Lymph and lymphatic system

* The lymphatic system is a network of lymphatic vessels and lymph nodes in different areas of body that maintains homeostasis as well as immunity of our body.

lymphatic system returns fluids that have leaked from the blood vascular system back to the blood to maintain blood volume.

the lymphatic system consists of :-

- lymph
- lymphatic vessels
- Lymph nodes
- lymphoid organs and tissues

→ Lymph :- Lymph is a clear watery fluid that circulates through the lymphatic vessels. once the interstial fluid drains into lymphatic vessels, it is called lymph. So lymph is identical in composition to interstitial fluid.

* formation of lymph :- As blood vessels circulates through the body, most components of blood plasma such as nutrients, gases, hormones filter through the blood capillaries walls to form interstitial fluid and reabsorbed back by venous capillaries. The excess filtered fluid (about 3l per day) drains into the lymphatic vessels and becomes lymph. The interstitial fluid enters into the lymphatic vessels is called fluid.

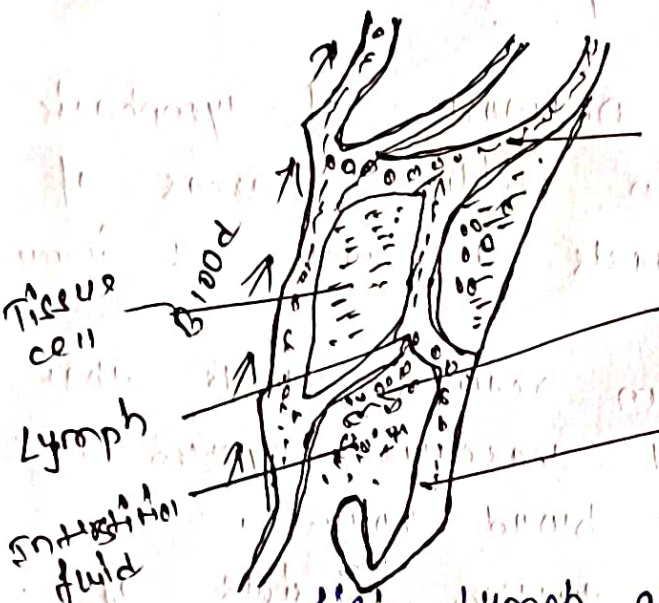
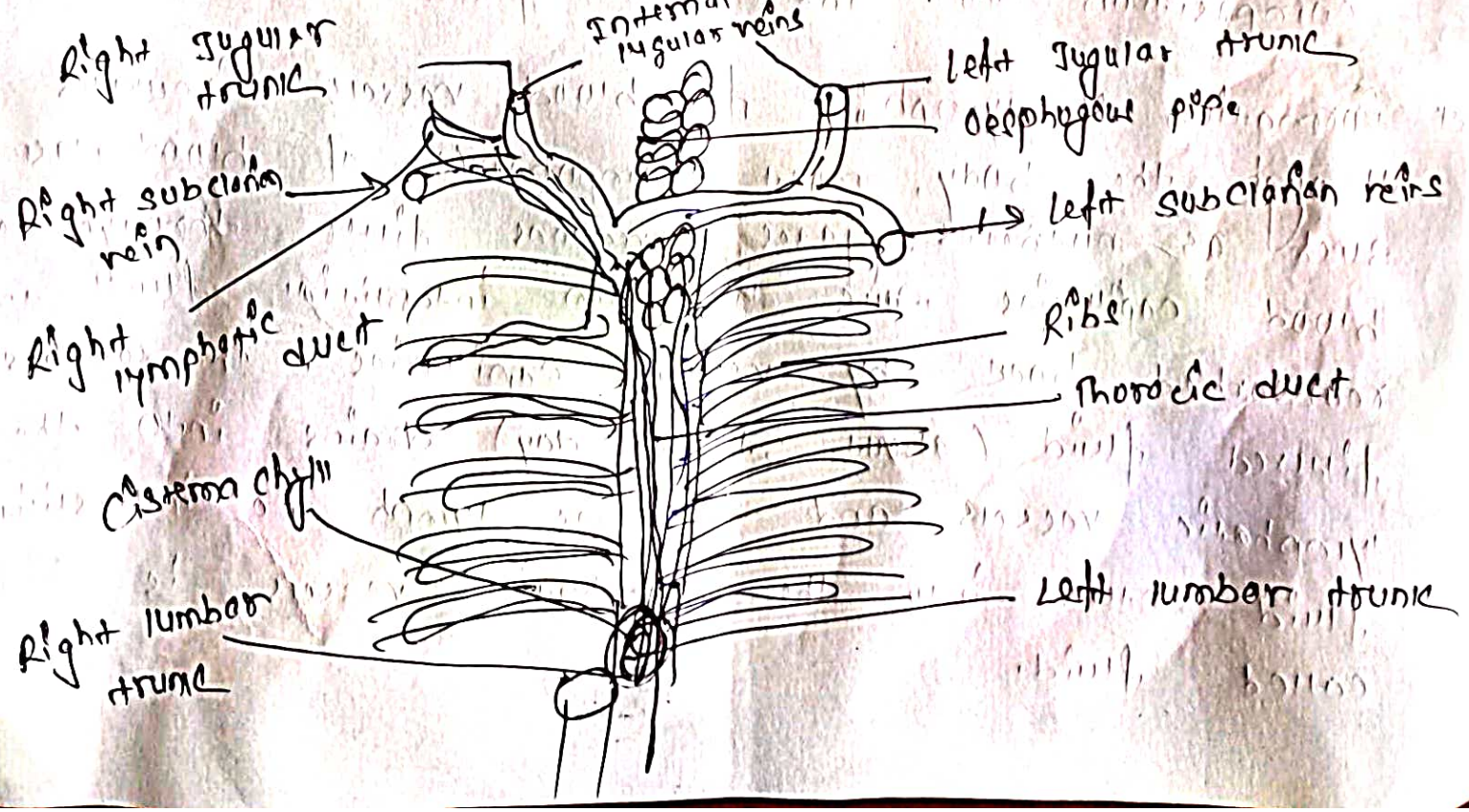


