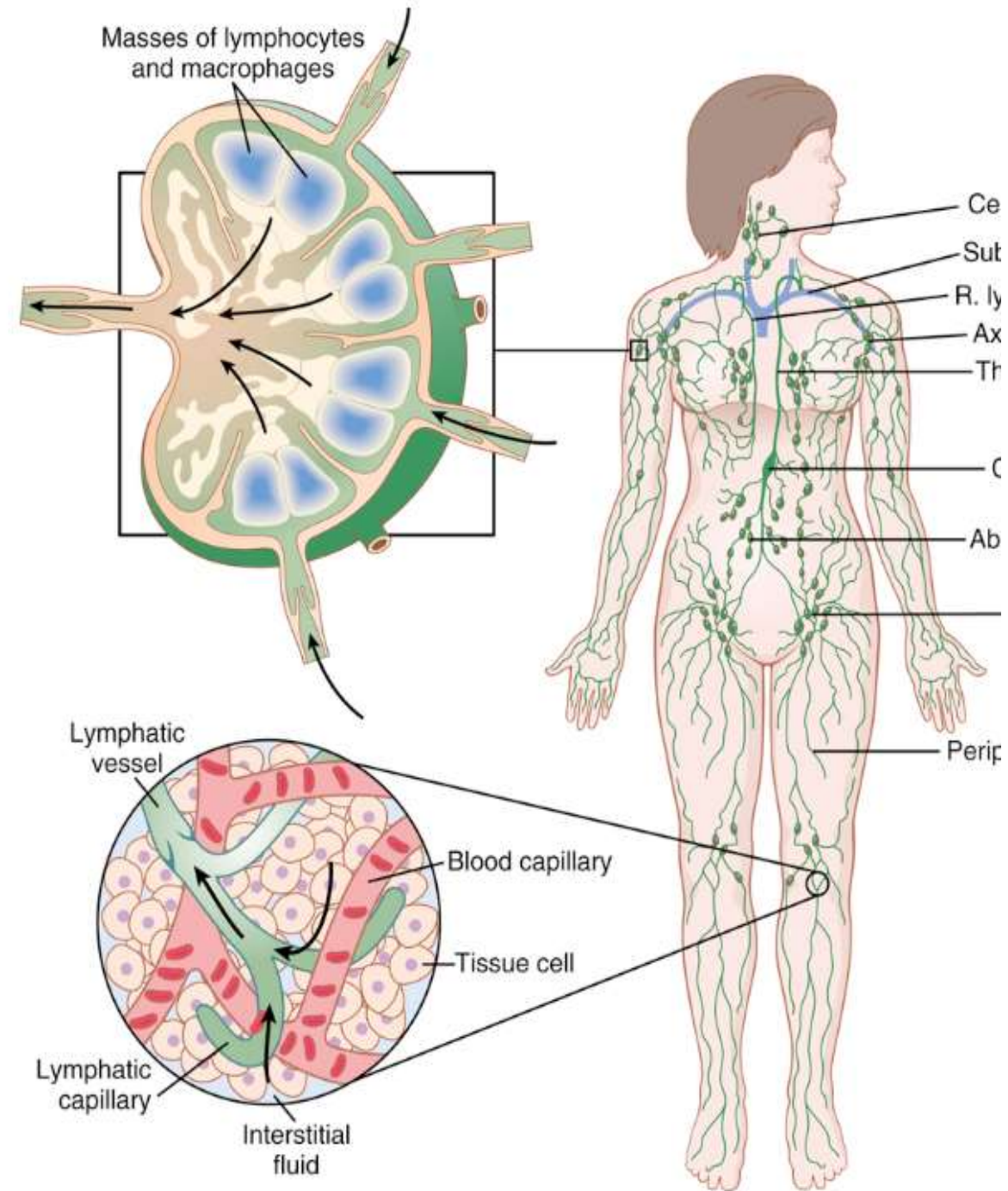


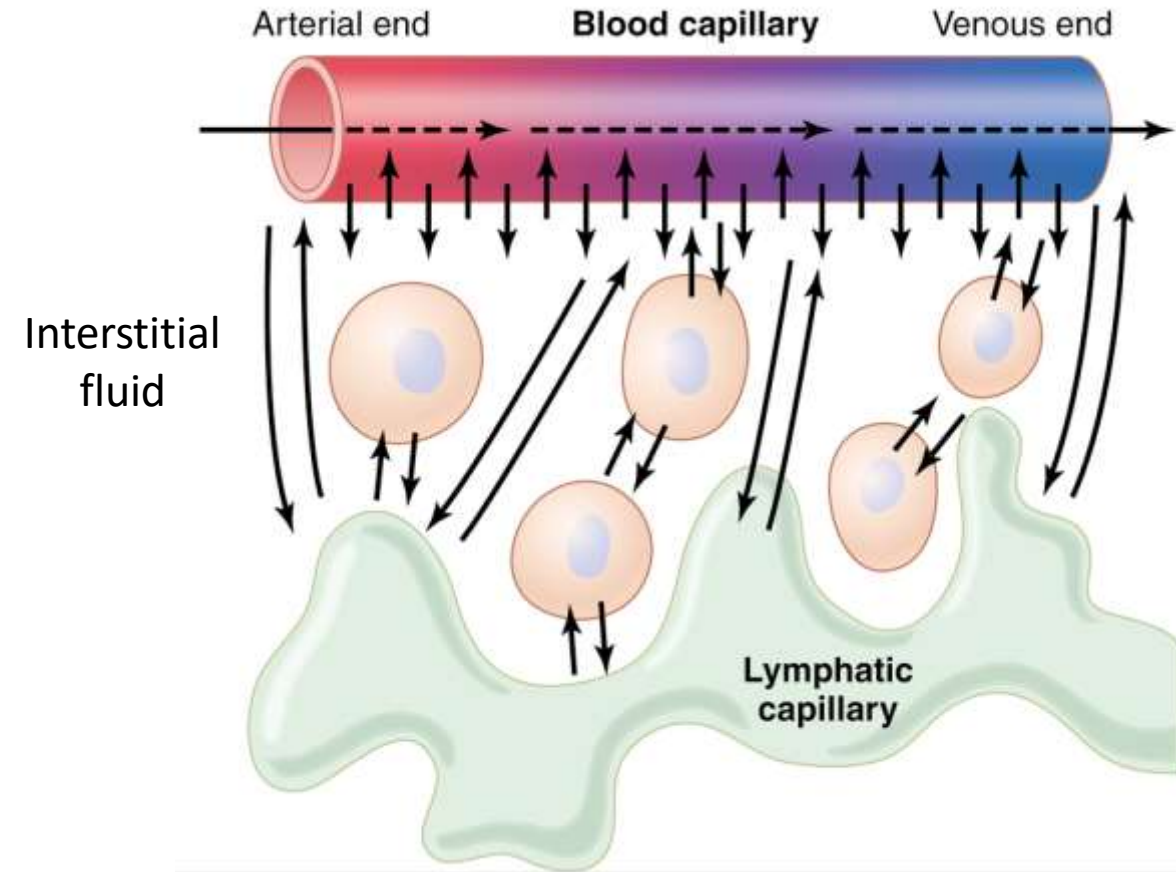
Lymphatic System

Fatima Daoud, MD, PhD.



