

# THE LYMPH VASCULAR SYSTEM :

by

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**stage 1**

# Lymphatic system

Lymphatic System consists of:

**A. Cells**

1. Lymphocytes (B,T, natural killer)
2. Antigen-presenting cells (dendritic cells, Langerhans' cells & macrophage)

**B. Lymphatic tissue** –diffuse and nodular

**C. Lymphatic organ** ,lymph nodes, spleen, thymus)

**D. Lymphatic vessels** that carry the cells and fluid

The main function of the lymphoid organs is to protect the organism against invading pathogens or antigens (bacteria, parasites, and viruses). The immune response occurs when the organism detects the pathogens, which can enter the organism at any point. For this reason, lymphatic cells, tissues, and organs have wide distribution in the body.

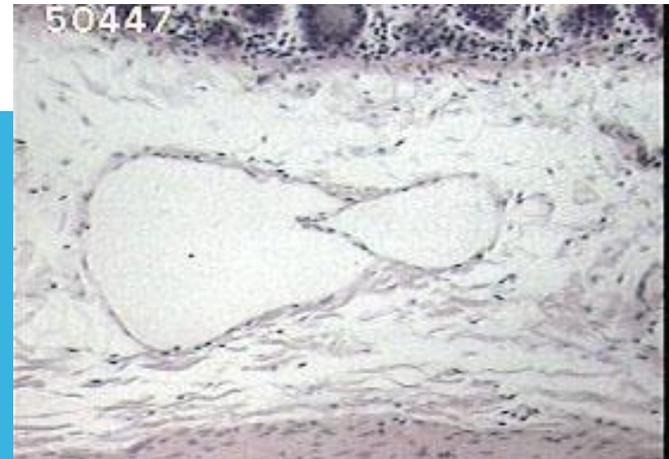
The major lymphoid organs are the

- lymph nodes,
- tonsils,
- thymus, and
- spleen.

# THE LYMPH VASCULAR SYSTEM

The lymphatic system consists of lymph capillaries and lymph vessels. This system starts as blind-ending tubules or lymphatic capillaries in the connective tissue of different organs. These vessels collect the excess interstitial fluid (lymph) from the tissues and return it to the venous blood via the large lymph vessels, the thoracic duct and right lymphatic duct. Also, to allow greater permeability, the endothelium in lymph capillaries and vessels is extremely thin. The structure of larger lymph vessels is similar to that of veins except that their walls are much thinner. Lymph movement in the lymphatic vessels is similar to that of blood movement; that is, the contractions of surrounding skeletal muscles forces the lymph to move forward. Also, the lymph vessels contain more valves to prevent a backflow of collected lymph. Lymph vessels are found in all tissues except the central nervous system, cartilage, bone and bone marrow, thymus, placenta, and teeth.

LYMPHATIC VESSEL WITH A VALVE



## 1- LYMPH CAPILLARIES :

**Lymph capillaries are thin-walled, blind tubes that branch to form a rich network in organs and tissues. They are wider and more irregular than blood capillaries. The wall of a lymph capillary consists only of a thin continuous endothelium and a discontinuous basal lamina that is present only in patches or may even be absent. Externally, the endothelium is surrounded by a small amount of collagenous connective tissue.**

## 2- COLLECTING LYMPH VESSELS

**Collecting lymph vessels differ from lymph capillaries in size and the thickness of their walls. Although three coats - intima, media, and adventitia- are described as in blood vessels, they are not clearly delineated. The tunica intima consists of an endothelium supported by a thin network of elastic fibers. tunica media is composed of smooth muscle cells ,with a few fine elastic fibers.**

**The tunica adventitia is the thickest coat and consists of bundles of collagen fibers, elastic fibers, and some smooth muscle cells.**

## Cells of lymphatic tissue :

The cells of lymphatic tissue are present as fixed and free cells. **Fixed cells are the reticular cells** **reticular cells** appear as elongated or stellate elements with round or oval, palely stained nuclei and, lightly basophilic cytoplasm responsible for the formation and maintenance of reticular fibers.

### . **lymphocyte:**

**Lymphocytes** are the cells that carry out immune responses.

Morphologically, all types of lymphocytes appear very similar, but functionally, they are very different. When lymphocytes are properly stimulated, **B lymphocytes and T lymphocytes** are produced.

