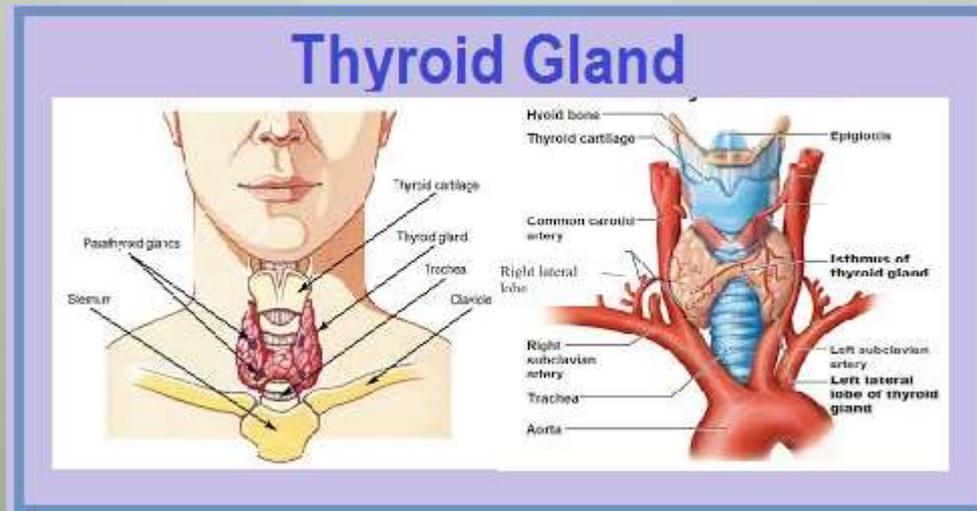




4. THYROID HORMONES .



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Thyroid Hormones

•Functions of the Thyroid Gland :

1. Maintains normal oxidative metabolism.
2. Necessary for normal growth and maturation.
3. Affects calcium metabolism.

•Actions of thyroid hormones:

- 1) General Metabolism (Calorigenesis) : Increase oxygen consumption, increase heat production and B.M.R .
- 2) Increase blood glucose level by stimulating glycogenolysis, gluconeogenesis, they also increase glucose uptake by the tissues.
- 3) Decrease blood cholesterol and phospholipids .
- 4) Increase protein synthesis , and they also increase protein breakdown (in normal level of thyroid hormones it causes protein synthesis) . An excess of circulating hormones induces a net protein deficit due to excessive catabolic activity while decreased hormone levels result in decreased protein anabolism . Therefore in both hypo-and hyperthyroidism, growth development, and the maintenance of structural and other tissues are usually impaired .
- 5) Cause diuresis and increase excretion of K^+ , Ca^{++} and PO^{--} in urine
- 6) Stimulate conversion of B-Carotenes to vitamin A

7) Growth and tissue differentiation and maturation :

Thyroxine is necessary for growth and maturation of most tissues through;

- Stimulation of growth hormone secreting cells in the anterior pituitary and help its action.
- Stimulation of protein synthesis

8) CNS: Thyroxine is essential for normal activity and development of CNS

9) Cardiovascular system : - Thyroid hormones increase the heart rate due to increase in O₂ consumption, rhythmicity , sensitivity of S.A.N. to circulating adrenaline as it increase the number of β receptors.

- Increase cardiac output (by potentiating the chronotropic and inotropic effects of circulating catecholamine and by direct action on the heart) (it increase the number and affinity of β receptors to catecholamines).

- Decrease the peripheral resistance (vasodilatation) .

- Increase Systolic A.B1.P. and decrease (or unaltered) diastolic A.B1.P. ---- increase the pulse pressure

10) Blood ; increase R.B.Cs. formation.

11) Mammary gland : Promote Galactopoiesis , maintain milk secretion during lactation

12) Gonads : Thyroxine is important for normal gonadal function. It also inhibit prolactin hormone production .

13) G.I.T.: enhance motility and increase appetite ,

14) Respiratory system : increase pulmonary ventilation.