Lymph

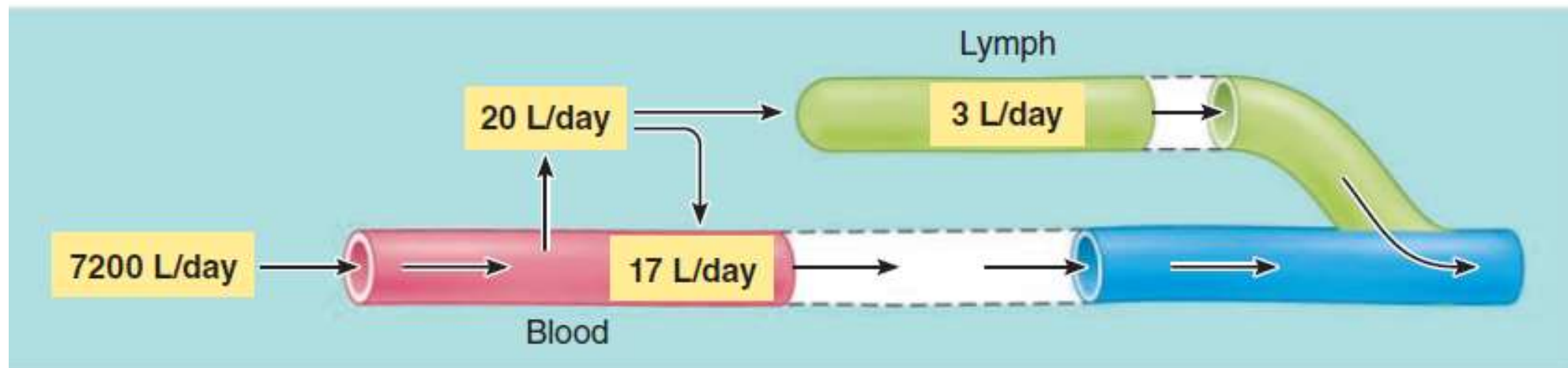
Lymph is derived from interstitial fluid that flows into the lymphatics. Therefore, lymph as it first enters the terminal lymphatics has almost the same composition as the interstitial fluid.



Hematology

Lymph

- Even under normal circumstances, slightly more fluid is filtered out of the capillaries into the interstitial fluid than is reabsorbed from the interstitial fluid back into the plasma.
- On average, about one tenth of the fluid instead enters the lymphatic capillaries and returns to the blood through the lymphatic system rather than through the venous capillaries. The total quantity of all this lymph is normally only 2 to 3 L/day.



Lymph

Function

- Return of excess filtered fluid.
- Return of filtered protein
- Transport of absorbed fat.
- Defense against disease.

Lymph

Initial Lymphatic Capillaries

These lymphatic valve-like openings are larger than the pores in blood capillaries. Consequently, large particles in the interstitial fluid, such as escaped plasma proteins and bacteria, can gain access to initial lymphatics but are excluded from blood capillaries.

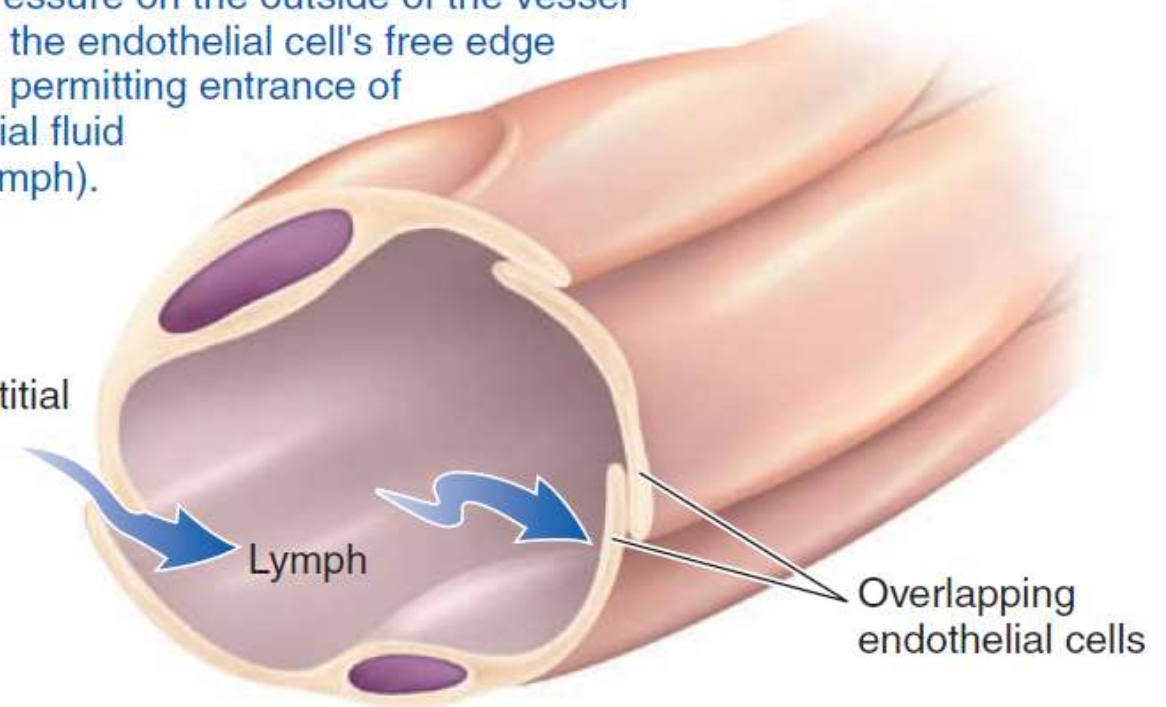
Fluid pressure on the outside of the vessel pushes the endothelial cell's free edge inward, permitting entrance of interstitial fluid (now lymph).

Interstitial fluid

Lymph

Overlapping endothelial cells

Fluid pressure on the inside of the vessel forces the overlapping edges together so that lymph cannot escape.



