



Lymphatic system

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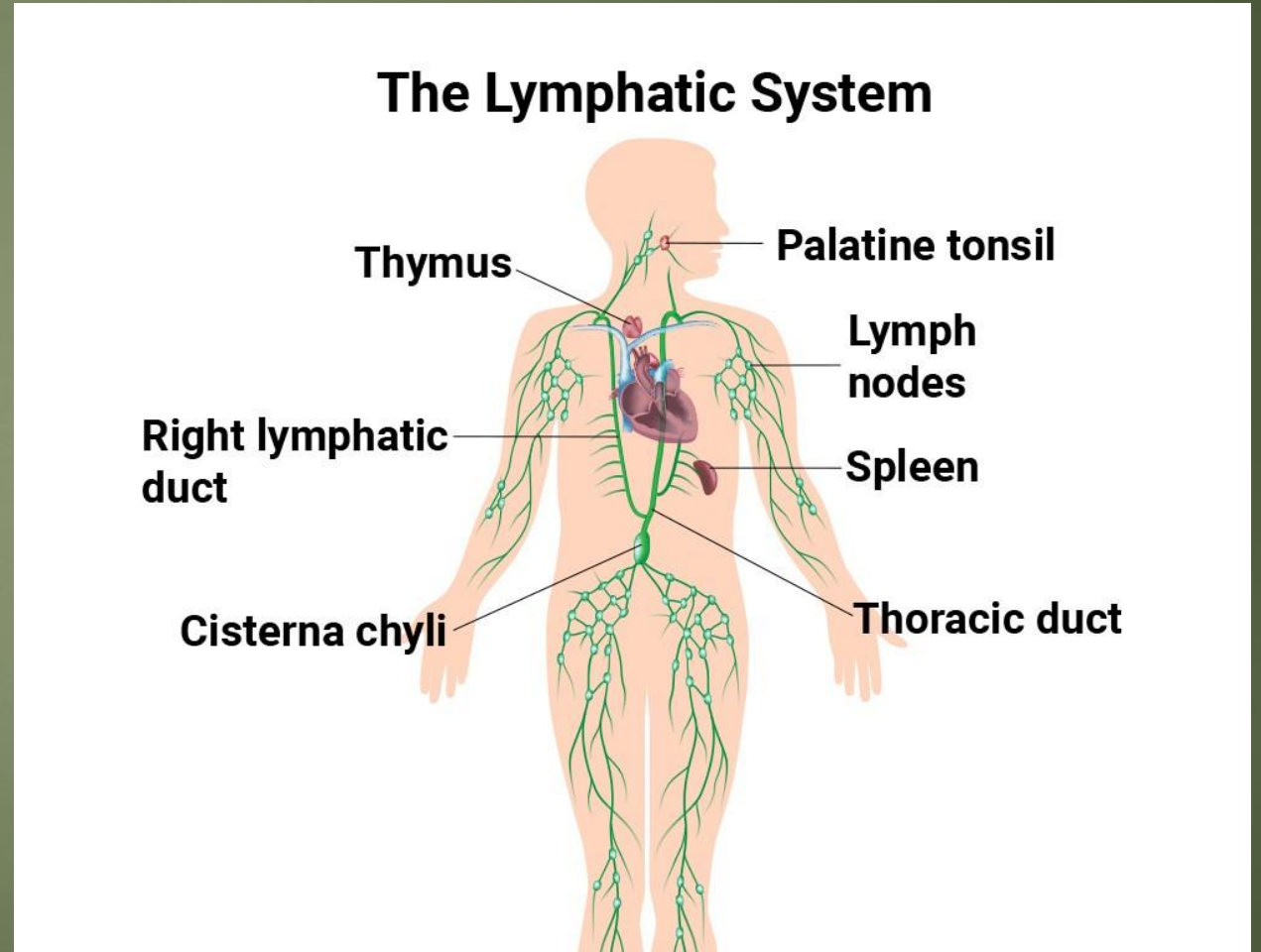
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Introduction

- The Lymphatic system is a major part of body's immune system.
- The lymphatic system is a subset of the circulatory system, with a number of functions.
- The lymphatic system is a network of organs, lymph nodes, lymph ducts, and lymph vessels that make and move lymph from tissues to bloodstream.
- Lymphatic system is a specialized form of reticular connective tissue that consist of tissues and organs that produce, mature and store lymphocytes and macrophages, for the body's defence purpose.

