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**Topic: Thyroid Gland**

### **Thyroid Gland**

- The name “thyroid” was introduced by Thomas Wharton in 1656. It is derived from Greek, ‘Throes’ a shield.
- Thyroid gland is a butterfly-shaped, median endocrine gland located below larynx. It is bilobed in birds and mammals (single lobed in reptiles). Right and left lobes are connected by a narrow nonglandular median part called ‘isthmus’.
- Thyroid is the ventral evagination of the floor of pharynx and is endodermal in origin.
- Thyroid gland is homologous to the endostyle of lower chordates.
- Thyroid gland is the largest endocrine gland in body. It produces hormones like thyroid hormones and calcitonin.
- The thyroid gland consists of numerous spherical hollow sacs called thyroid follicles and parafollicular cells.
- Thyroid follicles are lined with a simple cuboidal epithelium composed of follicular cells. The interior of the follicles contains colloid, a protein-rich fluid.

- The follicular cells produce two hormones; thyroxine also called tetraiodothyronine or  $T_4$  because it contains four atoms of iodine and triiodothyronine or  $T_3$ , which contains three atoms of iodine.  $T_3$  and  $T_4$  together are known as thyroid hormones.
- The parafollicular cells (or C-Cells) lie between follicles and secrete a hormone known as Calcitonin (or thyrocalcitonin).

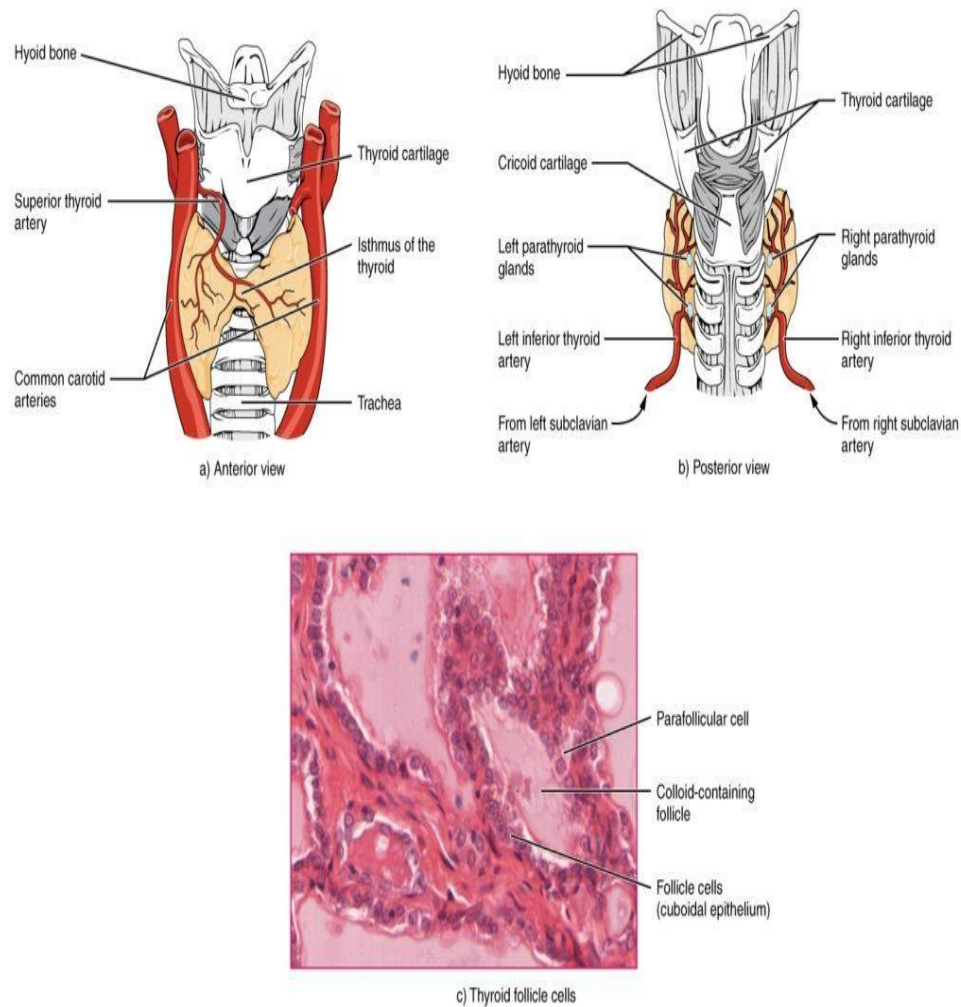


Fig. Thyroid Gland, A- Anterior view, B- Posterior View , C- Thyroid Follicle Cells

## Production and role of thyroid hormone:

The follicular cells of thyroid follicles actively accumulate iodide from the blood and secrete it into the colloid.

