Lab.6 Thymus Gland

What is the thymus gland?

The thymus is the gland in which the maturation of T lymphocytes occurs. It is composed of two lobes of different sizes connected together by connective tissue and covered by a thin fibrous capsule. Within each of the lobes there is a superficial region of tissue referred to as the **cortex** as well as a deep region known as the **medulla**. Some of the T cells produced in the cortex travel to the medulla from where they enter the bloodstream through the medullary veins and become an addition to the lymphocytes that are present in the peripheral blood and the lymphoid organs.

The outer layer of the gland is full of thymocytes or cells that represent different stages of T cells maturation between lymphoid "newborn" cells from the bone marrow and immature T cells. The inner part of this gland consists of two medullary regions, which continue into one another, and it also contains mature lymphocytes and epithelial cells that secrete hormones (timostimolina, thymopoietin, thymopentin, thymosin, etc.).

When **T cells** fully mature they flow into the bloodstream and migrate to the lymph glands and the spleen.

The production of T cells from the thymus gland begins in embryonic life, around the eighth week of gestation. The activity of this gland, which is essential for the immune system, decreases with time: it begins to decrease during puberty and shrinks towards adulthood causing a small amount of T cells to be produced. The renewal of these cells is continuously performed in the peripheral lymphoid organs.

The main arterial supply of the thymus gland is provided through the anterior intercostal arteries and small branches from the internal thoracic arteries. The venous blood drains into the left branchio cephalic and internal thoracic veins

Thymus Gland

One of the essential parts of the lymphatic system, which is located in the mediastinum beneath the sternum, is the thymus gland.

- The thymus stretches from the fourth intercostal gap of the vertebrae to the lower margin of the thyroid gland.
- Unlike other endocrine glands, the thymus gland is exclusively active prior to puberty. At puberty, the gland expands to its maximum size before being gradually replaced by adipose tissue.
- A vital component of the immune system, the thymus gland acts as a barrier against various diseases, cancers, and antigens.

- The thymus is particularly crucial for the adaptive or thymus-dependent arm of the immune system since it is necessary for the growth and activation of immune cells.
- The thymus contains immune cells such as macrophages, neutrophils, and dendritic cells in addition to secretory cells.
- Cytokines like tumour necrosis factor (TNF) and interferon sustain the growth of the secretory cells and the control of their secretions.
- Autoimmune conditions like myasthenia gravis can affect the anatomy and operation of the gland.

Structure of Thymus Gland

1. The thymus gland is a bilobed gland with two pyramid-shaped lobes, each of which has a surface that is lobulated and has two distinct regions: the outer cortex and the inner medulla.
2. An interior connective tissue septum and a thick connective tissue capsule surround and separate each of the gland's lobes.
3. An intricate three-dimensional network of star-shaped reticular cells makes up the majority of the gland's mass.
4. Based on many characteristics, including antigenic expression, ultrastructure, and the ability to create thymic hormones, the epithelial cells of the thymus gland are categorised into four main subtypes.
5. Subcapsular cortical, inner cortical, medullary, and Hassall's corpuscles are the subtypes.
6. Loosely packed lymphocytes can be found in the gland's outer cortex, while reticulocytes with abundant cytoplasm can be found in the medulla.
7. Small bodies made up of concentric arrays of squamous cells are also present in the structure and are known as Hassall's concentric corpuscles, Hassall's bodies, or thymic corpuscles.
8. Infants and early children have big thymuses, which reach their maximum size during puberty. After puberty, the gland gradually starts to consolidate so that adipose tissue can take its place.
9. The inferior thyroid, internal thyroid, and intercostal arteries all give blood to the thymus gland.
10. Sternohyoid and sternothyroid muscles, both of which are bilateral, link the gland to the sternum.

Hormones of Thymus Gland

Thymosin, thymopoietin, and serum thymic factor are the three hormones that are produced by the thymus gland. The T cells are not all affected by thymic hormones in the same way. The hormones' mode of action at the cellular level is based on their interaction with adenylyl cyclase and binding to the appropriate cell receptors.

Thymosin

1. The main hormone secreted by the gland is thymosin, which is generated by the epithelial cells of the cortex and medulla.
2. Thymosin's ability to trigger T cell differentiation and improve various immune cells' immunological capabilities is its most significant function.
3. The phenotypic markers in lymphocytes have also been linked to an increase in thymosin levels.
4. Thymosin is a protein that can withstand heat up to 80°C and may also contain a small quantity of sugar.

Thymopoietin

1. A polypeptide hormone produced by the thymus called thymopoietin serves more neuromuscular purposes than immunological ones.
2. Increased hormone levels are known to also cause T cell activation and differentiation, though.

