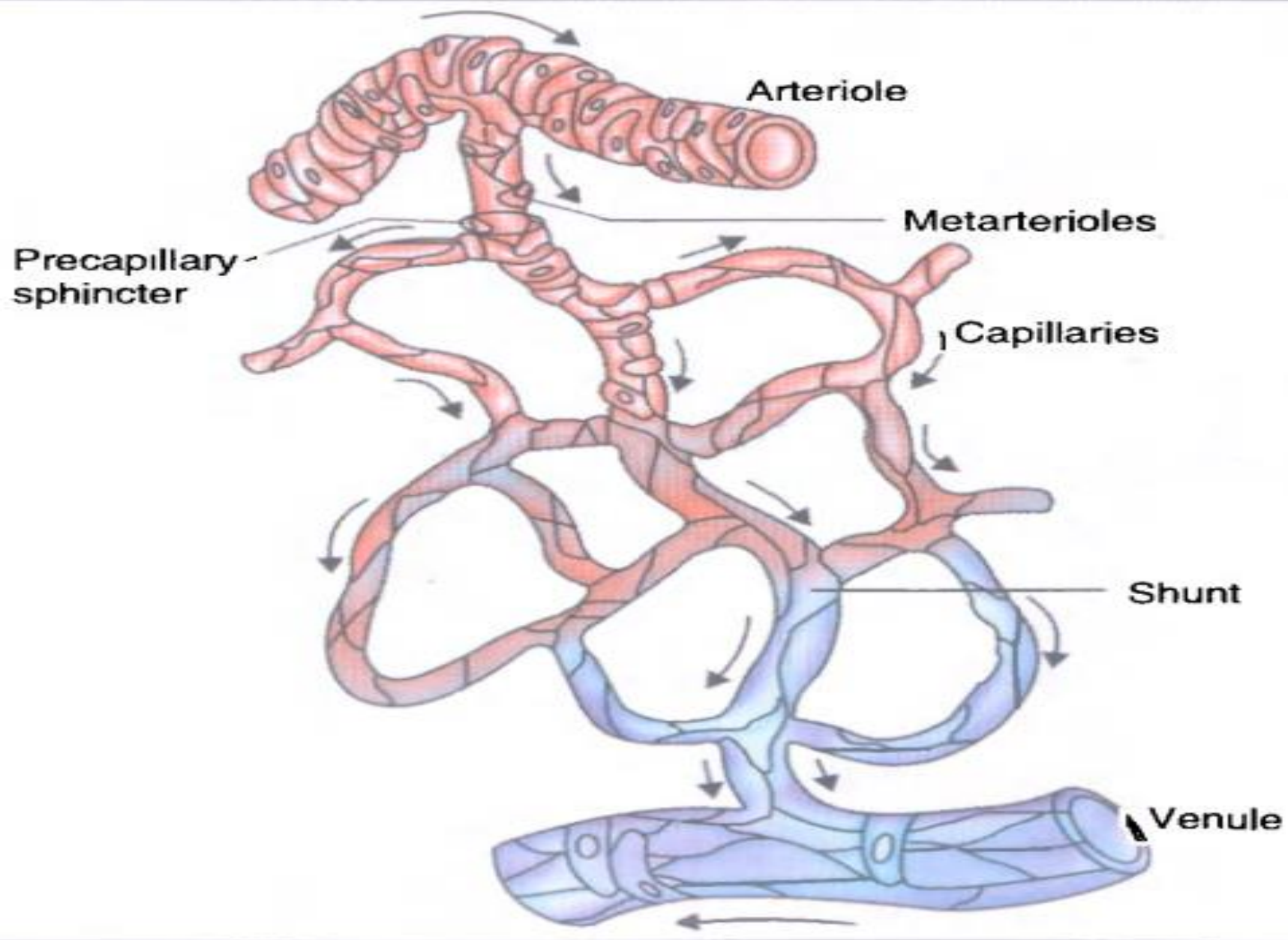
ARTERIES

Characteristic Features

1. Arteries are *thick-walled*, being uniformly thicker than the accompanying veins, except for the arteries within the cranium and vertebral canal where these are thin.
2. Their *lumen is smaller* than that of the accompanying veins.
3. **Arteries have no valves.**
4. An artery is usually accompanied by vein(s) and nerve(s), and the three of them together form the *neurovascular bundle* which is surrounded and supported by a fibroareolar sheath

