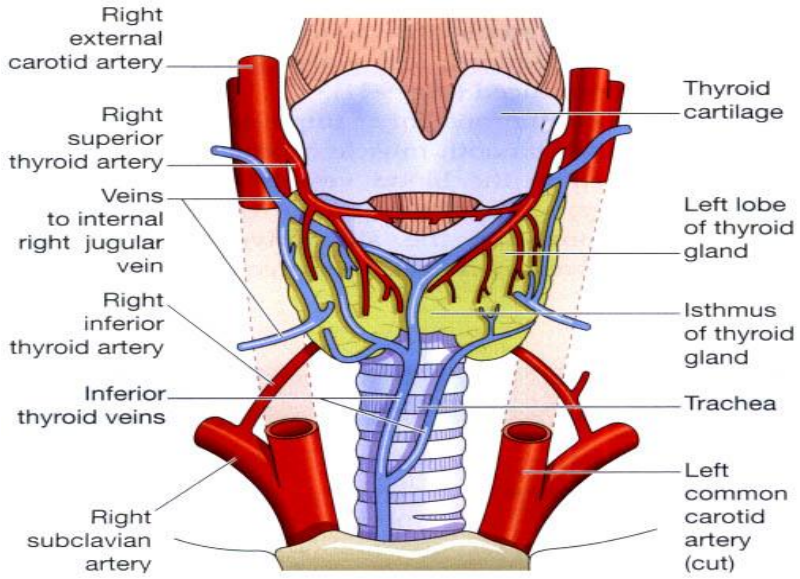
UNIT-4 THYROID GLAND

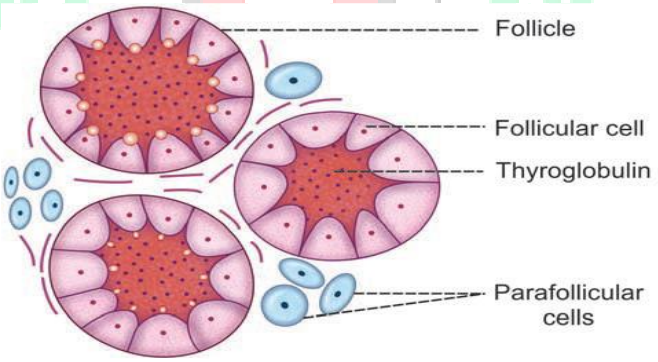
INTRODUCTION

- Thyroid is an endocrine gland situated at **the root of the neck on either side of the trachea**.
- Situated in the neck in front of the larynx and trachea at the level of the 5th, 6th and 7th cervical and 1st thoracic vertebrae.
- It weighs about **20 to 40 g** in adults.
- Thyroid is **larger in females** than in males.
- It is surrounded by a fibrous capsule has **two lobes,** which are connected in the middle by an **isthmus**.
- It resembles a **butterfly** in shape.

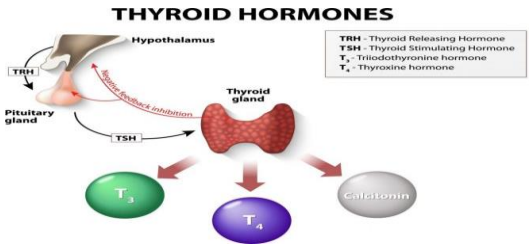


- The lobes are roughly **cone-shaped**, about 5 cm long and 3 cm wide.

- The *arterial blood supply* to the gland is through the **superior and inferior thyroid arteries**.
- The superior thyroid artery is a branch of the **external carotid artery** and the inferior thyroid artery is a branch of the **subclavian artery**.
- The *venous return* is by the thyroid veins which drain into the **internal jugular veins**.
- **Two parathyroid glands** lie against the posterior surface of each lobe and are sometimes embedded in thyroid tissue.
- The recurrent **laryngeal nerve** passes upwards close to the lobes of the gland and on the right side it lies near the inferior thyroid artery.
    - HISTOLOGY
- 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 which secrete calcitonin.



HORMONES OF THYROID GLAND:



Thyroid gland secretes three hormones:

1. Tetraiodothyronine or T4 (thyroxine)
2. Tri-iodothyronine or T3
3. Calcitonin.

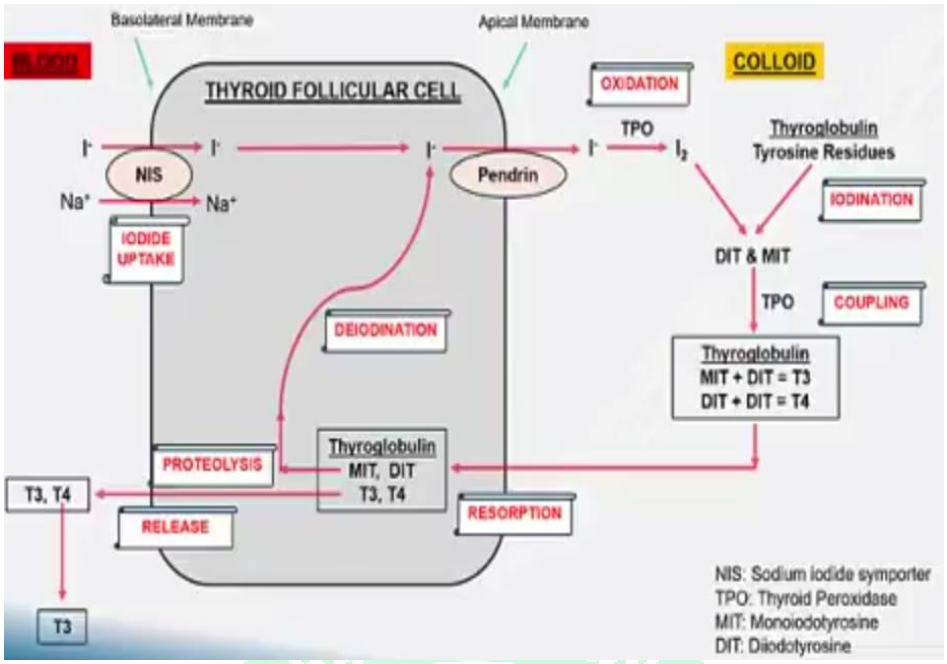
- Both T4 and T3 are iodine-containing derivatives of amino acid **tyrosine.**
- The potency of T3 is four times more than that of T4.
- T4 acts for longer period than T3. Duration of T4 action is **four times more** than T3 action.
- **T3 has less affinity** for plasma proteins and combines loosely with them, so that it is released quickly.
- **T4 has more affinity** and strongly binds with plasma proteins, so that it is released slowly. Therefore, T3 acts on the target cells immediately and T4 acts slowly.
- Thyroid hormones have long half-life. **T4 has a long half life of 7 days**. Half-life of T3 is varying between 10 and 24 hours.

SYNTHESIS OF HORMONES:

Synthesis of thyroid hormones takes place in **thyroglobulin**.

Synthesis of it occurs in **six** stages:

- Thyroglobulin synthesis
- Iodide trapping
- Oxidation of iodide
- Transport of iodine into follicular cavity
- Iodination of tyrosine
- Coupling reactions.



Thyroglobulin Synthesis

- Endoplasmic reticulum and Golgi apparatus in the follicular cells of thyroid gland synthesize and secrete thyroglobulin continuously.
- Thyroglobulin molecule is a large glycoprotein containing **140 molecules of amino acid tyrosine.**
- After synthesis, thyroglobulin is **stored in the follicle**.

Iodide Trapping

- Iodide is actively transported from blood into follicular cell, against electrochemical gradient. This process is called **iodide trapping.**
- Normally, iodide is **30 times more concentrated** in the thyroid gland than in the blood.
- During hyperactivity of the thyroid gland, the concentration of iodide increases **200 times more**.

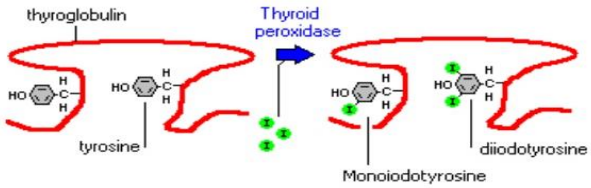
Oxidation of Iodide

- Iodide must be oxidized to elementary iodine and it occurs inside the follicular cells in the presence of **thyroid peroxidase.**
- Absence or inactivity of this enzyme stops the synthesis of thyroid hormones.

Transport of Iodine into Follicular Cavity

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

Iodination of Tyrosine

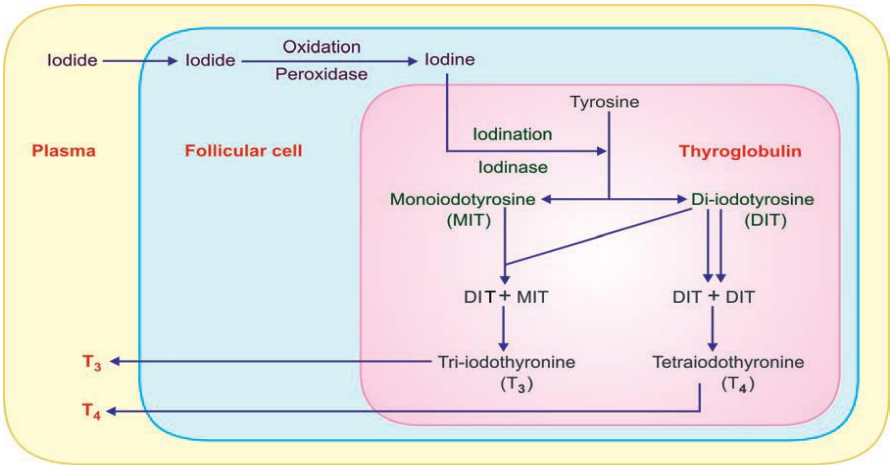


- Combination of iodine with tyrosine is known as **iodination**. It takes place in thyroglobulin.
- First, iodine is transported from follicular cells into the follicular cavity, where it binds with thyroglobulin. This process is called **organification** of thyroglobulin.
- Then, iodine (I) combines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

Coupling Reactions

Iodotyrosine residues get coupled with one another. The coupling occurs in different configurations, to give rise to different thyroid hormones.

- Tyrosine + I = Monoiodotyrosine (MIT)
- MIT + I = Di-iodotyrosine (DIT)
- DIT + MIT = Tri-iodothyronine (T3)
- MIT + DIT = Reverse T3
- DIT + DIT = Tetraiodothyronine or Thyroxine (T4)



STORAGE AND RELEASE:

- After synthesis, the thyroid hormones remain in the **form of vesicles within thyroglobulin** and are stored for long period.
- Thyroglobulin itself is not released into the bloodstream.
- On the other hand, the hormones are first **cleaved from thyroglobulin** and released into the blood.
- MIT and DIT are not released into blood. These Iodotyrosine residues are deiodinated by an enzyme called **iodotyrosine deiodinase**, resulting in the release of iodine.
- The iodine is **reutilized** by the follicular cells for further synthesis of thyroid hormones.

REGULATION OF HORMONE