fig:- lymph and its formation

→ Lymphatic vessels :- lymph vessels are thin walled structures that carry lymph.

lymphatic vessels begins as lymphatic cappillaries, which join up to form lymphatic vessels. Larger lymphatic vessels unite to form lymphatic trunk.

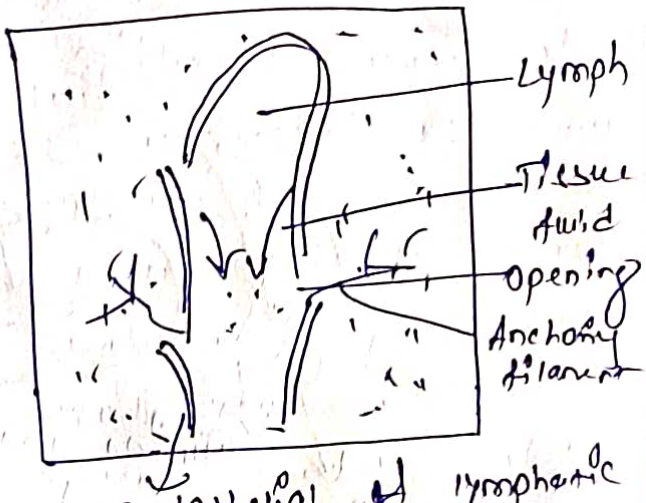
Lymphatic trunk opens into two large lymphatic duct - ① right lymphatic duct
② Left lymphatic (Thoracic duct)



structure :-

lymph capillaries :-

* lymph capillaries are made up of single layered endothelial cells.
* The edge of one endothelial cell overlap with other endothelial cell and forms flap like minivalves that ensure lymph flow only in one way, i.e towards the thorax.
* lymphatic capillaries are attached to the surrounding tissue by anchoring filaments, which contain collagen filament and elastic fibres.



lymphatic vessel :-

* structure similar as vein
* Thin walls and more valve
* 3 tunica layers - intima, media and adventitia
  - Tunica intima :- inner layer, made up of single flattened simple squamous epithelium composed of epithelium cells endothelium and cells are called endothelial cells.
  - Middle Tunica media :- smooth muscle and elastic tissue that are arranged in circular fashion around endothelium.
  - The outermost adventitia consists of fibrous tissue.
* Afferent lymphatic vessels :- the vessels that enters lymph node.
* Efferent lymphatic vessels :- the vessels that leaves lymph node.

