lymphatic vessels :

General Functions of Lymphatic System:

1. Returns Fluid from Tissues to Blood

~85% of fluids that leak out of blood returns to blood via

blood capillaries -----15% returns via lymph capillaries

if lymphatic system becomes blocked ⟹ edema

2. Returns Large Molecules to Blood

~25-50% of blood proteins leak out of capillaries each day

they cannot get back into capillaries, instead lymphatic capillaries pick them up and return them to the blood.

If lymphatics are blocked blood protein decreases leading to fluid imbalances in body.

3. Absorb and Transport Fats

Special lymphatic capillaries (=**lacteals**) in villi of small intestine

absorb all lipids and fat soluble vitamins from digested food.

4. Hemopoiesis

Some WBC's (lymphocytes, monocytes) are made in lymphatic tissues (not bone marrow) including body's main supply of lymphocytes

5. Body Defense/Immunity

lymphoid tissue is an important component of the Immune

System .The major role of WBC's is in body defense. Lymphatic system screens body fluids and removes pathogens and damaged cells.

Lymphatic vessels

Lymphatic vessels are part of the lymphatic and immune system in the body. Their draining function is very important especially during an inflammation. Lymphatic vessels are tubes that assist the cardiovascular system in the removal of tissue fluid from the tissue spaces of the body; the vessels then return the fluid to the blood. The lymphatic system is essentially a drainage system, and there is no circulation. Lymphatic vessels are found in all tissues and organs of the body except the central nervous system, the eyeball, the internal ear, the epidermis of the skin, the cartilage, and the bone.

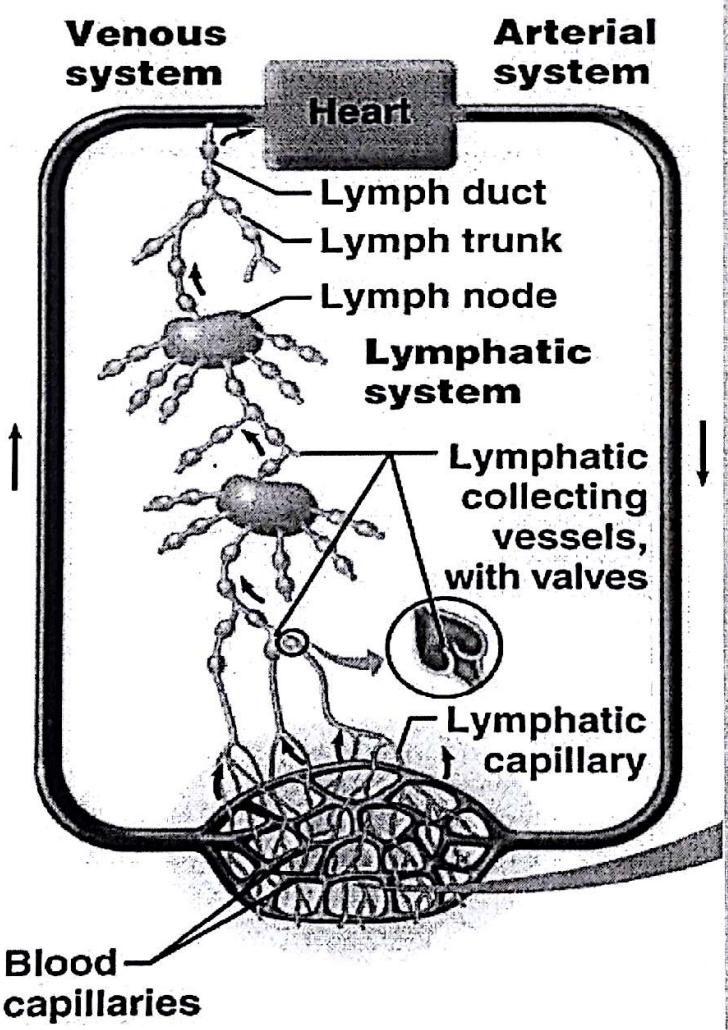
The lymphatic vessels are exceedingly delicate, and their coats are so transparent that the fluid they contain is readily seen through them. They are interrupted at intervals by constrictions, which give them a knotted or beaded appearance; these constrictions correspond to the situations of valves in their interior. Lymphatic vessels have been found in nearly every texture and organ of the body which contains bloodvessels.

