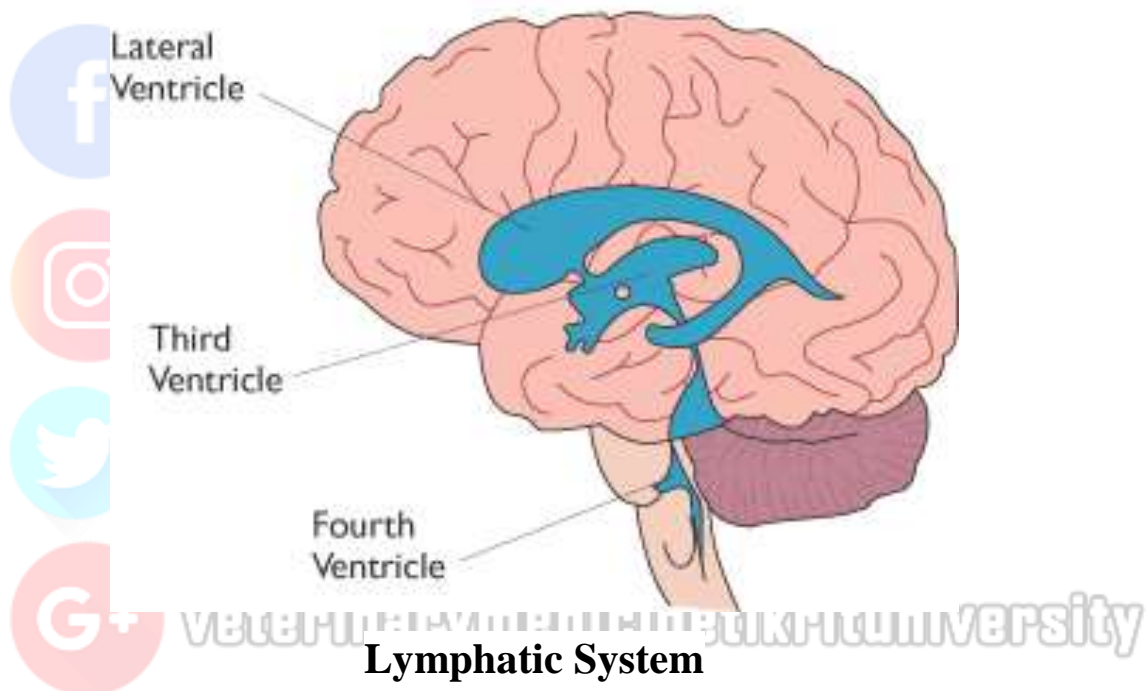


## Cerebrospinal Fluid

Cerebrospinal Fluid is a clear liquid separates the middle and inner Meninges and fills four interconnected VENTRICLES and make by specialized cells ( ependymal cells ). Cerebrospinal Fluid acts as a Transport Medium for substances that are important to Brain Function and PROTECTS the Brain from mechanical injury by acting as a Shock Absorber..



## Lymphatic System

The **lymphatic system** is part of the circulatory system and a very important part of the immune system, comprising a network of lymphatic vessels that carry a clear fluid called lymph (from Latin, *lympa* meaning "water") directionally towards the heart.

**Lymph** is a transparent fluid and yellow. It is formed when fluid leaves the **capillary bed** in tissues due to hydrostatic pressure. The composition of lymph is similar to that of blood plasma, with the majority of the volume (around 95%) comprised of water. The remaining 5% is composed of proteins, lipids, carbohydrates (mainly glucose), various ions and some cells (mainly lymphocytes), although this can vary depending on where in the body the lymph is produced.