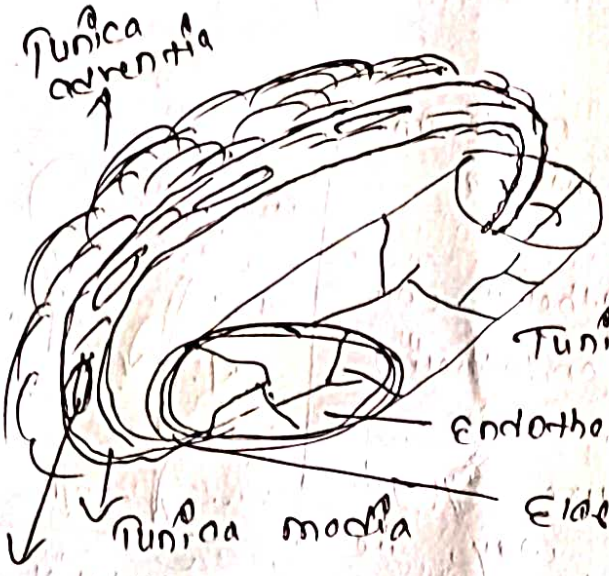


Fig:- Any portion of lymphatic vessels

* lymphatic trunk:-

= Lymphatic vessels exist lymph nodes and unite to form lymphatic trunks.

⇒ The major trunks are:-

- Lumbar trunks (Right and left)
- Intestinal trunks
- Bronchomediastinal trunks (Right & left)
- Subclavian trunks (Right & left)
- Jugular trunks (Right & left)

⇒ The lumbar trunks drains lymph from the lower part of the body, the limbs, the wall and viscera of the pelvis, the kidneys, the adrenal glands and the abdominal wall.

⇒ The intestinal trunk drains lymph from the stomach, intestines, pancreas, spleen and part liver.

The bronchomediastinal trunks drains from the thoracic wall, heart and lungs.

The subclavian trunks drain the upper limbs.

The jugular trunks drain the head and neck.

* lymphatic duct:-
  - Thoracic duct
  - Right lymphatic duct

Thoracic duct/ left lymphatic duct:-

- Main duct for the lymph return to blood
- 38-45 cm length
- Begins at cisterna chyli (an enlarged lymph sac which receives lymph from right and left lumbar trunc and intestinal trunc)
- Receives lymph from cisterna chyli, left jugular, left subclavian and left bronchomediastinal trunks.
- Thoracic duct drains lymph into venous blood at the function of the left internal jugular and left subclavian veins.

Right lymphatic duct:-

- About 1.2 cm height
- Receives lymph from right jugular, right subclavian and right bronchomediastinal trunks.
- Drains into venous blood at the function of the right internal jugular and right subclavian veins.

⇒ Circulation of lymph:-

There is no 'pump' like the heart, involved in the onward movement of lymph, but the muscle layer in the wall of the large lymph vessels has an intrinsic ability to contract rhythmically.

