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The Lymphatic System

Learning Outcomes

1. Describe the function of lymphatic system in the maintenance of interstitial fluid volume.
2. Describe the effects of Interstitial Fluid Pressure on Lymph Flow.
3. Describe how changes in capillary hydrostatic pressure, plasma oncotic pressure, capillary permeability, and lymphatic function can lead to tissue edema

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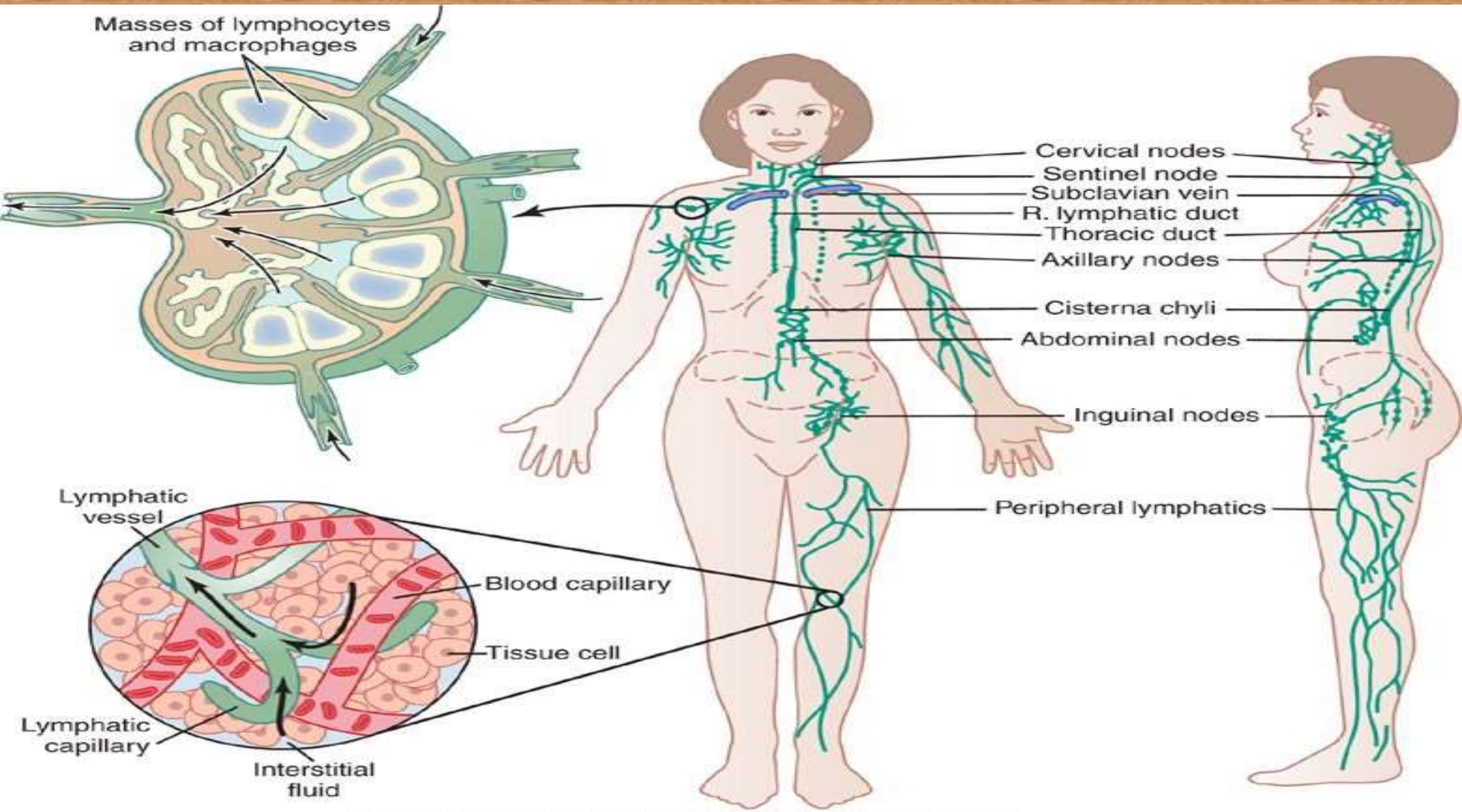
Lymphatic System

