بسم الله الرحمن الرحيم

كلية آشور الجامعة – قسم تقنيات المختبرات الطبية
د. صالح احمد : 2021 – 2022

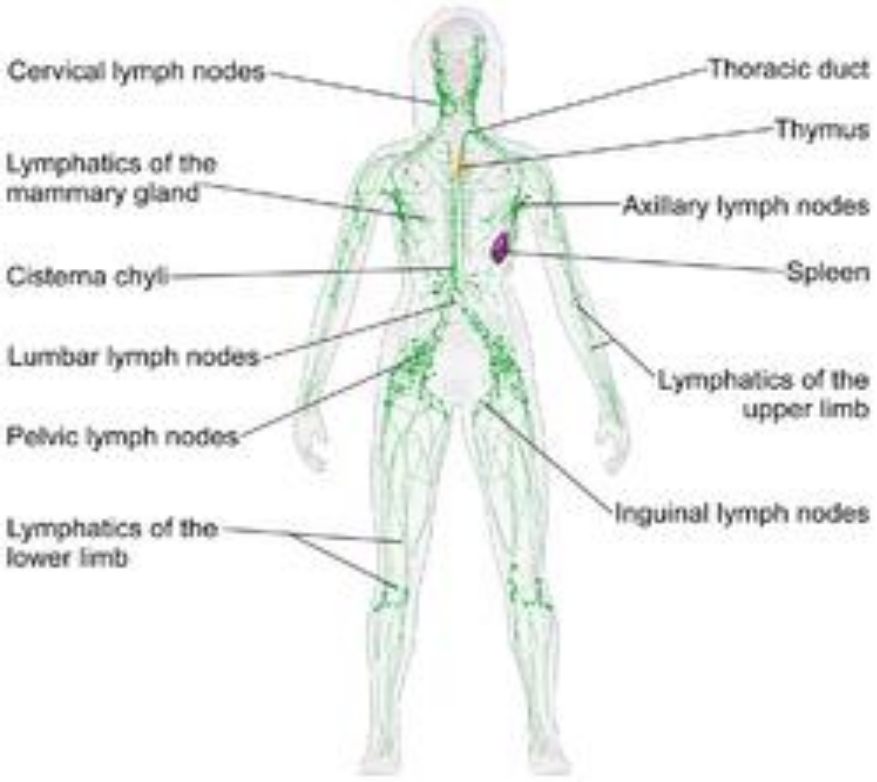
Human Physiology 2nd stage
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Lymphatic Physiology

The **lymphatic system** is part of the vascular system and an important part of the immune system. The lymphatic system is a series of vessels, ducts, and trunks that remove interstitial fluid from the tissues and return it the blood. The lymphatics are also used to transport lipids and cells of the immune system. Cells of the immune system all come from the hematopoietic system of the bone marrow. Unlike the circulatory system, the lymphatic system is not a closed system.

The main function of lymphate system is that of defense in the immune system. Lymph is very similar to blood plasma; it contains lymphocytes tissue for support. It also contains waste products and cellular debris together with bacteria and proteins. The spleen and the thymus are lymphoid organs of the immune system. The tonsils are lymphoid organs, which are associated with the digestive system. The system includes all the structures dedicated to the circulation and production of lymphocytes, which also includes the bone marrow.

Lymphoid organs are certain organs, which are part of the lymphatic system; include **the thymus**, **spleen**, **tonsils**, and **appendix**, with some special tissue in the **gut**. The lymphatic system includes a system of lymphatic capillaries, vessels, nodes, and ducts that collects and transports lymph, which is a clear to slightly yellowish fluid, similar to the plasma in blood.



Human lymphatic system

The lymphatic organs are divided into the primary lymphoid organs, which are the maturation sites of B and T cell , and the secondary lymphoid organs. Primary lymphoid organs include the thymus, bone marrow, fetal liver. In humans the thymus and bone marrow is the main key in immune function. All lymphocytes derive from stem cells in the bone marrow. Stem cells destined to become B-lymphocytes remain in the bone marrow as they mature, while T cells migrate to the thymus to undergo further growth. Mature B and T lymphocytes exit from the primary lymphoid organs and transported via the bloodstream to the secondary lymphoid organs.

Composition of lymphatic: Lymph contains a variety of substances, including proteins, salts, glucose, fats, water, and white blood cells. Unlike the blood, lymph does not normally contain any red blood cell. The major components of the

lymphatic system include lymph, lymphatic vessels, and lymphatic organs that contain lymphoid tissues. Lymph has a composition similar but not identical to that of blood plasma. Lymph that leaves a lymph node is richer in lymphocytes than blood plasma. The lymph formed in the human digestive system called chyle is rich in triglycerides (fat), and looks milky white because of its lipid content.