Parts of lymphatic system

1. Lymph
2. Lymphatic vessels
 - ✓ Lymph trunks and ducts
 - ✓ Thoracic (left lymphatic) duct
 - ✓ Right lymphatic ducts
3. Lymphatic tissue
 - ✓ Lymph nodes
 - ✓ Tonsils
 - ✓ Spleen
 - ✓ Thymus gland

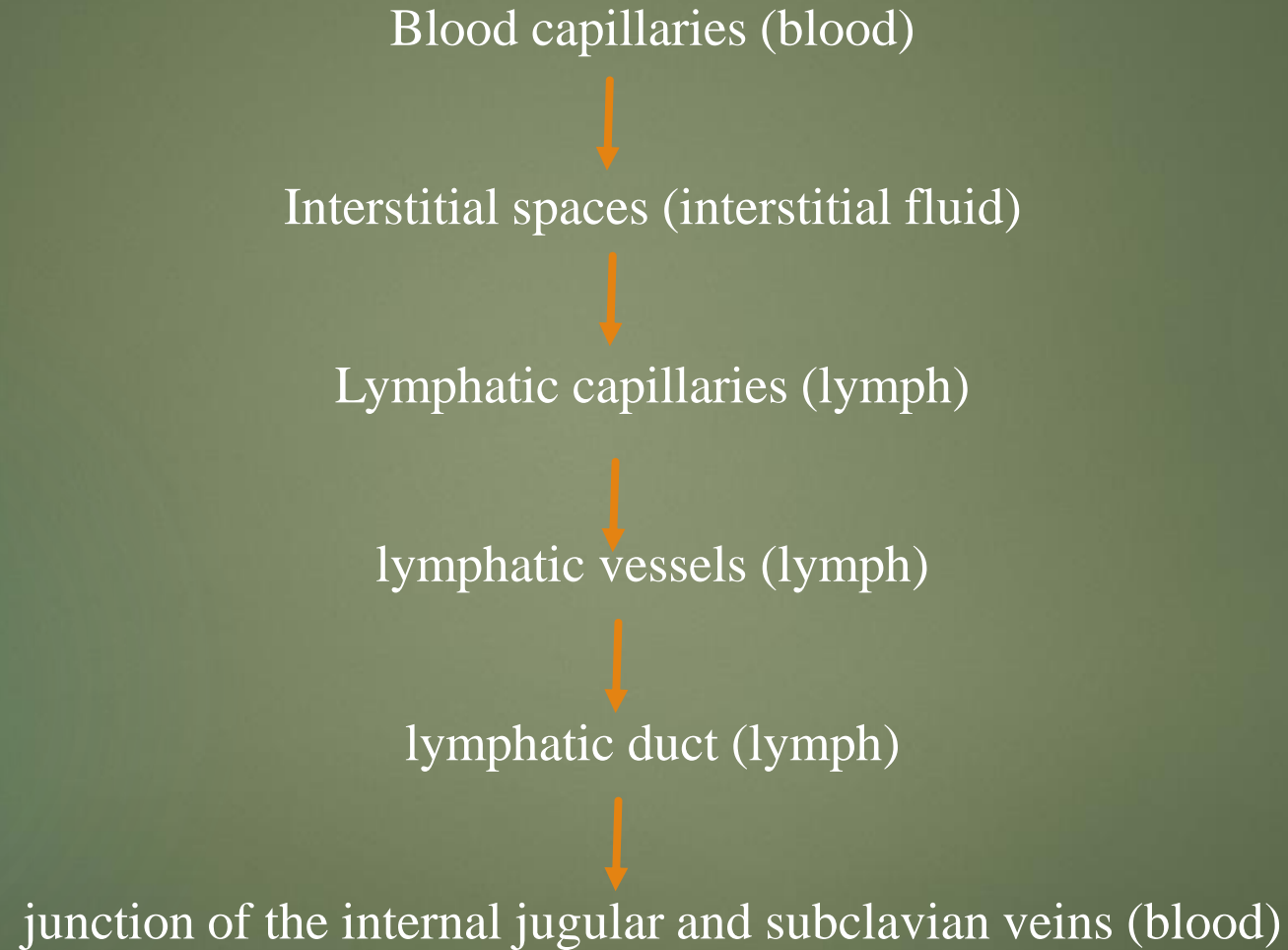


Lymph

- ✓ The excess interstitial fluid drains into the lymphatic capillaries is called as lymph.
- ✓ lymph is a clear watery fluid similar in composition to plasma with the exception of plasma proteins.
- ✓ Live transport the plasma proteins that seep out of the capillary beds back to the bloodstream.
- ✓ It also carries a bacteria and cell debris from damage tissue which are then filter out and destroyed by the lymph nodes.
- ✓ Lymph contains lymphocytes which circulate in the lymphatic system allowing them to patrol the different region of the body.
- ✓ In the small intestine fats absorbed from the lymphatic capillaries called as lacteals gives the lymph a milky appearance.

