



# **\*Lymphatic system\***

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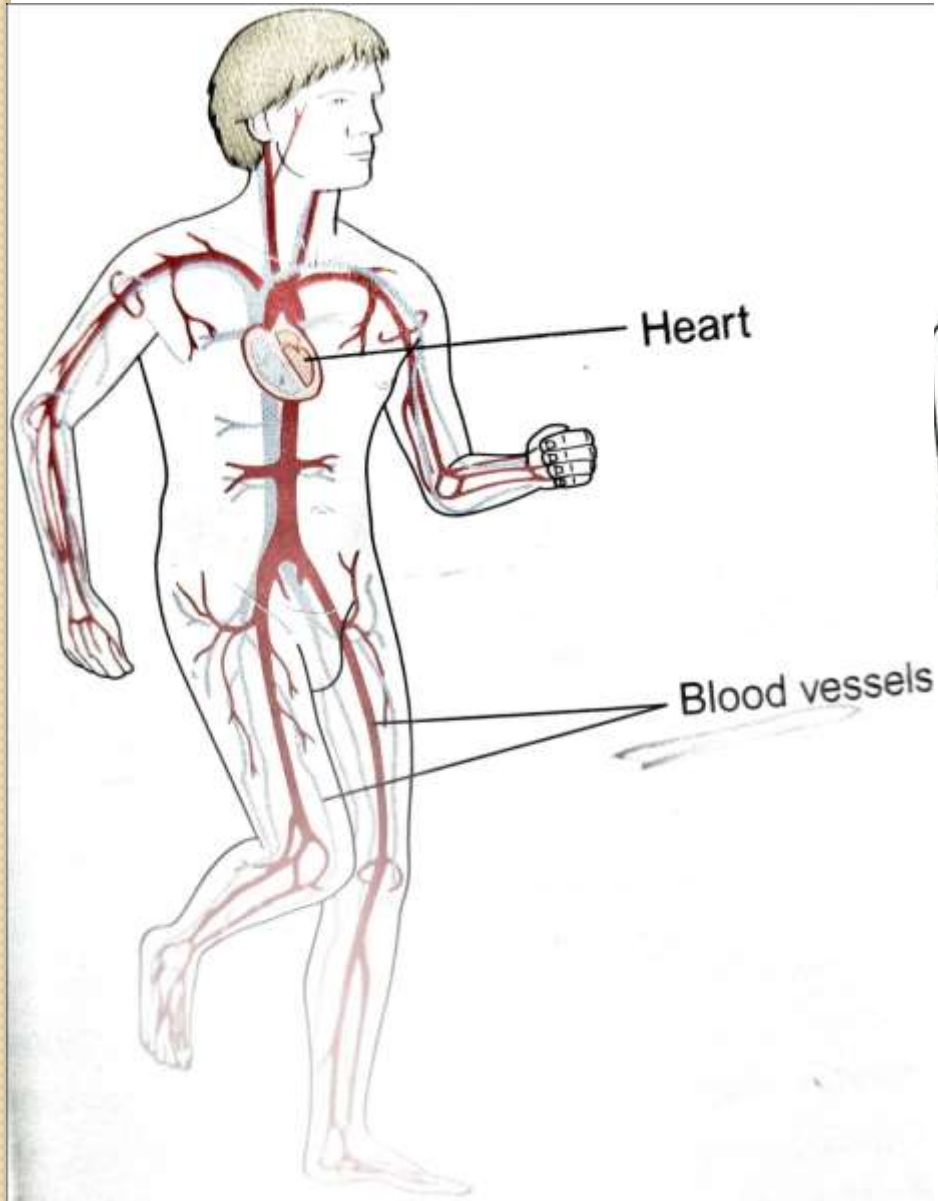
# Lymphatic system

Lymphatic system - is the part of vascular system and an important part of the immune system. Comprising a large network of lymphatic vessels that carry a clear fluid called lymph (from latin lymphra meaning water )