Types of Arteries and Structure

- 1 . *Large arteries of elastic type*, e.g. aorta and its main branches (brachiocephalic, common carotid, subclavian and common iliac) and the pulmonary arteries.
2. *Medium and small arteries of muscular type*, e.g. temporal, occipital, radial, popliteal, etc.
3. *Smallest arteries of muscular type* are called arterioles. They measure 50-100 micron in diameter.

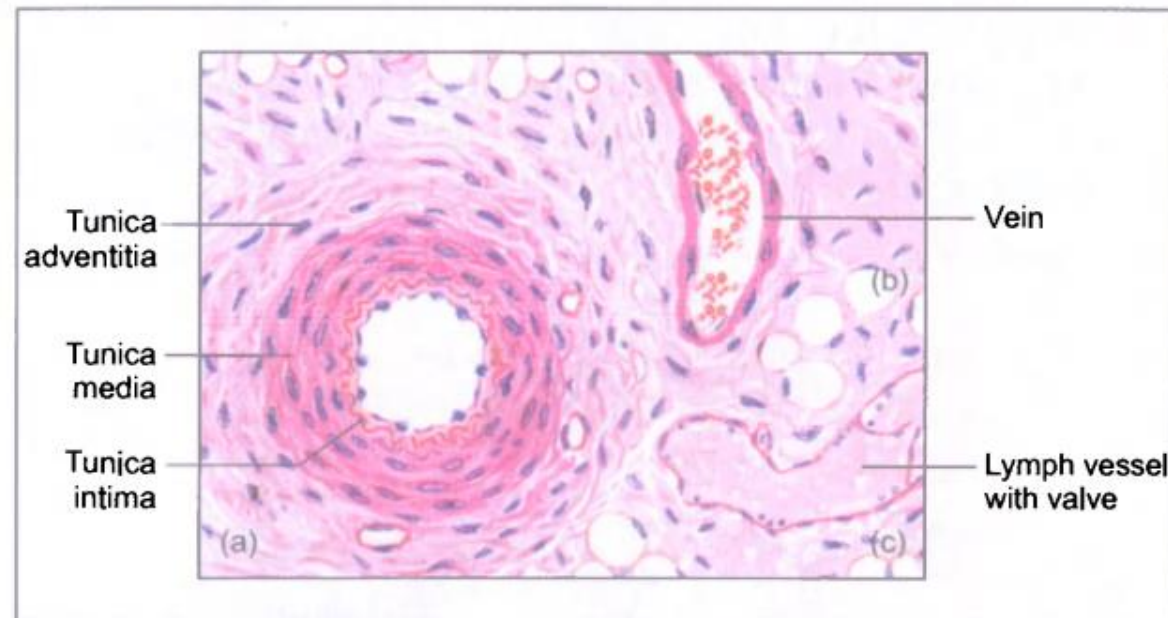


Microscopically, all arteries are made up of three coats

(a) The inner coat is called *tunica intima* (Fig.)

(b) The middle coat is called *tunica media*.

(c) The outer coat is called *tunica adventitia*. It is strongest of all coats and merges with the perivascular sheath



