# The Lymphatic System by Lady Carla Davis, MPH

Specializing in Nutrition

The **Lymphatic system** is an extensive, complex network of <u>lymphatic vessels</u>, <u>lymph nodes</u>, <u>ducts</u>, and lymphoid organs and tissues. It extends to every part of the vertebrate body except the brain and spinal cord. The lymphatic system has three essential functions: drainage to help balance body fluids, absorption of fatty acids and fat-soluble nutrients in the stomach, and <u>immune-system</u> regulation. It also complements the <u>circulatory system</u> (blood vessels and veins).

The circulatory system processes about 35 pints/20 liters of blood daily through capillary filtration that removes <u>plasma</u> from the blood. As the blood circulates through the body, about 3 pints/500 ml of blood <u>plasma</u> seeps into tissues through the thin capillary walls.

Plasma is the transport medium for delivering nutrients to the cells. Additionally, it expels waste products (e.g., urea, creatinine, bacteria, protein, salts, etc.) through the kidneys, liver, and lungs. Plasma also distributes heat throughout the body and helps to maintain homeostasis.



Wikipedia

## **Fluid Balance**

While supplying oxygen and nutrients to the body, the blood plasma leaks fluid outward at the capillary level into tiny interstitial spaces surrounding the cells. Lymph capillaries connect these spaces to the lymphatic system. Since this <u>interstitial</u> or <u>extracellular fluid</u> cannot reenter the blood vessels, the lymphatic system provides an accessory return route to the blood to maintain a dynamic equilibrium.

Fluid overload in the <u>interstitial spaces</u> creates hydrostatic pressure, which then drives the fluid into the lymphatic capillaries. Hydrostatic pressure forces the fluid overload in the <u>interstitial spaces</u> into the lymphatic capillaries. While in the lymphatic capillaries and collecting vessels, interstitial and <u>lymph</u> fluids are similar at first. However, the lymph changes composition along its course as it passes through lymph vessels and mixes with other substances. Once in the lymphatic system, this extracellular, clear, colorless fluid, now called <u>lymph</u>, drains into <u>lymphatics</u>, which are larger vessels. This whole process prevents the accumulation of excess tissue fluid or <u>edema</u>.

Lymph contains oxygen, glucose, amino acids, sodium, potassium, chloride, bicarbonate, magnesium, calcium, small amounts of amino acids, vitamins, enzymes, and other nutrients needed by tissue cells. It also helps regulate hormones.

While on its way back to the bloodstream, lymph fluid passes through tiny lymphatic capillaries that infuse almost every tissue in the body. A dense amount of these minute vessels enrich the lungs, gut, genitourinary system, and skin dermis. However, the skin epidermis, mucus membranes, bone marrow, and central nervous system do not contain any lymphatic capillaries.

Before emptying into the bloodstream, lymph fluid also makes its way through the spleen and thymus to the <u>lymph nodes</u>. When bacteria enter the lymph channels, it is transported to <u>lymph nodes</u> to be isolated. Lymph can also transport <u>Metastatic</u> cancer cells.

Lymph nodes, located at intervals, filter the lymph to remove foreign materials such as infectious microorganisms. Valves prevent lymph from flowing backward. There are primary valves at the lowest level of the lymphatics vessels and bi-leaflet secondary valves in larger collecting vessels that actively pump the lymph. Pumping occurs through movement or intrinsic contractility of specialized muscle cells in lymphatic vessel walls. Circular exercises and muscle contractions pressing on the <u>lymph nodes</u> help transport lymph through the vessels.

These vessels converge to form larger vessels called <u>lymphatic trunks</u>, connected to veins at the base of the neck. One trunk connects to the right lymphatic duct to drain the upper right portion of the body and return the lymph to the bloodstream via the right subclavian vein. The other connects to the thoracic duct, which drains the rest of the body into the left subclavian vein.