In the colloid, iodide is oxidized into iodine and attached to a tyrosine residue of thyroglobulin protein. Thyroglobulin is also synthesized and secreted by follicular cells.

The attachment of one iodine to tyrosine produces moniodotyrosine (MIT); the attachment of two iodines produces diiodotyrosine (DIT). Within the colloid, enzymes modify the structure of MIT and DIT and couple them together.

When two DIT molecules that are appropriately modified are coupled together, a molecule of tetraiodothyronine ( $T_4$ ) is produced. The combination of one MIT with one DIT forms triiodothyronine ( $T_3$ ).

Upon stimulation by TSH, the thyroid hormones, bound to thyroglobulin, are taken into the follicular cells. Hydrolysis reactions within the follicular cells release the free  $T_4$  and  $T_3$ , which are secreted.

The major hormone secreted by the thyroid gland is thyroxine ( $T_4$ ). It travels in the blood attached to carrier proteins. The thyroid also secretes a small amount of triiodothyronine ( $T_3$ ).

The carrier proteins have a higher affinity for  $T_4$  than for  $T_3$ . Approximately 99.96% of the  $T_4$  in the blood remain attached to carrier proteins in the plasma.

Free T4 and T3 enter target cells. Once the free T4 passes into the target cell cytoplasm, it is enzymatically converted into T3. Hence it is the T3 rather than T4 that is active within the target cells.

The actions of thyroid hormones are mediated by their binding to nuclear receptors. Receptors for thyroid hormone are, like all the steroid hormone receptors, act as transcription factors that regulate gene expression in target cells.

Unlike some steroid receptors (such as glucocorticoids) , thyroid hormone receptors exist in the nucleus, not the cytoplasm, and may remain bound to DNA in the absence of hormone binding.

Thyroid hormones play an important role in the regulation of the basal metabolic rate. It increases the basal metabolic rate in most tissues (exceptions include brain, spleen and testes) by stimulating the use of cellular oxygen.

When the basal metabolic rate increases, cellular metabolism of carbohydrates, lipids, and proteins increases. As cells produce and use more ATP, more heat is generated, and body temperature rises. This phenomenon is called the calorogenic effect.

A second major effect of thyroid hormones is to stimulate synthesis of  $\text{Na}^+ -\text{K}^+$  ATPase. Together with human growth hormone and insulin thyroid hormones accelerate body growth, particularly the growth of the nervous and skeletal systems.

Calcitonin is a peptide hormone secreted by parafollicular cells of the thyroid gland that are distinct from the thyroid follicles. Thyroid cells produce calcitonin in response to high calcium levels in the blood. It decreases plasma calcium concentration by decreasing mobilization of calcium from bones; therefore promotes osteoblastic activity.

## **Parathyroid gland**

The parathyroid glands are four small glands present on the back side of the thyroid gland, one pair each in the two lobes of the thyroid gland.

They secrete parathyroid hormone (PTH) or collip's hormone, which increases levels of calcium in the blood. Its secretion is regulated by the calcium level in the blood.

Bone tissue acts as a storage reservoir for calcium and PTH stimulates the removal of calcium from the bone to increase levels in the blood; therefore it stimulates osteoclastic activity.

It increases the reabsorption of calcium by the renal tubules of kidney so that less in urine but at the same time it stimulates the loss of phosphates in the urine.

It also stimulates kidney to secrete calcitriol which, in turn, increases calcium absorption from the digested food in the gut. PTH is thus a hypercalcemic hormone; i.e. it increases the blood calcium levels.

## **Thymus Gland**

The thymus is located behind the sternum between the lungs. It grows during childhood, but gradually decreases in size after puberty.

The hormones produced by the thymus—thymosin, thymic humoral factor, thymic factor and thymopoietin—promote the maturation of T-cells and may retard the aging process.

Thymus hormones called thymosins stimulate the development and differentiation of T-lymphocytes or T-cells. They play a role in regulating the immune system by stimulating other kinds of immune cells as well. It is also responsible for growth during childhood.

