

Lymphatic System

The lymphatic system represents an accessory route through which fluid can flow from the interstitial spaces into the blood.

- *Lymph is tissue fluid that enters the lymphatic vessels. It drains into the venous blood via the thoracic and right lymphatic ducts.*It contains clotting factors and clots on standing in vitro.*In most locations, it also contains proteins that traverse capillary walls and return to the blood via the lymph. Its protein content is generally lower than that of plasma, which contains about 7 g/dL, but lymph protein content varies with the region from which the lymph drains (Table 27-11).
- *Water-insoluble fats are absorbed from the intestine into the lymphatics, and the lymph in the thoracic duct after a meal is milky because of its high fat content (see Chapter 25)*Lymphocytes enter the circulation principally through the lymphatics, and there are appreciable numbers of lymphocytes in thoracic duct lymph.

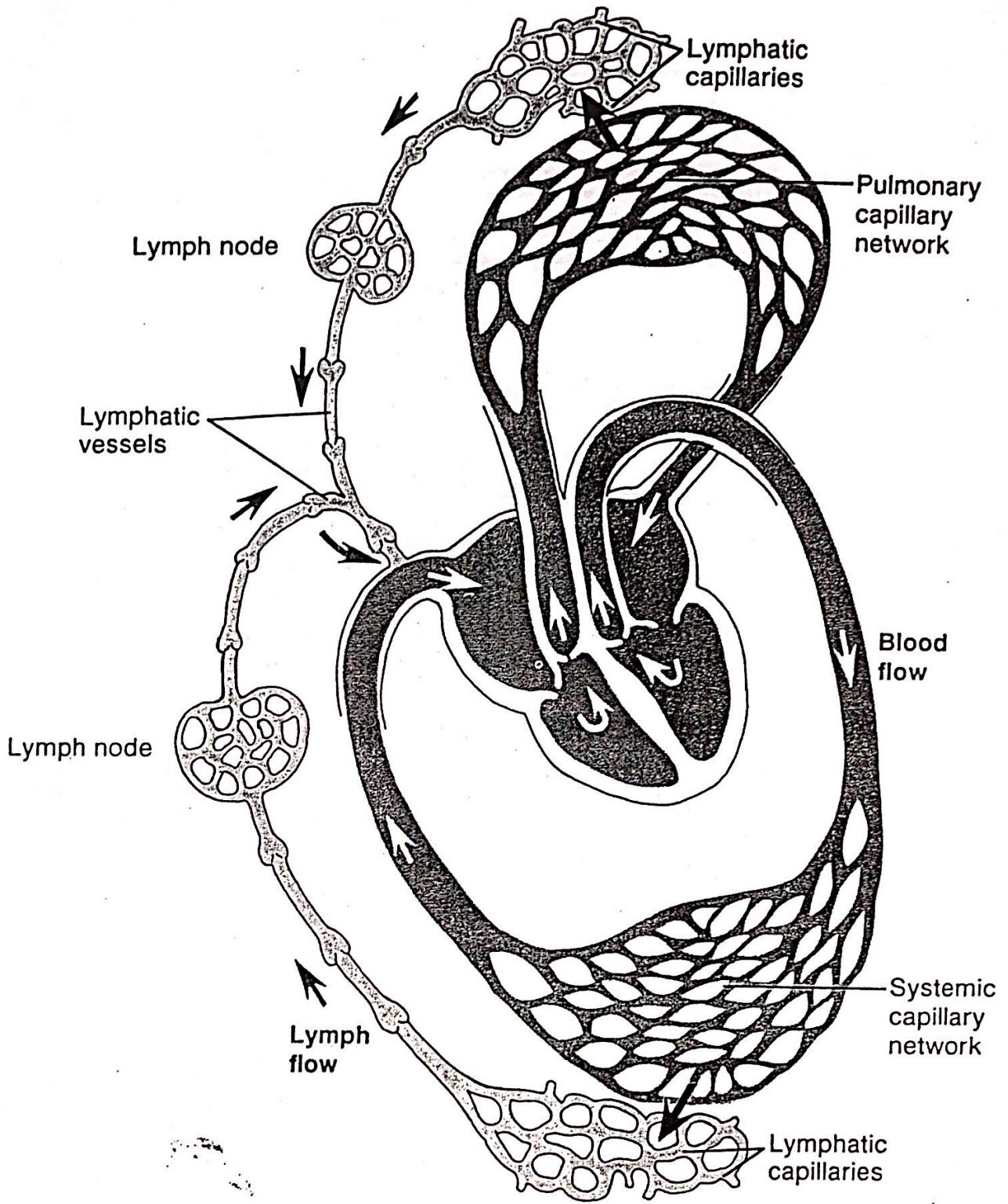
Table 27-11. Probable approximate protein content of lymph in humans.¹