Blood Supply of Arteries

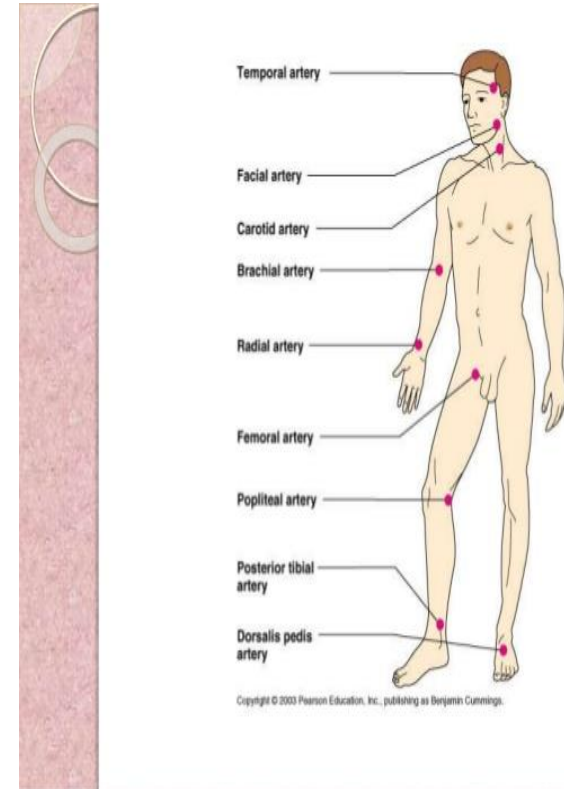
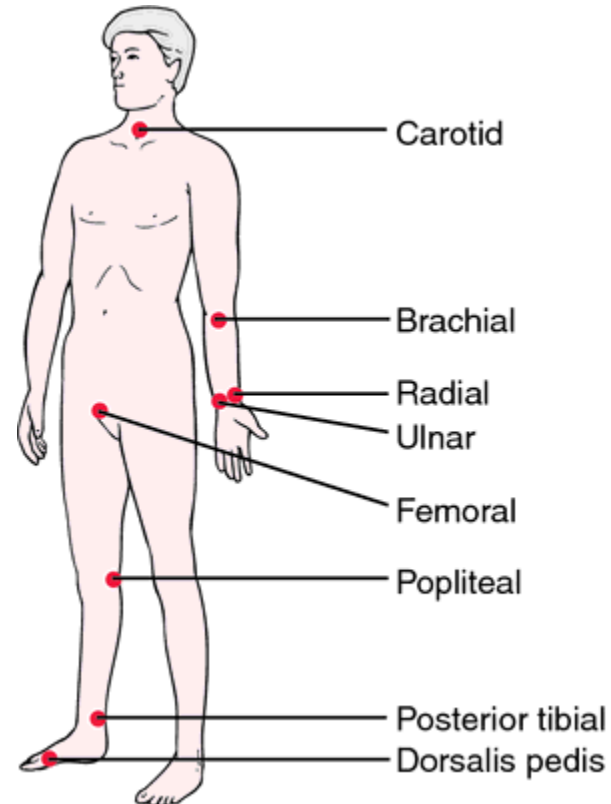
The large arteries (of more than 1 mm diameter) are supplied with blood vessels.

The nutrient vessels, called *vasa vasorum*, form a dense capillary network in the tunica adventitia, and supply the adventitia and the outer part of tunica media.

The rest of the vessel wall (intima + inner part of media) is nourished directly by diffusion from the luminal blood

Palpable Arteries

Some arteries can be palpated through the skin. These are: common carotid, facial, brachial, radial, abdominal aorta, femoral, posterior tibial and dorsalis pedis



Nerve Supply of Arteries

- The nerves supplying an artery are called *nervi vascularis*

VEINS

Characteristic Features

1. Veins are *thin-walled*, being thinner than the arteries.
2. Their *lumen* is *larger* than that of the accompanying arteries.
3. Veins have valves which maintain the unidirectional flow of blood, even against gravity. Since the venous pressure is low (7 mm Hg), the valves are of utmost value in the venous return. However, the valves are absent:
 - (a) In the veins of less than 2 mm diameter.
 - (b) In the venae cavae.
 - (c) In the hepatic, renal, uterine, ovarian (not testicular), cerebral, spinal, pulmonary, and umbilical veins.
4. The muscular and elastic tissue content of the venous walls is much less than that of the arteries. This is directly related to the low venous pressure.