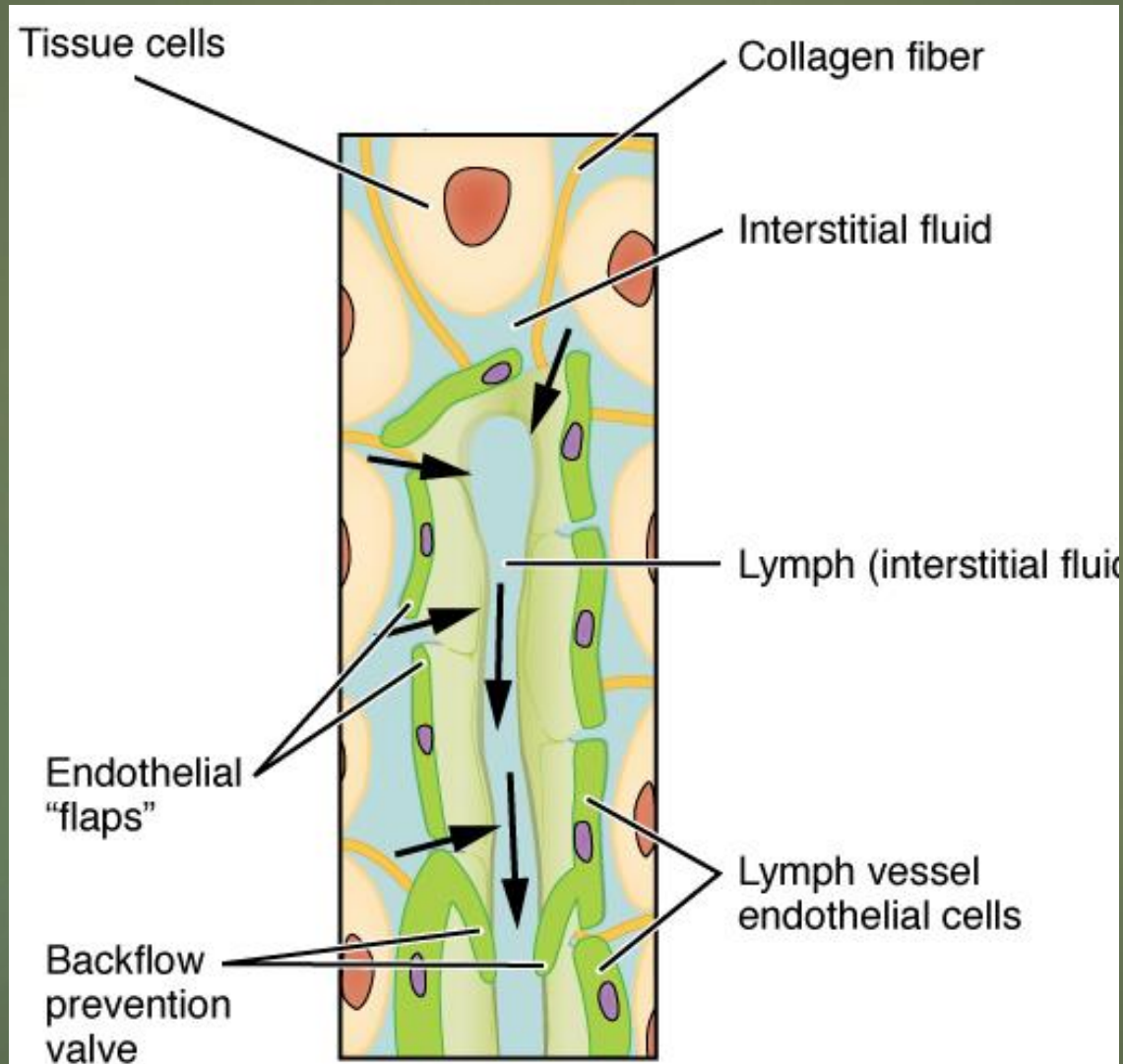


Flow of lymph



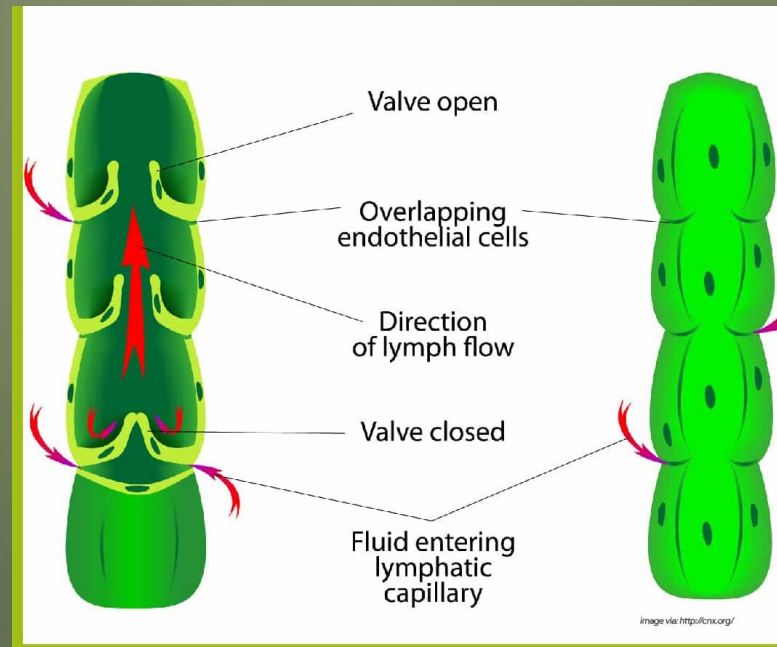
Lymphatic capillaries

- These are tiny thin-wall vessels.
- These are closed at one end.
- The main purpose is to drain excess interstitial fluid from around the cell to venous circulation.
- The wall of lymphatic capillaries is made up of endothelium.
- These are larger in diameter.
- The anchoring filament holds endothelial cells to the nearby tissues.
- A lacteal is a lymphatic capillaries present in mucosa of small intestine.
- It absorbs dietary fats and lipids soluble vitamins from the small intestine.
- A special type of lymph known as chyle is produced in the digestive system as lymph absorbs triglycerides from the intestinal villi.



Lymphatic vessels

- Lymphatic capillaries combined together to form lymphatic vessels.
- These are thin wall structure that carry live.
- Lymph vessels are lined by endothelial cells.
- A lymph vessels pushes lymph from lymph capillaries to the lymphatic trunk and duct.



Lymph trunk and lymph ducts

- ▶ The lymphatic fluid passes from the lymphatic capillaries to the lymphatic vessels.
- ▶ These vessels are connected with lymph nodes and further they unite to form lymph trunks.
- ▶ The five major lymph trunks are:
 1. Lumbar lymph trunk
 2. Intestinal lymph trunk.
 3. Bronchomediastinal lymph trunk
 4. Subclavian lymph trunk
 5. Jugular lymph trunk

This 5 lymph trunks further pass the lymph to two lymphatic ducts.

1. Left lymphatic duct:

- It is the main collecting duct of lymphatic system and is about 15-18 inches long.
- It receives lymph from the left side of head neck and chest, the left upper limb and the entire body inferior to the ribs.