Without which we would die within about 24 hours

- An accessory route through which fluid can flow from the interstitial spaces into the blood

- 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

Lymph Channels of the Body



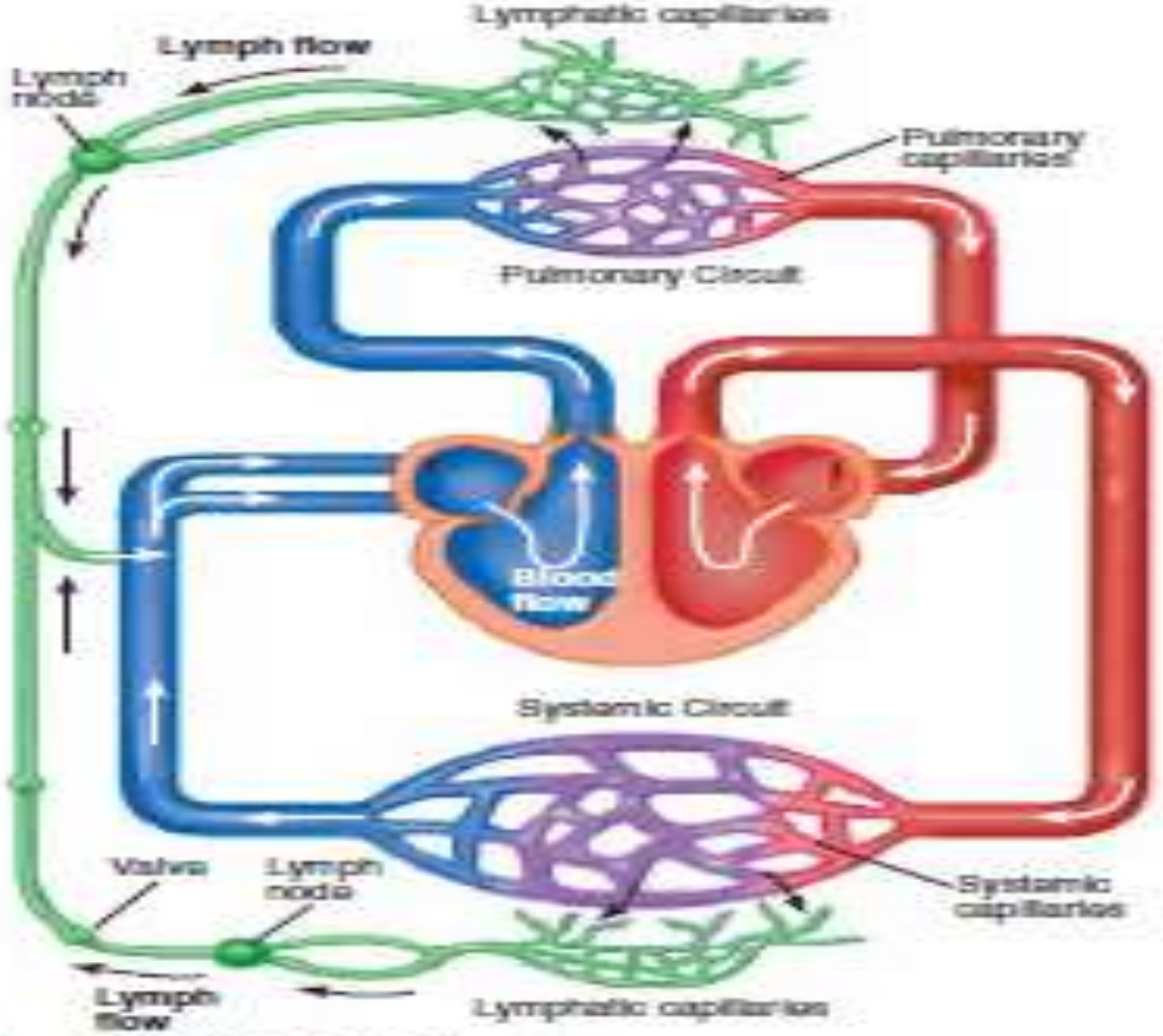
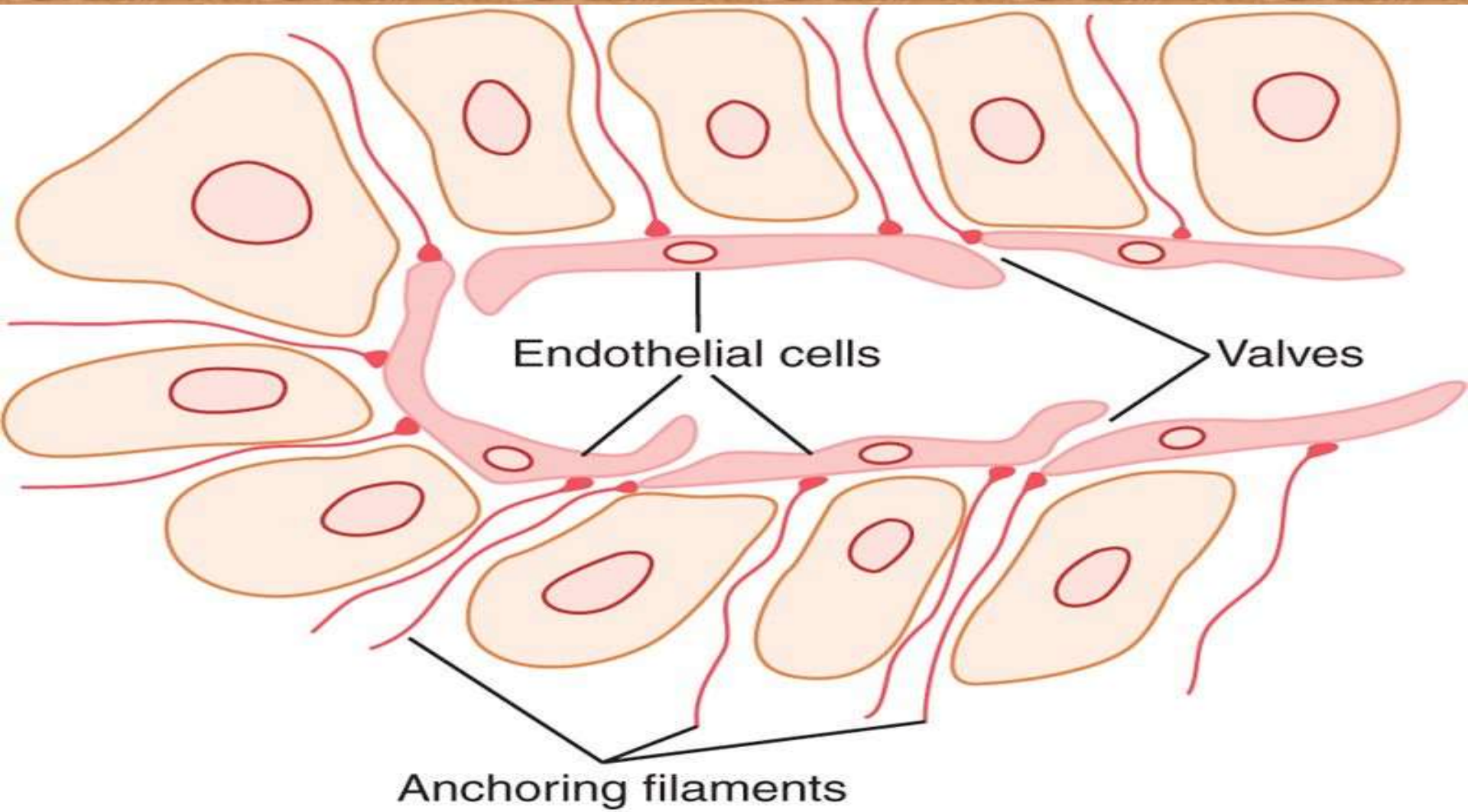


Figure 14.24 The lymphatic system.