Arteries vs Veins

1. Arteries carry oxygenated blood, away from the heart except pulmonary artery	Veins carry deoxygenated blood, towards the heart except pulmonary veins
2. These are mostly deeply situated in the body	These are superficial and deep in location
3. These are thick-walled, highly muscular except arteries of cranium and vertebral column	These are thin-walled
4. These possess narrow lumen	These possess wide lumen
5. Valves are absent	Valves are present which provide unidirectional flow of blood
6. These are reddish in colour	These are bluish in colour
7. These show spurty movement of blood giving pulse	These show sluggish movement of blood
8. Blood in arteries moves with pressure	Blood in veins moves under very low pressure
9. Arteries empty up at the time of death	Veins get filled up at time of death
10. If arterial wall is injured, the blood comes out like a 'fountain' in a large area all around the artery	If venous wall is injured, blood comes out, collects in a pool in a small area around vein

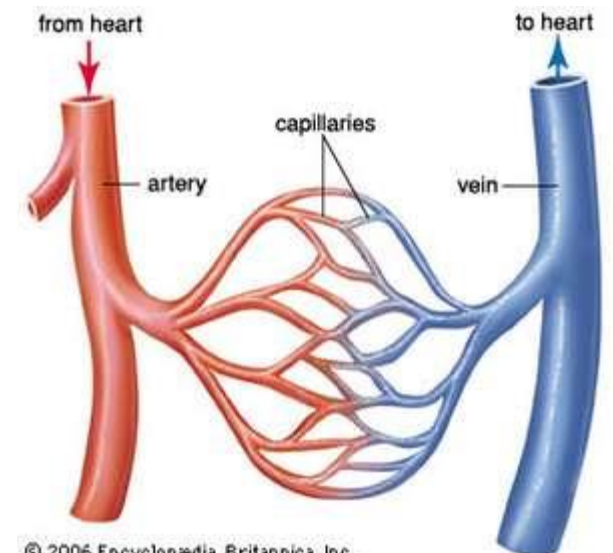
Blood and Nerve Supply of Veins

The larger veins, like the arteries, are supplied with nutrient vessels called *vasa vasorum*.

Nerve : same as arteries

CAPILLARIES

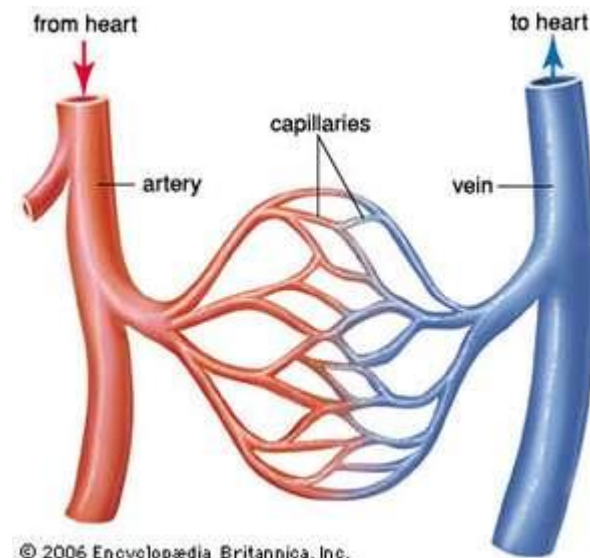
- Capillaries (capillus = hair) are networks of microscopic endothelial tubes interposed between the metarterioles and venules
- The capillaries are replaced by cavernous (dilated) spaces in the sex organs, splenic pulp and placenta.