### **T- lymphocytes or T- cells:**

T cells arise from lymphocytes that are carried from the bone marrow to the **thymus gland**.

They mature, differentiate, and acquire surface receptors and before migrating to peripheral lymphoid tissues and organs. The thymus gland produces mature T cells early in life.

T cells carry out immune responses when stimulated. There are four main types of differentiated T cells:

- helper T cells,**
- **cytotoxic T cells,**
- memory T cells,**
- **suppressor T cells**

## 1-T- helper cells

When encountering an antigen, **helper T cells** assist other lymphocytes by secreting immune chemicals called **cytokines( interleukins)**. **Cytokines** are protein hormones that stimulate proliferation, secretion, differentiation, and maturation of B cells into **plasma cells**, which then produce immune proteins called **antibodies ( immunoglobulins)**.

## 2- cytotoxic T-cells:

**Cytotoxic T cells** specifically recognize antigenically different cells such as virus-infected cells, foreign cells, or malignant cells and. These lymphocytes become activated when they combine with antigens that react with their receptors.

## 3- Memory T- cells :

**Memory T cells** are the long-living progeny of T cells. They respond rapidly to the same antigens in the body and stimulate immediate production of cytotoxic T cells.

## 4- suppressor T- cells

**Suppressor T cells** may decrease or inhibit the functions of helper T cells and cytotoxic T cells, and thus modulate the immune response.

## **B –lymphocyte or B-cells :**

**B cells** mature and become immunocompetent in bone marrow. After maturation, blood carries B cells to the non-thymic lymphoid tissues such as lymph nodes, spleen, and connective tissue. B cells are able to recognize a particular type of antigen owing to the presence of **antigen receptors** on the surface of their cell membrane.

**Plasma cells** secrete large amounts of antibodies specific to the antigen that triggered plasma cell formation. Antibodies react with the antigens and initiate a complex process that eventually destroys the foreign substance that activated the immune response.

**memory B cells.** These memory cells produce a more rapid immunologic response should the same antigen reappear.



# Lymphatic tissue

Lymphatic tissue divided into

## 1: Diffuse Lymphatic Tissue

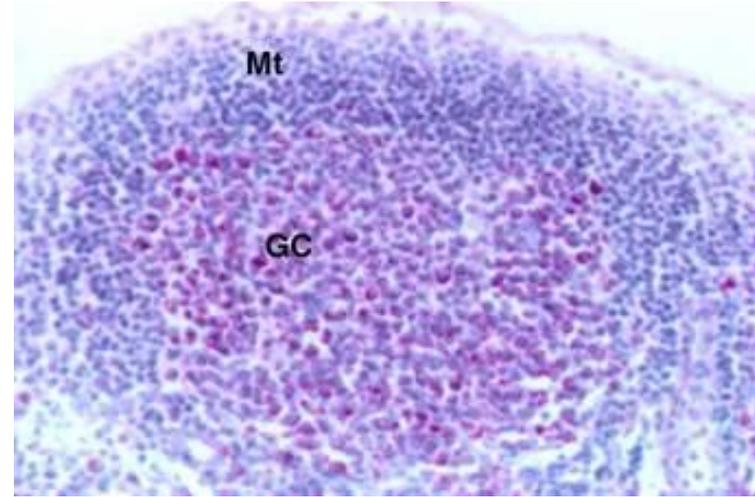
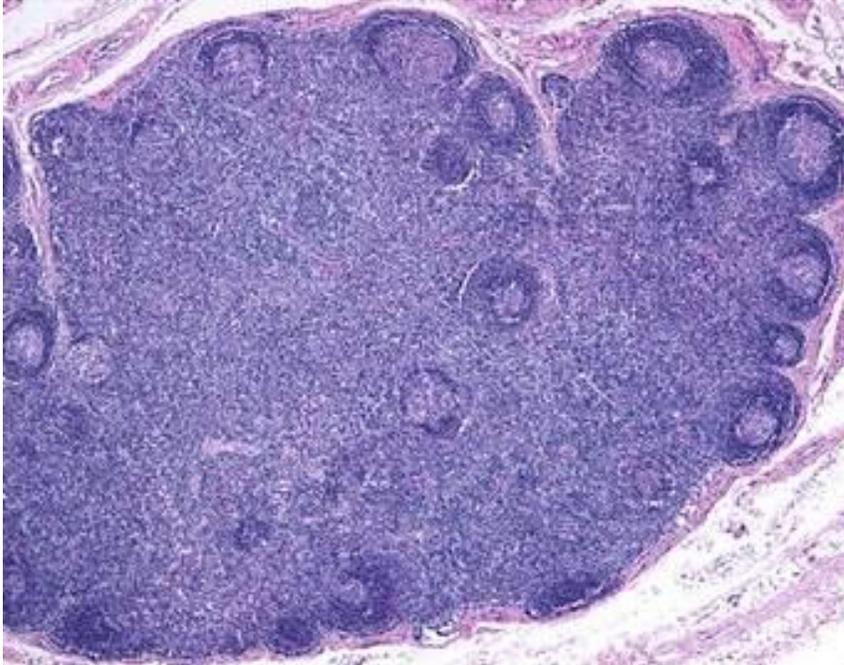
It appears as a loose aggregate of cells with no distinct demarcation from surrounding tissue. Diffuse lymphatic tissue is prominent in the connective tissue that underlies the epithelium of the intestine. Any antigen that does penetrate the epithelial lining induces an immune response in the lymphatic tissue.