15) Muscles: \uparrow or \downarrow thyroid hormones level cause muscular weakness (Thyrotoxic myopathy)

• Regulation of thyroid secretion:

1- Thyrotropin (Thyroid stimulating hormone -TSH):

It is a hormone secreted from the anterior pituitary gland (see page 25 and Fig.20)

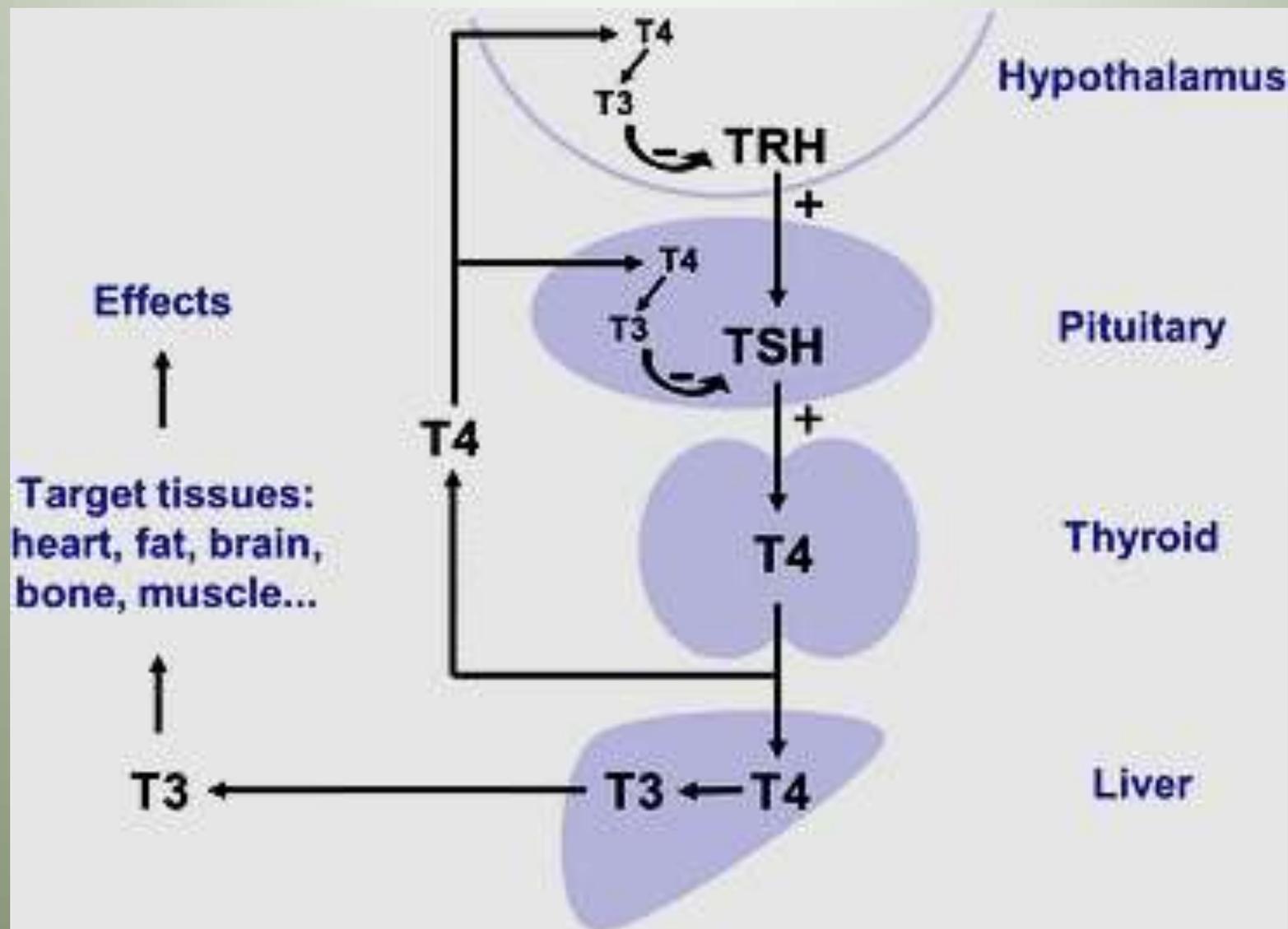
2- Long Acting Thyroid Stimulator (L.A.T.S.):

It is a hormone probably formed by lymphocytes , related chemically to antibodies, stimulating the thyroid gland, with long acting effect (TSH is rapid and of short duration effect). It is considered at present to be the cause of thyrotoxicosis (Hyperthyroidism).