CAPILLARIES

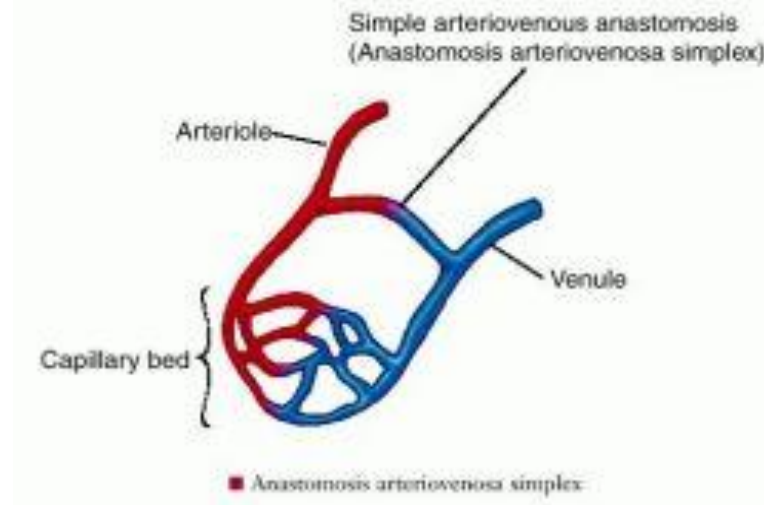
- Size

The average diameter of a capillary is 6-8 micron, just sufficient to permit the red blood cells to pass through in 'single file'. But the size varies from organ to organ. It is smallest in the brain and intestines, and is largest (20 micron) in the skin and bone marrow.



ANASTOMOSES

- **Definition**
A precapillary or postcapillary communication between the neighbouring vessels is called anastomoses.
- Circulation through the anastomosis is called *collateral circulation*.



Types

- **A. Arterial anastomoses** is the communication between the arteries, or branches of arteries. It may be actual or potential.
- **1. In *actual arterial anastomosis*** the arteries meet end to end. For example, palmar arches ,plantar arch, circle of Willis, intestinal arcades, labial branches of facial arteries.
- **2. In *potential arterial anastomoses*** the communication takes place between the terminal arterioles.
- **B. Venous anastomoses** is the communication between the veins or tributaries of veins. For example, the dorsal venous arches of the hand and foot.
- **C. Arteriovenous anastomosis (shunt)** is the communication between an artery and a vein.

END-ARTERIES

Arteries which do not anastomose with their neighbors are called end

- arteries .
- Examples:
 - 1. Central artery of retina and labyrinthine artery of internal ear are the best examples of an absolute end arteries.
 - 2. Central branches of cerebral arteries and vasa recta of mesenteric arteries.
 - 3. Arteries of spleen, kidney, lungs and metaphyses of long bones

APPLIED ANATOMY OF CVS

The **blood pressure** is the arterial pressure exerted by the blood on the arterial walls. The maximum pressure during ventricular systole is called *systolic pressure*; the minimum pressure during ventricular diastole is called *diastolic pressure*.

Haemorrhage (bleeding) is the obvious result of rupture of the blood vessels. Venous haemorrhage causes oozing of blood; arterial haemorrhage causes spurting of blood

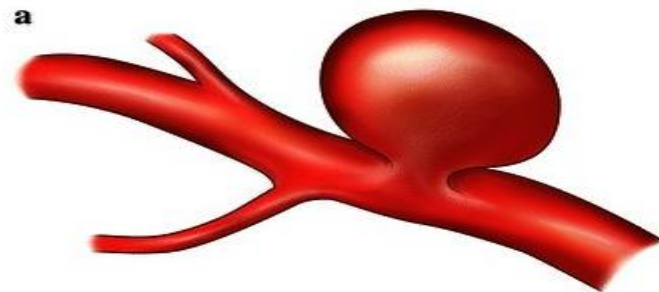
APPLIED ANATOMY OF CVS

Arteriosclerosis: In old age the arteries become stiff. This phenomenon is called arteriosclerosis. This causes a variable reduction in the blood supply to the tissues and a rise in systolic pressure.