- Essentially all the lymph vessels from the left side of the head, the left arm, parts of the chest region and 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 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

- About one tenth of the fluid enters the *lymphatic capillaries* and returns to the blood through the lymphatic system
- The total quantity of all this lymph is normally only 2 to 3 liters each day.

Terminal Lymphatic Capillaries and Their Permeability



- Substances of high molecular weight, such as proteins, cannot be absorbed from the tissues in any other way, although they can enter the lymphatic capillaries
- The reason for this is a special structure of the lymphatic capillaries

- Endothelial cells of the lymphatic capillary are attached by *anchoring filaments* to the surrounding connective tissue
- At the junctions of adjacent endothelial cells, the edge of one endothelial cell overlaps the edge of the adjacent cell forming a valve
- Interstitial fluid can push the valve open and flow directly into the lymphatic capillary

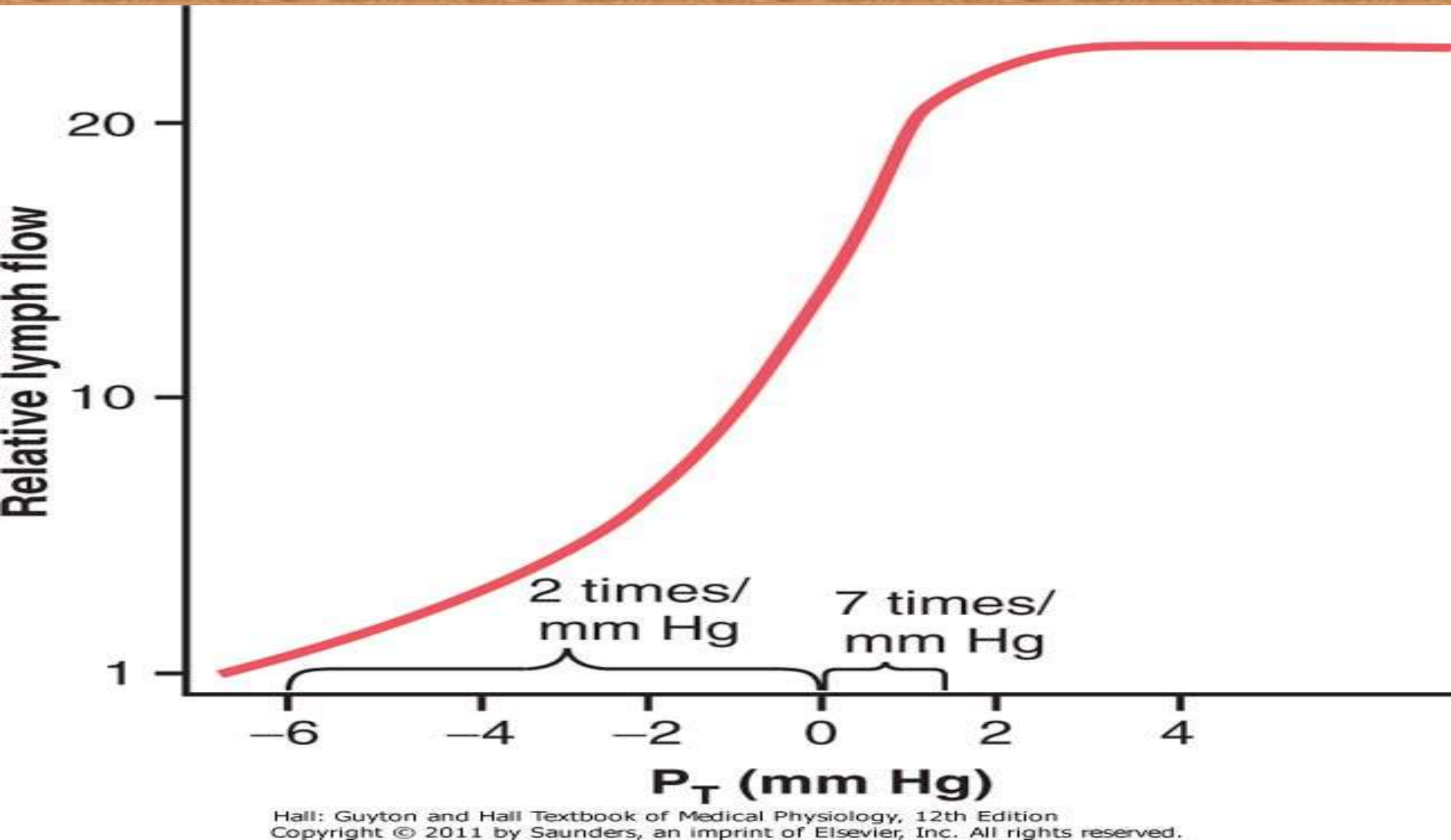
Formation of Lymph

- Lymph is derived from interstitial fluid that flows into the lymphatics
- Protein concentration in the lymph of most tissues averages about 2 g/dl
- In the liver, lymph has a protein concentration as high as 6 g/dl
- Lymph in the intestines has a protein concentration as high as 3 to 4 g/dl
- 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.

Rate of Lymph Flow

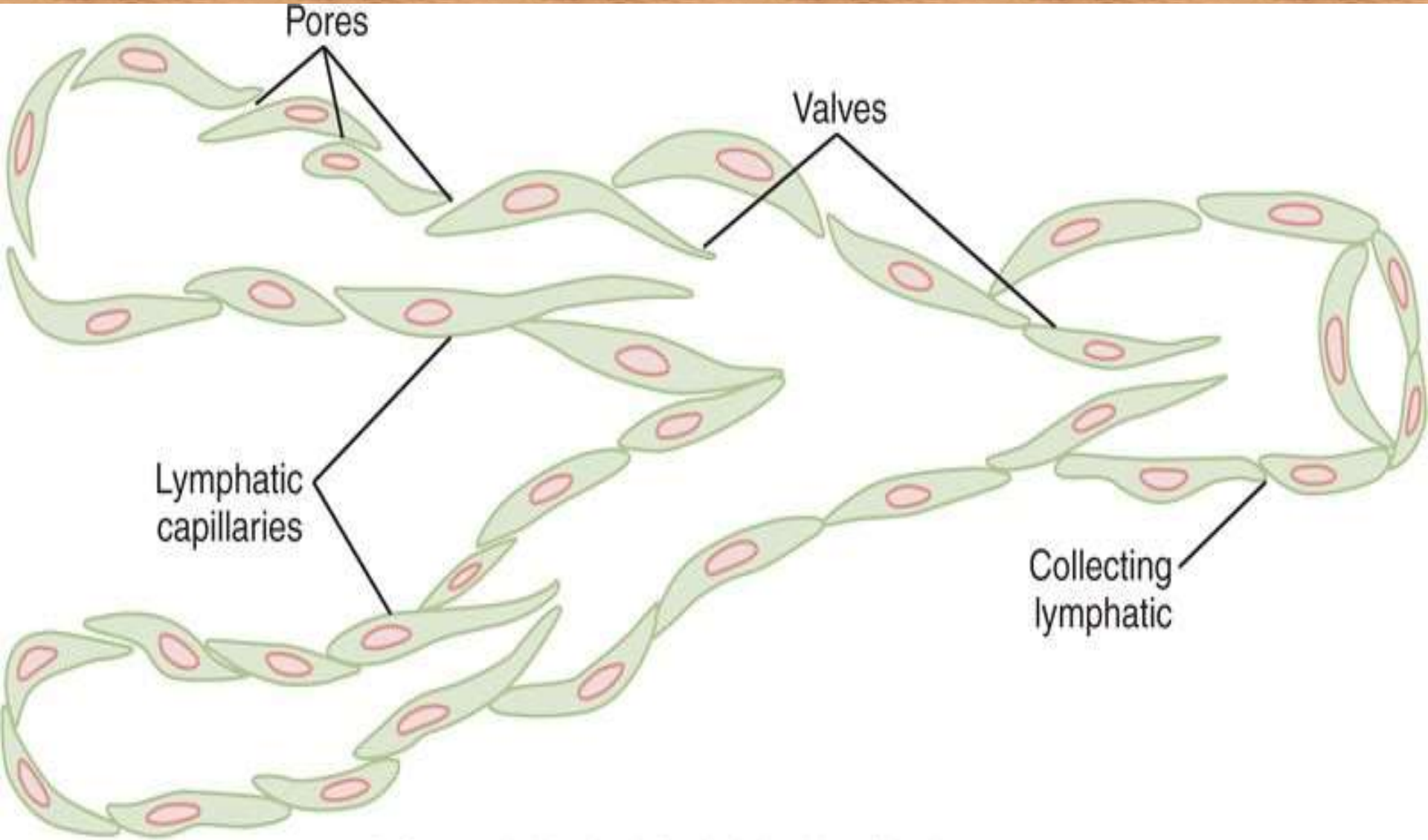
- About 100 milliliters per hour of lymph flows through the *thoracic duct* of a resting human, and approximately another 20 milliliters flows into the circulation each hour through other channels, making a total estimated lymph flow of about 120 ml/hr or 2 to 3 liters per day.