2. Right lymphatic duct:

- It receives lymph from the right side of head and neck right upper limb right side of the thorax right lung right side of the heart and part of the liver.

Spleen


- The spleen contains reticular and lymphatic tissue and is the largest lymph organ.
- It 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 vary in size in different individuals but it is usually about 12 cm long 7 cm wide and 2.5 CM thick.
- It weighs about 200 grams.

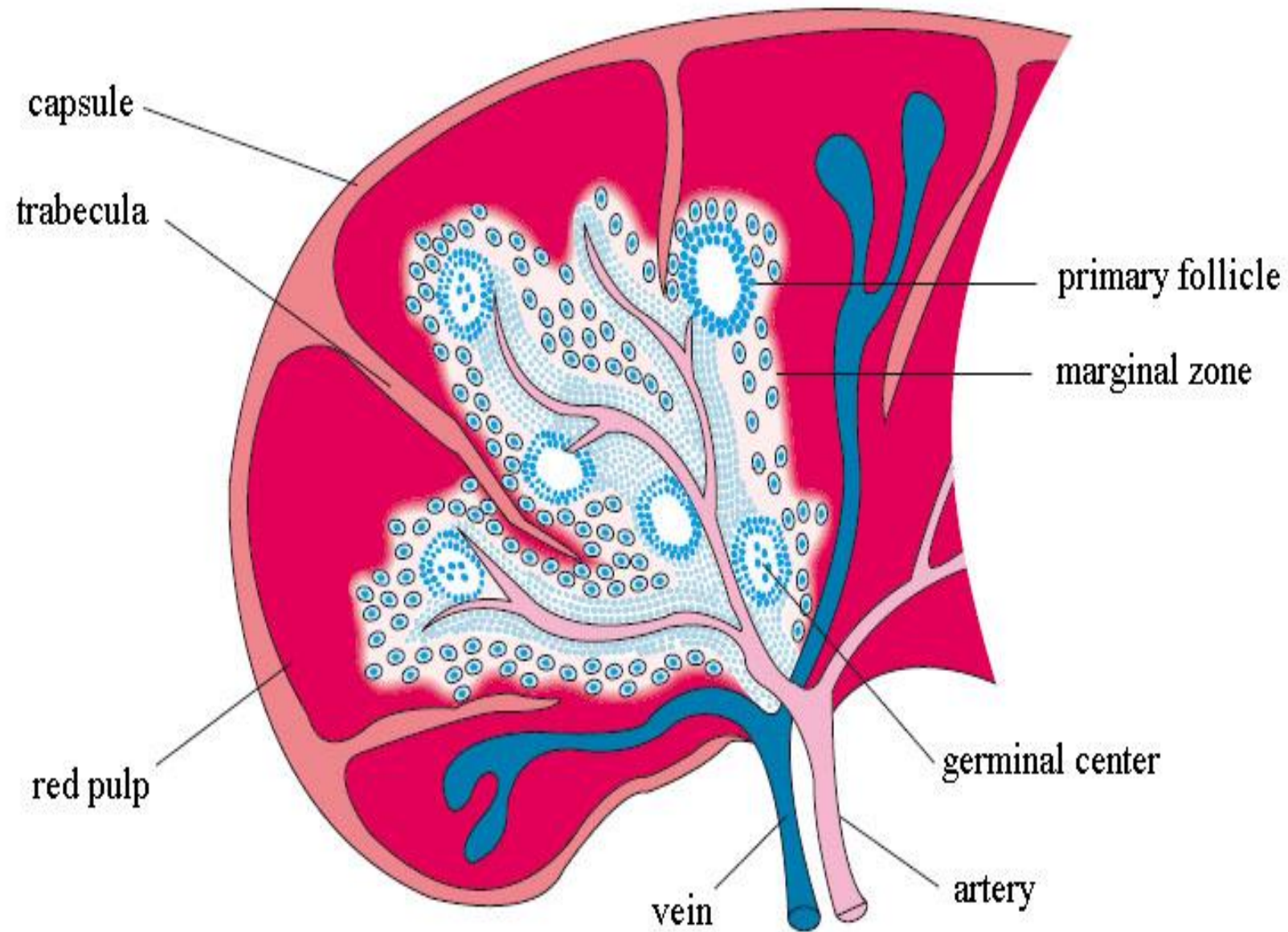
Organs associated with the spleen

- Superiorly and posteriorly- diaphragm.
- Inferiorly- left colic flexure of the large intestine.
- Anteriorly- fundus of the stomach.
- Medially- pancreas and left kidney
- Laterally- diaphragm which separates the spleen from the 9th 10th and 11th rib and the intercostal muscle.