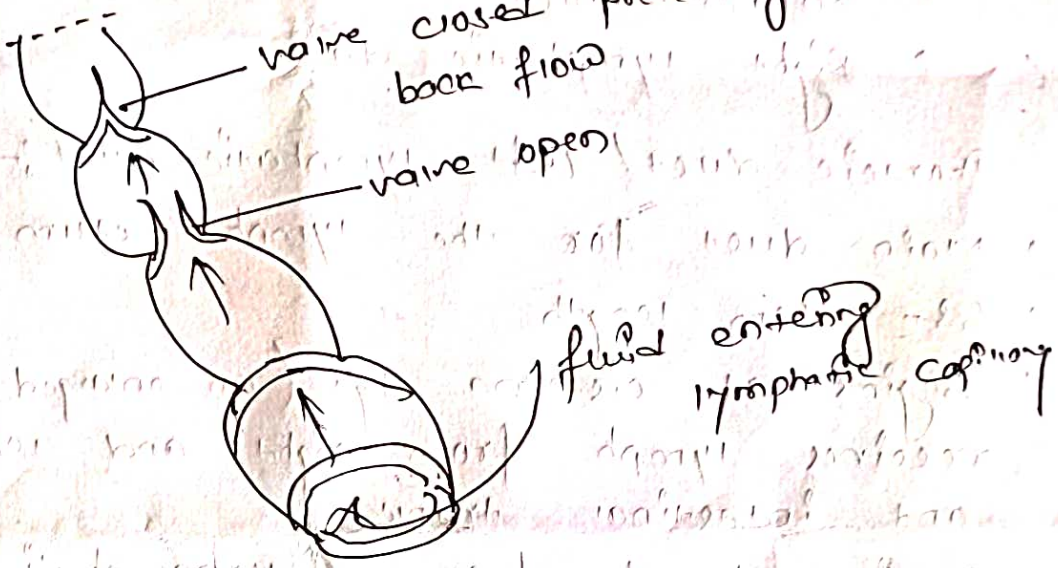


fig:- A lymph vessel cut open to show the valve.

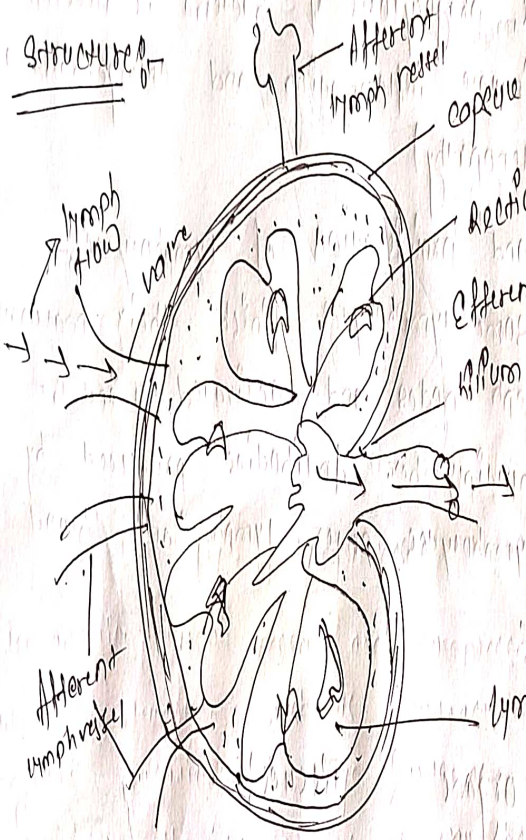
In addition, lymph vessels are compressed by activity in adjacent structures, such as contraction of muscle and regular pulsation of large arteries. This 'milking' action on the lymph vessel wall helps to push lymph along.

Changes in the thoracic pressure associated with the respiratory cycle also assist lymph movement. At the peak of inspiration, when the pressure in the chest is at its lowest, lymph is 'sucked' along the right lymphatic duct and so increases lymph flow into the subclavian vein.

Lymph nodes :-

Lymph nodes are oval or bean-shaped organs that lie along the length of lymph vessels, often in groups. The lymph draining through a number of nodes, usually 8-10, before returning to the venous circulation. These nodes are small in size and some largest nodes are about the size of almond.

Structure :-



Lymph node have an outer capsule of fibrous tissue. The main substance of the node consist of reticular and lymphatic tissue. The lymphatic tissue is packed with immune and defence cells, including lymphocytes & macrophages.

As many as four or five lymph afferent vessels may enters a lymph node. But only one efferent lymph vessel that carries lymph away from node. Each node has concave surface called hilum,

⇒ Function :-

* Defence :-

lymph flows slowly through lymph nodes and is filtered by the reticular and lymphatic tissue as it passes. particulate matter may include bacteria, dead and live phagocytes containing ingested microbes, damaged tissue cells and inhaled particles. In some cases, phagocytosis of bacteria is incomplete, they may stimulate inflammation and enlargement of node. (lymphadenopathy)

* Maturation and proliferation of lymphocytes :-

Some lymphocytes finish their maturation process in lymph nodes and activated T- and B- lymphocytes multiply here. Antibodies produced by sensitized B-lymphocytes enter lymph and blood draining node.