Effect of Interstitial Fluid Pressure on Lymph Flow



Lymphatic Pump Increases Lymph Flow

- When a collecting lymphatic or larger lymph vessel becomes stretched with fluid, the smooth muscle in the wall of the vessel automatically contracts
- Each segment of the lymph vessel between successive valves functions as a separate automatic pump
- Slight filling of a segment causes it to contract and the fluid is pumped through the next valve into the next lymphatic segment
- In a very large lymph vessel such as the thoracic duct, this lymphatic pump can generate pressures as great as 50 to 100 mm Hg



Pumping Caused by External Intermittent Compression of the Lymphatics

- Any external factor that intermittently compresses the lymph vessel also can cause pumping e.g.
  1. Contraction of surrounding skeletal muscles
  2. Movement of the parts of the body
  3. Pulsations of arteries adjacent to the lymphatics
  4. Compression of the tissues by objects outside the body
- The lymphatic pump becomes very active during exercise
- During periods of rest, lymph flow is sluggish, almost zero.

Functions of Lymphatic system

- It maintains the balance of fluid between the blood and tissues, known as fluid homeostasis.
- It forms part of the body's immune system and helps defend against bacteria and other intruders.
- It facilitates absorption of fats and fat-soluble nutrients in the digestive system

Factors That Increase Lymph Formation:

- Increase capillary hydrostatic pressure
- Increase capillary permeability caused by increase temp and decrease oxygen supply
- Decrease plasma colloid osmotic pressure
- Increase metabolic activity

Factors That Promote Lymph Flow:

- Elevated capillary hydrostatic pressure
- Decreased plasma colloid osmotic pressure
- Increased interstitial fluid colloid osmotic pressure
- Increased permeability of the capillaries