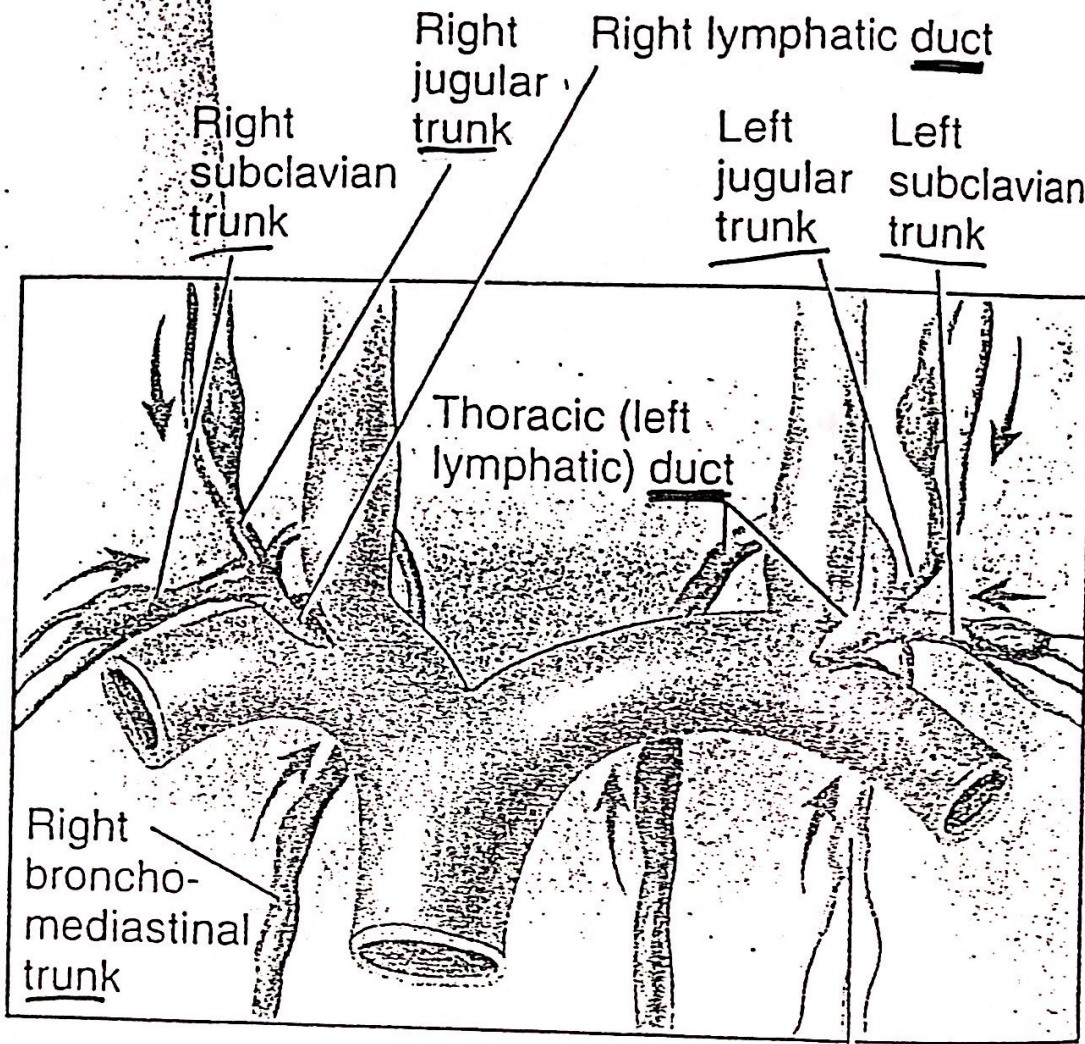
Source of Lymph	Protein Content (g/dL)
Choroid plexus	0
Ciliary body	0
Skeletal muscle	2
Skin	2
Lung	4
Gastrointestinal tract	4.1
Heart	4.4
Liver	6.2

¹Data largely from JN Diana.