## *Theoretical physiology*

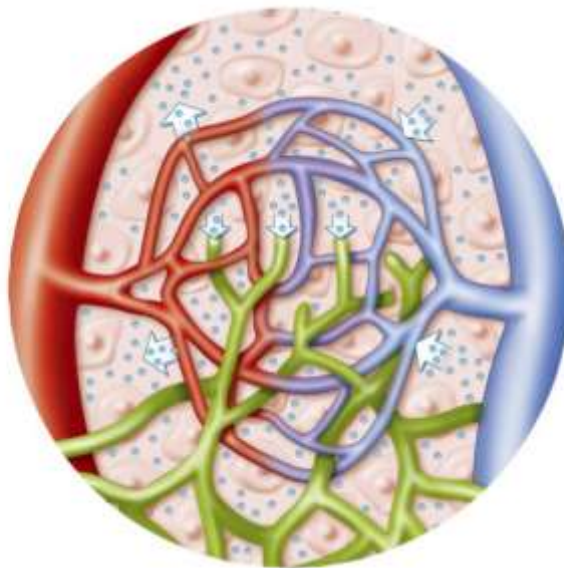
## *2<sup>nd</sup> stage*

The average adult produces about 3 litres of lymphatic fluid each day, although this can vary in illness.

Lymphatic tissues begin to develop by the end of the fifth week of embryonic development. Lymphatic vessels develop from lymph sacs that arise from developing veins, which are derived from mesoderm.

### **The functions of the lymphatic system are:**

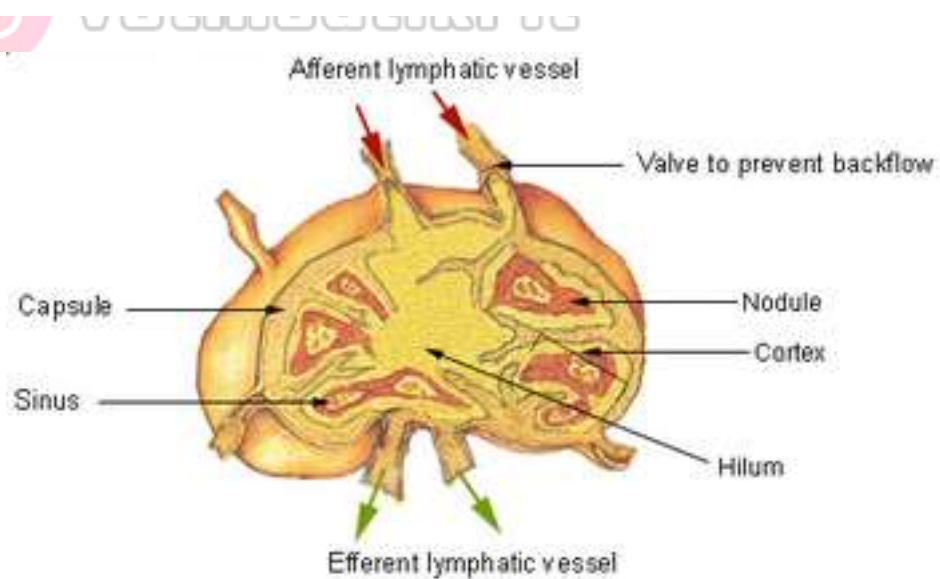
1. **Fluid balance:** The lymphatic vessels transport back to the blood fluids that have escaped from the blood vascular system. The amount of returned fluid about 3 L of interstitial fluid remained in the interstitial spaces, edema would result, causing tissue damage and eventually death. The remaining fluid enters the lymphatic capillaries, where the fluid is called lymph.



2. **Fat absorption:** The lymphatic system absorbs fats and other substances from the digestive tract. Lacteals are special lymphatic vessels located in the lining of the small intestine. Fats enter the lacteals and pass through the lymphatic vessels to the venous circulation.



3. **defenses functions:** The lymphoid tissues and organs has phagocytic cells and lymphocytes, which play essential roles in body defense and resistance to disease.



### ***Anatomy of the Lymphatic System***

The lymphatic system actually consists of two semi-independent parts:

- 1- a network of lymphatic vessels and lymph nodes .
- 2- a various lymphoid tissues and organs scattered throughout the body, lymph node and Lymphatic organ ( spleen, tonsils and thymus gland ).