3. Iodine Supply :

- Excess iodine to normal person → stored in the gland without any increase in thyroxine level .
- Excess iodine to mild or severe hypothyroidism (with enlargement due to increase TSH, decrease I₂ content , normal or decreased T₄) →the gland returns to normal condition and decreases the hyperplasia because iodine inactivates the TSH.
- Excess iodine to hyperthyroid person decreases T₄ formation due to inactivation of TSH and inhibition of T₄ biosynthesis i.e **Wolff-Chaikoff effect** (inhibition of organification of trapped iodide by excess iodide or iodine administration).

4. Autonomic nervous system .Sympathetic nerve stimulate thyroid secretion and effect.



- **Thyroid hormone receptors:**

- Two types of thyroid hormone receptors are known in the nuclei of the target cells:

1. **hTR α receptors** (for general metabolic function) .

2. **hTR β receptors** (play a special role in brain development and maturation and TSH secretion).

- The thyroid hormones enter the cells and binds to the receptors in the nuclei. The thyroid hormone-receptor complex binds to DNA and increase the expression of specific genes → formation of mRNA that trigger the production of various enzymes.

- **Thyroid hormone resistance :**

- It is an abnormality in which there is a resistance to the effect of T3 and T4 in tissues and pituitary as a result of mutation in gene that codes for hTR β receptors.

- The patients are not clinically hypothyroid as they maintain high plasma levels of T3 and T4 and the hTR α receptors are unaffected . The plasma TSH level is high and is non-suppressible (thyroid hormone resistance in the pituitary).

- A few patients have peripheral resistance with normal pituitary sensitivity, normal T3 and T4 and TSH , however they have hypo-metabolism and they require large doses of thyroid hormone to increase their metabolic rate.

- N.B. “Attention Deficit-Hyperactivity Disorder” (ADHD):**

- A condition diagnosed in children who are overactive and impulsive with thyroid hormone resistance. This suggests that hTR β receptors play a special role in brain development .

- Disorders of Thyroid Function:

- (A) Hypothyroidism**

- 1-Cretinism:** Causes:

This is hypothyroidism occurring in utero or early life due to complete absence of the thyroid gland or due to a metabolic defect (the gland is unable to make the hormones) . The defect is usually detected at 6 months of age.

- 2. Myxoedema:** Causes:

This is hypothyroidism in adults due to damage of the thyroid tissue as after unavoidable surgical removal.

- B) Hyper-thyroidism (thyrotoxicosis)-(Grave's disease) –(Exophthalmic goitre):** Causes:

- Excessive production of thyroid hormones , as a result of presence of LATS (long acting thyroid stimulator in the serum of patients).
- It is an autoimmune disease in which T lymphocytes activated by antigens in the thyroid gland stimulates B lymphocytes → production of antibodies:
 - Some of the antibodies damage the thyroid gland: a condition known as Hashimoto's thyroiditis → Hypothyroidism .
 - Some of the antibodies are formed against components of TSH receptors → excessive stimulation. → Hyperthyroidism These antibodies are known as Thyroid Stimulating Immunoglobulins (TSI) or LATS.

Types of congenital hypothyroidism



HYPOTHYROIDISM



Hyperthyroidism symptoms



Hand tremors



Difficulty in sleeping



Hair loss



Menstrual problems



Swollen eyes



Weight loss



Irregular heart rate



Elevated blood pressure



Nervousness



Feeling hungry

Thyrocalcitonin

•It is a calcium lowering hormone, secreted by the para-follicular or C- cells of the thyroid gland. It is a polypeptide with a molecular weight of about 3600 .

•**Action:**

- If injected , it lowers rapidly the plasma calcium level by preventing transfer of calcium from bone to blood (suppress mobilization of Ca^{++} from bone).

- It decreases osteoclast activity and number.

- It increases Na^+ , Ca^{++} , and phosphate excretion in urine. So it causes decrease in plasma Ca^+ level and inorganic phosphate.

N.B.: There is general agreement that the hormone is relatively inactive in adult animals and humans.

•**Regulation of secretion:**

It is secreted as a result of rise in Ca^{++} level in plasma i.e. by simple feed-back mechanism.

Thank You