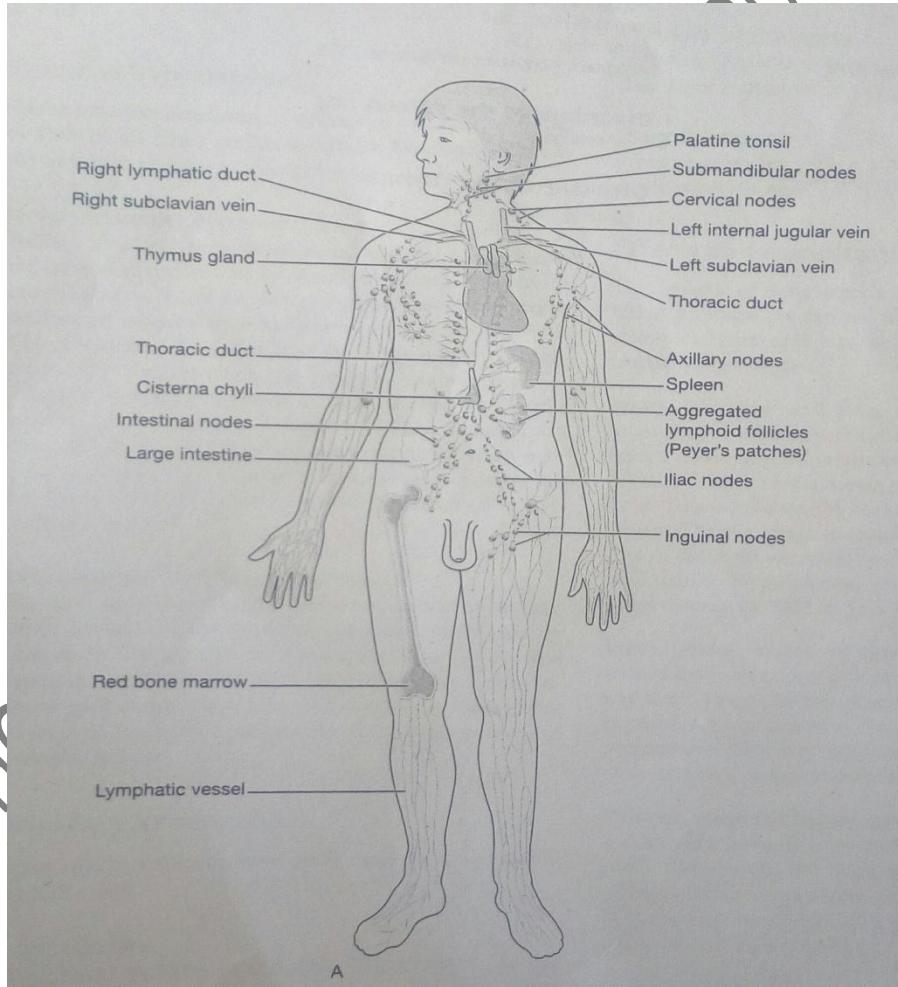


## The lymphatic system

All body tissues are bathed in tissue fluid, consisting of the diffusible constituents of blood and waste materials from cells. Some tissue fluid returns to the capillaries at their venous end and the remaining diffuses through the more permeable walls of the lymph capillaries, forming lymph. Lymph passes through vessels of increasing size and a varying number of lymph nodes before returning to the blood. The lymphatic system consists of (fig 3.1) :

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



**Fig 3.1 Major parts of the lymphatic system**

## **Lymph**

Lymph is a clear watery fluid, similar in composition to plasma, with the important exception of plasma proteins, and identical in composition to interstitial fluid. Lymph contains lymphocytes, which circulate in the lymphatic system allowing them to patrol the different regions of the body.

### **The lymph capillaries:**

These originate as blind-end tubes in the interstitial spaces. 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.

### **Large lymph vessel**

The walls of lymph vessels are about the same thickness as those of small veins and have the same layers of tissue, i.e. a fibrous covering, a middle layer of smooth muscle and elastic tissue and an inner lining of endothelium. Lymph vessels have numerous cup-shaped valves to ensure that lymph flows in one way only, i.e. towards the thorax. Lymph vessels become large as they join together, eventually forming two large ducts, the thoracic duct and the right lymphatic duct, which empty lymph into the subclavian veins.