Structure

- 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 macrophages is called splenic Pulp, and lies between the trabeculae.
- The structures entering and leaving the spleen at a hilum are:
 - a. The splenic artery a branch of coeliac artery
 - b. The splenic vein a branch of the portal vein
 - c. Lymph vessels (efferent only)
 - d. Nerves.

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- Blood passing through the spleen flows in sinusoid. Which have distinct pores between the endothelial cells allowing it to come into close association with splenic pulp.
 - This is essential for removing ageing or damage cell from the bloodstream one of the spleen's function.
 - The spleen consists of two different kinds of tissue.
 - White pulp it consists of masses of lymphocytes and macrophages.
 - Red pulp it consists of blood sinuses.



Function

1. Phagocytosis

- Old and abnormal erythrocytes are destroyed mainly in the spleen and the breakdown product bilirubin and iron are transported to the liver via the splenic and portal veins.
- Other cellular material, example leukocytes platelets and bacteria is 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 returns most of these volume to the circulation example in haemorrhage.

3. Immune response

- Spleen contains T and B lymphocytes which are activated by the presence of antigen example in infection.
- Lymphocytes proliferation during serious infection can cause and treatment of the spleen.

4. Erythropoiesis


- The spleen and liver are important sites for fetal blood cell production and the spleen can also fulfill this function in adults in times of great need.