Lymph

Initial Lymphatic Capillaries

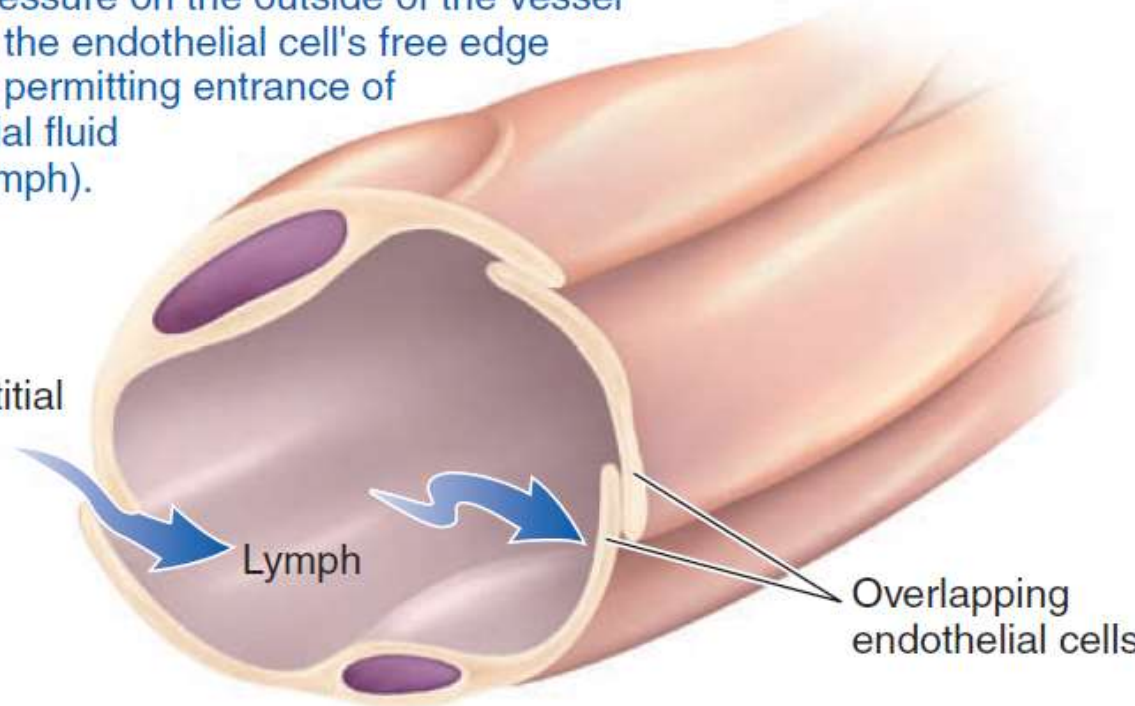
Fluid pressure on the outside of the vessel pushes the endothelial cell's free edge inward, permitting entrance of interstitial fluid (now lymph).

Interstitial fluid

Lymph

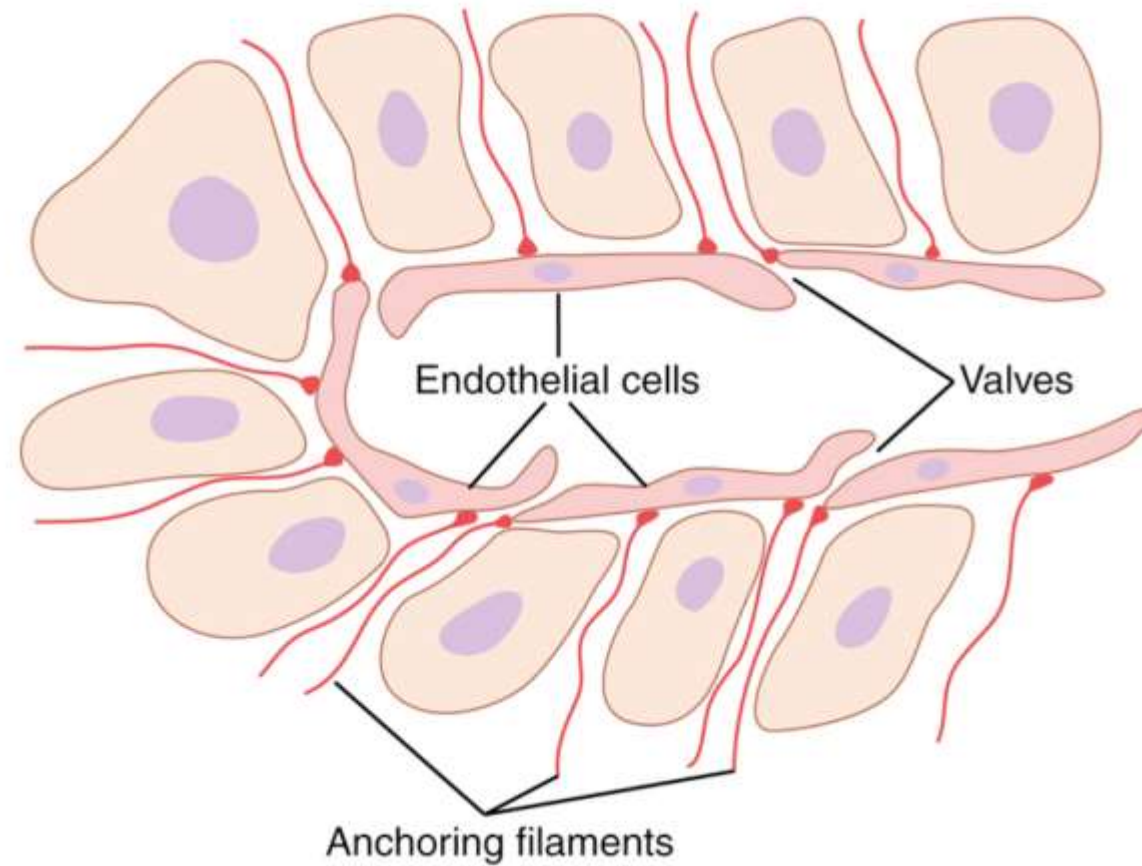
Overlapping endothelial cells

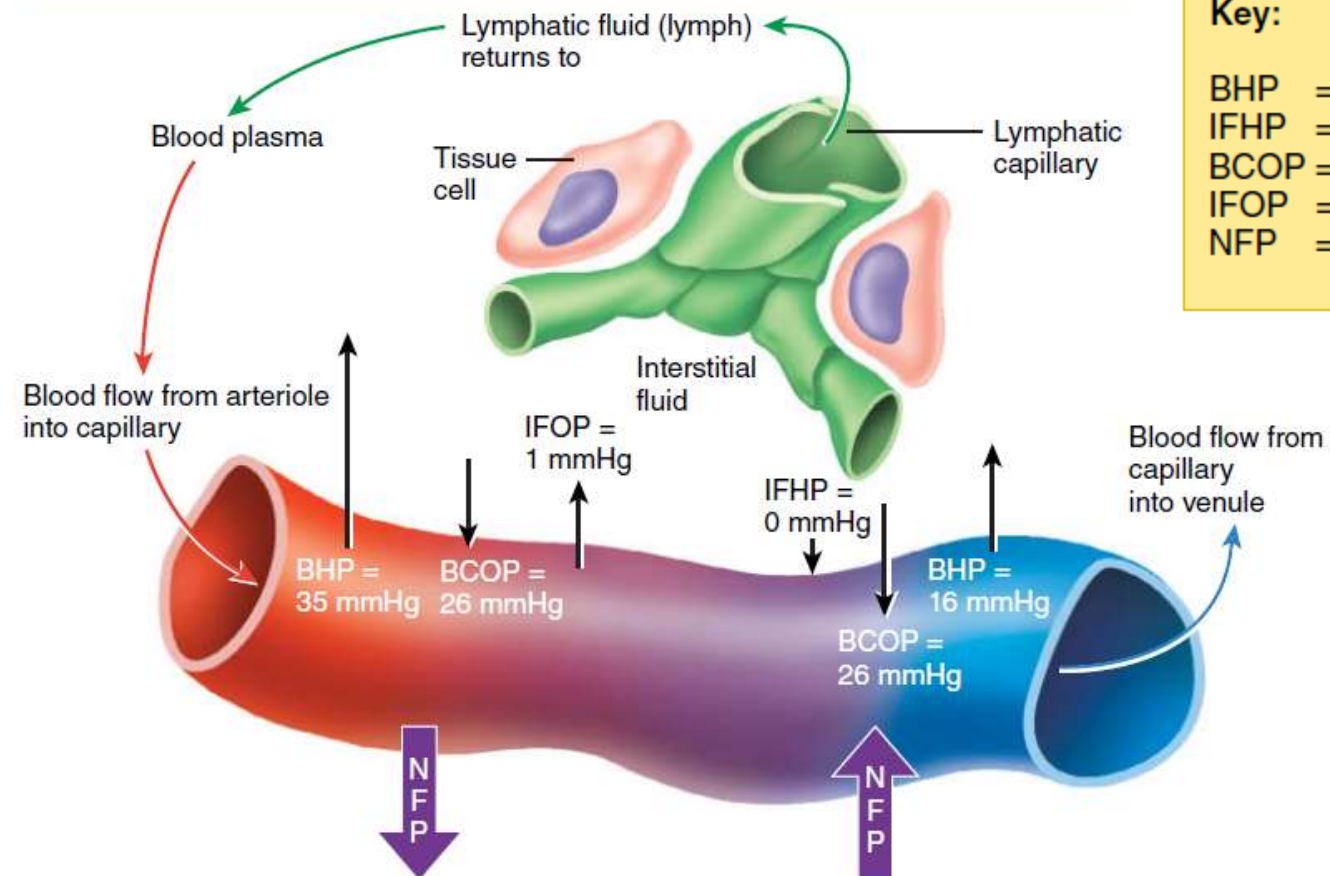
Fluid pressure on the inside of the vessel forces the overlapping edges together so that lymph cannot escape.



