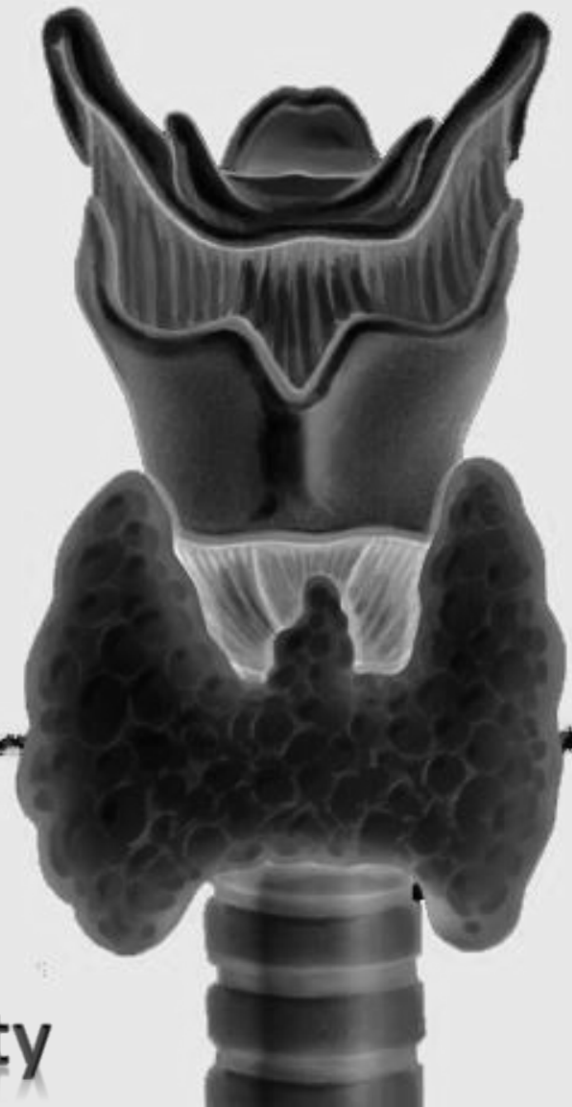


Thyroid gland

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Structure

- It is formed of two lobes connected by a narrow isthmus .
- The gland is formed of thyroid follicles , each follicle is surrounded by a single layer of epithelial cells and its lumen is filled with a protein material called colloid (which is formed and secreted by follicular cells).
- In between the follicles there are other cells called parafollicular cells .
- The gland is richly supplied with blood vessels .

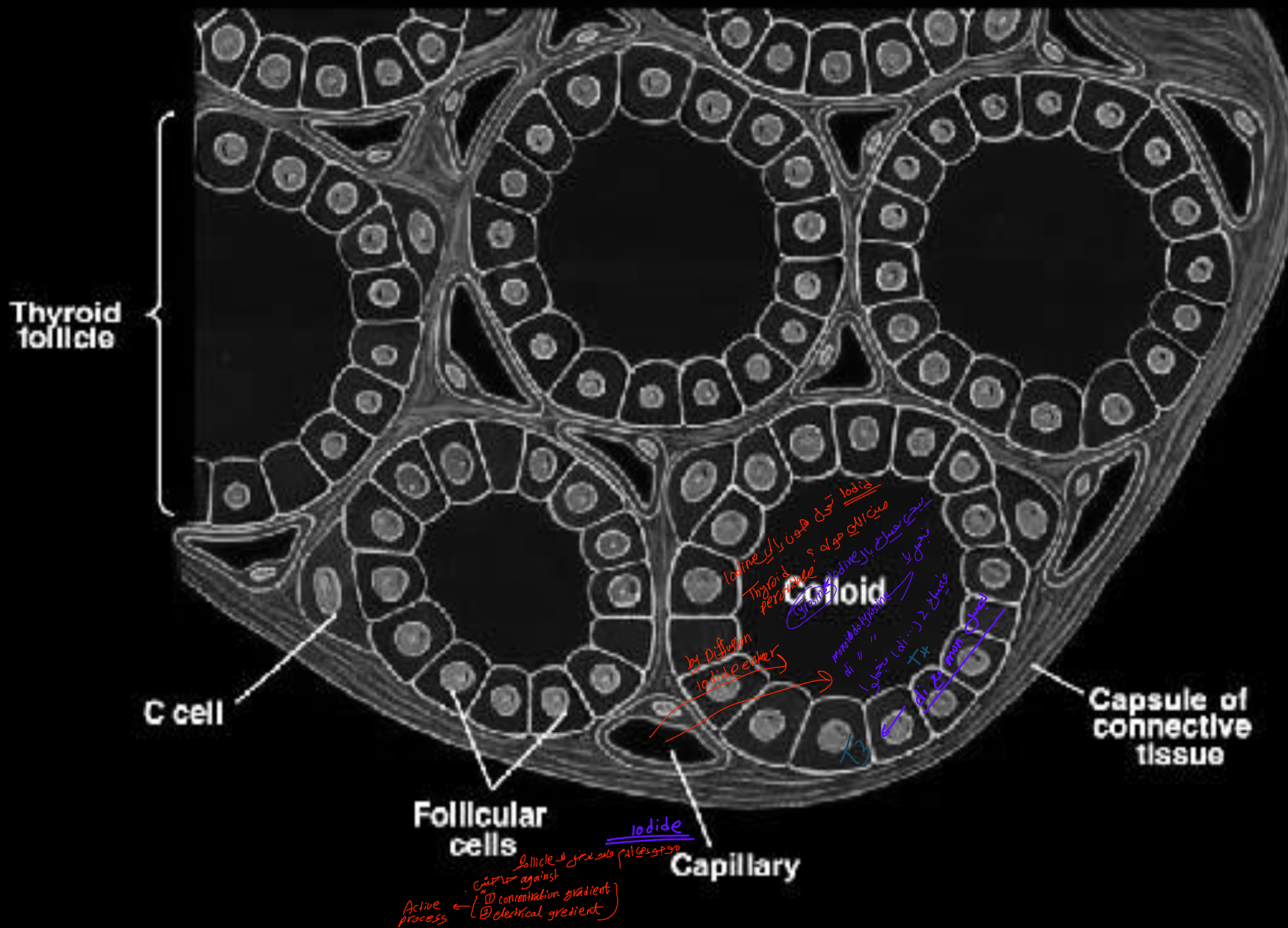
Ex thyroid: normal thyroid fun → cuboidal

