Lecture 6: Blood Vessels- Structure and Function

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Components of Circulatory System

Blood Vessel

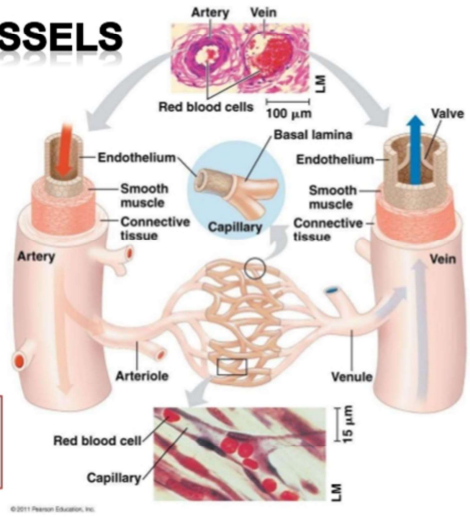
- Blood vessels are intricate networks of hollow tubes that transport blood throughout the entire body.
- Blood vessels are constructed of layers of connective tissue and muscle.
- Three major types of blood vessels
  - The arteries: Carry the blood away from the heart
  - The capillaries: Enable the actual exchange of water and chemicals between the blood and the tissues
  - The veins: Carry blood from the capillaries back toward the heart.

Blood Vessel Types

3 major types
Arteries
Capillaries
Veins

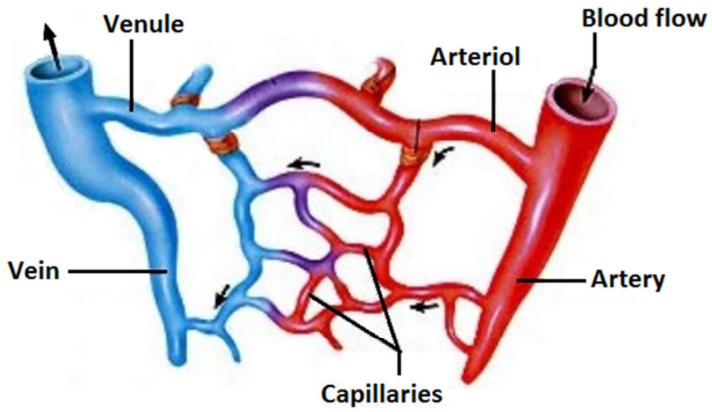
2 sub-types
Arterioles
Venules

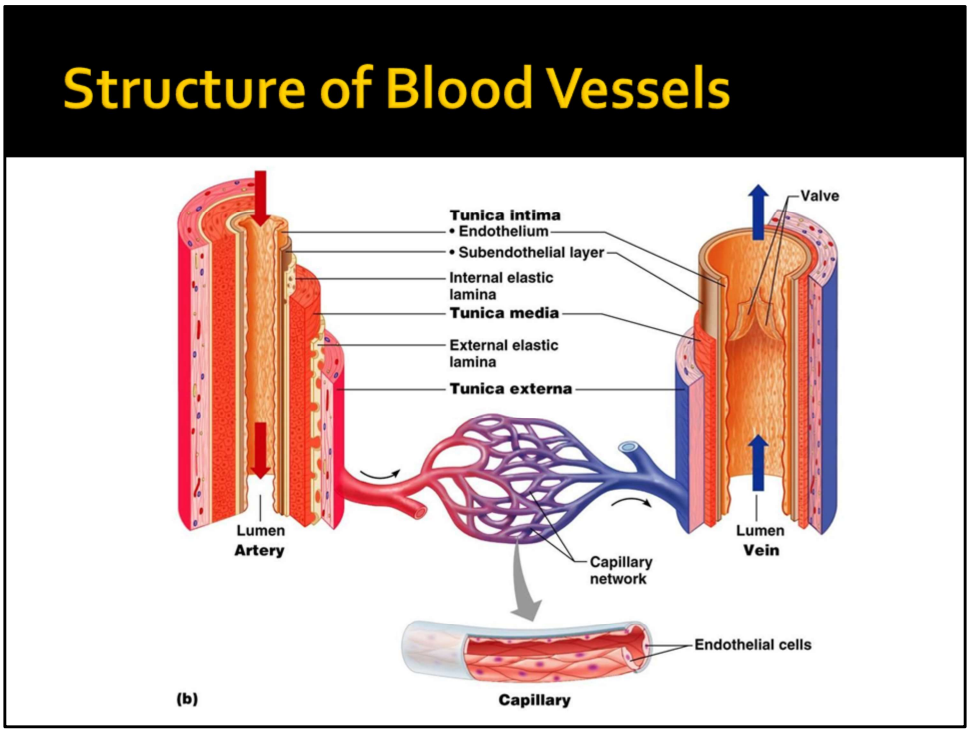
60,000 miles or **100,000km** of blood vessels



How Blood Travel Through Vessel?