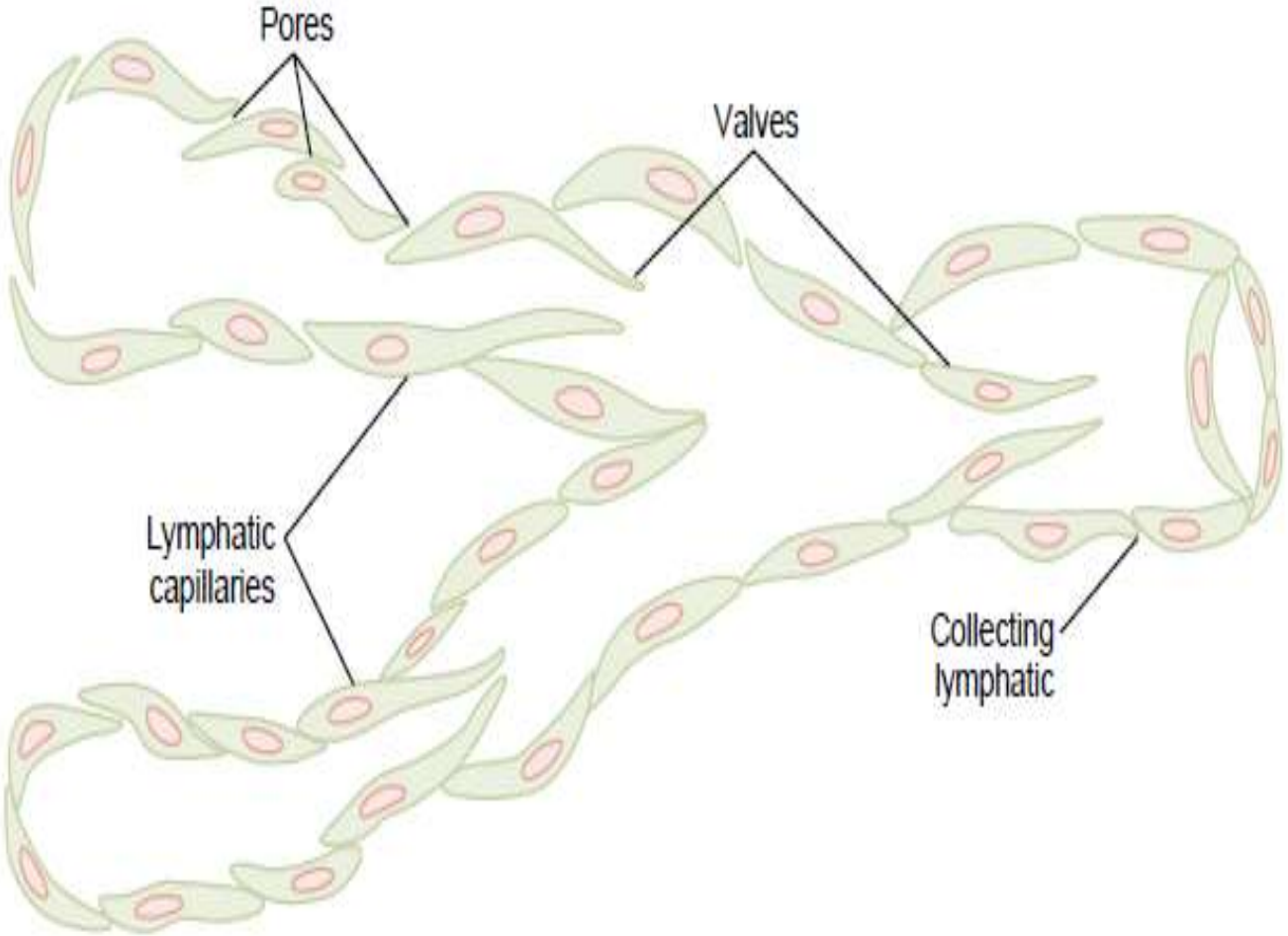


FIGURE 16–11

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

Obstruction of lymphatics

- Elephantiasis is a **condition characterized by gross enlargement of an area of the body**, especially the limbs. Other areas commonly affected include the external genitals. Elephantiasis is caused by obstruction of the lymphatic system, which results in the accumulation of lymph in the affected areas.
- It is caused by parasitic worms which spreads from person through mosquitoes.

Lymphangiography

It is a procedure for studying lymphatic vessels and lymph nodes. Conditions such as

- Lymphomas
- Metastatic diseases

Thank you