## **Lymphatic Vessels**

The function of the lymphatic vessels is to form drainage system that picks up excess tissue fluid, now called **lymph**. lymphatic vessels form a one-way system, and lymph flows only toward the heart.

## **Lymph Nodes**

lymph nodes help to protect the body by removing foreign materials such as bacteria and tumor cells from the lymphatic stream and by producing lymphocytes that contribute in immune response.

## **Other Lymphoid Organs**

Lymph nodes are just one of the many types of lymphoid organs in the body. Others are the spleen, thymus gland, tonsils, and Peyer's patches of the intestine.

## **Spleen**

The spleen is a soft, blood-rich organ that filters blood.

- **Location.** The spleen is located on the left side of the abdominal cavity, just beneath the diaphragm, and turned around the anterior aspect of the stomach.
- **Function.** Instead of filtering lymph, the spleen filters and cleans the blood of bacteria, viruses, and other debris; it provides a site for lymphocyte proliferation and immune surveillance, but its most important function is to destroy worn-out red blood cells and return some of their breakdown products to the liver.
- **Fetal spleen:** In the fetus, the spleen is an important hematopoietic (blood cell-forming) site, but as a rule only lymphocytes are produced by the adult spleen.

## **thymus gland**

The thymus gland functions at peak levels only during youth.

## *Theoretical physiology*

## *2<sup>nd</sup> stage*

- **Location:** The thymus gland is a lymphoid mass found low in the throat overlying the heart.
- **Functions:** The thymus gland produces thymosin, which work as chelating factor to Pre-Tcell and maturation of Pre-Tcell occur in thymus gland and eventually converted in to T-Lymphocyte cell .

## **Tonsils**

The tonsils are small masses of lymphoid tissue that ring the pharynx (the throat), where they are found in the mucosa.

- **Function:** Their job is to trap and remove any bacteria or other foreign pathogens entering the throat.
- **Tonsillitis:** They carry out this function so efficiently that sometimes they become congested with bacteria and become red, swollen, and sore, a condition called tonsillitis.

## **Peyer's Patches**

Peyer's patches resemble the look of the tonsils.

- **Location:** Peyer's patches are found in the wall of the small intestine.
- **Function:** The macrophages of Peyer's patches are in an ideal position to capture and destroy bacteria (always present in tremendous numbers in the intestine), thereby preventing them from penetrating the intestinal wall.

## **Lymphocytes**

Lymphocytes exist in two major cells : the B lymphocytes, or B cells, and the T lymphocytes, or T cells.

## *Theoretical physiology*

## *2<sup>nd</sup> stage*

**Origin:** Like all blood cells, lymphocytes originate from hemocytoblasts in red bone marrow.

- **B lymphocytes:** The B lymphocytes, or **B cells**, produce antibodies and oversee humoral immunity.
- **T lymphocytes:** The T lymphocytes, or **T cells**, are non-antibody-producing lymphocytes that constitute the cell-mediated arm of the adaptive defense system.
- **Maturation of T cells:** T cells arise from lymphocytes that migrate to the thymus, where they undergo a maturation process of 2 to 3 days, directed by thymic hormones; only those maturing T cells with the sharpest ability to identify foreign antigens survive.
- **Maturation of B cell:** B cells develop immunocompetence in bone marrow.

***Q1 \ fill in the blanks :***

- 1- Cerebrospinal Fluid make by ----- and stored in -----.***
- 2- Functions of Cerebrospinal Fluid are ----- and -----.***
- 3- Lymphatic tissues derived from -----.***
- 4- ----- are special lymphatic vessels located in the lining of the small intestine and absorb fats.***

***Q2 \ Define a lymph and explain functions of lymphatic system in details .***

***Q3\ enumerate lymphoid organs and explain functions of each one .***