**07. The Lymphatic system**

A circulatory system as complicated as that of the blood requires support. In the human body this is provided by the lymphatic system.

**The Lymphatic system**

The lymphatic system is a subsidiary circulation entwined with the blood circulation. It provides a channel through which excess tissue fluid is returned to the bloodstream.

**TOPIC 1: STRUCTURE AND FUNCTION**

**WHAT IS THE LYMPHATIC SYSTEM?**

In order to understand the lymphatic system it is necessary to understand what happens in the circulatory system at tissue level. Blood travels to and from the tissues delivering nutrients and removing waste. Whole blood never leaves the capillaries but leucocytes and the 'passengers' (oxygen, food and water) can. Once outside the capillaries they are carried by a derivative of blood plasma called tissue, or interstitial, fluid. This fluid circulates throughout the tissues, delivering food, oxygen and water to the cells and collecting carbon dioxide and other waste. However, when it has finished its work and needs to return to the capillaries, not all of it can pass through the capillary walls because the pressure inside the capillaries is too high. The fluid that is left is picked up by a different set of capillaries, called the lymphatic capillaries. They have larger pores in their walls than blood capillaries and the pressure inside them is lower. Thus, excess tissue fluid, substances made of large molecules, fragments of damaged cells and foreign matter such as micro-organisms drain away into them. The fluid, known as lymph, is filtered by the lymph nodes then collected by the lymphatic ducts before entering the right and left subclavian veins and returning to the bloodstream.

**WHAT IS THE STRUCTURE OF THE LYMPHATIC SYSTEM?**

The lymphatic system consists of lymphatic capillaries, lymphatic vessels, lymph nodes and lymphatic ducts. The fluid in lymphatic capillaries and vessels is called lymph.

**WHAT DOES IT DISTRIBUTE AND COLLECT?**

Lymph, a fluid similar to blood plasma.

**Structure:** contains waste materials as well as leucocytes and lymphocytes (in order to ingest bacteria and cell debris) but no erythrocytes.

**Function:** transports excess waste (that blood cannot carry) away from tissues; adds extra leucocytes and lymphocytes to the blood.

**HOW DOES LYMPH MOVE?**

Several factors help to circulate lymph -

* The contraction of skeletal muscles collapses the vessels and because there are valves present, lymph is directed towards the upper part of the body
* A slight oncoming pressure from the tissue fluids
* Movement of the lymph towards the thorax during inspiration
* **Suction:** negative pressure helps to pull the lymph upwards into the lymphatic ducts, where lymph collects before being recirculated. These ducts empty into the subclavian veins which, because they are close to the heart, have negative pressure in them. This pressure pulls on the ducts and thus on the lymph vessels connected to them.

Any obstruction of the lymphatic flow results in oedema, the swelling of tissues due to the collection of excess fluid.

**WHAT ARE LYMPHATIC CAPILLARIES?**

The vessels which work with blood to collect excess tissue fluid. Lymphatic capillaries eventually unite to form lymphatic vessels.

**Structure:** fine, blind-ended permeable tubes, composed of a single layer of endothelial cells. They occur in all spaces between tissues, except in the central nervous system.

**Function:** carry excess tissue fluid away from tissue space.

**WHAT ARE LYMPHATIC VESSELS?**

These are vessels which transport lymph around the lymphatic system.

**Structure:** thin-walled, collapsible vessels similar to veins but carrying lymph not venous blood. They have valves (semi-lunar) to keep the lymph moving centripetally (in the direction of the heart) and prevent back flow. Consisting of a double layer of lining membrane, these valves give the vessels a knotted or beaded appearance. They have three layers:

* An outer layer of fibrous tissue
* A middle layer of muscular and elastic tissue
* An inner layer of endothelial cells.

**Function:** lymphatic vessels collect lymph from the lymphatic capillaries and then convey lymph towards the heart. Many lymph vessels run into the subcutaneous tissue (beneath the dermis) and all the lymphatic vessels pass through one or more lymphatic nodes.

**WHAT IS THE CONNECTION BETWEEN BLOOD AND LYMPH?**

The lymphatic system is a subsidiary circulation, helping the blood circulation to carry out its functions. It removes excess fluid from tissues and carries large particles that cannot pass through the smaller pores of the blood capillaries. Lymph nodes and the spleen filter lymph (the name of the fluid in the lymphatic system) and take out the waste materials it contains as well as producing antibodies and lymphocytes which are added to the lymph to be transported to the blood.

**WHAT ARE LYMPH NODES?**

All the small and medium-sized lymph vessels open into lymph nodes, which are strategically placed throughout the body. An afferent vessel transports lymph to the node and an efferent vessel transports the filtered lymph back to the system.

**Structure:** each node is made of lymphatic tissue, surrounded by a wall of tough, white fibrous tissue supported by inward strands of fibrous tissue called trabeculae. Lymph nodes vary in size.