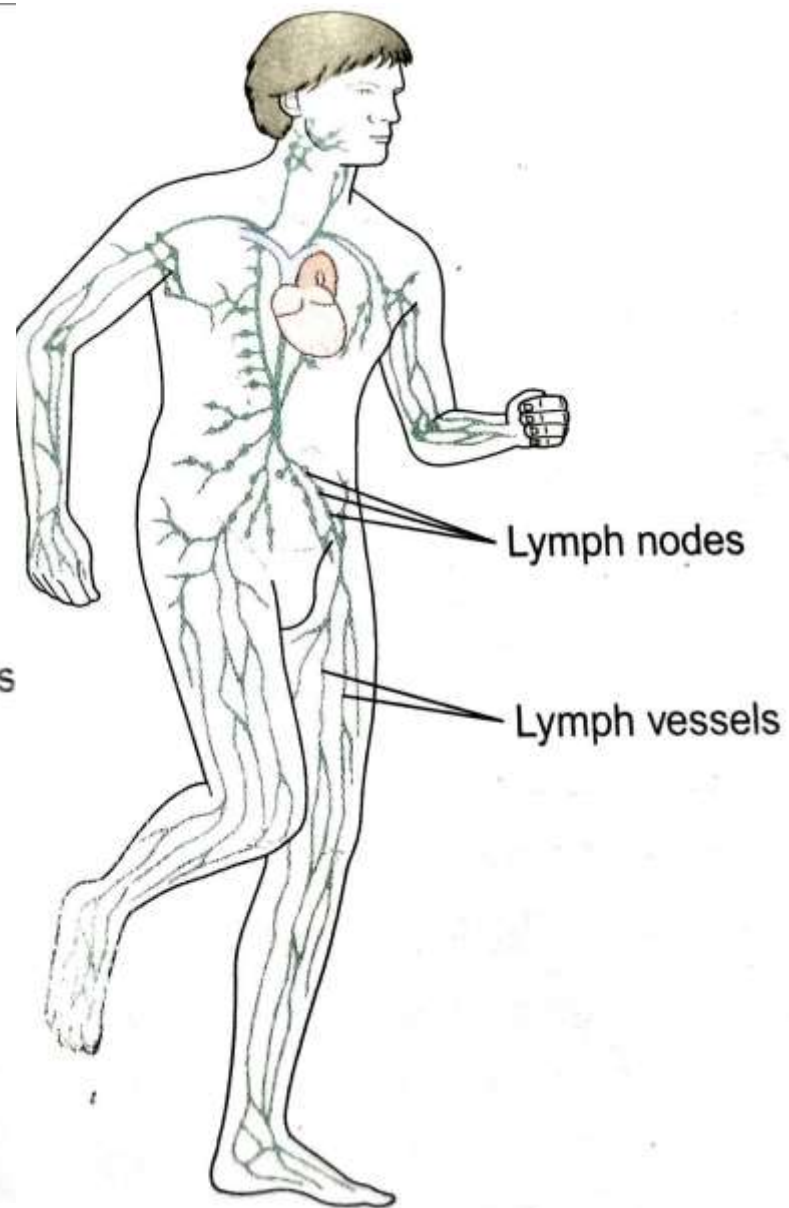
Directionally towards the heart.

**Composition** – The lymphatic system consists of:

- Lymph
- Lymph vessels
- Lymph nodes
- Lymph organs, e.g. spleen and thymus
- Diffuse lymphoid tissue, e.g. tonsils
- Bone marrow.



**The circulatory system**



**The lymphatic system: Lymph nodes and vessels**

**Lymph** - Lymph is a clear watery fluid that flows through the lymphatic system, similar in composition to plasma, and identical in composition to interstitial fluid.

Lymph transports the plasma proteins. It also carries away larger particles, e.g. bacteria and cell debris from damaged tissues, which can then be filtered out and destroyed by the lymph nodes.