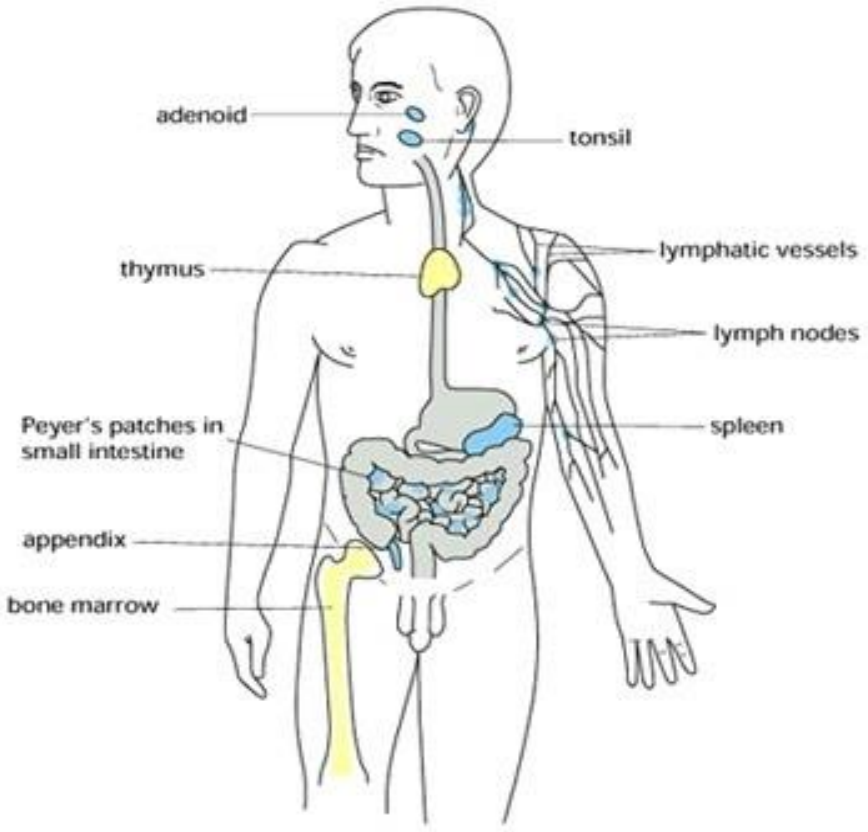
Thymus: is located behind the sternum in the upper part of the chest. It is a bilobed organ that consists of an outer, lymphocyte-rich cortex and an inner medulla. In humans the thymus appears early in fetal development and continues to grow until puberty, after it begins to shrink. The decline of the thymus is thought to be the reason T-cell production decreases with age. In the cortex of the thymus, developing T cells, called thymocytes.

Bone marrow: In mammals bone marrow is the primary organ for B-lymphocyte development. Unlike the thymus, the bone marrow does not atrophy at puberty, and therefore there is no decrease in the production of B-lymphocytes with age.

Spleen: The spleen is located in the upper-left part of the abdomen. It is tucked up under the ribs. The spleen synthesizes antibodies in its white pulp and filter the blood. It removes old or damaged red blood cells; Red pulp of the spleen forms a reservoir that contains over half of the body's monocytes. These monocytes, upon moving to injured tissue, turn into dendritic cells and macrophages. The spleen is a center of activity of the mononuclear phagocyte system and its absence causes a certain infections.

Tonsils: The tonsils are masses of lymphoid tissue found in the back of the throat and nasal cavity. They’re part of the immune

system, so they help fight infections, but removing the tonsils doesn't appear to increase the risk of infections. Infected tonsils are usually red and swollen, or they may have a whitish coating on them.



The appendix: The appendix is a pouch of lymphatic tissue that's attached to the large intestine. It's located in the lower-right area of the abdomen. Although it's made of lymphatic tissue, the appendix doesn't appear to have much lymphatic function in humans. Can cause appendicitis when bacteria start to multiply. The result is abdominal pain. Some lymphatic tissue similar to the tonsils is also located in the digestive tract.

Lymphoid tissue: is found in many organs including the lymph nodes, which found primarily in the armpits, groin, chest, neck, and abdomen. Lymphoid tissues contain lymphocytes, which play a key role in the immune system. The system also includes all the structures dedicated to the circulation and production of lymphocytes, including the spleen, thymus, and bone marrow.

Functions of Lymph:

1. Lymph acts to transports oxygen, food materials, hormones, etc., to the body cells and brings carbon dioxide and other metabolic wastes.

2. Lymph keeps the body cells moist.

3. Lymph nodes produce lymphocytes. Lymph takes lymphocytes and antibodies from the lymph nodes to the blood.

4. It destroys the invading microorganisms and foreign particles.

5. It absorbs and transports fat and fat-soluble vitamins from the intestine.

6. It brings plasma protein macromolecules synthesized in the liver cells and hormones produced in the endocrine glands to the blood. These molecules cannot pass into the narrow blood capillaries but can diffuse into the lymphatic capillaries.

7. Lymph maintains the volume of the blood. As soon as the volume of the blood reduces in the blood vascular system, the lymph rushes from the lymphatic system to the blood vascular system.

Lymph structure: Lymph nodes are kidney or oval shaped and range in size from a few millimeters to about 1–2 cm. Each lymph node is surrounded by a fibrous capsule, which extends inside the lymph node to form trabeculae.

Hemodynamics:

Is the dynamics of **blood flow**. Hemodynamic response continuously monitors and adjusts to conditions in the body and its environment. Thus, hemodynamics explains the physical laws that govern the flow of blood in the blood vessels. Blood flow ensures the transportation of nutrients, hormones, metabolic wastes, O_2 and CO_2 throughout the body to maintain cell-level metabolism, the regulation of the pH, osmotic pressure

and temperature of the whole body, and the protection from microbial and mechanical harms.

Factors affecting lymph Movement:

Some factors that increase local tissue pressure which facilitate **lymph** formation such as respiration, muscle contraction (e.g., peristalsis, walking), elevated capillary filtration (e.g., venous hypertension and increased capillary permeability).

Many extrinsic factors are influence the active lymph pump, such as neurotransmitters and inflammatory products.