Lymph

Anchoring filaments





Key:

BHP = Blood hydrostatic pressure
 IFHP = Interstitial fluid hydrostatic pressure
 BCOP = Blood colloid osmotic pressure
 IFOP = Interstitial fluid osmotic pressure
 NFP = Net filtration pressure

Net filtration at arterial end of capillaries (20 liters per day)

Net reabsorption at venous end of capillaries (17 liters per day)

Net filtration pressure (NFP)

$$= (BHP + IFOP)$$

Pressures promoting filtration

–

$$(BCOP + IFHP)$$

Pressures promoting reabsorption

Arterial end

$$NFP = (35 + 1) - (26 + 0) = 10 \text{ mmHg}$$

Net filtration

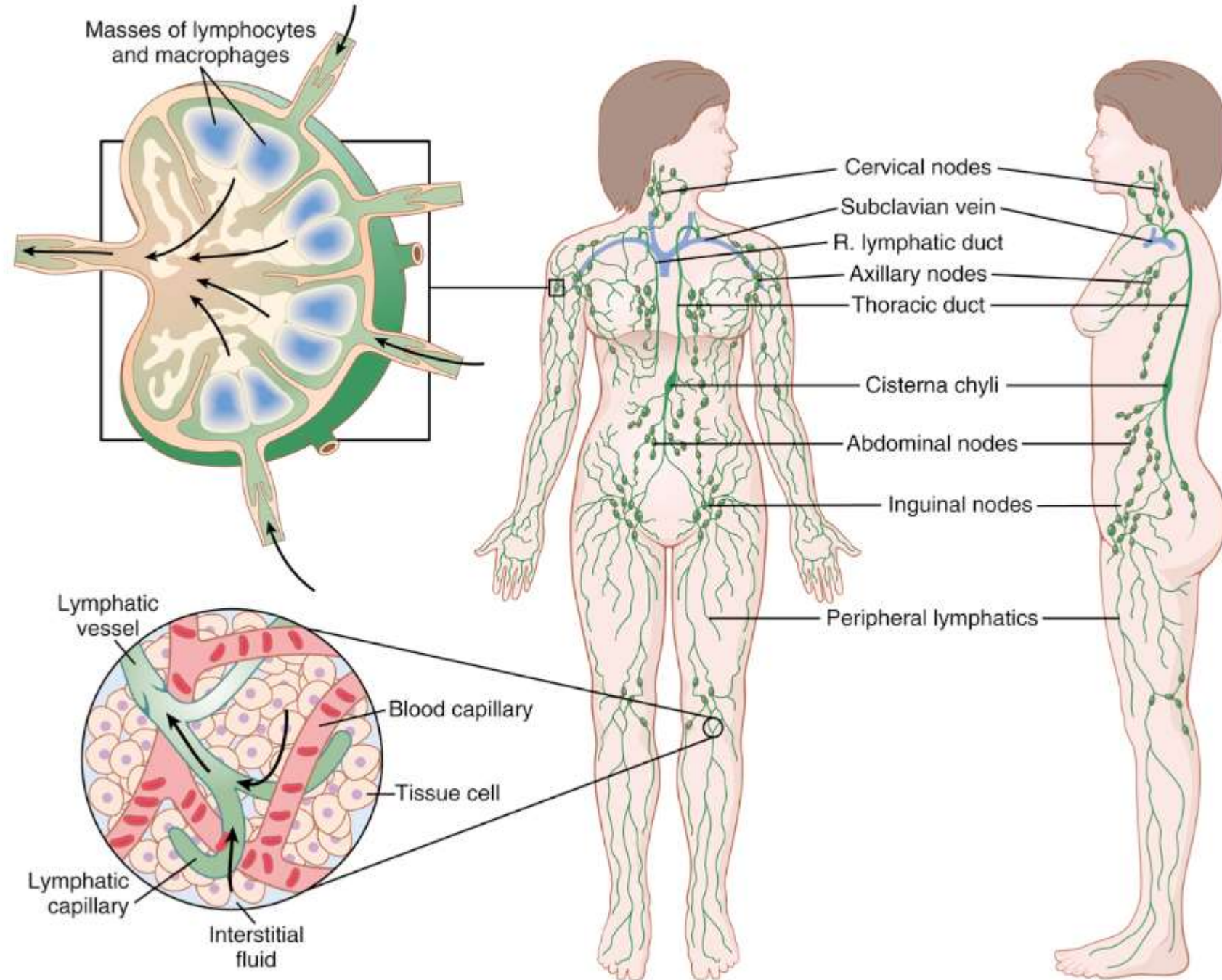
Venous end

$$NFP = (16 + 1) - (26 + 0) = -9 \text{ mmHg}$$

Net reabsorption

Result

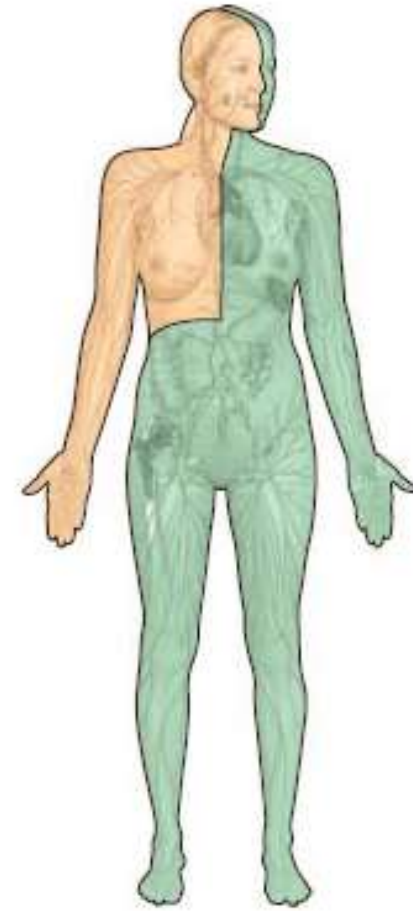
- Almost all tissues of the body have special lymph channels that drain excess fluid directly from the interstitial spaces



