



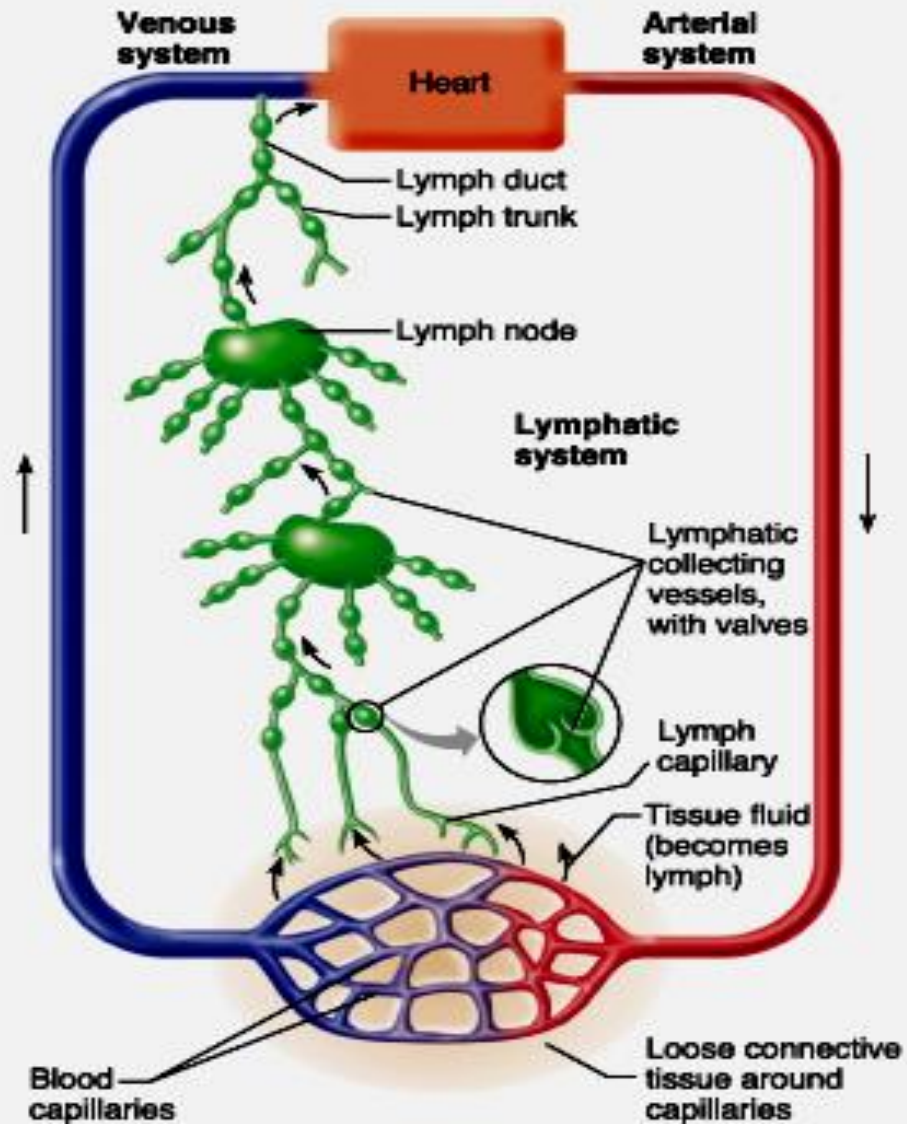
Lymph

Reference Books:

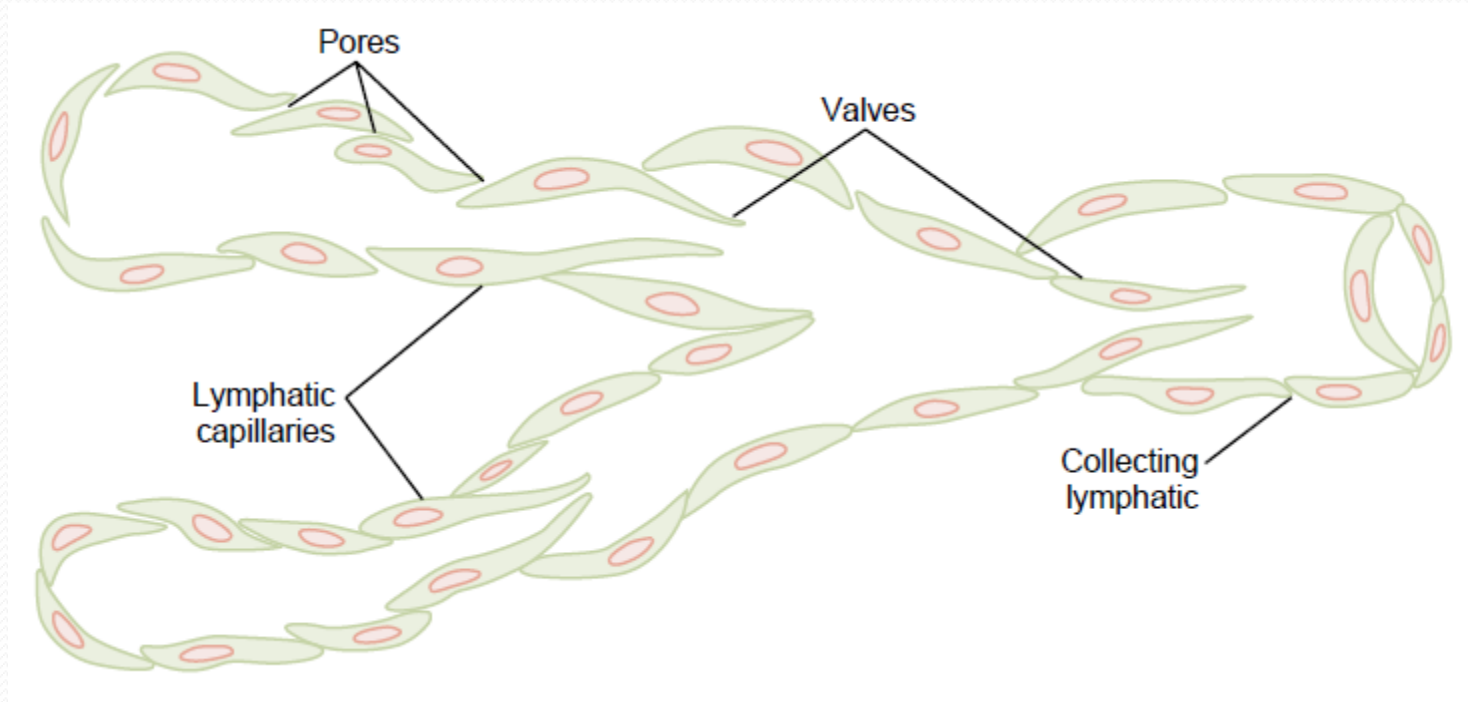
- **Text Book of Medical physiology** (Guyton and Hall)
Eleventh edition