⊗ The lymphatic system consists of lymph capillaries, lymphatic vessels, lymphatic ducts, and lymph nodes.* Lymph capillaries originate as microscopic blind ends and converge to form larger and larger vessels, which drain into two main trunks, the *thoracic duct*, which empties into the left subclavian vein at its junction with the internal jugular vein, and the *right lymphatic duct*, which empties into the right subclavian vein at its junction with the right internal jugular vein (Fig. 2-1)* Lymph nodes, situated at intervals in the course of the lymphatic vessels, are especially numerous along the main tributaries that empty into the thoracic duct or right lymphatic duct.

Is transport fluid from interstitial spaces to the





(b) Detailed anterior view

Left broncho-mediastinal trunk

Chart 19.1 Typical lymphatic pathway

Tissue fluid

leaves the interstitial space and becomes

Lymph

as it enters the

Lymphatic capillary

that merges with other capillaries to form the

Afferent lymphatic vessel

that enters the

Lymph node

where lymph is filtered and leaves via the

Efferent lymphatic vessel

that merges with other vessels to form the

Lymphatic trunk

that merges with other trunks and joins the

Collecting duct

that empties into the

Subclavian vein

where lymph is added to the blood.

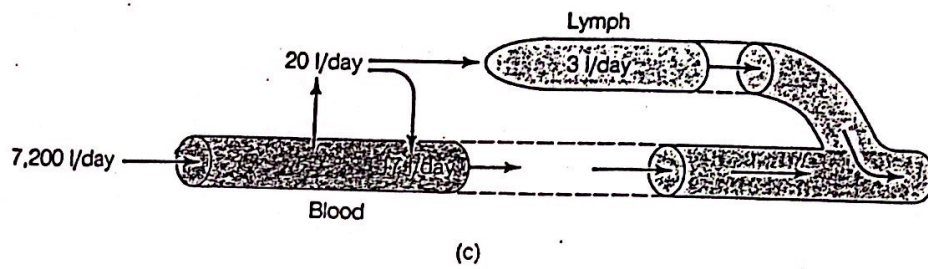
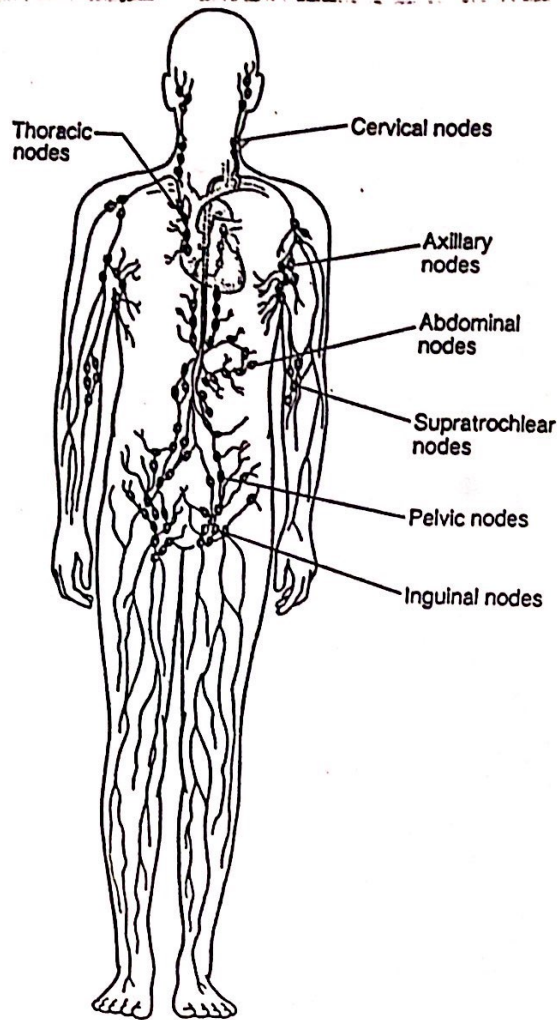


FIGURE 8-17 Lymphatic System (a) Blind-ended lymphatic capillaries pick up excess fluid filtered by blood capillaries and return it to venous system. (b) Lymph empties into venous system near its entrance to right atrium. (c) Lymph flow averages 3 l/day compared with 7,200 l/day blood flow.