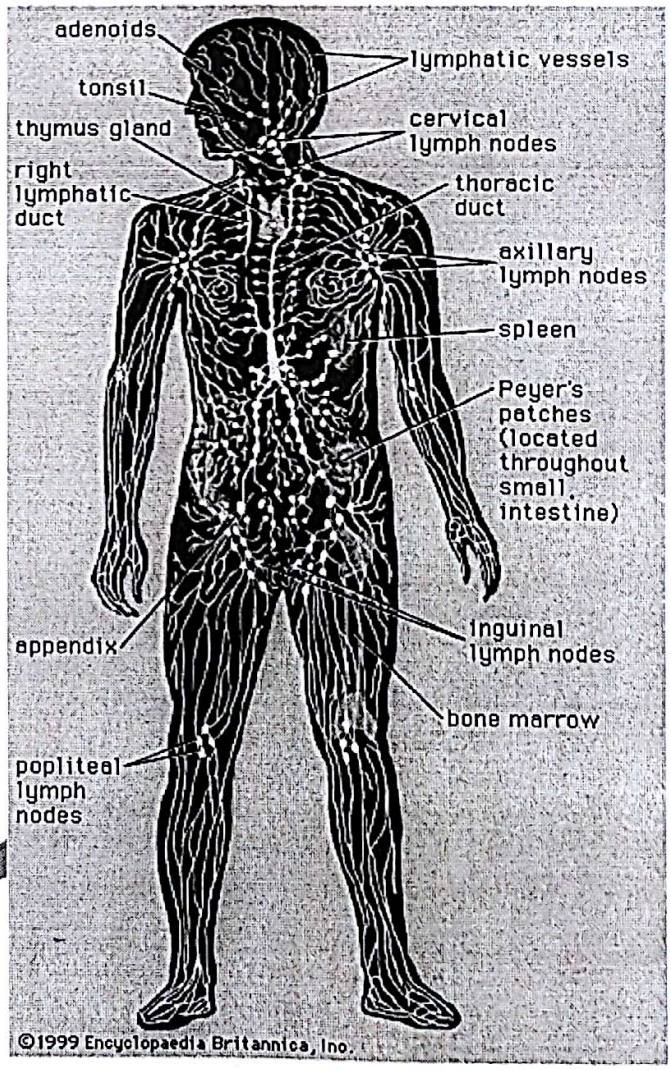
Lymphatic vessels have several similarities to veins. Both are thin walled and return fluid to the right hand side of the heart. The movement of the fluid in both is brought about by the contraction of the muscles that surround them and both have valves to prevent backflow. One important difference is that lymph passes through at least one **lymph node** or gland before it reaches the blood system.

- ≈ 3L*l* day of lymph is generated
- Proteins escaped from the blood or secreted by tissues are transferred back to the blood by the lymphatics
- Lymph flow is facilitated by muscle pumps, the respiratory pump, valves, and smooth muscle (in the walls of the trunks & thoracic duct)
- Smaller vessels drain into larger vessels.