Functions of Thymus Gland

1. The thymus gland's primary job is to stimulate the growth, activation, and differentiation of T cells so that they can act as the messengers of cellular immunity.
2. Prothymocytes are stimulated to develop into thymocytes and T lymphocytes by the thymic hormones thymosin and thymopoietin.
3. The gland also triggers the secretion of cytokines, which are crucial for regulating T cell growth at various stages.
4. By the 12th week of pregnancy, the thymus is already contributing to foetal immunity, and it continues to function throughout foetal life and into childhood.
5. The thymus is an endocrine gland that is known to create human growth hormone, which is crucial for the body's expansion and development.

Disorders of Thymus Gland

Thymic cysts

1. The thymus gland may include congenital thymic cysts, which would prevent the thymocytes from proliferating.

2. These cysts are benign and may typically be removed. Because their immune systems are compromised, people with thymic cysts experience symptoms like coughing and upper respiratory tract infections

Involution

1. Infants that experience neglect, malnourishment, and abuse frequently experience thymic involution.
2. The thymus is vulnerable to stress, therefore it can also happen after chemotherapy, radiation therapy, and steroid therapy.
3. When it comes to newborns and young children, thymus involution is far more uncommon.
4. Premature involution is a sign of societal issues like abuse.

Hypoplasia

1. Hypoplasia, which typically occurs in newborns, is a decrease in the number of cells in an organ.
2. The third and fourth pharyngeal pouches' abnormal development leads to hypoplasia of the thymus.
3. It has been hypothesised that substances like alcohol or organic acids affect the neural crest, which interferes with the pharyngeal pouch's ability to differentiate.
4. The degree of hypoplasia and the amount of genetic material that is defective determine how the illness will appear clinically.

Hypogammaglobulinemia

Low serum levels of immunoglobulin or antibodies are the cause of the condition known as hypogammaglobulinemia. The primary elements of the humoral immune response, immunoglobulins are capable of recognising antigens to initiate a biological response and eliminate the infectious cause. The most prevalent primary immunodeficiency, hypogammaglobulinemia, affects the majority of patients with immune system deterioration. It must be swiftly detected and treated in order to reduce the substantial morbidity and death linked to this disorder. Laboratory studies, clinical observations, vaccine response, and genetic testing are all included in the evaluation. IVIG transfusions, antibiotics, and glucocorticoids are used as treatment. In order to examine, evaluate, manage, and treat patients with this condition appropriately, the practitioner or interprofessional team is highlighted in this activity.

Pure red cell aplasia

The illness known as pure red cell aplasia (PRCA) is characterised by severe reticulocytopenia, severe normocytic normochromic anaemia, and a substantial reduction or absence of erythroid precursors from the bone marrow. A congenital type of PRCA is Diamond-Blackfan anaemia.

PRCA that has been acquired might occur as the main disorder or as a result of another disorder or agent. An autoimmune condition known as primary acquired PRCA is typically antibody-mediated. The morphologic features of PRCA can also be seen in myelodysplastic syndromes. Secondary acquired PRCA may be linked to autoimmune or collagen vascular diseases like

systemic lupus erythematosus, lymphoproliferative diseases like chronic lymphocytic leukaemia or large granular lymphocyte leukaemia, infections, particularly B19 parvovirus, thymoma and other solid tumours, as well as a number of other diseases, medications, or toxic substances. Immunosuppression is commonly used as a treatment for PRCA, however particular pathogenic subtypes have particular therapeutic techniques connected with them. Whether used in conjunction with corticosteroids or not, cyclosporine A seems to be the most potent immunosuppressive medication.

Myasthenia gravis

1. Antibodies in myasthenia gravis (MG) prevent neurons and muscles from communicating with one another, which causes the skeletal muscles to weaken.
2. The voluntary muscles of the body, particularly those that govern the eyes, mouth, throat, and limbs, are impacted by myasthenia gravis.
3. Although the illness can affect anyone at any age, young women (between the ages of 20 and 30) and older men are more likely to contract it.
4. Breathing or swallowing issues can occur during a myasthenia gravis crisis.
5. Myasthenia gravis has no known cause and no known treatment, although early diagnosis and immediate medical attention can help people live longer, more active lives.

Thymus Cancer

Under the breastbone in your chest, there is an organ called the thymus gland. It is a component of your body's immune system's lymphatic system. Lymphocytes, a type of white blood cell that aids in the body's ability to fight infection, are produced by the thymus gland.

- Thymoma and thymic carcinoma are the two main types of thymus cancer, both of which are extremely uncommon. When cancerous cells develop on the thymus' outer surface, cancer develops.
- Thymic carcinoma is more aggressive than thymoma and is also more challenging to treat. Type C thymoma is another name for thymic cancer.
- Thymoma patients may also have autoimmune conditions including rheumatoid arthritis, myasthenia gravis, or acquired pure red cell aplasia.