Lecture title: Thyroid gland

Lecturer Affiliation: University of Mosul / College of Veterinary Medicine / Department of Physiology, Biochemistry and Pharmacology

Thyroid gland

Thyroid gland releases thyroid hormones; triiodothyronine (T_3), and itis prohormone thyroxin (T_4), they are tyrosine based-hormones thatregulate body metabolism.

Thyroid hormones synthesis, transport, and catabolism

1. Thyroid gland follicular epithelial cells synthesize thyroid hormone by incorporating iodine (I) into the amino acid on the surface of the thyroglobuline (Tg) a protein secreted into the colloid of the follicle (fig.).
2. Iodide is a key substrate for thyroid hormone synthesis.
3. The trapping of iodide (I^-) from blood circulation is the first step in the formation of thyroid hormones.
4. The trapping is done by thyroid follicular cells and promoted by TSH.
5. Trapping enzyme, Na^+-K^+ ATPase, catalyzes the process and

require oxygen and it is ATP dependent.

6. After trapping, peroxidase enzyme catalyzes oxidation of I^- resulting in very high active iodine. This iodine is bind to Tg forming monoiodotyrosine (MIT) or diiodotyrosine (DIT).

7. Within a few minutes of TSH stimulation, the process of hormonogenesis is accomplished.

8. Deiodination of MIT and DIT by the action of the enzyme deiodinase

form T3 and T4.

9. Result iodine is recycled within the gland, and T3 and T4 are release into blood circulation by simple diffusion.

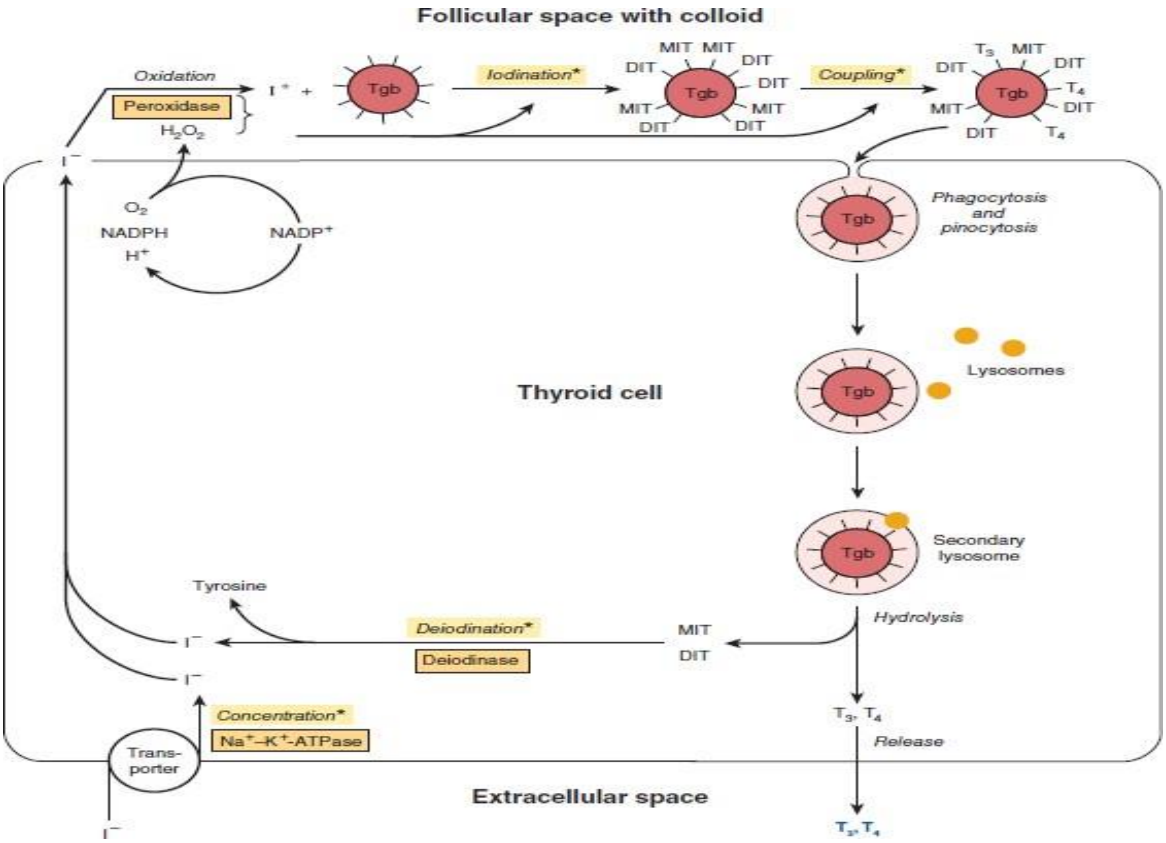
10. Thyroid gland secretes predominantly T4 and only small amount of T3.

11. Approximately 85% of T_3 in blood is produced from T_4 by a family of enzymes known as monodeiodinase which are active in liver, heart, muscle,and kidney.

12. Because of long half-life (about 7 days), T_4 can be regarded as a prohormone, in contrast to T_3 which has relatively short half-life (about 18 hours).

13. Immediately when thyroid hormones enter circulation, they are bind mainly (about 99%) to thyroxine-binding globulin (TBG).

14. After performing their actions, thyroid hormones undergo different reactions as deiodination, oxidation, and conjugation. Released iodine is returned into iodine pool. While thyroid hormones amino acids are deaminated and decarboxylated in the liver



Functions of thyroid hormone

Regulate two main types of process:

1. Metabolic pathways to:

a. Modulate oxygen consumption.

b. Regulate basal metabolic rate (BMR).

c. Control lipid, carbohydrate, and protein metabolism.

2. Trigger cell differentiation and maturation in many tissues.

Thyroid hormones act nearly on all body cells via two different mechanisms:

1. A direct action of T4, and T_3 on plasma membrane or on subcellularorganelles.
2. T_3 act by binding to nuclear receptors affecting gene expression.

Thyroid hormones (T3 and/or T4) deficiency results in a well-known clinical problem, hypothyroidism, in contrast hyperthyroidism (sometimes called thyrotoxicosis) due to excess thyroid hormone levels. While goiter is refer to the enlargement of thyroid gland, and interestingly it is related to hypothyroidism or hyperthyroidism, the majority (90%) of goiter is due to iodine deficiency.

Parathyroid gland

Parathyroid glands are exist in all air-breathing vertebrates andhave two distinct types of cells:

1. Chief cells, the abundant, that contain a prominent Golgi apparatus, these cells synthesis and secrete parathyroid hormone (PTH).

2. Oxyphil cells, the rare, contain oxyphil granules and large number of mitochondria. The number of this type of cells rise with age, and their functions remain unclear.

Parathyroid hormone (PTH)

A linear polypeptide 84 amino acids with molecular weight of 9500 Da, PTH has short half-life (about 10 minutes) in which they rapidly cleaved in Kupffer cells of liver into inactive fragments

Functions of PTH

1. The main action of PTH is to fine regulation of blood calcium in theblood.
2. Act directly on bone to elevate bone resorption and mobilize Ca^{2+}.
3. Increase osteolysis and number of osteoclast in bones.
4. Decrease phosphorus concentration in blood (leading to elevate Ca^{2+}amount) by rise of phosphate excretion in the urine.
5. Increase formation of 1,25 DHC and this increase intestinal Ca^{2+}absorption via calbindi