Lymphatic Pathway

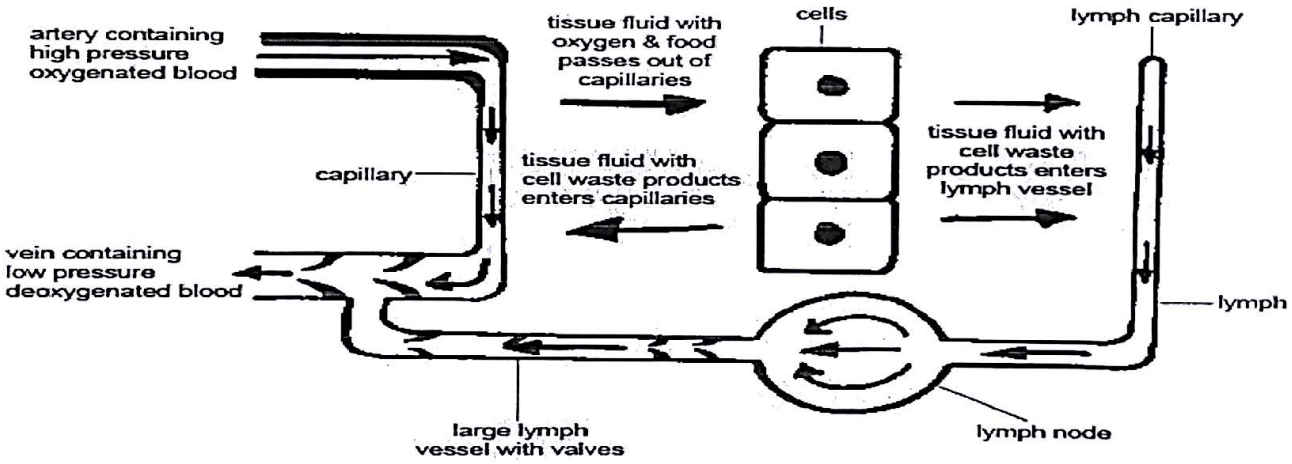
Lymphatic capillary
↓
Lymphatic vessel
↓
Lymph node
↓
Lymphatic vessel
↓
Lymphatic trunk
↓
Collecting duct
↓
Subclavian vein

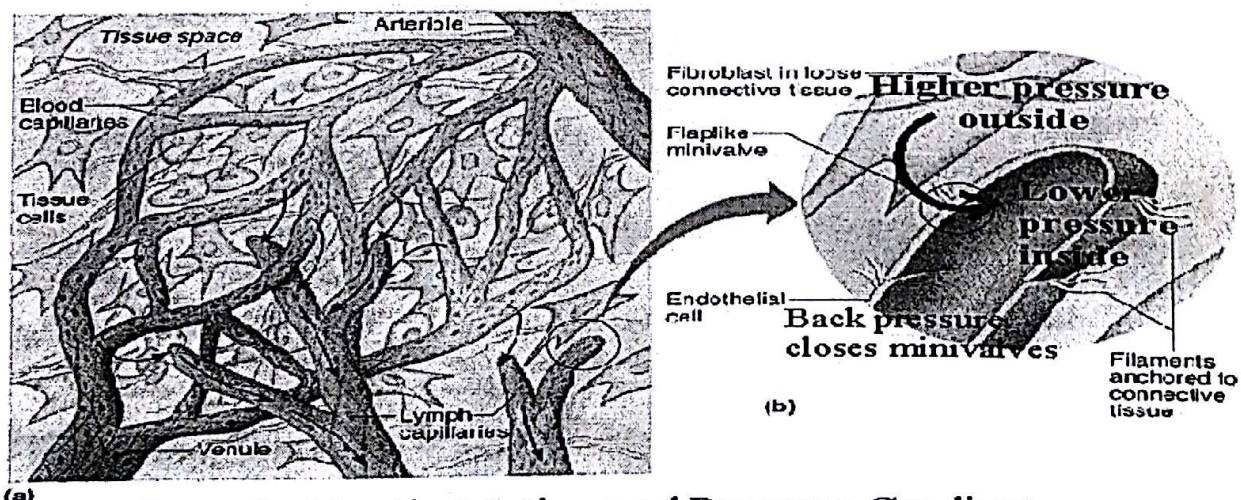




Lymph is the name given to tissue fluid once it has entered a lymphatic vessel.