By way of the lymphatic vessels, the lymphatic system removes this remaining fluid and particulate matter (collected from all bodily tissues) via the veins into the bloodstream. A disruption of fluid processing can result in <u>lymphedema</u> or edema.

The primary lymphoid organs are the <u>thymus</u> which generates lymphocytes from immature <u>progenitor cells</u>, and <u>bone marrow</u>, which manufactures <u>white blood cells</u> (leukocytes). The different types of white blood cells are <u>granulocytes</u> (neutrophils, eosinophils, basophils, and mast cells), monocytes, and lymphocytes (T cells and B cells).

Higher than normal white blood cells in your body may mean you have an infection or inflammation, a bone marrow disorder, or possibly certain types of cancer.



tissues, and lymph nodes.

Human Lymphatic System, quora.com

# Absorption

In addition to removing excess fluid and fighting infections, the lymphatic system plays a vital role in intestinal function by transporting fats for growth, <u>neural development</u>, <u>brain function</u>, and <u>nutrition</u>.

About 29.75 pints/17 liters of filtered blood is quickly reabsorbed directly into the blood vessels. The remaining 5.25 pints/3 liters remain in the intestinal fluid.

Part of the gut membrane in the small intestine contains tiny finger-like protrusions called <u>villi</u> which optimize nutrient absorption and aids in digestion. Each <u>villus</u> contains tiny lymph capillaries known as <u>lacteals</u>.

Lymph transports dietary fats from <u>lacteals</u> in the <u>digestive system</u> to the blood via <u>chylomicrons</u>, which are ultra-low-density <u>lipoproteins</u> (ULDL). ULDLs is one of the five major groups of lipoproteins (sorted by density) that enable fats and <u>cholesterol</u> to move

within the water-based solution of the bloodstream. They consist of <u>triglycerides</u> (85–92%), <u>phospholipids</u> (6–12%), <u>cholesterol</u> (1–3%), and <u>proteins</u> (1–2%).



Chylomicron Structure Wikipedia ApoA, ApoB, ApoC, ApoE (apolipoproteins); T (triacylglycerol); C (cholesterol); green (phospholipids)

<u>Chylomicrons</u> transport lipids from the intestine to <u>adipose</u>, <u>cardiac</u>, and <u>skeletal muscle</u> <u>tissues</u>. Then <u>lipoprotein lipase</u> activity hydrolyzes their triglyceride components. This allows the tissues to absorb the released <u>free fatty acids</u>. The liver takes up the fat from a large portion of the hydrolyzed triglyceride core.

There are three stages of <u>chylomicrons</u>: Nascent, Mature, and Remnant. Nascent chylomicrons are composed primarily of triglycerides (85%). They also contain some cholesterol and <u>cholesteryl esters</u>. While circulating in blood, chylomicrons exchange components with <u>high-density lipoproteins</u> (HDL) known as mature chylomicrons. Chylomicron becomes a remnant after the triglycerides stores are distributed and the chylomicron returns <u>APOC2</u> to the HDL but keeps <u>APOE</u>. APOE is required for cholesterol transportation from astrocytes to neurons and is the principal cholesterol carrier in the brain. Chylomicron remnants are considered a significant risk factor for cardiovascular disease.

These absorbed fats and fat-soluble vitamins form a milky white fluid from chyme called <u>chyle</u>, which contains lymph and emulsified fats, or free fatty acids. Chyle delivers nutrients indirectly when it reaches venous blood circulation. Blood capillaries take up other nutrients directly.

The type of oil and fat a person consumes is critical for proper growth, neural development, brain function, immune regulation, hormone balance, and other bodily systems. A deficiency or imbalance of essential fatty acids or consumption of damaged fats and oils damage these complex systems and pathways which can lead to many diseases, including type 2 diabetes and immune failure. A daily supply of organic <u>essential fatty acids</u> (omega 3 in particular) in balance is essential.