**Functions:**

* To filter the lymph, remove and destroy harmful micro-organisms, tumour cells, damaged or dead tissue cells, large protein molecules and toxic substances. This filtering system prevents toxic materials from reaching the bloodstream and causing septicaemia. If this occurs, it can cause the node to swell. In severe cases, this may cause cell destruction and an abscess on the node.
* To produce new lymphocytes and antibodies and add them to the lymph as necessary.
* Lymphatic tissue cells within the node may become activated to form antibodies against a particular infection. They may then continue to form antibodies for several years or even a lifetime.

**WHAT IS LYMPHATIC TISSUE?**

Lymph nodes are made of lymphatic tissue. This contains many types of cells:

* **Phagocytes -** white blood cells that engulf and destroy harmful (pathogenic) waste and bacteria
* **Lymphocytes -** white blood cells that produce antibodies
* Cells dividing to form new lymphocytes.

**WHAT ARE LYMPHATIC DUCTS?**

All lymph passes into two main lymphatic vessels or ducts:

**1. The right lymphatic duct**

This is only 1.5cm long, positioned at the root of the neck and empties into the right subclavian vein to rejoin the circulatory system.

**Function:** receives all the drained lymph from the right side of the head, chest and neck and from the right arm.

**2. The thoracic duct**

This is the largest lymphatic vessel. It is 40cm long extending from the second lumbar vertebra to the root of the neck and empties into the subclavian vein to rejoin the circulatory system.

**Function:** collects and drains lymph from the left side of the head, the neck, both lower limbs, the left side of the trunk and the left arm.

**SPECIAL AREAS CONTAINING LYMPHATIC TISSUE**

**3. Tonsils**

**4. Thymus gland** (behind sternum)

**5. Peyer's patches** (wall of small intestine)

**6. Appendix**

**7. Spleen**

**SPLEEN**

The spleen is an organ which both produces and destroys cells. It is a non-essential organ and is sometimes removed due to damage after accidents, as other organs can perform the same functions. The spleen lies on the upper left-hand side of the abdomen.

**Structure:** the spleen has an outer capsule of fibrous tissue extending into a network of fibrous strands called trabeculae. This network supports the splenic pulp which consists of several different types of cells.

**Functions:**

* Forms new lymphocytes
* Destroys thrombocytes and erythrocytes
* Helps to remove foreign particles from the circulation
* Helps to fight infection, becoming enlarged in certain diseases, e.g. malaria and typhoid fever
* Acts as a blood reservoir. Blood sinuses within the spleen normally hold a large amount of blood which is pushed into general circulation if the spleen contracts. Contraction usually occurs two or three times a minute, but in cases of shock or even during exercise, the spleen may contract faster and for a longer period to help maintain pressure in the circulation.

**TOPIC 2: DISEASES AND DISORDERS (PATHOLOGIES)**

**OEDEMA/WATER RETENTION**

Swelling due to excess fluid in the tissue spaces and serous cavities

**LYMPHOEDEMA**

Oedema associated with an obstruction in the lymphatic vessels

**HODGKIN'S LYMPHOMA**

Cancer of the lymphatic tissue.

**CELLULITE**

Lumpy deposits of body fat especially on women's thighs.

**INFECTIOUS MONONUCLEOSIS (GLANDULAR FEVER)**

An acute disease characterized by fever and swollen lymph nodes and an abnormal increase of mononuclear leucocytes or monocytes in the bloodstream; not highly contagious;

**LYMPHADENITIS**

The inflammation of lymph nodes.

**NON-HODGKIN LYMPHOMA**

A type of lymphoma, a cancer in the lymphatic system; causes the cells in the lymphatic system to abnormally reproduce, eventually causing tumours to grow.

**HASHIMOTO'S THYROIDITIS (CHRONIC LYMPHOCYTIC THYROIDITIS)**

is an autoimmune disease where the body's own T-cells attack the cells of the thyroid.

**LYMPHOMA**

Is a type of cancer that originates in lymphocytes of the immune system. They often originate in lymph nodes, presenting as an enlargement of the node (a tumour).

**SYSTEMIC LUPUS ERYTHEMATOSUS**

An inflammatory disease of connective tissue with variable features including fever, weakness, joint pains and skin lesions on the face, neck or arms.

**INTERRELATIONSHIPS**

**Lymphatic system links to:**

**Circulatory:** transports excess waste and toxins, which the circulatory system cannot cope with, away from the cells and tissues. Also works closely with the circulatory system to strengthen the body's immunity.

**Digestive:** lymphatic vessels in the small intestines (inside the lacteal of the ileum) help with the absorption of fats during digestion. These are then transported around the body in the circulatory system and distributed to cells to be used as energy.

**Muscular:** lactic acid formed when overexercising muscles, or from tension and general fatigue in the muscular system, is drained away in the lymphatic system.

**Summary**

The lymphatic system:

* Provides a channel for transporting excess tissue fluid away from tissues and back to the blood circulation.
* Collects and transports lymph from tissue cells.
* Nodes filter lymph of harmful materials before returning it to the blood circulation.
* Produces new lymphocytes.
* Produces antibodies.
* Lymphatic capillaries in the lining of the small intestine assist in the absorption of fat droplets.