Lymphatic System

- The lymphatic system represents an accessory route through which fluid can flow from the interstitial spaces into the blood.
- The lymphatics can carry proteins and large particulate matter away from the tissue spaces, neither of which can be removed by absorption directly into the blood capillaries. This return of proteins to the blood from the interstitial spaces is an essential function.



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Structure of lymphatic capillaries and a collecting lymphatic, showing also the lymphatic valves.

Lymph Channels of the Body

- Almost all tissues of the body have special lymph channels that drain excess fluid directly from the interstitial spaces.
- Essentially all the lymph vessels from the lower part of the body eventually empty into the *thoracic duct*, which in turn empties into the blood venous system at the juncture of the *left internal jugular vein and left subclavian vein*.
- Lymph from the left side of the head, the left arm, and parts of the chest region also enters the thoracic duct before it empties into the veins.

- Lymph from the right side of the neck and head, the right arm, and parts of the right thorax enters the *right lymph duct (much smaller than the thoracic duct)*, which empties into the blood venous system at the juncture of the *right subclavian vein and internal jugular vein*.

Formation of Lymph

- Lymph is derived from interstitial fluid that flows into the lymphatics. Therefore, lymph as it first enters the terminal lymphatics has almost the same composition as the interstitial fluid.

- The protein concentration in the interstitial fluid of most tissues averages about 2 g/dl, and the protein concentration of lymph flowing from these tissues is near this value. Conversely, lymph formed in the liver has a protein concentration as high as 6 g/dl, and lymph formed in the intestines has a protein concentration as high as 3 to 4 g/dl. Because about two thirds of all lymph normally is derived from the liver and intestines, the thoracic duct lymph, which is a mixture of lymph from all areas of the body, usually has a protein concentration of 3 to 5 g/dl.

- The lymphatic system is also one of the major routes for absorption of nutrients from the gastrointestinal tract, especially for absorption of virtually all fats in food. Indeed, after a fatty meal, thoracic duct lymph sometimes contains as much as 1 to 2 per cent fat.

Rate of Lymph Flow

About 100 milliliters per hour of lymph flows through the thoracic duct of a resting human, and approximately another 20 milliliters flows into the circulation each hour through other channels, making a total estimated lymph flow of about 120 ml/hr or 2 to 3 liters per day.

Effect of Interstitial Fluid Pressure on Lymph Flow.

Normal lymph flow is very little at interstitial fluid pressures more negative than the normal value of -6 mm Hg. Then, as the pressure rises to 0 mm Hg (atmospheric pressure), flow increases more than 20-fold. Any factor that increases interstitial fluid pressure also increases lymph flow if the lymph vessels are functioning normally.

Such factors include the following:

- Elevated capillary pressure
- Decreased plasma colloid osmotic pressure
- Increased interstitial fluid colloid osmotic pressure
- Increased permeability of the capillaries
- All of these cause a balance of fluid exchange at the blood capillary membrane to favor fluid movement into the interstitium, thus increasing interstitial fluid volume, interstitial fluid pressure, and lymph flow all at the same time.

- When the interstitial fluid pressure becomes 1 or 2 millimeters greater than atmospheric pressure (greater than 0 mm Hg), lymph flow fails to rise any further at still higher pressures.
- This results from the fact that the increasing tissue pressure not only increases entry of fluid into the lymphatic capillaries but also compresses the outside surfaces of the larger lymphatics, thus impeding lymph flow.
- At the higher pressures, these two factors balance each other almost exactly, so that lymph flow reaches what is called the “maximum lymph flow rate.”