Lymphtic capillaries are a network of fine vessels"Blind ended," that drain lymph from the tissues, larger than capillaries. The capillaries are in turn drained by small lymph vessels, which unite to form large lymph vessels. Lymph vessels have a beaded appearance because of the presence of numerous valves along their course.



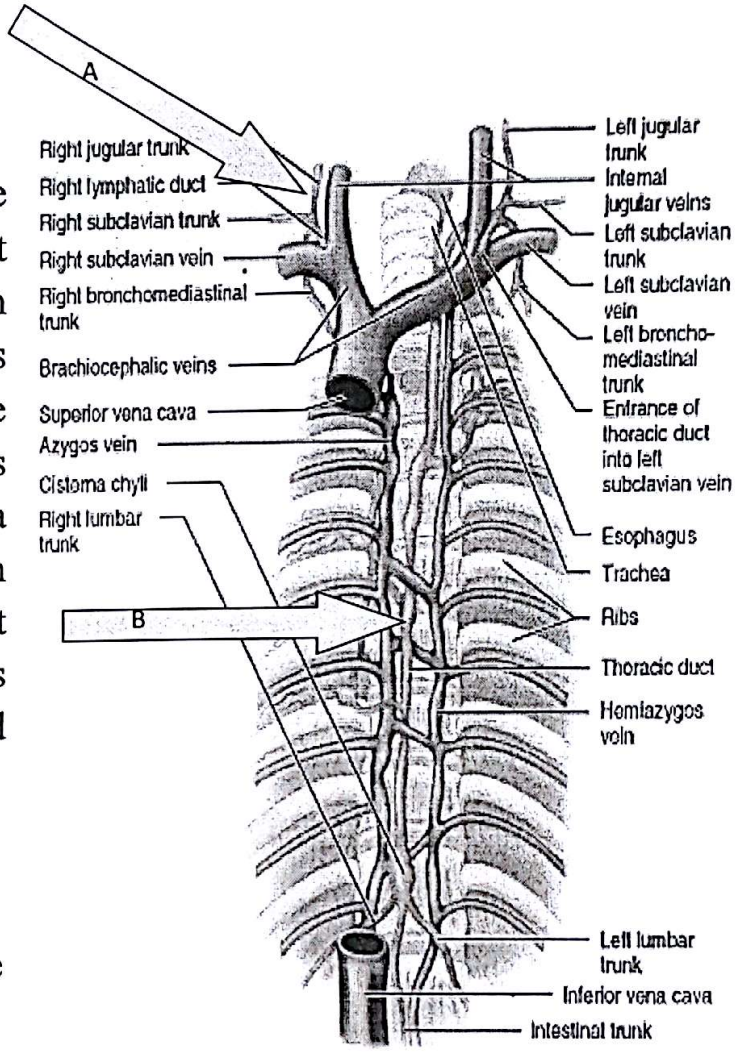


Lymphokinetic Motion and Pressure Gradient

Blood capillaries → Interstitial Fluid → Lymph capillaries → Lymph veins → Lymph ducts → Large circ. Veins

Highest pressure

Lowest pressure



Before lymph is returned to the bloodstream, it passes through at least one lymph node and often through several. The lymph vessels that carry lymph to a lymph node are referred to as afferent vessels those that transport it away from a node are efferent vessels. The lymph reaches the bloodstream at the root of the neck by large lymph vessels called the right lymphatic duct and the thoracic duct.