Lymph also transport fats from the digestive system to the blood via chylomicrones (chylomicrones is lipoprotein particles that consists of triglycerides, phospholipid, cholesterol and protein, transport fat from the intestine to liver).

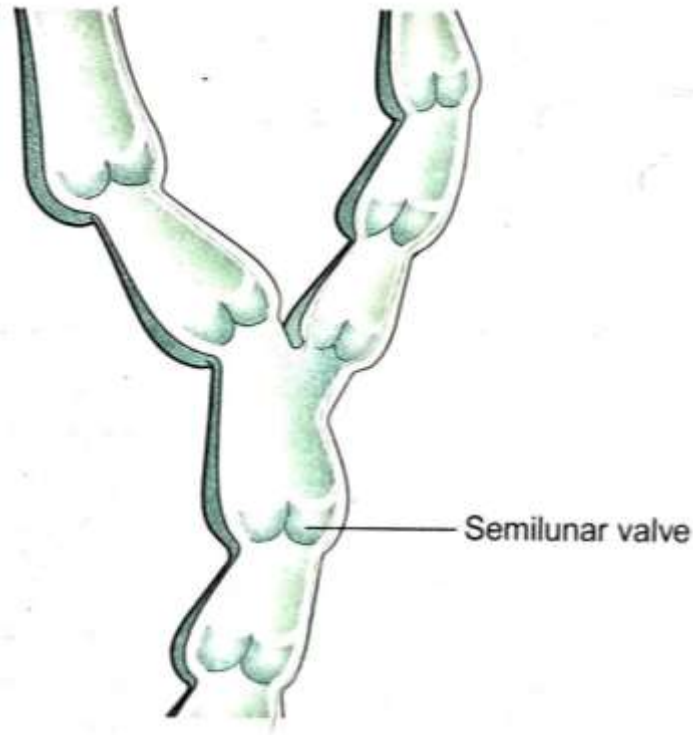
Lymph contains lymphocytes, which circulate in the lymphatic system allowing them to patrol the different regions of the body.

## **Lymph capillaries**

They have the same structure as blood capillaries, i.e. a single layer of endothelial cells, but their walls are more permeable to all interstitial fluid constituents, including proteins and cell debris. The tiny capillaries join up to form larger lymph vessels. Nearly all tissues have a network of lymphatic vessels, important exceptions being the central nervous system, the cornea of the eye, the bones and the most superficial layers of the skin.