Heart ➡ Artery ➡ Arteriol ➡ Capillary ➡ Venule ➡ Vein ➡ Heart





The arteries and veins have three layers, but the middle layer is thicker in the arteries than it is in the veins:

Tunica intima (the thinnest layer): a single layer of simple squamous endothelial cells glued by a polysaccharide intercellular matrix, surrounded by a thin layer of subendothelial connective tissue interlaced with a number of circularly arranged elastic bands called the internal elastic lamina.

Tunica media (the thickest layer in arteries): circularly arranged elastic fiber, connective tissue, polysaccharide substances, the second and third layer are separated by another thick elastic band called external elastic lamina. The tunica media may (especially in arteries) be rich in vascular smooth muscle, which controls the caliber of the vessel.

Tunica adventitia: (the thickest layer in veins) entirely made of connective tissue. It also contains nerves that supply the vessel as well as nutrient capillaries (vasa vasorum) in the larger blood vessels.

Difference Between Arteries and Veins

	Arteries	Veins
1.	Carry oxygenated blood, away from the heart except pulmonary artery	Carry deoxygenated blood, towards the heart except pulmonary veins
2.	Mostly deeply situated in the body	Superficial and deep in location
3.	Thick-walled, highly muscular except arteries of cranium and vertebral column	Thin-walled
4.	Posses narrow lumen	Posses wide lumen
5.	Valves are absent	Valves are present which provide unidirectional flow of blood
6.	Reddish in colour	Bluish in colour
7.	Shows spurt movement of blood giving pulse	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

The chief **difference between arteries and veins** is the job that they do. **Arteries** carry oxygenated blood away from the heart to the body, and **veins** carry oxygen-poor blood back from the body to the heart. Your body also contains other, smaller blood vessels.

Major differences are 1, 3, 4, 5, 8

Comparison Chart of Arteries and Veins

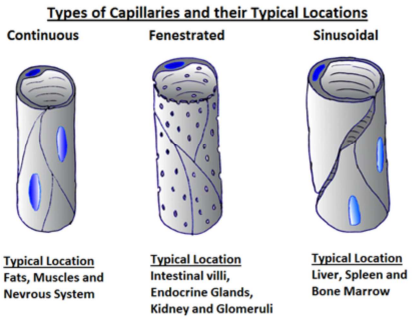
	Arteries	Veins
Oxygen Concentration	Arteries carry oxygenated blood (with the exception of the pulmonary artery and umbilical artery).	Veins carry deoxygenated blood (with the exception of pulmonary veins and umbilical vein).
Types	Pulmonary and systemic arteries.	Superficial veins, deep veins, pulmonary veins and systemic veins
Direction of Blood Flow	From the heart to various parts of the body.	From various parts of the body to the heart.
Anatomy	Thick, elastic muscle layer that can handle high pressure of the blood flowing through the arteries.	Thin, elastic muscle layer with semilunar valves that prevent the blood from flowing in the opposite direction.
Overview	Arteries are red blood vessels that carry blood away from the heart. resistance vessels	Veins are blue blood vessels that carry blood towards the heart. capacitance vessels
Disease	Artherogenesis- myocardial ischemia	Deep vein thrombosis
Thickest layer	Tunica media	Tunica adventitia
Location	Deeper in the body	Closer to the skin
Rigid walls	More rigid	Collapsible
Valves	Aren't present (except for semi-lunar valves)	Are present, especially in limbs

Capillaries

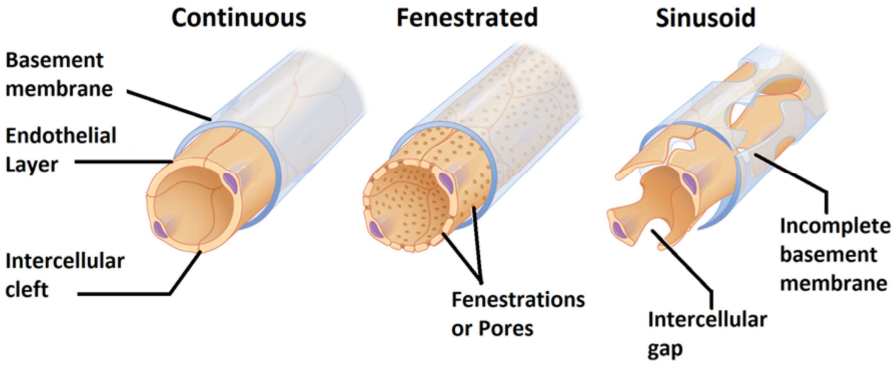
- Capillaries
  - Capillaries are extremely small vessels located within the tissues of the body that transport blood from the arteries to the veins.
  - Fluid exchange between capillaries and body tissues takes place at capillary beds.