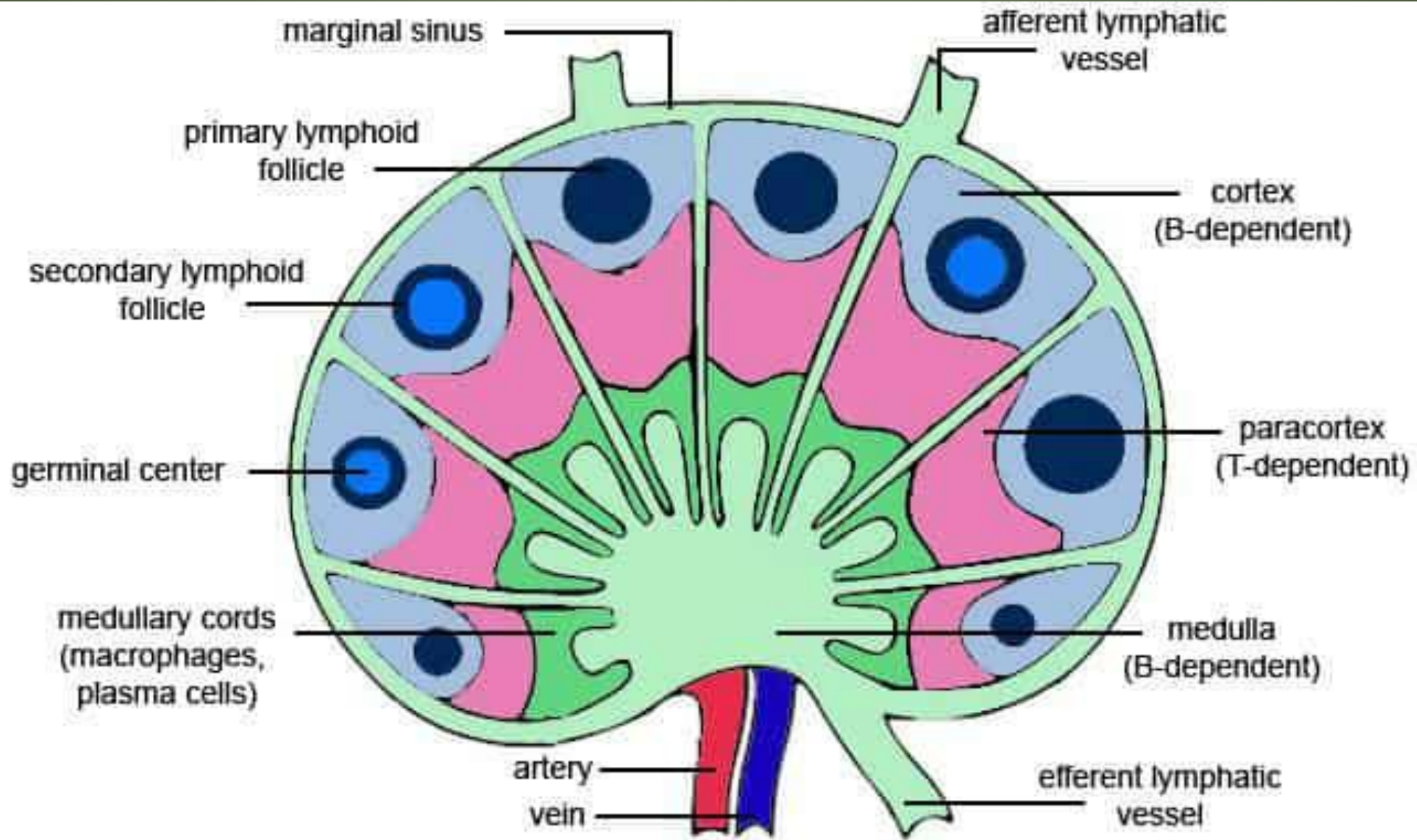
Lymph nodes

- Lymph nodes are oval or bean shaped organ that lies along the length of lymph vessel often in groups.
- The live drains through a number of nodes usually 8-10 before returning to the venous circulation.
- This notes very considerable inside some are as small as pinhead and the largest are about the size of an almond.

Structure

- The oval or bean shaped organ located along the length of lymphatic vessels are called as lymph nodes. The range from 1 to 25 mm in length.
- They are Grace pink in colour.
- Lymph nodes are scattered throughout the body usually in groups. these groups are arranged in two sets superficial and deep.
- Each node is covered by dense connective tissue called as capsule.
- Capsular extensions are called as trabeculae.
- Internally node has two parts outer cortex and inner medula.
- The outer cortex contents densely packed lymphocytes arrange in masses called as follicles.
- The outer rim of each follicle contains T lymphocytes and macrophages.


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- In the medulla the lymphocytes are arranged in strands call as medullary rays.
 - Internal to the capsule is a supporting network of reticular fibres and fibroblast.
 - Along with capsule, trabeculae, reticular fibres and fibroblast constitute the stoma of lymph node.
 - Each node has a concave surface called as hilum.
 - Four or five afferent lymph vessels may enter a lymph node while only one efferent vessels carries lymph away from the nodes.



Functions

1. 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 living cells, besides containing ingested microbes, cells from malignant tumors, worn out and damaged tissue cells, and inhaled particles.
- Organic material is destroyed in lymph nodes by macrophages and antibodies. Some inorganic particles cannot be destroyed by phagocytosis. These remain inside the macrophages, causing no damage or killing the cell.