Lymph Flow Follows Venous Circulation Lymph vessels have the same organization and routing as the vascular tree, Lymphatic vessels have no separate pump (heart), All lymph returns to the vena cava and to the right side of the heart

Lymph ducts

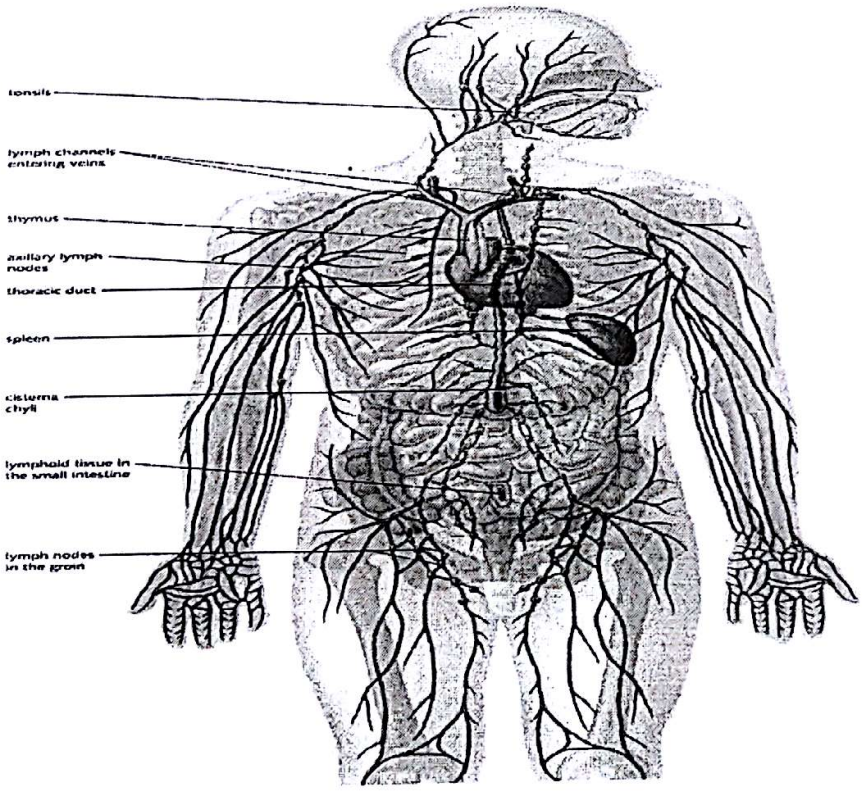
A* Right lymphatic duct

about ½ inch long , drains lymph from upper right side of body (arm & head).

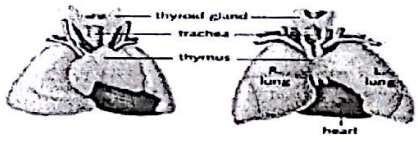
B* Thoracic (left) duct

main collecting duct of the lymphatic system, 38-45 cm long, drains 75% of body, begins as a dilation known as the **cisterna chyli** located anterior to lumbar disk. It is an elongated, sac-like structure formed by the junction of a variable number of lumbar, intestinal, liver, and descending intercostal lymphatic trunks.

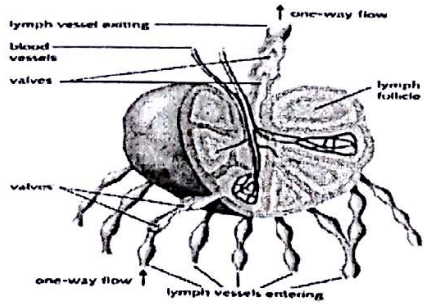
Lymph returns to the venous drainage through right and left lymphatic ducts at the junction of the internal jugular and subclavian veins.



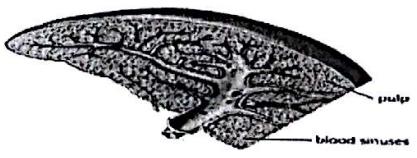
Lymph vessels draining body tissues, via lymph nodes, and finally emptying into veins at the base of the neck.



The relative size of the thymus in a full-term fetus (left), compared to the thymus in an adult.



Section of a lymph node.