**Lymph vessels** – Lymph vessels are thin walled vessels structured like blood vessels that carry lymph.

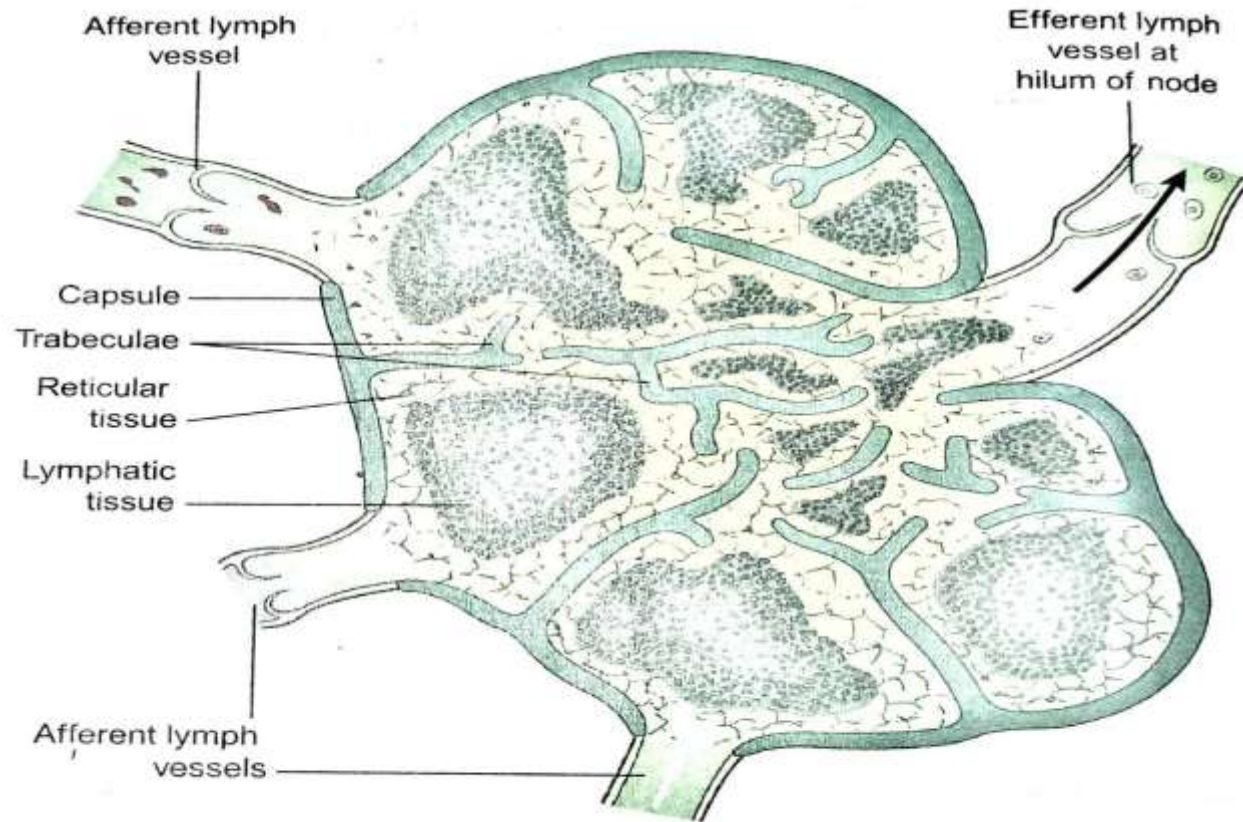
Lymph vessels that carry lymph, to a lymph node are called afferent lymph vessels and those that carry it from a lymph node are called efferent lymph vessels from where the lymph may travel to another lymph node may be return to a vein or may travel to a larger lymph duct.



**Figure: A lymph vessel cut open to show valves**

**Lymph node** - Lymph nodes are oval or bean shaped that lie often in group along the length of lymph vessels.

## **Structure of lymph node**



**Figure – Section through a lymph node ( Arrows indicate the direction of lymph flow )**

- Lymph nodes have an outer capsule of fibrous tissue that dips down into the node substance forming partitions or trabeculae.
- The main substance of the node consists of **reticular tissue** and **lymphatic tissue**, containing many lymphocytes and macrophages.
- Reticular cell/tissue – produce the network of fibrous that provide internal structure with in the lymph node.
- Lymphatic tissue – contain immune and defence cells, including lymphocytes and macrophages.
- As many as 4 or 5 afferent lymph vessels may enter a lymph node while only one efferent vessel carries lymph away from the node.
- Each node has a concave surface called hilum where an artery enters and a vein and the efferent lymph vessel leave.