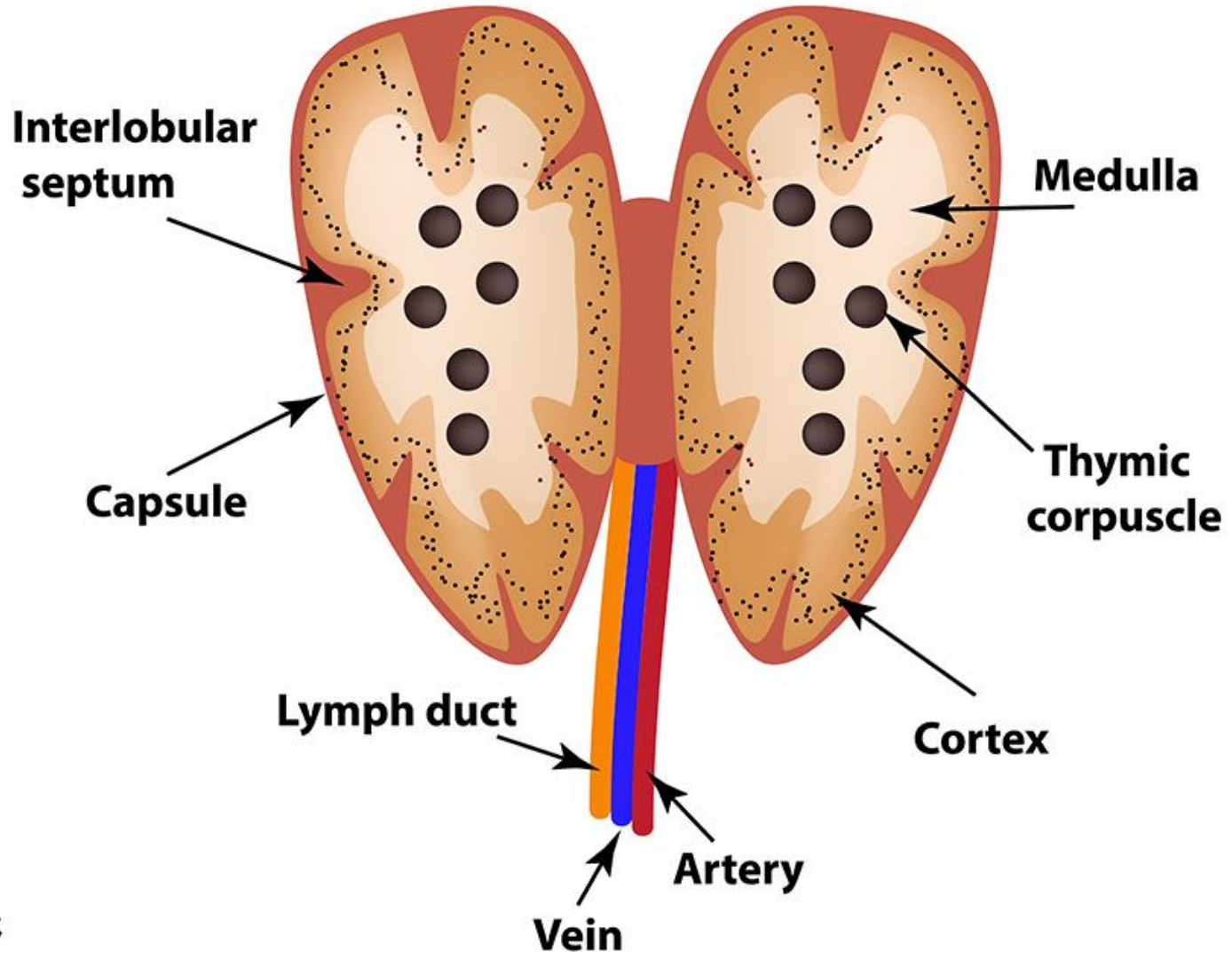
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- In some cases where phagocytosis of bacteria is incomplete they may stimulate inflammation and enlargement of the nodes.

2. 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 the node.

Thymus

- The thymus is a small triangular organ found just posterior to the sternum and anterior to the heart. it is made up of glandular epithelium and hematopoietic connective tissues.
- The thymus gland has following important role
- It causes maturation and discharge of t cells.
- It act as an endocrine gland releasing the thymic factor which is related to growth
- It releases hormone Sen which is related to the development of immune competence, i.e the ability of cell to react to foreign substances.



Exam oriented questions

1. Give the function of lymphatic tissue. (3M)
2. Give different parts of lymphatic system. (3M)
3. Write a short note on lymph. (5M)
4. Write a short note on lymph node. (5M)
5. Describe composition and function of lymph. (5M)
6. Explain structure and function of lymph node and spleen. (10M)
7. Explain structure and function of spleen. (10M)
8. Draw and label lymph node. (3M)
9. Define lymph and write the function of lymphatic nodes. (3M)
10. Write structure and functions of lymphatic system. (10M)

References

1. D. K. Ingawale, S.K. Mandlik, Human Anatomy and Physiology, 3rd edition, Nirali Prakashan, page number 159 -168.
2. R. Phate, Human Anatomy and Physiology, 1st edition, Career publication, page number 67 -71.