

The Lymphatic System & the Immune Response

The lymphatic system is closely associated with the cardiovascular system. It transports excess tissue fluid to the bloodstream and helps defend the body against disease causing agents.

Lymphatic Pathways

1. Lymphatic capillaries:
 - a. Lymphatic capillaries are microscopic, closed-end tubes that extend into interstitial spaces.
 - b. They receive lymph through their thin walls.
 - c. Lacteals are lymphatic capillaries in the villi of the small intestine.
2. Lymphatic vessels:
 - a. Lymphatic vessels are formed by the merging of lymphatic capillaries.
 - b. They have walls similar to veins and possess valves that prevent the backflow of lymph.
 - c. Larger lymphatic vessels lead to lymph nodes and then merge into lymphatic trunks.
3. Lymphatic trunks and collecting ducts:
 - a. Lymphatic trunks drain lymph from relatively large body regions.
 - b. Trunks lead to two collecting ducts within the thorax.
 - c. Collecting ducts join the subclavian veins.

Tissue Fluid and Lymph

1. Tissue fluid formation:
 - a. Tissue fluid originates from blood plasma and includes water and dissolved substances that have passed through the capillary wall.
 - b. It generally lacks proteins of larger molecular size, but some smaller protein molecules leak into interstitial spaces.
 - c. As the protein concentration of tissue fluid increases, osmotic pressure increases also.
2. Lymph formation:
 - a. Rising osmotic pressure in the tissue fluid interferes with the return of water to the blood capillaries.
 - b. Increasing pressure with interstitial spaces forces some tissue fluid into lymphatic capillaries, and this fluid becomes lymph.
3. Function of lymph:
 - a. Lymph returns protein molecules to the bloodstream.
 - b. It transports foreign particles to the lymph nodes.

Movement of Lymph

1. Flow of lymph:
 - a. Lymph is under low pressure and may not flow readily with aid from external forces.
 - b. Forces that aid in the movement of lymph include the squeezing action of skeletal muscles and low pressure in the thorax created by breathing movements.
2. Obstruction of lymph movement:
 - a. Any condition that interferes with the flow of lymph results in edema.
 - b. Obstruction of the lymphatic vessels due to surgery also results in edema.

Lymph Nodes

1. Structure of a lymph node:
 - a. Lymph nodes are usually bean-shaped, with blood vessels, nerves, and efferent lymphatic vessels attached to the indented region; afferent lymphatic vessels enter at points on the convex surface.
 - b. Lymph nodes are enclosed in connective tissue that extends into the nodes and subdivides them into nodules.
 - c. Nodules contain masses of lymphocytes and macrophages, as well as spaces through which lymph flows.
2. Location of lymph nodes:
 - a. Lymph nodes generally occur in groups or chains along the paths of larger lymphatic vessels.
 - b. They occur primarily in cervical, axillary, and inguinal regions, and within the pelvic, abdominal, and thoracic cavities.
3. Functions of lymph nodes:
 - a. Lymph nodes are centers for production of lymphocytes that act against foreign particles.
 - b. They contain macrophages that remove foreign particles from lymph.

Thymus and Spleen

1. Thymus:
 - a. The thymus is a soft, bilobed organ located within the mediastinum.
 - b. It tends to decrease in size after puberty.
 - c. It is composed of lymphatic tissue, which is subdivided into lobules.
 - d. Lobules contain lymphocytes, most of which are inactive, that develop from precursor cells in bone marrow.
 - e. Some lymphocytes leave the thymus and function in providing immunity.
 - f. The thymus may secrete a hormone called thymosin, which stimulates lymphocytes that have migrated to other lymphatic tissues.

2. Spleen:
 - a. The spleen is located in the upper left portion of the abdominal cavity.
 - b. It resembles a large lymph node that is encapsulated and subdivided into lobules by connective tissue.
 - c. Spaces within the lobules are filled with blood.
 - d. It contains numerous macrophages and lymphocytes, which filter foreign particles and damaged red blood cells from the blood.

Body Defenses Against Infection

Infection is caused by the presence and multiplication of pathogens. The body is equipped with specific and nonspecific defenses against infection.

Nonspecific Immunity

1. Species resistance - Each species of organism is resistant to certain diseases that may affect other species, but susceptible to diseases that other species may be able to resist.
2. Mechanical barriers:
 - a. Mechanical barriers include skin and mucous membranes.
 - b. As long as mechanical barriers remain unbroken, they prevent the entrance of pathogens.
3. Enzymatic actions:
 - a. Enzymes of gastric juice are lethal to some pathogens.
 - b. Enzymes in tears have antibacterial actions.
4. Interferon
 - a. Interferon is a group of hormone-like peptides produced by certain cells in response to the presence of viruses or tumor cells.
 - b. It can interfere with the proliferation of viruses; it stimulates phagocytosis, and enhances the activity of cells that help resist infections and the growth of tumors.
5. Inflammation:
 - a. Inflammation is a tissue response to damage, injury, or infection.
 - b. The response includes localized redness, swelling, heat, and pain.
 - c. Chemicals released by damaged tissues attract various white blood cells to the site of the inflammation.
 - d. Clotting may occur in body fluids that accumulate in affected tissues.
 - e. Fibrous connective tissue may form a sac around the injured tissue and thus prevent the spread of pathogens.