Lymph

Major Drainage Routes

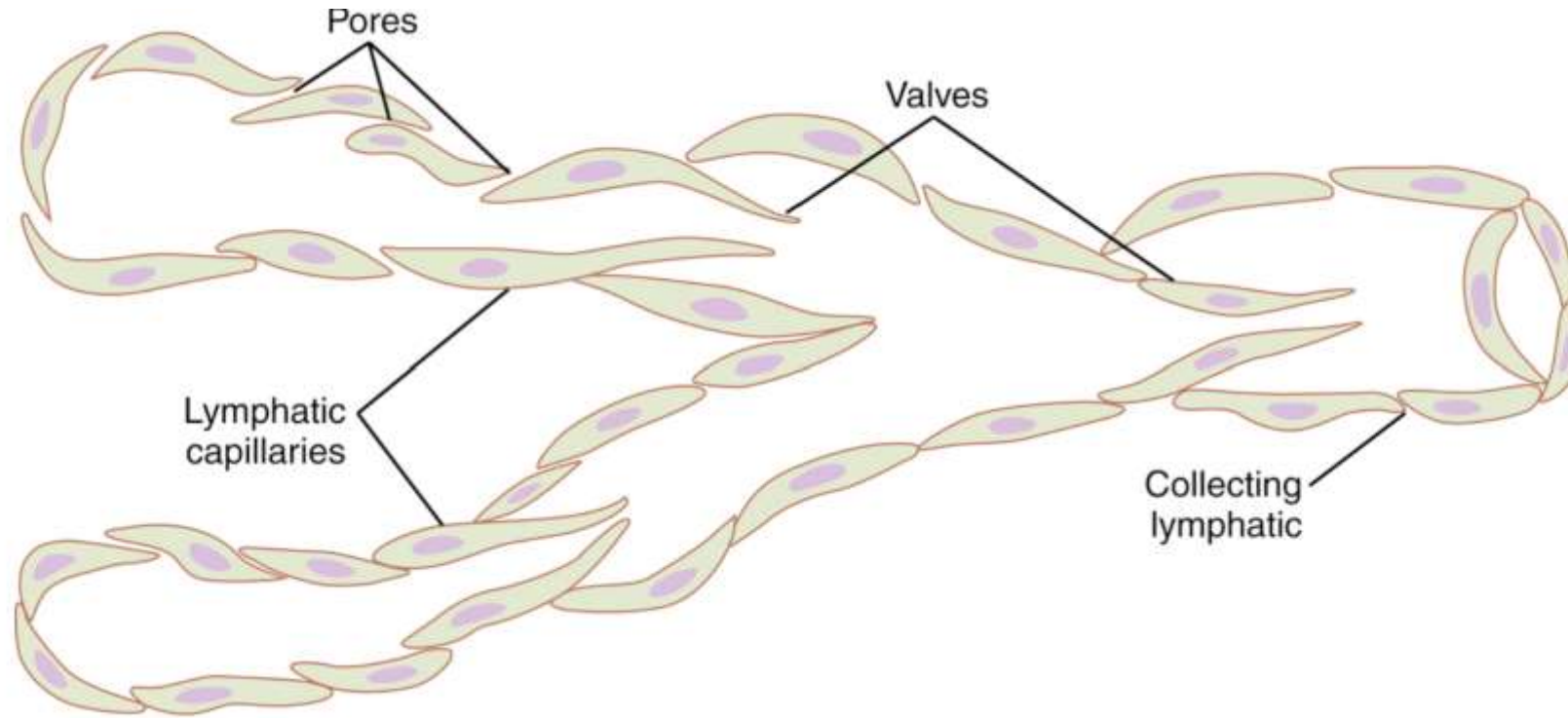
- lower part of the body → empty into the thoracic duct → empties into the blood venous system.
- Left side of the head, left arm, and parts of the chest region → thoracic duct before it empties into the veins.
- Right side of the neck and head, right arm, and parts of the right thorax enters the right lymph duct.



(b) Areas drained by right lymphatic and thoracic ducts

-  Area drained by right lymphatic duct
-  Area drained by thoracic duct

Lymph

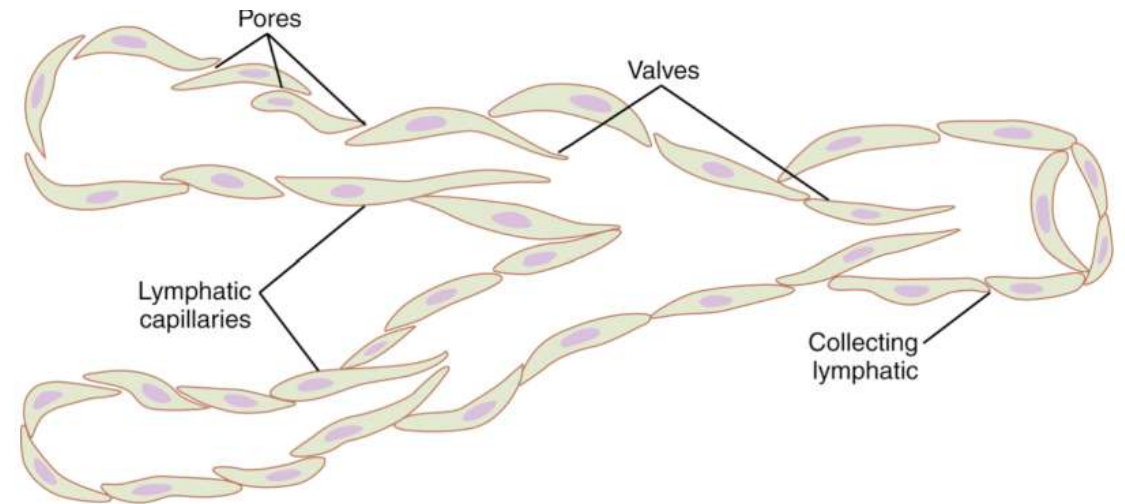


Initial lymphatic capillary	Collecting lymphatic vessel
Overlapping endothelial edges form entry flaps in the wall.	Valves inside the lumen separate successive vessel segments.
Allow fluid to move from the tissue into the vessel.	Allow lymph to move forward toward the venous circulation.
Close to resist leakage back into the tissue.	Close to prevent backward flow along the vessel.