## 2: Nodular Lymphatic Tissue

Nodular lymphatic tissue contains the same structural elements as diffuse lymphatic tissue, differing only in that the components are organized into compact, circumscribed structures. Lymphatic nodules (also called **follicles**) may be present as **solitary nodules**, as occur in the appendix and the Peyer's patches of the ileum.

Histologically, some lymphatic nodules appear as rounded collections of densely packed small lymphocytes this nodule is called a **primary nodule**. Other lymphatic nodules contain a lightly staining central area surrounded by a deeply stained cap of closely packed small lymphocytes. The pale region has been called a **germinal center** and the whole structure a **secondary nodule**. Lymphatic nodules are prominent in organs such as the tonsils, lymph nodes, and spleen but are absent from the thymus. *Germinal* centers produce **B-cells** that can migrate through the cap to leave the center and eventually pass to other lymphatic tissues.

# PRIMARY LYMPHATIC NODULE/FOLLICLE (LN) AGGREGATION OF LYMPHOCYTES IN LAMINA PROPRIA OR SUBMUCOSA



# Peyer's patches :

Peyer's patches occur in the wall of the ileum.

Consist of very large spherical aggregates (nodules ) of dense lymphoid tissue which may show germinal centers . most of the mass of each nodule is located in the submucosa ,but the nodule extends into lamina propria and bulges into the lumen of ileum. Their function in screening of the lumen of small intestine, probably to prevent colon bacteria from migrating up into small intestine . IgA antibodies secreted by plasma cells generated by peyer's Patches seriously impair bacterial motility and inhibit attachment of bacteria to intestinal walls .



## Table Shows Comparative Between Blood Vessles and Lymphatic

Cardiovascular System	Lymphatic System
<i>Blood</i> is responsible for collecting and distributing oxygen, nutrients and hormones to the tissues of entire body.	<i>Lymph</i> is responsible for collecting and removing waste products left behind in the tissues.
<i>Blood flows</i> in the arteries, capillaries, and veins.	<i>Lymph flows</i> in an open circuit from the tissues into lymphatic vessels.
<i>Blood</i> flows towards the heart and away from the heart.	<i>Lymph</i> flows in one direction only (towards the heart).
<i>Blood</i> is pumped by the heart to all parts of the body.	<i>Lymph is not pumped.</i> It passively flows from the tissues into the lymph capillaries.
<i>Blood</i> consists of the liquid plasma that transports the red and white blood cells and platelets.	<i>Lymph</i> that has been filtered and is ready to return to the cardiovascular system is a clear or milky white fluid.
<i>Blood is visible</i> and damage to blood vessels causes obvious signs such as bleeding or bruising.	<i>Lymph is colourless or translucent</i> and damage to the lymphatic system is difficult to detect until swelling occurs.
<i>Blood is filtered</i> by the kidneys.	<i>Lymph is filtered</i> by lymph nodes located throughout the body.