Section of the spleen. The vein and its tributaries drain the complex of blood sinuses that form the 'pulp', in which lymphatic nodules are embedded

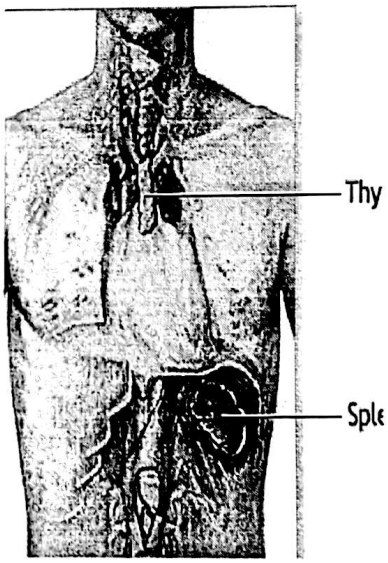
Lymphatic tissues

Lymphatic tissues are a type of connective tissue that contains large numbers of lymphocytes. Lymphatic tissue is organized into the following organs or structures: the thymus, the lymph nodes, the spleen, and the lymphatic nodules. Lymphatic tissue is essential for the immunologic defenses of the body against bacteria and viruses.

The lymphoid tissues are divided functionally into primary and secondary organs.

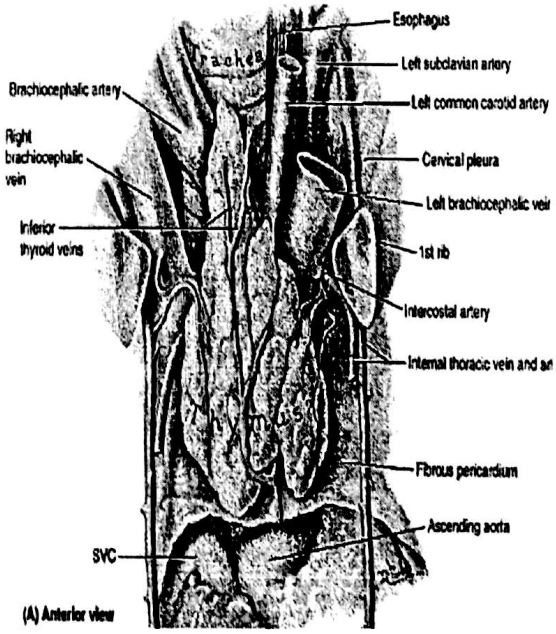
a. The central (primary) lymphoid organs are the thymus and the bone marrow.

b. The peripheral (secondary) lymphoid tissues are the lymph nodes, spleen, diffuse lymphoid tissues, and lymphoid follicles.



Thymus gland

The thymus gland is a primary lymphoid organ, and it is a flattened, bilobed structure lying between the sternum and the pericardium (**located in the inferior part of the neck and the anterior part of the superior mediastinum. It lies posterior to the manubrium and extends into the anterior mediastinum, anterior to the fibrous pericardium).** In the newborn infant, it reaches its largest size relative to the size of the body. The thymus continues to grow until puberty but thereafter undergoes involution. It has a pink, lobulated appearance and is the site for development of T (thymic) lymphocytes. Thymus produces hormones: thymosin & thymopoietin both promote development and maturation of lymphocytes (T-lymphocytes).



Spleen

The spleen is reddish largest single soft mass of lymphatic tissue in the body that occupies the left upper part of the abdomen between the stomach and the diaphragm. It is oval, flat bean shaped and has a notched anterior border, with its long axis, 12 cm long, it's located lateral to stomach (below diaphragm in left hypochondriac region), lying along the line of the tenth rib resembles a large lymph node that is encapsulated & subdivided into lobules by connective tissues

Relations

- Anteriorly: The stomach, tail of the pancreas, and left colic flexure. The left kidney lies along its medial border.
- Posteriorly: The diaphragm; left pleura (left costodiaphragmatic recess); left lung; and 9th, 10th, and 11th ribs.

