HUMAN ANATOMY & PHYSIOLOGY-II- BP201T

UNIT: 4 (ENDOCRINE SYSTEM)
CLASS: 4

TOPIC: THYROID GLAND

Thyroid is an endocrine gland situated at the root of the neck on either side of the trachea. It has two lobes, which are connected in the middle by an isthmus. Thyroid is larger in females than in males.

Thyroid gland is composed of large number of closed follicles. These follicles are lined with cuboidal epithelial cells, which are called the follicular cells. Follicular cavity is filled with a colloidal substance known as thyroglobulin, which is secreted by the follicular cells. Follicular cells also secrete tetraiodothyronine (T4 or thyroxine) and tri-iodothyronine (T3). In between the follicles, the parafollicular cells are present, secrete calcitonin.

Thyroid gland secretes three hormones:

1. Tetraiodothyronine or T4 (thyroxine)

2. Tri-iodothyronine or T3

3. Calcitonin.

Both T4 and T3 are iodine-containing derivatives of amino acid tyrosine.

The potency of T3 is four times more than that of T4. T4 acts for longer period than T3. Duration of T4 action is four times more than T3 action. This is because of the difference in the affinity of these hormones to plasma proteins. T3 has less affinity for plasma proteins and combines loosely with them, so that it is released quickly. T4 has more affinity and strongly binds with plasma proteins, so that it is released slowly.

T4 has a long half-life of 7 days. Half-life of T3 is varying between 10 and 24 hours.

Degradation of thyroid hormones occurs in muscles, liver and kidney.

Synthesis of thyroid hormones occurs in five stages: 1. Thyroglobulin synthesis 2. Iodide trapping 3. Oxidation of iodide 4. Transport of iodine into follicular cavity 5. Iodination of tyrosine 6. Coupling reactions.

1. Thyroglobulin Synthesis

Endoplasmic reticulum and Golgi apparatus in the follicular cells of thyroid gland synthesize and secrete thyroglobulin continuously.

2. Iodide Trapping

Iodide is actively transported from blood into follicular cell, against electrochemical gradient. This process is called iodide trapping.

3. Oxidation of Iodide

Iodide must be oxidized to elementary iodine, because only iodine is capable of combining with tyrosine to form thyroid hormones. The oxidation of iodide into iodine occurs inside the follicular cells in the presence of thyroid peroxidase.

4. Transport of Iodine into Follicular Cavity

From the follicular cells, iodine is transported into the follicular cavity by an iodide-chloride pump called pendrin.

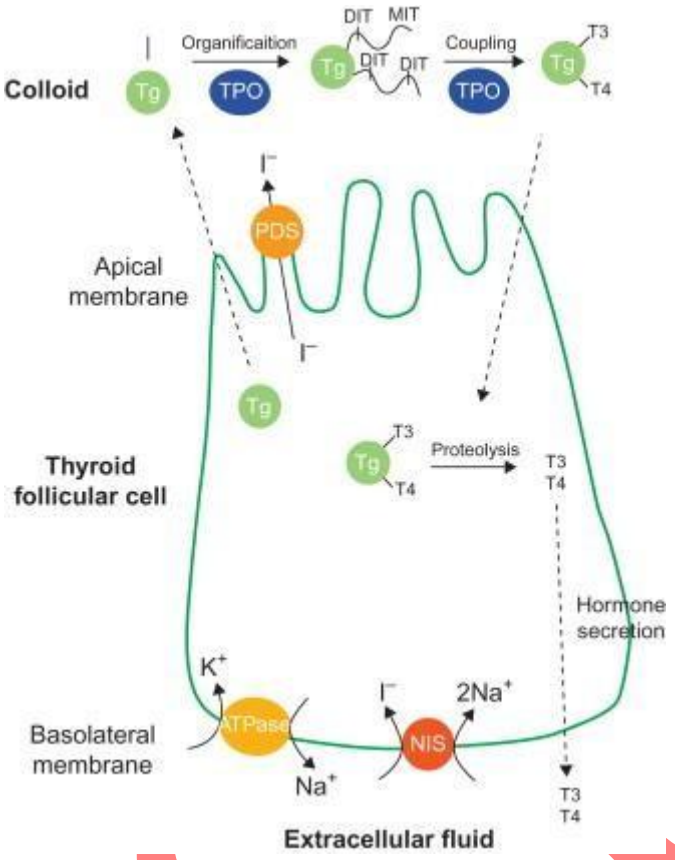
5. Iodination of Tyrosine

Combination of iodine with tyrosine is known as iodination. It takes place in thyroglobulin. First, iodine is transported from follicular cells into the follicular cavity, where it binds with thyroglobulin. This process is called organification of thyroglobulin. Then, iodine (I) combines with tyrosine, which is already present in thyroglobulin. Tyrosine is iodized first into monoiodotyrosine (MIT) and later into di-iodotyrosine (DIT). MIT and DIT are called the iodotyrosine residues.

6. Coupling Reactions

Iodotyrosine residues get coupled with one another. One molecule of DIT and one molecule of MIT combine to form tri-iodothyronine (T3). Sometimes one molecule of MIT and one molecule of DIT combine to produce another form of T3 called reverse T3 or rT3. Two molecules of DIT combine to form tetrai-odothyronine (T4), which is thyroxine.

Thyroid gland is unique in this, as it is the only endocrine gland that can store its hormones for a long period of about 4 months.



Thyroglobulin itself is not released into the bloodstream. On the other hand, the hormones are first cleaved from thyroglobulin and released into the blood.

Follicular cell sends foot-like extensions called pseudopods, which close around the thyro globulin-hormone complex. This process is mediated by a receptor-like substance called megalin, which is present in the membrane of follicular cell. Pseudopods convert thyroglobulin-hormone com□plex into small pinocytic vesicles. Then, lysosomes of the cell fuse with these vesicles. Digestive enzymes such as proteinases present in lysosomes digest (proteolysis) the thyroglobulin and release the hormones. Now, the hormones diffuse through base of the follicular cell and enter the capillaries.

FUNCTIONS OF THYROID HORMONES

Thyroid hormones have two major effects on the body:

I. To increase basal metabolic rate

II. To stimulate growth in children.

When iodine intake is high, the enzymes necessary for synthesis of thyroid hormones are inhibited by iodide itself, resulting in suppression of hormone synthesis. This effect of iodide is called **Wolff-Chaikoff effect.**