Different Types of Capillary

- Continuous Capillaries
  - Making up the majority of the capillaries
  - Have continuous, unbroken walls
  - Consists of cells that are connected by tight junctions.
- Fenestrated Capillaries
  - Permeable vessels
  - Have continuous walls between endothelial cells
  - The cells have numerous pores
- Sinusoidal Capillaries
  - Have large gaps between endothelial cells that permit the passage of blood cells.

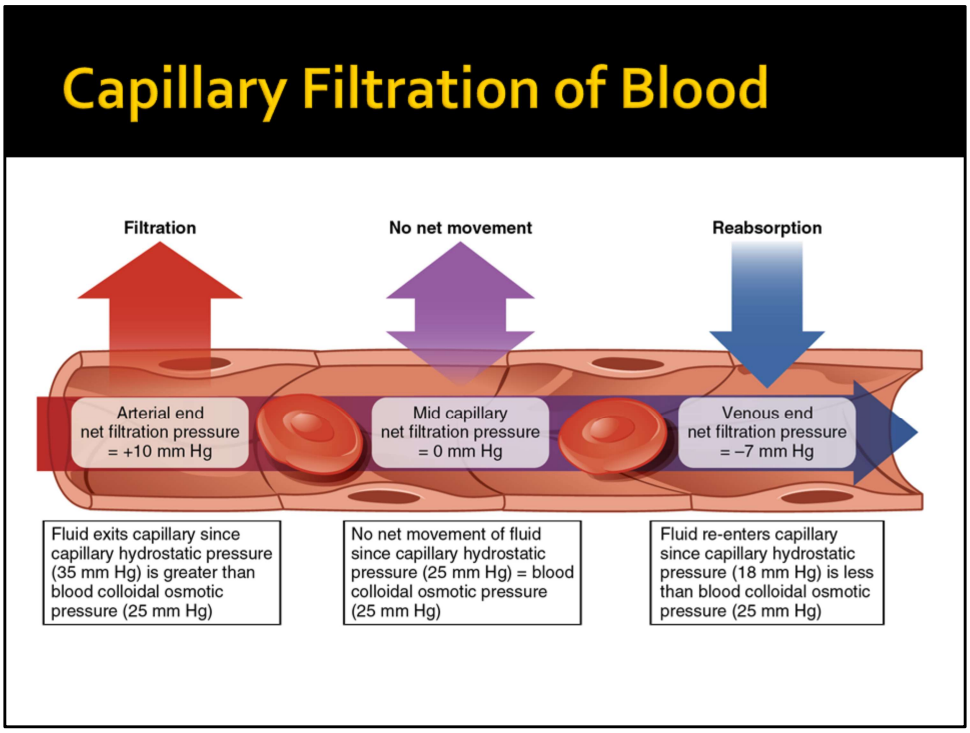


Different Types of Capillary



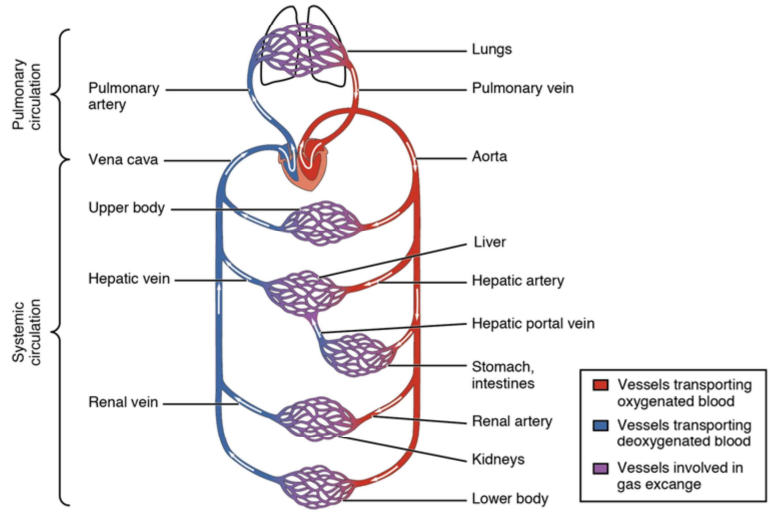
Capillary Filtration of Blood

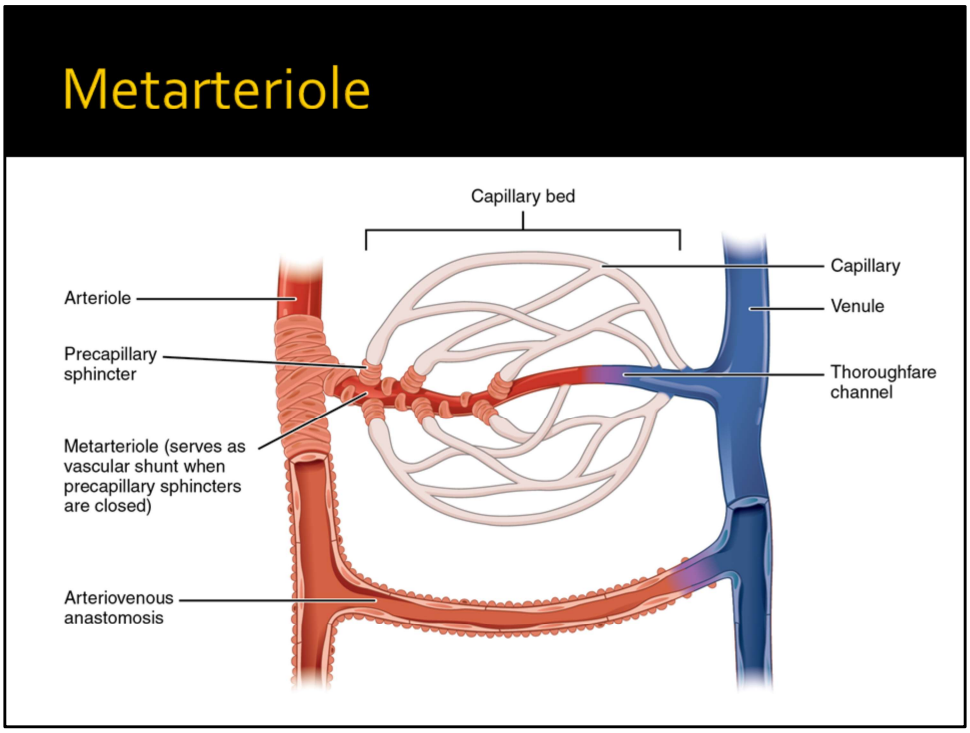
- **Colloid osmotic pressure**, also referred to as oncotic pressure, is a measurement of pressure exerted within the cardiovascular system by proteins found in blood plasma. The special nature of these protein cells helps ensure that fluids pass in and out of the capillaries at the proper rate.
- **Osmotic pressure** in general refers to the pressure that must be maintained on either side of a cell membrane to prevent a solution, or solids dissolved in a liquid, from passing through that cell membrane.
- **Hydrostatic pressure** is the force that fluid molecules exert on each other because of the Earth's gravitational pull. This force occurs whether the fluid is in motion or at a complete standstill, and it forces fluids forward or outward when encountering an area of least resistance.
- **Colloid** is the end result of dispersing one substance evenly and microscopically in another without any changes in the structure of either.



Capillary action (sometimes capillarity, capillary motion, or wicking) is the ability of a liquid to flow in narrow spaces without the assistance of, and in opposition to, external forces like gravity.

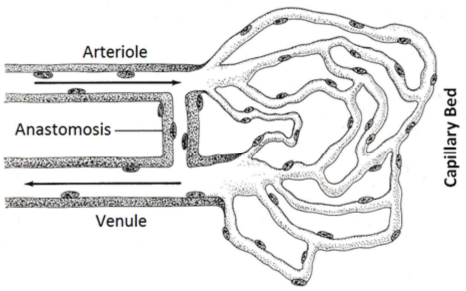
Capillary Networks





A Metarteriole (or arterial capillary[citation needed]) is a short vessel that links arterioles and venules.[1] Instead of a continuous tunica media, they have individual smooth muscle cells placed a short distance apart, each forming a precapillary sphincter that encircles the entrance to that capillary bed. Constriction of these sphincters reduces or shuts off blood flow through their respective capillary beds. This allows the blood to be diverted to elsewhere in the body.[citation needed]
Metarterioles exist in the mesenteric microcirculation, and the name was originally conceived only to define the "thoroughfare channels " between arterioles and venules. In recent times the term has often been used instead to describe the smallest arterioles directly prior to the capillaries.[1]

Anastomosis



- An **anastomosis** (plural **anastomoses**) is the reconnection of two streams that previously branched out, such as blood vessels or leaf veins.
- E.g. Atriovenous anastomosis

In circulatory anastomoses, many arteries naturally anastomose with each other, for example **the inferior epigastric artery and superior epigastric artery**, or **the anterior and/or posterior communicating arteries in the Circle of Willis in the brain**. The circulatory anastomosis is further divided into arterial and venous anastomosis. Arterial anastomosis includes actual arterial anastomosis (e.g. palmar arch, plantar arch) and potential arterial anastomosis (e.g. coronary arteries and cortical branch of cerebral arteries). Anastomoses also form alternative routes around capillary beds in areas in which large blood supply is not needed, and in this way help to regulate systemic blood flow.

Thanks a Lot

Read Carefully, Write Clearly and Draw Nicely