A healthy lymphatic system plays a vital role in the absorption and digestion of fat-soluble vitamins such as vitamins A, D, E, and K, which are necessary for growth and development and a robust immune system.

# **Immune System Regulation**

**Lymphoid tissue**, cells, and organs that make up the lymphatic system include white blood cells (leukocytes), bone marrow, the thymus, spleen, lymph nodes, nodules, tonsils, adenoids, appendix, and Peyer's patches. (Description from Britannica)

Lymphoid tissue has several different structural organizations related to its particular function in the immune response. The most highly organized lymphoid tissues are in the thymus and lymph nodes, which are well-defined encapsulated organs with easily identifiable architectures. In the spleen, the lymphoid tissue is a cylinder of loosely organized cells surrounding small arteries. In the bone marrow, this tissue is mixed with the blood-forming cells.

The most diffuse lymphoid tissue is found in the loose connective-tissue spaces beneath most wet epithelial membranes, such as those that line the gastrointestinal tract and the respiratory system. Many lymphatic system cells in these spaces wander to locate invading microorganisms and foreign material. In response to such invasions, they establish localized centers of cell production identified as nodules, which are different from nodes. Nodules are smaller than nodes, do not act as a filter, nor have a well-defined connective-tissue capsule as a boundary. Some nodules become permanent structures, such as the tonsils, appendix, and Peyer's patches, which line the small intestine. Most nodules appear and disappear in response to local needs.

The <u>lymph nodes</u> (lymph glands) are small, encapsulated bean-shaped structures that filter lymph. There are <u>500–600 lymph nodes</u> throughout the body along the lymphatic routes. They are especially prevalent in areas around the armpits (axillary nodes), groin (inguinal node), neck (cervical nodes), and knees (popliteal nodes). The nodes contain lymphocytes, which enter the bloodstream via specialized vessels called the high endothelial venules. T cells congregate in the inner cortex (paracortex), and B cells are organized in germinal centers in the outer cortex. Lymph, along with antigens, drains into the node through afferent (incoming) lymphatic vessels and percolates through the lymph node, where it comes in contact with and activates lymphocytes. Activated lymphocytes, carried in the lymph, exit the node through the efferent (outgoing) vessels and eventually enter the bloodstream throughout the body.

When there is an infection, these nodes swell up due to a buildup of lymph fluid, bacteria or other organisms, and immune system cells.

The lymphoid system includes several types of cells—for example, reticular cells and white blood cells such as macrophages and lymphocytes. Reticular cells provide structural support since they produce and maintain the thin networks of fibers that are a framework for most lymphoid organs. Macrophages help eliminate invaders by engulfing foreign materials and initiating the immune response. These cells may be embedded in one place, such as lymph nodes, or wander in the loose connective-tissue spaces. Lymphoid tissue has a central role in metastasis, the process by which cancer cells spread to tissues distant from the site of tumor origin. This is because of the proximity of lymph vessels to tumor masses in organs or other tissues.

The most common cell type in the lymphoid tissue is the lymphocyte. Like macrophages, lymphocytes are formed from stem cells in the bone marrow and then transported in the blood to the lymphoid tissue. T lymphocytes mature in the thymus before proceeding to the other lymphoid organs, such as the spleen. B lymphocytes mature in the bone marrow, then go directly to the lymphoid organs. Both T and B lymphocytes play a key role in immune responses to infectious microorganisms.