Thoracic duct: This duct begins at the cisterna chyli, which is a dilated lymph channel situated in front of the bodies of the 1<sup>st</sup> two lumbar vertebrae. The duct is about 40 cm long and opens into the left subclavian vein in the root of the neck. It drains lymph from both legs, the pelvic and abdominal cavities, the left half of the thorax, head and neck and the left arm.

Right lymphatic duct: This is a dilated lymph vessel about 1 cm long. It lies in the root of the neck and opens into the right subclavian vein. It drains lymph from the right half of the thorax, head and neck and the right arm.

## **Lymphatic organs and tissues**

### **Lymph nodes**

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

### Structure of lymph nodes ( fig. 3.2):

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 and lymphatic tissue containing many lymphocytes and macrophages. As many as four or five efferent lymph vessels may enter a lymph node while only one afferent vessel carries lymph away from the node. Each node has a concave surface called the hilum where an artery enters and a vein and the afferent lymph vessel leaves. Lymph from the head and neck passes through deep and superficial cervical nodes. Lymph from the upper limbs passes through nodes situated in the elbow region, then through the deep and superficial axillary nodes.

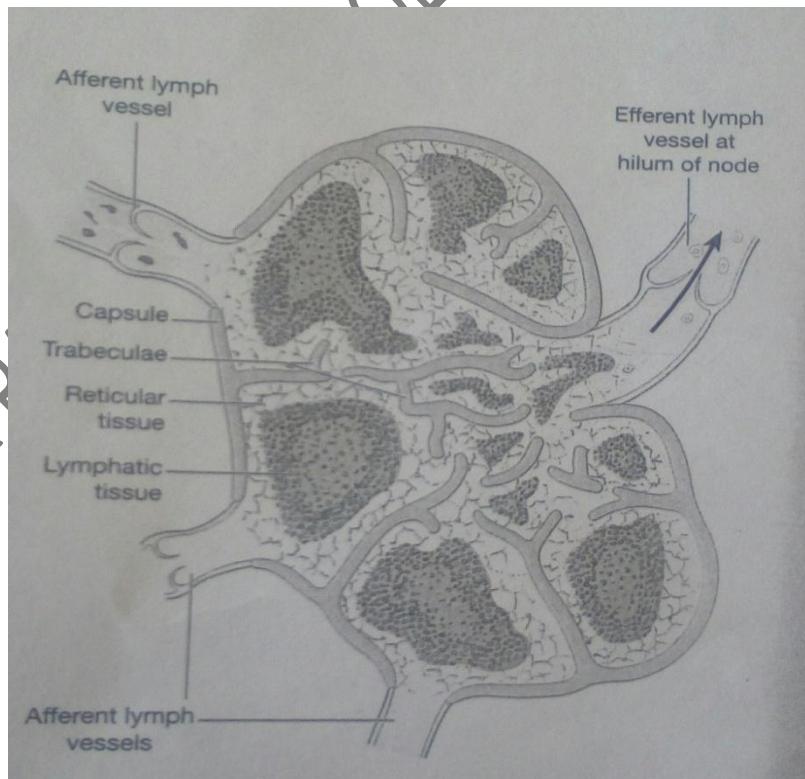


Fig 3.2. The section through a lymph node

## Functions of lymph nodes

Filtering and Phagocytosis: Lymph is filtered by the reticular and lymphoid tissue as it passes through lymph nodes

Proliferation of lymphocytes: Activated T- and B-lymphocytes multiply in lymph nodes. Antibodies produced by sensitized B-lymphocytes enter lymph and blood draining the node.

## The spleen(Fig.3.3)

The spleen contains reticular and lymphatic tissue and is the largest lymph organ.

The spleen lies in the left hypochondriac region of the abdominal cavity between the fundus of the stomach and the diaphragm. It is purplish in colour and varies in size in different individuals, but is usually about 12cm long, 7cm wide and 2.5cm thick. It weighs about 200g.