Lymph

The Intrinsic Lymphatic Pump

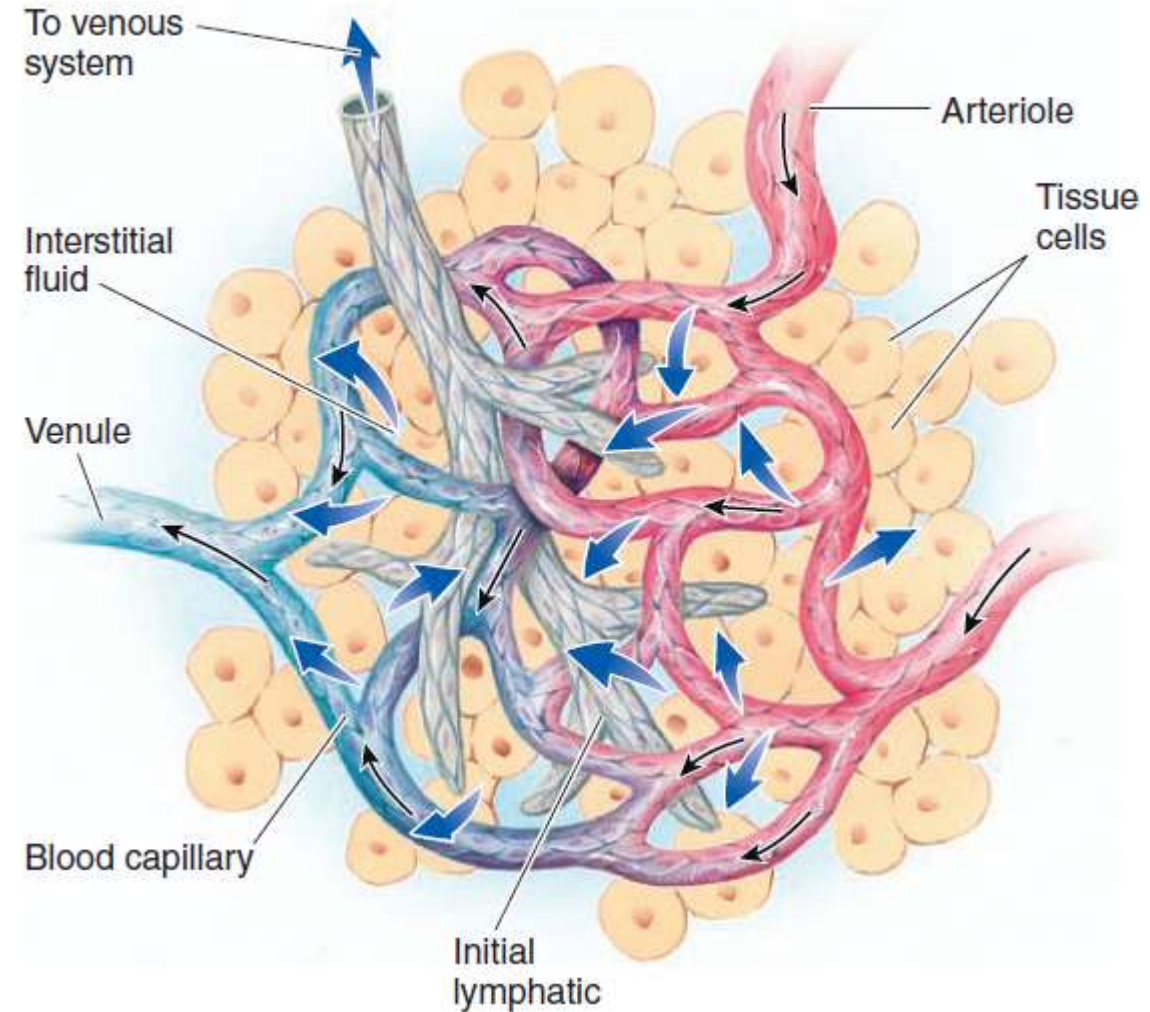
- Collecting lymphatic vessels contain smooth muscle in their walls.
- Lymph entering a vessel stretches the wall, triggering contraction.
- Contraction raises pressure and pushes lymph forward.
- One-way valves prevent backflow.
- Repeated filling and contraction move lymph toward the venous circulation.



Lymph

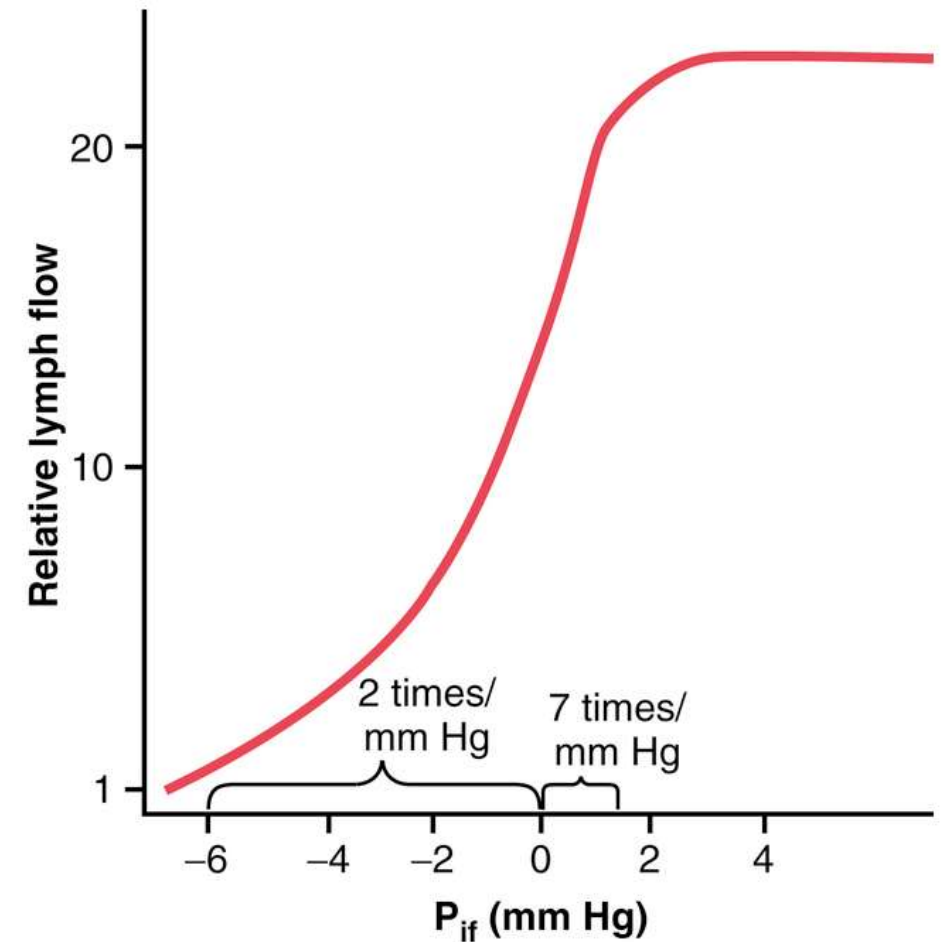
External Assistance to Lymph Flow

- Contraction of skeletal muscles squeezes the lymph out of the vessels.