⇒ Lymphatic organs & Tissues :-

Spleen :- Spleen contains reticular and is the largest lymph organ. It lies between the fundus of stomach and diaphragm. It is purplish in colour, usually about 12cm long, 7cm wide and 2.5cm thick. It weighs about 200g.

organs attached with Spleen :-

Superiorly - diaphragm
Inferiorly - Large intestine
Anteriorly - Stomach
medially - pancreas, left kidney
Laterally - Diaphragm
Intercostal muscles

Structure :—

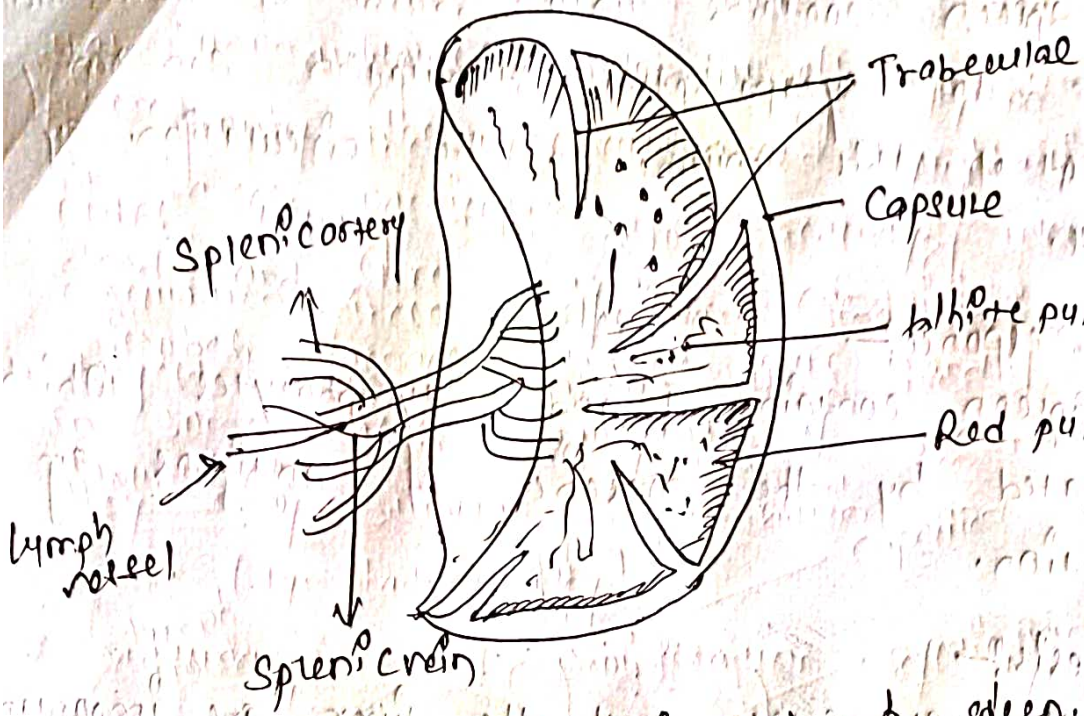


fig:- Section through spleen.

Oval in shape, Anterior surface covered with capsule, deep into organ forming trabeculae. White pulp is area of lymphatic tissue, Red pulp is suffused with blood, the structure consist:—

* Splenic artery, a branch of the coeliac artery
* Splenic vein, a branch of portal vein
* lymph vessel (efferent only)
* Nerves.

Functions :—

* phagocytosis :— Old and abnormal erythrocytes are destroyed mainly in the spleen, transported through liver via splenic and portal veins. Transportation of leucocytes, protists and bacteria are phagocytosed in the spleen.

* Storage of blood:-

The spleen contains upto 350ml of blood, and in response to sympathetic stimulation can rapidly return most of this volume to the circulation eg haemorrhage.

* Immune response:-

The spleen contains T- and B-lymphocytes which are activated by the presence of antigens eg in infection.

* Erythropoiesis:-

The ~~liver~~ spleen and the liver are important sites of fetal blood cell production, and spleen can also fulfill this function in adults at time of great needs.

Disorders:-

Lymphangitis:- Inflammation of lymph vessels

Lymphadenitis:- Infection of lymph nodes

Lymphadenopathy:- Enlargement of lymph nodes

Splenomegaly:- Enlargement of spleen

Lymphoedema:- Swelling in tissues where lymphatic drainage has been obstructed in some way.