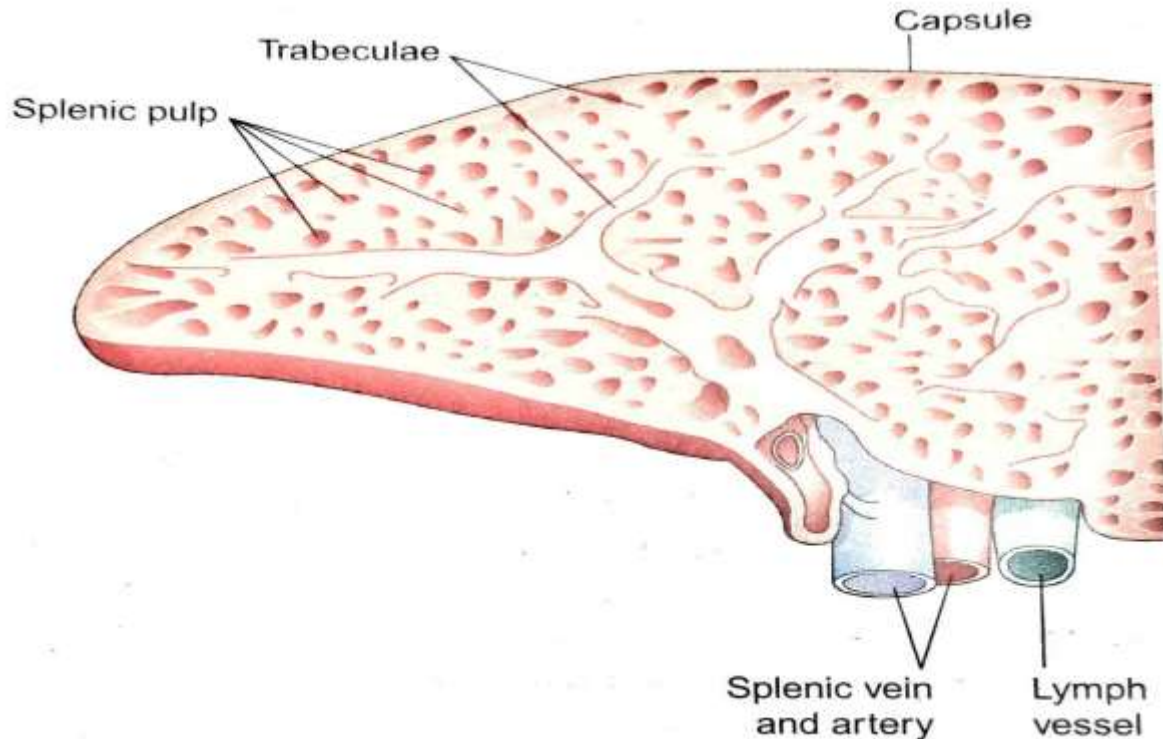


## **Function -**

- Filtering – lymph is filtered by the reticular and lymphatic tissue as it passes through lymph node. Particulate matter may include – bacteria, dead or live phagocytes.
- Phagocytosis – organic material is destroyed in lymph nodes by macrophages and antibodies.
- Proliferation of lymphocytes - Activated T and B – lymphocytes multiply in lymph nodes.

**Spleen** – The spleen contains reticular and lymphatic tissue and is the largest lymph organ. It is purplish in color and varies in size in different individuals but is usually about 12 cm long, 7 cm wide and 2.5 cm thick. Its weight is about 200 gm. The spleen lies in between the fundus of the stomach and the diaphragm.

**Structure –**



**Figure – A section through the spleen**

- Spleen is slightly oval in shape.
- The anterior surface is covered with peritonium.
- The cellular material consisting of lymphocytes and macrophages is called **splenic pulp** and lies between the trabeculae.
- The structures entering and leaving the spleen at the hilum are –  
Splenic artery – a branch of the coeliac artery (abdominal artery )  
Splenic vein – a branch of the portal vein (Hepatic vein)  
Lymph vessels  
Nerve
- Blood passing through the spleen, flows in sinusoids (vascular channels), which have distinct pores between the endothelial cells, allowing it to come into close association with splenic pulp.
- This is essential for the spleen's function in removing ageing or damaged cells from the blood stream.

# Functions

- 1. Phagocytosis** – The old and abnormal erythrocytes are mainly destroyed in the spleen and the breakdown product bilirubin and iron are transported to the liver via the splenic and portal veins.  
Other cellular material eg. Leukocytes, platelets and bacteria and phagocytosed in the spleen.
- 2. Storage of blood** – The spleen contains up to 350 ml of blood and in response to sympathetic stimulation can rapidly return most of this volume to the circulating e.g. in hemorrhage.
- 3. Immune response** – The spleen contain T and B lymphocytes which are activated by the proliferation during serious infection can cause enlargement of the spleen (Splénomegaly).
- 4. Erythropoiesis** – The spleen and liver are important sites of fetus blood cell production and the spleen can also fulfill this function in adult in times of great need.