Relationship between interstitial fluid pressure and lymph flow

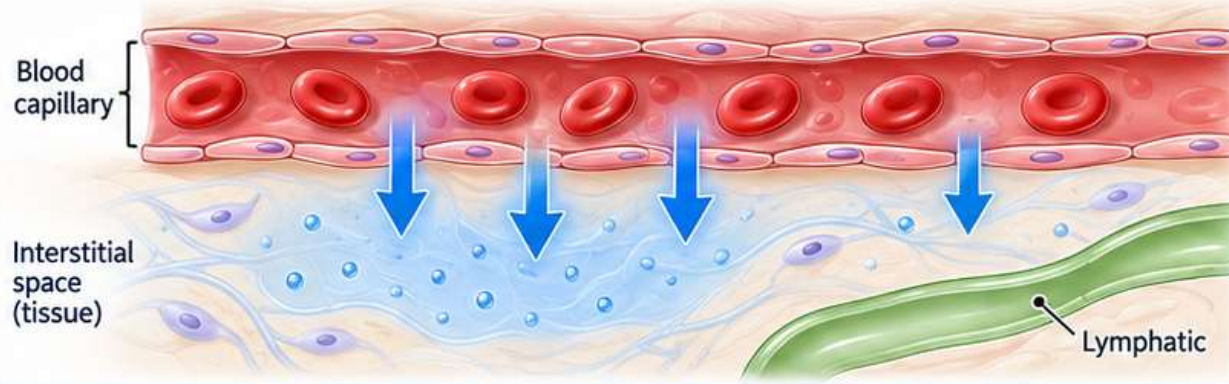
Increase net fluid movement into the interstitial, would increase interstitial fluid volume, interstitial fluid pressure, and lymph flow all at the same time.



How Edema Develops

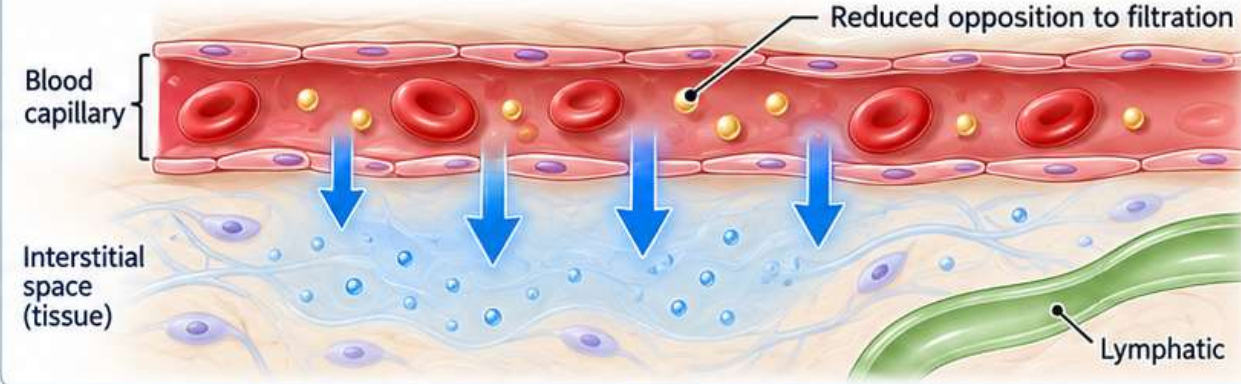
1 Increased capillary hydrostatic pressure

