19.2D: Lymphatic Capillaries

Lymph capillaries are tiny, thin-walled vessels, closed at one end and located in the spaces between cells throughout the body.

Learning Objectives

- Describe the location, structure, and role of lymphatic capillaries in maintaining the pressure of the interstitial fluid.

Key Points

- Lymph or lymphatic capillaries are tiny thin-walled vessels, closed at one end and located in the spaces between cells throughout the body, except in the central nervous system and non-vascular tissues.
- Lymphatic capillaries are slightly larger in diameter and have greater oncotic pressure than blood capillaries.
- When pressure is greater in the interstitial fluid than in lymph, the minivalve cells separate slightly and interstitial fluid enters the lymphatic capillary. When pressure is greater inside the lymphatic capillary, the cells of the minivalves adhere more closely, and lymph cannot flow back into interstitial fluid.
- Anchoring filaments attach to the minivalves to anchor the capillary to connective tissue, and also pull the capillary open to increase lymph collection when the tissue is swollen.
- Because lymph capillaries have a closed end, lymph is pushed forward into larger vessels as the pressure inside the capillary increases as lymph accumulates from fluid collection.
- Edema can occur when interstitial fluid accumulation in tissues is greater than fluid removal (acute inflammation) or when the lymph vessels are obstructed in some way (elephantiasis).
Key Terms

- **interstitial fluid**: Also called tissue fluid, a solution that bathes and surrounds the cells of multicellular animals.
- **lymph capillaries**: Tiny thin-walled vessels, closed at one end and located in the spaces between cells throughout the body, collect fluid from the tissues.

Lymphatic circulation begins in the smallest type of lymph vessels, the lymph capillaries. These regulate the pressure of interstitial fluid by draining lymph from the tissues.

Structure of Lymphatic Capillaries

Lymph or lymphatic capillaries are tiny thin-walled vessels, closed at one end and located in the spaces between cells throughout the body. These are particularly dense within connective tissue. Lymphatic capillaries are slightly larger in diameter than blood capillaries and contain flap-like "minivalves" that permit interstitial fluid to flow into them but not out, under normal conditions.

Lymphatic capillaries are primarily made out of an endothelium layer that sits on a permeable basement membrane. The flap-like minivalves, located at gap-like junctions in the endothelium, are formed from the overlap of endothelial cells and are normally closed. Attached to the outer opening of the minivalves are anchoring filaments containing elastic fibers. They extend out from the lymphatic capillary, attaching the endothelium to fibroblast cells in the connective tissue. Unlike larger lymphatic vessels, lymphatic capillaries do not contain smooth muscle nor do they have a well developed adventitia, only small elastic filaments that perform a similar function.

Function of Lymphatic Capillaries

The lymph capillaries serve a variety of important functions.

Fluid Pressure Regulation

Lymphatic capillaries collect lymph fluid from the tissues, which allows them to regulate the pressure of interstitial fluid. This fluid is essentially plasma that leaks out of cardiovascular capillaries into the tissues due to the forces of hydrostatic or oncotic pressure. When pressure is greater in the interstitial fluid than in lymph due to accumulation of interstitial fluid, the minivalves separate slightly like the opening of a one-way swinging door so that fluid can enter the lymphatic capillary. When pressure is greater inside the lymphatic capillary, the cells adhere more closely to each other to prevent lymph backflow. The anchoring filaments are also pulled when the tissues are swollen. This opens the lymph capillaries more, increasing their volume and reducing their pressure to further facilitate fluid flow into the capillaries.

Lymph capillaries have a greater oncotic pressure (a pulling pressure exerted by proteins in solution) than blood plasma due to the greater concentration of plasma proteins in lymph. Additionally, the greater size of lymphatic capillaries compared to cardiovascular capillaries allows them to take more fluid proteins into lymph compared to plasma, which is the other reason for their greater levels of oncotic pressure. This also explains why lymph flows into the lymph capillaries easily, since fluid follows proteins that exert oncotic pressure.
Edema Prevention

Under normal conditions, lymph capillaries prevent the accumulation of edema (abnormal swelling) in the tissues. However, edema will still occur during acute inflammation or diseases in which lymph vessels are obstructed. During inflammation, fluid leaks into the tissues at a rate faster than it can be removed by the lymph capillaries due to the increased permeability of cardiovascular capillaries. During lymph vessel obstruction (such as through elephantiasis infection), lymph will be unable to progress normally through the lymphatic system, and pressure within the blocked off lymph capillaries increases to the point where backflow into tissues may occur, while the pressure of interstitial fluid gradually rises.

Drive Lymph Through Lymphatic Vessels

**Lymph Capillaries in the Tissue Spaces**

[Lymph capillary diagram]

**Lymph Capillary**: Diagram showing the formation of lymph from interstitial fluid (labeled here as “tissue fluid”). Note: how the tissue fluid is entering the blind ends of lymph capillaries (indicated by deep green arrows).

The lymphatic capillaries bring lymph further into the lymphatic vessels. The capillaries have external valves but no internal valves or smooth muscle, so the pressure of lymph accumulation itself must propel the fluid forward into the larger vessels. Because lymphatic capillaries have a closed end and minivalves normally prevent backflow into tissues, the pressure of lymph becomes higher as more lymph is collected from the tissues, which sends the lymph fluid forward. Multiple capillaries converge in collecting vessels, where the internal valves and smooth muscle start to appear. This moves lymph further along the system despite the fall in pressure that occurs when moving from the higher-pressure capillaries to the lower-pressure collecting vessels.