## **Thymus gland**

- The thymus gland lies in the upper part of the media sternum behind the sternum and extents upwards into the root of the neck.
- Its weight about 10 – 15 gm at birth and grows until puberty.
- Its maximum weight at puberty is between 30 and 40 gm.

### **Structure –**

The thymus consists of two lobes joint by areolar tissue. The lobes are enclosed by the fibrous capsules which dips into their substance dividing them into lobules that consists of an irregular branching framework of epithelial cells and lymphocytes.

**Function –** the main function of the thymus gland is release thymosin hormone that will stimulate the maturation of T – cells.

# Disorder of lymphatic system

**1. Lymphatic obstruction/ Lymphoedema** – When lymph vessel is obstructed lymph accumulates to the obstruction resultant swelling and the size of the area affected depend on the size of the vessel involved –

Lymphoedema usually lead to – Inflammation, Fibrosis of the lymph vessel.

**Cause** – Most common cause are tumors and following surgical removal of lymph nodes.

- 1. Tumors** – A tumors may grow into and block a lymph vessel or node and obstruction the flow of lymph.
  - 2. Surgery** – In some surgical procedures lymph nodes are removed because cancer cells may have already spread to them.
- This aims to prevent growth of secondary tumours in local lymph nodes and further spread of the disease via the lymphatic system.

## 2. Lymphomas –

These are malignant tumours of lymphoid tissue and are classified as either Hodgkins or non-Hodgkins lymphomas.

**Hodgkins disease** – These are progressive painless enlargement of lymph nodes throughout the body as lymphoid tissue within them proliferates.

- The disease is malignant and the cause is unknown.
- The disease spreads to adjacent nodes and to other tissues in a constant way.

**Treatment** – Depends on the stage of disease at which it begins chemotherapy.

- Radiotherapy
- Immunotherapy
- Stem cell transplant.

## **Non-Hodgking lymphoma (NHL) –**

- Non-Hodgking lymphoma is associated with immunodeficiency states and certain viral infection including HIV.

-NHL include multiple Myeloma (Located in the plasma cells in bone marrow) and Burkitt's lymphoma (Cancer start in immune cell called B-cell) and may occurs in any lymphoid tissue or in bone marrow.

-Immunological deficiency leads to increased incidence of infections and if the bone marrow or spleen or both involved there may be varying degree of anemia and leucopenia (decrease in the number of leukocytes).



### 3. Splenomegaly (Disorder of the spleen)

This is enlargement of the spleen and is usually secondary to other conditions.

Eg. Infection, circulatory disorder, blood disease malignant neoplasms.

**Infection** – Spleen may be infected by blood borne microbes or local spread of infection.

- Acute infections are rare.
- Some chronic non-pyrogenic infections cause splenomegaly.
- The most commonly occurring primary infection include –
- Tuberculosis.
- Typhoid fever
- Malaria
- Infection mononucleosis

\* **Circulatory disorders** – Splenomegaly due to congestion of blood occurs when the flow of blood through the liver is impeded by eg. Fibrosis in liver cirrhosis or portal venous congestion in right-sided heart failure.

\* **Blood disease** – Splenomegale may itself cause blood disorders when the spleen is enlarge for any reason especially in portal hypertension, excessive and premature haemolysis of RBCs or phagocytosis of normal white blood cells and platelets leads to marked anemia, leucopenia and thrombocytopenia.

\* **Tumors** – Splenomegale caused by infiltration of malignant cells is characteristic of some conditions especially chronic leukaemia, Hodgkings and non-hodgkings lymphoma.