Locations of Lymph Nodes

Lymph nodes generally occur in groups or chains along the larger lymphatic vessels. Although they are widely distributed throughout the body, they are lacking in the tissues of the central nervous system.

The major locations of lymph nodes, shown in figure 19.10, are as follows:

1. **Cervical region.** Nodes in the cervical region occur along the lower border of the mandible, in front of and behind the ears, and deep within the neck along the paths of the larger blood vessels. These nodes are associated with the lymphatic vessels that drain the skin of the scalp and face, as well as the tissues of the nasal cavity and pharynx.
2. **Axillary region.** In the underarm region, nodes receive lymph from vessels that drain the arm, the wall of the thorax, the mammary gland (breast), and the upper wall of the abdomen.
3. **Inguinal region.** Nodes in the inguinal region receive lymph from the legs, the external genitalia, and the lower abdominal wall.
4. **Pelvic cavity.** Within the pelvic cavity, nodes occur primarily along the paths of the iliac blood vessels. They receive lymph from the lymphatic vessels of the pelvic viscera.
5. **Abdominal cavity.** Within this cavity, nodes occur in chains along the main branches of the mesenteric arteries and the abdominal aorta. These nodes receive lymph from the abdominal viscera.
6. **Thoracic cavity.** Nodes of the thoracic cavity occur within the mediastinum and along the trachea and bronchi. They receive lymph from the thoracic viscera and from the internal wall of the thorax.

RELATED ORGANS

Three organs closely related to the lymphatic system are the spleen, tonsils, and thymus. All of these organs are composed largely of lymphoid tissue, a specialized form of connective tissue characterized by a framework of reticular tissue (see Chapter 4, page 87) and the presence of lymphocytes.

Chart 19.2 Major organs of the lymphatic system

Organ	Location	Function	Organ	Location	Function
Lymph nodes	In groups or chains along the paths of larger lymphatic vessels	Center for lymphocyte production; house T-lymphocytes and B-lymphocytes that are responsible for immunity; phagocytes filter foreign particles and cellular debris from lymph	Thymus	Within the mediastinum behind the upper portion of the sternum	Houses lymphocytes, changes undifferentiated lymphocytes into T-lymphocytes
			Spleen	In upper left portion of abdominal cavity beneath the diaphragm and behind the stomach	Serves as blood reservoir; phagocytes filter foreign particles, damaged red blood cells, and cellular debris from the blood; houses lymphocytes

Tonsils

Several groups of tonsils, forming a ring of lymphoid tissue, guard the entrance of the alimentary and respiratory tracts from invasion by microorganisms.

Lymph Capillaries. Lymph capillaries, the smallest conducting vessels of the lymphatic system, are thin-walled tubes composed of a single layer of overlapping endothelial cells attached by anchoring filaments to the surrounding connective tissue. The interior overlapping edges of the cells seem to act as valves, forming openings into the capillaries through which fluid can enter and, when closed by backflow, preventing outflow.

Lymph Vessels. Lymph vessels, into which the lymph capillaries drain, have three-layered walls similar to the walls of veins, and valves, more numerous than in veins, which permit lymph to flow in only one direction. These valves give lymph vessels a characteristic beaded appearance.

Lymph Trunks and Ducts

Lymph passes from lymphatic capillaries into lymphatic vessels and then through lymph nodes. Lymphatic vessels exiting lymph nodes pass lymph either toward another node within the same group or on to another group of nodes. From the most proximal group of each chain of nodes, the exiting vessels unite to form lymph trunks. The principal trunks are the lumbar, intestinal, bronchomediastinal, subclavian, and jugular trunks (Figure 22.3). Lymph passes from lymph trunks into two main channels, the thoracic duct and the right lymphatic duct, and then drains into venous blood.

Tissues

that lack lymphatic capillaries include avascular tissues (such as cartilage, the epidermis, and the cornea of the eye), the central nervous system, portions of the spleen, and bone marrow.