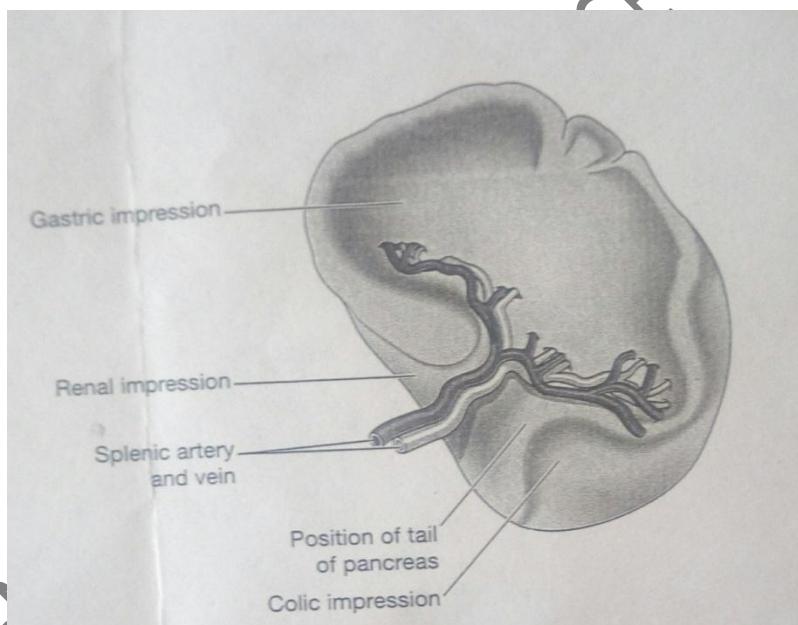


Fig. 3.3. The spleen

## Structure of the spleen (fig3.4)

The spleen is slightly oval in shape with the hilum on the lower medial border. The anterior surface is covered with peritoneum. It is enclosed in a fibroelastic capsule that dips into the organ, forming trabeculae. The cellular material, consisting of lymphocytes and microphages, is called splenic pulp, and lies between the

trabeculae. Red pulp is the part suffused with blood and white pulp consists of areas of lymphatic tissue where there are sleeves of lymphocytes and macrophages around blood vessels. The structures entering and leaving the spleen at the hilum are;

- Splenic artery, a branch of the coeliac artery.
- Splenic vein, a branch of the portal vein
- Lymph vessels(efferent only)
- Nerves.