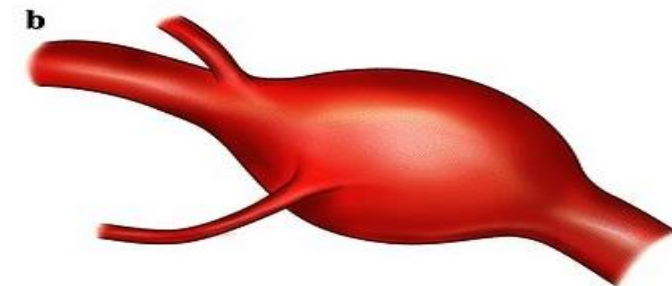
- **Arteritis and Phlebitis:** Inflammation of an artery is known as arteritis, and inflammation of a vein as phlebitis.
- **Atheroma** are patchy changes developed in the tunica intima of arteries due to accumulation of cholesterol and other lipid compounds.

Coronary arteries blockage: These may be opened up by stents.
Blocked coronary artery may be replaced by a graft

- **Aneurysm** is the swelling or dilation of blood vessels where part of the wall of artery inflates like a balloon. The wall of the blood vessel at the site of aneurysm is weaker and thinner than the rest of the blood vessels. Due to its likelihood to burst it poses a serious risk to health

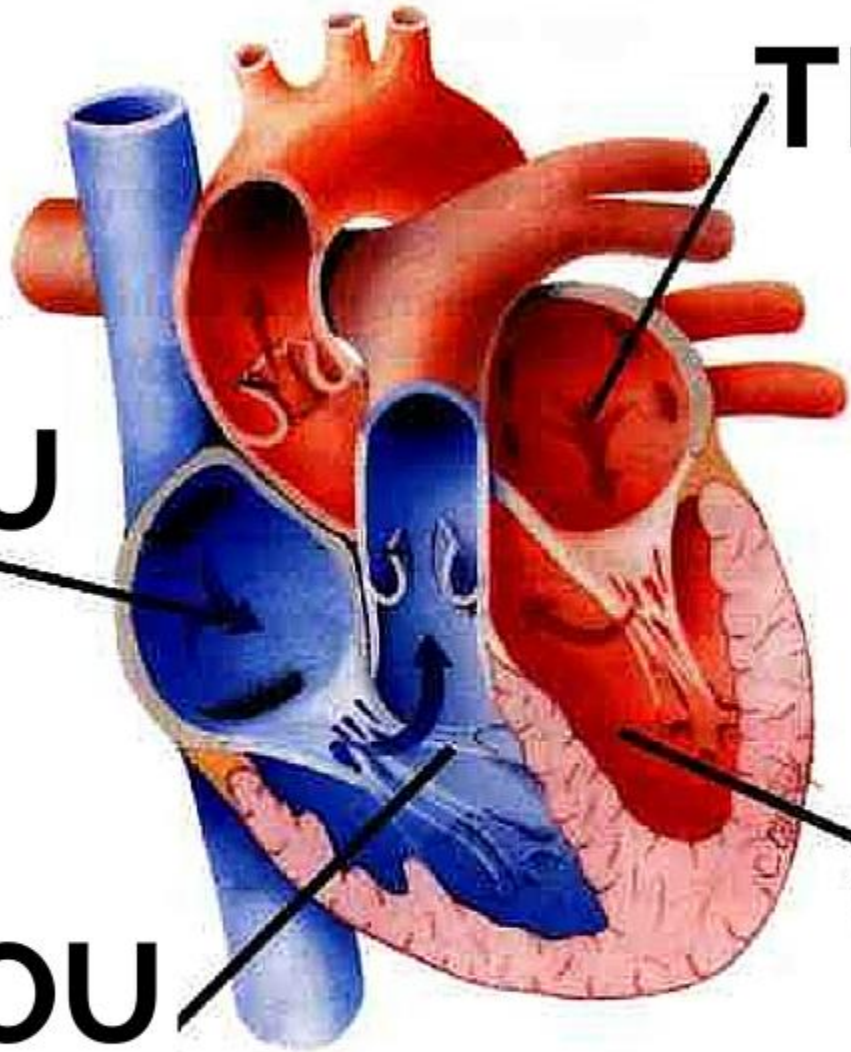


Saccular Aneurysm



Fusiform Aneurysm

THANK YOU



THANK YOU

THANK YOU

THANK YOU

FROM ALL 4 CHAMBERS OF MY HEART: