



ST. CATHERINE  
UNIVERSITY

# Blood Vessels

Corresponding textbook pages: 744–754,  
762–764

## A. Functions /Types

- Arteries
  - Arterioles
- Veins
  - Venules
- Capillaries



There are 3 primary forms of blood vessels, each with their own function.

Arteries always carry blood away from heart. Most arteries carry oxygenated blood, but not all do. The pulmonary arteries carry deoxygenated blood to the lung so that oxygen can be replenished.

Veins always carry blood to the heart. Most carry deoxygenated blood, but not all. The pulmonary veins bring the newly replenished oxygenated blood back to the heart.

Capillaries allow cells to interact with material in the blood. This is where exchange of nutrients, gases, and wastes occurs.

Arterioles and Venules are smaller versions of arteries and veins.

I think of arteries and veins as the freeways, they are a means of moving or transporting material from point A to point B. The capillaries are where the action actually takes place, like the streets and alleys of a neighborhood.

## B. Anatomy

- Arteries
  - Tunica externa
  - Tunica media
  - Tunica interna
- Veins
  - 3 layers
  - Less elastin
  - Valves



Arteries and veins are similar in their anatomy, but they do have some structural differences.

Arteries are composed of 3 layers.

1. The Tunica externa is the outer layer and helps anchor vessel in place. It is a sticky layer.
2. The Tunica media is the middle layer and made of smooth muscle. It controls the contraction and relaxation of the arteries diameter which in turn controls blood flow. It contains tons of elastin to bring the vessel back to shape after it stretches to accommodate the influx of blood.
3. The Tunica interna is the inner layer, also called the endothelium, and made of simple squamous epithelium. It surrounds the lumen, and this where cholesterol can build up.

Veins have the same 3 layers as arteries, but with 2 differences. Their tunica media is not as thick and lacks the quantity of elastin. In lower parts of the body and extremities, veins contain valves that keep blood going to the heart.

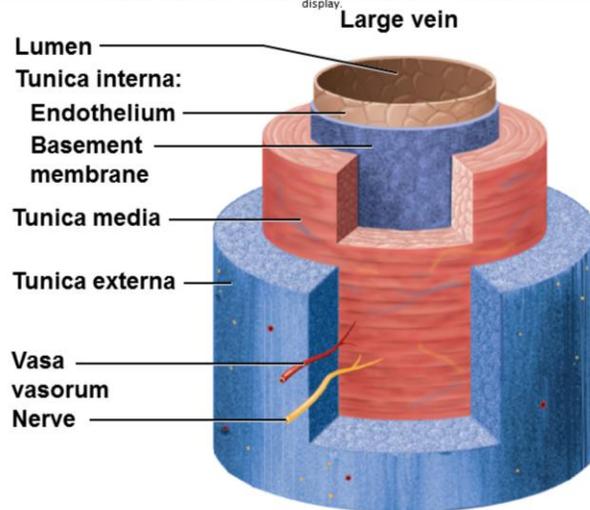
There is also blood behind any blood that stalls or pools, this keeps blood from flowing backwards.

Varicose veins occur when the veins become really thick and protrude off the skin. This is caused by standing for a long time which causes blood to pool because there is nothing helped back up it flow back up. With excess of blood the veins stretch a little and valves don't close completely causing more blood to pool.

One of the ways veins assist blood in returning to the heart is that it uses the pressure excreted from surrounding muscles. When the skeletal muscles contract, they apply pressure to help keep the blood moving. This is another good reason to exercise a lot. The more you move around, the more help your veins get in preventing your blood from stagnating.

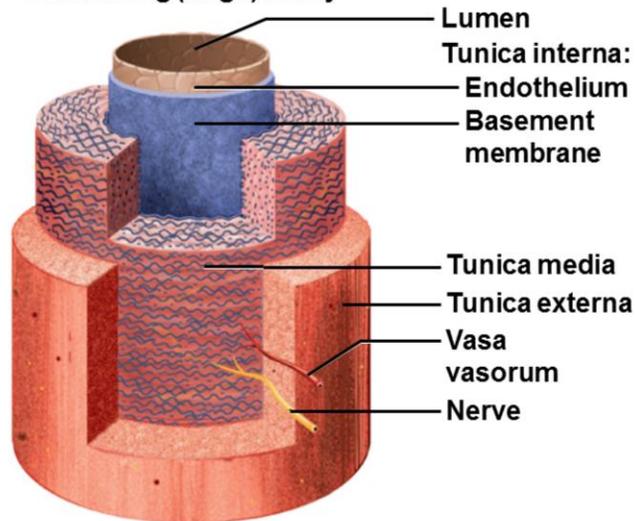
Fig. 20.2a

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Here is the anatomy of a vein. Notice the three tunics.

**Conducting (large) artery**



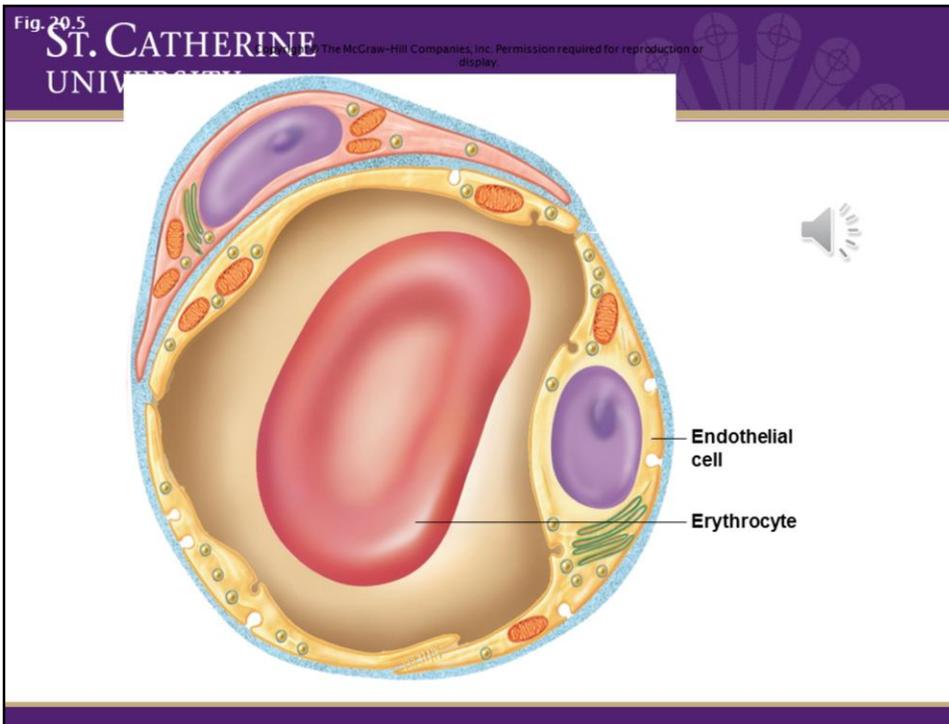
Here is our artery. Compare it to the vein in the previous slide. We still have the three tunics, and they are fairly similar. But, notice how they differ in the tunica media with the presence of elastic tissue.

## Anatomy Continued

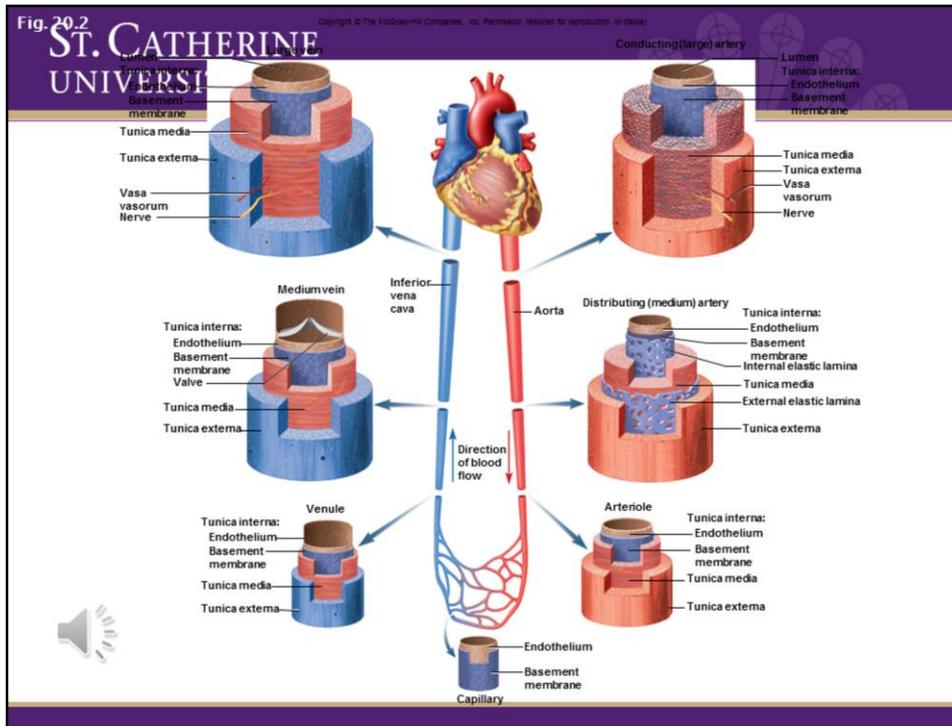
- Capillaries
  - Capillary Bed



Capillaries have an entirely different anatomy. They are made of 1 cell layer of squamous epithelium, this allows for easy diffusion of nutrients, wastes, and gases. They are really skinny, which allows blood flow to slow and RBCs have to go single file. With the blood cells single file and the blood flow slowed, this creates an opportunity for for more efficient exchange. Capillaries (as well as arteries and veins) are scarce in tendons and ligaments, absent in epithelial tissue, the cornea, the lens, and most cartilage



This is the anatomy of a capillary. The capillaries are considerably different than arteries and veins and the difference corresponds to their functions. Capillaries are the site of exchange, so they need to be a thin layer in order for substance to pass through. They also have a much narrower lumen, so narrow that the RBCs can only pass one at a time. This narrowing allows for blood to slow down and increases the amount of exchange that can occur.



This diagram shows all three together and how they change as they go through the circuit. Recall that blood vessels form a continuous and closed loop. We start out leaving the heart with large arteries. Arteries will branch in order to take blood to different tissues. Vessels continue to branch and decrease in size until we have capillaries. Capillaries form a net like structure and spread out in the tissues. This is the site of exchange. Once exchange occurs the capillaries start converging and forming large vessels. Veins increase in size as smaller vessels continue to merge together. They return the blood to the heart.



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# Cardiovascular Physiology

## A. Pulse

- Surge of Pressure
- Heart Rate

A pulse and heart rate are two physical manifestations of the cardiovascular system that can clue us into whether or not the system is working properly.

Each time the heart contracts, it sends out a surge of blood and pressure that is felt on the skin by a superficial artery. This is what is felt and referred to as the pulse. The number of times our vessel pulses, tells how often the heart is contracting and pushing out blood, or our heart rate.

## B. Blood Pressure

- How hard the blood is pressing on the wall of a vessel.
- Influenced by:
  - Size of Lumen
    - Vasoconstriction
    - Vasodilation
  - Blood volume



Blood Pressure is another physiological trait that is needs to be considered. Blood pressure is the force exerted by blood on the vessel wall. Or, how hard the blood is pressing on the wall of the vessel.

Blood pressure can be influenced by a number of factors. If you decrease the diameter of the blood vessel, you increase BP and conversely, if you increase the diameter, you decrease BP. The decrease and increase in vessel diameter is referred to as Vasoconstriction and Vasodilatation, respectively.

Another factor in blood pressure is the volume of blood present. If you increase blood volume, you increase BP. And, if you decrease blood volume, you decrease BP.

## Blood Pressure Continued

- 2 Types
  - Diastolic
  - Systolic
- Arteries > Capillaries > Veins
- Hypertension
- Hypotension



Because our ventricles cycle through contraction and relaxation, the amount of blood and level of blood pressure in the arteries ebbs and flows. Therefore, when we talk about blood pressure, we need to know what it is at its highest and what it is at its lowest. Systolic blood pressure is the highest BP experienced by the vessel (we usually use arteries to determine BP) and corresponds to ventricular contraction. Diastolic blood pressure is the lowest BP experienced by the vessel and corresponds to ventricular relaxation. The vessels closer to the heart experience higher pressure because more blood is flowing and it has not been dispersed down the many branches. Because arteries come right off the heart, they have the highest level of blood pressure. Conversely, because veins are at the end of the circuit, they experience very low blood pressure. Capillaries have some pressure, just enough to facilitate exchange. So, in rank of highest to lowest, Arteries  $\geq$  Capillaries  $\geq$  Veins.

Abnormal BP is usually a signal that something is very wrong in the body, and it doesn't necessarily have to be with the cardiac system. Hypertension is excessively high BP and can result from a variety of things. For instance, if there is too much water in the plasma, perhaps the kidneys are not working correctly. Hypotension is abnormally low BP and is often the result of shock.

Also, recall from the nervous system that the sympathetic system tends to raise BP

and parasympathetic tends to lower it. So, depending on what is happening with the rest of your body, BP can fluctuate throughout the day.



Testing Your Recall: p800 #3