#### Swollen lymph nodes can be a symptom of numerous conditions:

- Glandular fever: Also known as infectious mononucleosis, or mono, is common among teenagers, college students, and young people. It can cause long-lasting swelling, a sore throat, and fatigue. Malnourishment, a poor diet, and the Epstein-Barr virus (EBV), a highly contagious <u>herpes</u> virus, contribute to this illness.
- Tonsillitis: This is more common in children on a junk food diet than in adults. It occurs when the lymph nodes at the back of the mouth fight bacterial or viral infections. Sugar breeds bacteria. The body produces viruses to assist in the removal of bacteria and other toxins. A sugar-free diet is the best prevention for this illness.
- Pharyngitis: Some people refer to this infection as "strep throat." It results from a streptococcus bacterial infection and can cause lymph nodes to swell. Again, avoiding refined sugar and sugar products can prevent this illness.
- Cancer: Lymph nodes capture cancer cells. Thus, lymph nodes may become sites of secondary tumor formation. Cancer that starts in the lymphatic system is known as <u>lymphoma</u>. It is the most dangerous lymphatic disease.

Hodgkin lymphoma most commonly affects lymph nodes in the upper part of the body, such as the neck, chest, and arms. <u>Hodgkin lymphoma</u> affects B lymphocytes, a type of white blood cell. People with Hodgkin lymphoma will have a lymphocyte in their blood called Reed-Sternberg cells.

<u>Non-Hodgkin lymphoma</u> refers to types that do not involve these cells. Non-Hodgkin lymphoma can arise from B or T lymphocytes but is most common in B lymphocytes. There are many types of non-Hodgkin lymphomas. These can vary in their location and how aggressive their growth is. Exposure to the herbicide glyphosate/RoundUp can cause this type of cancer.

### Diseases of the lymphatic system

Secondary lymphoid organs provide a system of redundancy for antigen sampling by the immune system cells. Two autoimmune diseases, DiGeorge syndrome and <u>Nezelof</u> <u>Syndrome</u>, result in the thymus failing to develop. And, the subsequent reduction in T-cell results in a decrease in B-cell counts. The destruction of bone marrow also has devastating effects on the immune system. Not only because of its role as the site of B-cell development but also because it is the source of the stem cells that are the precursors for lymphocyte differentiation.

#### **Mucosa-associated tissues**

Another group of important secondary lymphoid structures is the mucosa-associated lymphoid tissues. These tissues are associated with mucosal surfaces of almost any organ, especially those of the digestive, genitourinary, and respiratory tracts. These organs are constantly exposed to a wide variety of potentially harmful microorganisms which require

their system of antigen capture and presentation to lymphocytes. For example, Peyer's patches, which are mucosa-associated lymphoid tissues of the small intestine, sample passing antigens and expose them to underlying B and T cells. Other, less-organized areas of the gut also play a role as secondary lymphoid tissue.

### Nurture Your Lymphatic System

Six of the best things you can do for your lymphatic are:

- Daily consumption of pure, structured spring water
- Daily circular exercises that include dancing, rapid walking, qi gong, tai chi, yoga, stretching, swimming, biking, and trampoline jumping
- Daily exposure to sunshine vitamin D and full spectrum daylight without sunglasses or sunscreen
- Daily vigorous body brushing
- Get a lymphatic drainage massage with Elektra Mg cream or lotion
- Have Infrared therapy on a Biomat

© 2022 Lady Carla Davis - <u>www.NourishingBasics.com</u>

<b>BLOOD</b> VEI	RSUS LYMPH
Blood is the red liquid which circulates inside arteries and veins, carrying respiratory gases and nutrients throughout the body	Lymph is a colorless fluid which bathes tissues and drains through the lymphatic system
Red color	Colorless
Circulates through arteries, veins, and the heart	Circulates through lymph capillaries, lymph nodes, and lymph vessels
Main transporting fluid of the body	Parallel transporting fluid, which connects tissue fluid to the circulatory system
Contains red blood cells	Lacks red blood cells
Consists of a high protein concentration	Consists of a low protein concentration
Contains more nutrients and wastes	Contains fewer nutrients and wastes
Belongs to the circulatory system	Belongs to the lymphatic system
Regulates body temperature and maintains pH	Transports fat and fat- soluble vitamins and stores lymphocytes
Clots rapidly due to the presence of fibrinogen	Clots slowly due to the presence of less fibrinogen Visit www.pediaa.com