More fluid is pushed into the tissues



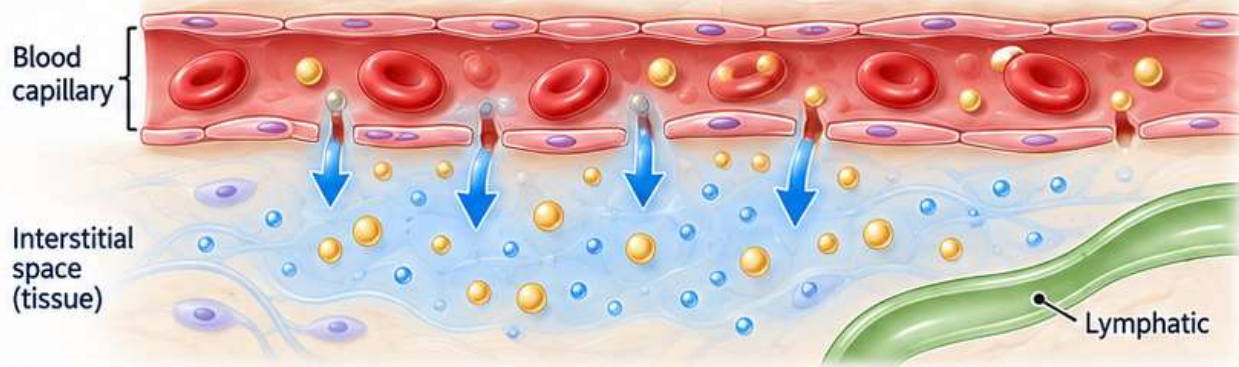
2 Reduced plasma protein concentration

Lower plasma colloid osmotic pressure



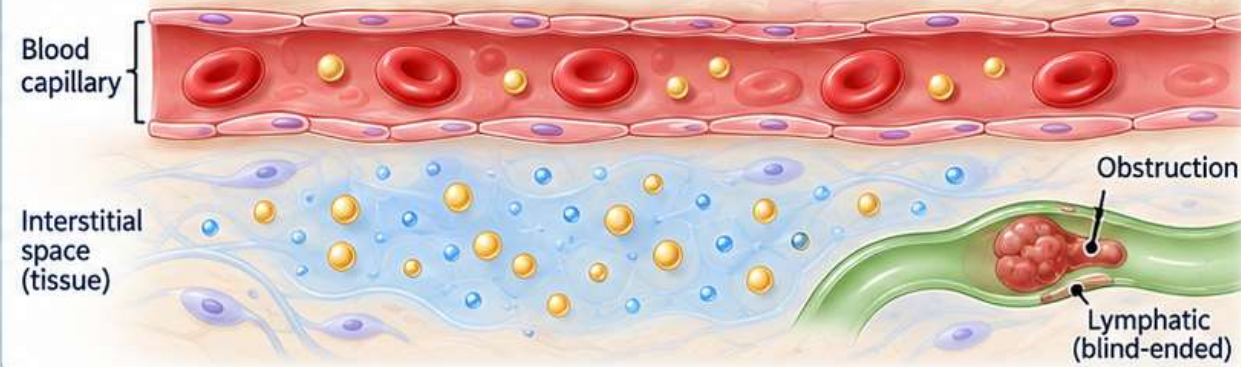
3 Increased capillary permeability

More fluid and protein enter the tissues



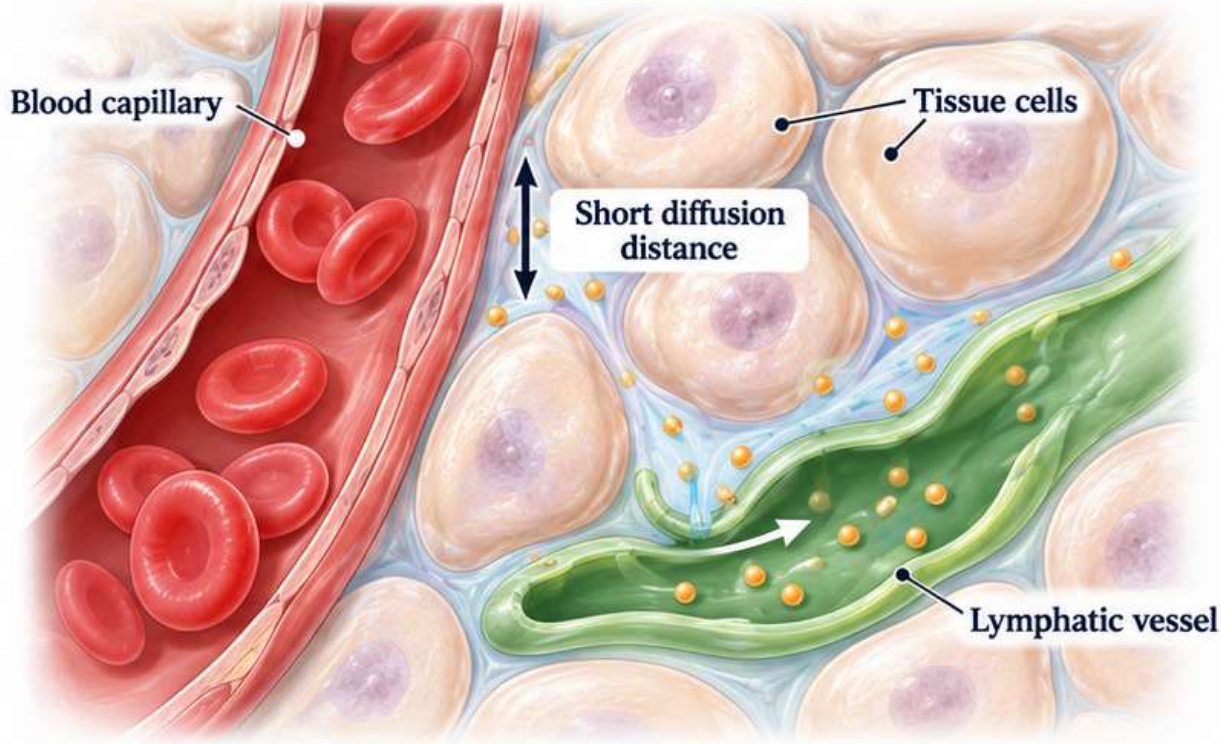
4 Impaired lymphatic drainage

Reduced removal of fluid and protein

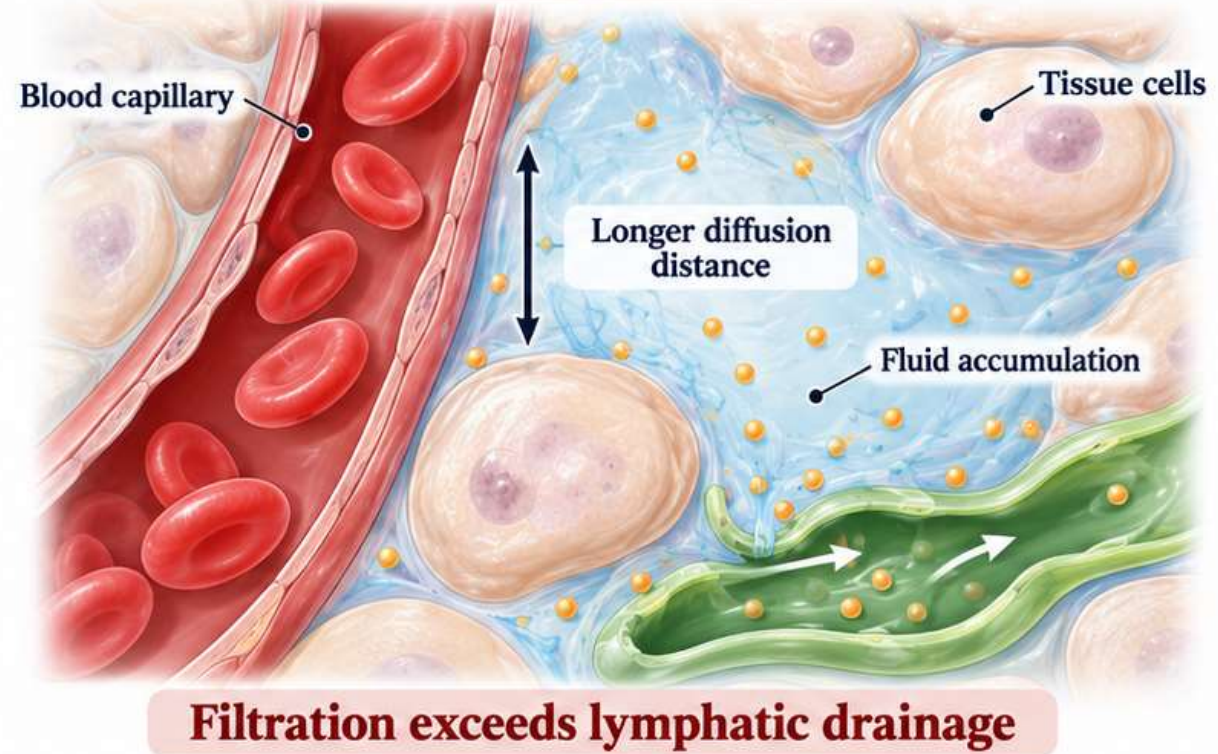


Why tissue fluid balance matters

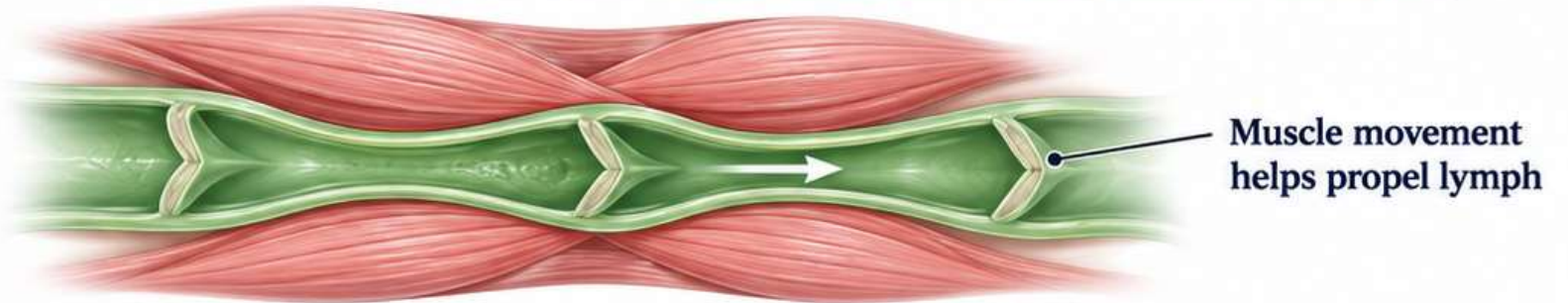
Effective lymphatic drainage



Edema



Lymphatics return fluid and proteins to the blood



Balanced tissue fluid supports effective exchange