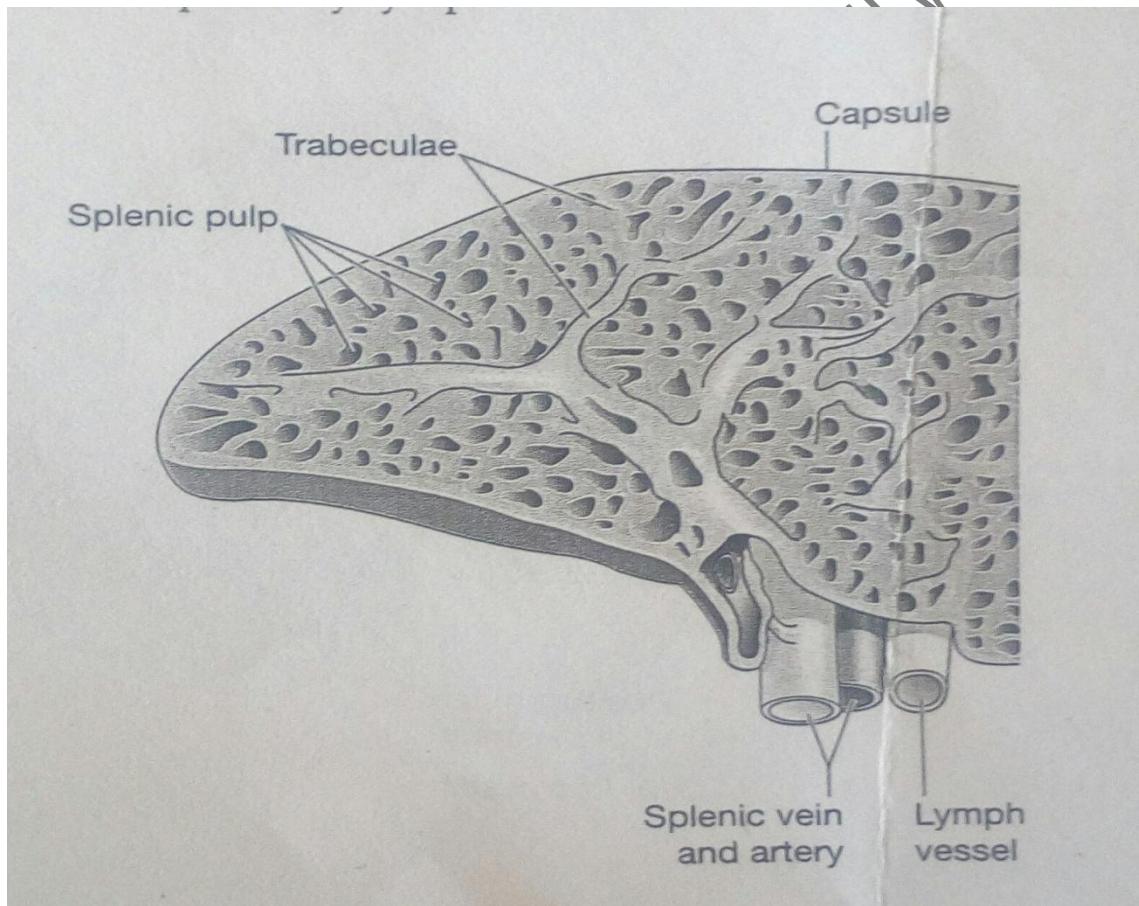


Fig.3.4 A section through the spleen

### Functions of the spleen

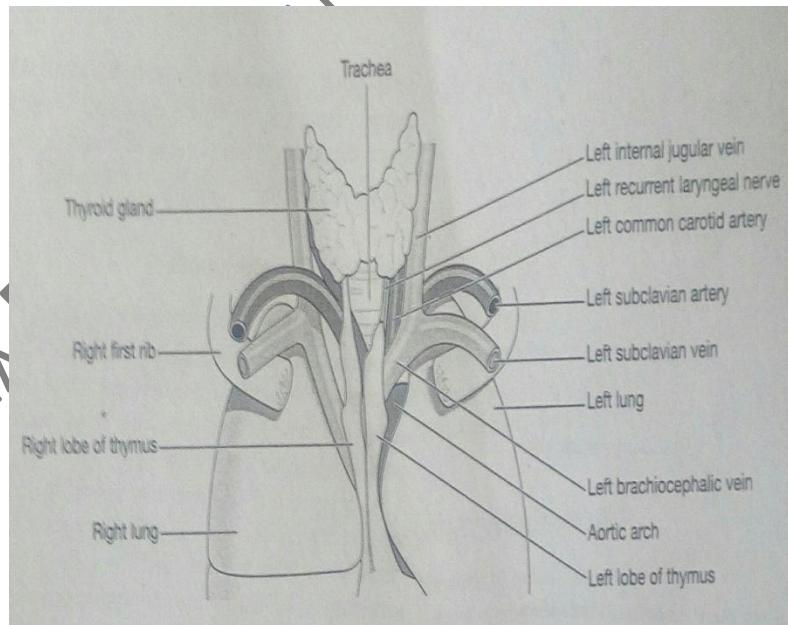
- 1) Phagocytosis
- 2) Storage of blood
- 3) Immune response
- 4) Erythropoiesis

### Thymus gland ( Fig. 3.5)

The thymus gland lies in the upper part of the mediastinum behind the sternum and extends upwards into the root of the neck. It weighs about 10-15 gm at birth and grows until puberty, when it begins to atrophy. Its maximum weight, at puberty, is between 30-40gm and by middle age it has returned to approximately its birth weight.

### Structure

The thymus consists of two lobes joined by areolar tissue. The lobes are enclosed by a fibrous capsule which dips into their substance, dividing them into lobules that consist of an irregular branching framework of epithelial cells and lymphocytes.



**Fig. 3.5 The thymus gland and the related structures.**

## Functions

- 1) Thymic processing produces mature T-lymphocytes that can distinguish 'self' tissue from foreign tissue, and also provides each T-lymphocyte with the ability to react to only one specific antigen from the millions, they encounter.
- 2) The maturation of the thymus and other lymphoid tissue is stimulated by thymosin, a hormone secreted by the epithelial cells that form the framework of the thymus gland.

## Tonsils

These are located in the mouth and throat, and will therefore destroy swallowed and inhaled antigens

## Aggregated lymphoid follicles (Peyer's patches)

These large collections of lymphoid tissue are found in the small intestine, and intercept swallowed antigens.