Functions:

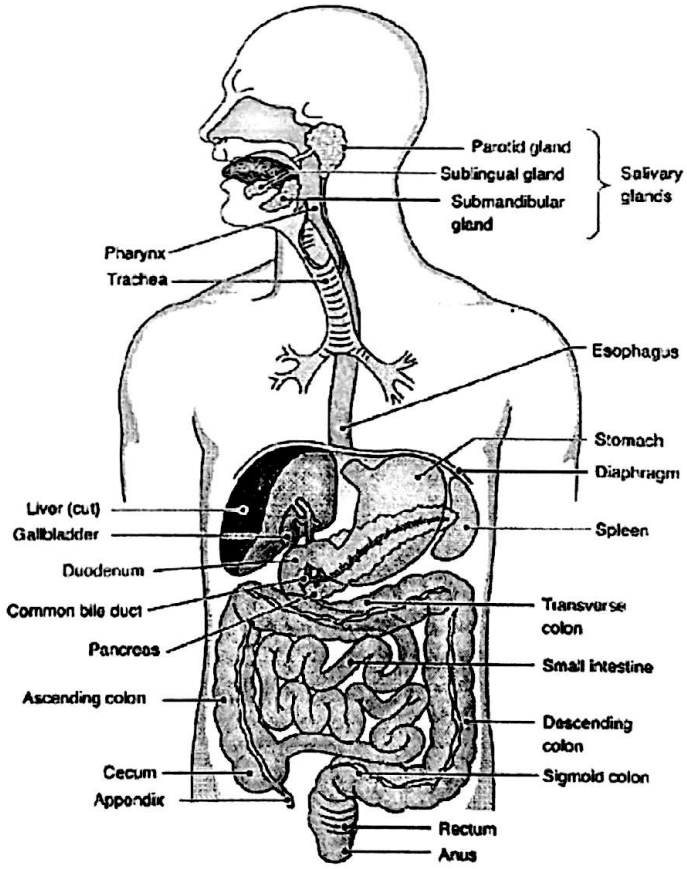
-remove abnormal blood cells

-store iron from recycled RBCs for reuse

-initiate immune response by B & T cells in response to antigens in blood

-store platelets

-site of fetal erythrocyte production

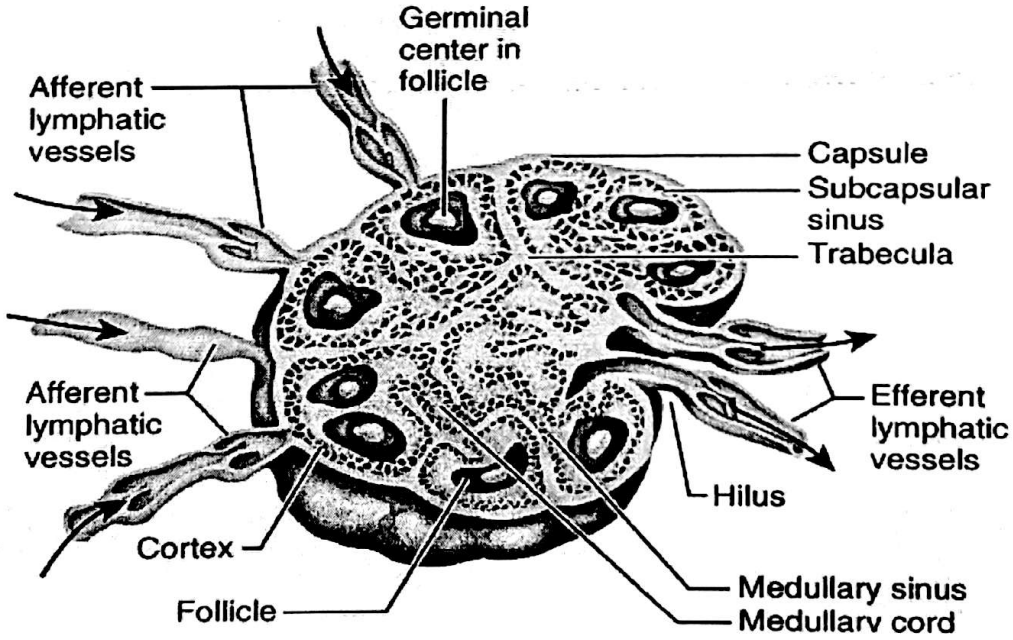


Lymph nodes

Lymph nodes are small, oval bean-shaped bodies 1-25mm scattered throughout body **covered by a capsule of dense connective tissue,** may be deep or superficial that occur along lymphatic vessels. They are abundant where lymphatic vessels merge

to form trunks, especially in the respiratory tree and GI tract, in the mammary glands, axillae, and groin, filter lymph fluid to trap foreign organisms, cell debris, and tumor cells.

Lymph flows into a node through afferent lymphatic vessels that enter the convex side of a node. It exits the node at the hilus, the indented region on the opposite, concave side of the node(hilum), through efferent lymphatic vessels. Efferent vessels contain valves that restrict lymph to movement in one direction out of the lymph node. The number of efferent vessels leaving the lymph node is fewer than the number of afferent vessels entering, slowing the flow of lymph through the node.



*hilum – indented region of bean- shaped node, blood vessels & nerves connect at the hilum of the lymph node.

*afferent vessels enter at various points on the convex surface of

the node & this is how lymph enters the node.

*efferent vessels (lymphatic vessels) exit at the hilum of the node &

lymph leaves the node through these vessels.

1. cleanse lymph

-as lymph flows through sinuses of node it slows down and microorganisms and foreign matter are removed

2. alert immune system to pathogens

3. important in hemopoiesis

- lymphocytes and monocytes are made here.

lymph nodes

1. submental & submaxillary lymph nodes

floor of mouth;

drain nose, lips teeth

2. cervical lymph nodes

neck

drain neck and head

3. superficial cubital (supratrochlear)

above bend in elbow

drain forearm

4. axillary lymph nodes

armpit (axilla) and upper chest

drains arm and upper thorax including breasts breasts contains 2 sets of lymphatics: (NOT mammary glands) those that drain the skin over breast excluding the areola and nipple those that originate in and drain deeper portions of breast and skin of areola and nipple numerous connections join the lymphatic systems of the breast with: the other breast axillary nodes (85% of lymph from breast enters them) abdominal nodes

5. thoracic lymph nodes

in thoracic cavity

receive lymph from lungs, airways, and mediastinum

6. abdominal lymph nodes

receive lymph from urinary and reproductive systems

7. intestinal and mesenteric lymph

nodes

receive lymph from the digestive tract

8. inguinal lymph nodes

in groin area

drain legs and genitals

9. popliteal lymph nodes

in back of knee

receive lymph from leg as lymphatic vessels converge they become larger and larger.

Tonsils

masses of lymphoidal tissue embedded in mucous membranes of covered by epithelium, with deep pits(=crypts) crypts often contain food debris, bacteria, dead wbc's etc

three main sets of tonsils:

pharyngeal tonsils (=adenoids)

on wall of pharynx behind nasal cavity

palatine tonsils

at post margin of oral cavity largest and most often infected = tonsilitis

usually *Streptococcus* today usually treated with antibiotics

lingual tonsils

on each side of root of tongue

Lymphatic Nodules

Lymphatic Nodules differ from Lymph Nodes in that lymphatic nodules are not surrounded by capsules (of dense connective tissue). They are also known as **mucosa-associated lymphatic tissue (MALT).**

found in the lamina propria of mucous membranes in various sites of the body, such as the gastrointestinal tract, thyroid, breast, lung, salivary glands, eye, and skin. MALT is populated by lymphocytes such as T cells and B cells, as well as plasma cells and macrophages, each of which is well situated to encounter antigens passing through the mucosal epithelium. In the case of intestinal MALT, M cells are also present, which sample antigen from the lumen and deliver it to the lymphoid tissue.

MALT can be functionally divided into effector sites and inductive sites.