hyper = → columnar

hypo = → squamous, flat, colloid ↑↑, size follicle ↑



Section of thyroid gland



Thyroid hormones

1. Thyroxine (T_4) : tetraiodothyronine
2. Triiodothyronine (T_3)

both T_3 & T_4 are formed by thyroid follicles

3. Calcitonin : secreted by parafollicular cells (C cells) it causes lowering of blood Ca^{++} level .



Transport of thyroid hormone

- Once T_3 and T_4 enter the circulation, they bound to ^{mainly albumin} plasma proteins and only less than 1% of the hormones are free.
- This free form of the hormone is the active form that can perform its actions.
- T_3 is more active than T_4 and T_4 is converted to T_3 inside target cells.



Mechanism of action :

- Thyroid hormone enter the cells , bind to the **receptor** in the **nucleus** → increase **transcription of mRNA** that stimulate the production of various **enzymes** in the **ribosomes** .



Actions of T_3 and T_4

1. Metabolic function

a. Calorigenic action : *general metabolic effect*

Thyroid hormones increase O_2 consumption, heat production and basal metabolic rate (BMR).

روح على كل من الغدة الكظرية
وبالغدة
↑ حرارة
↑ BMR

b. On protein metabolism :

Normal level of thyroid hormones increase protein synthesis (anabolic effect) .

High level of thyroid hormones increase protein breakdown (catabolic effect) .

excess anabolic و ليس



↑ glucose → transient

c. On carbohydrate metabolism : ↓ glucose

Thyroid hormone increase glucose absorption from GIT so blood glucose increase after meal , but rapidly fall to normal level again due to increased uptake of glucose by the tissues to be used for energy production .

d. On lipid and cholesterol metabolism : ↓ lipid

They lower blood lipid and cholesterol by increasing its removal from circulation by the liver.

فقدان سريع للدهون والكوليسترول من الدم
فقدان سريع للكوليسترول في الدم
high lipid + cholesterol in Blood.

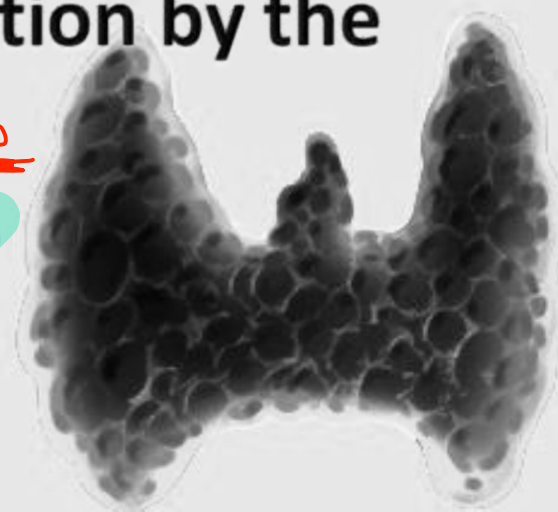
How to low Blood lipid + cholesterol ?
→ by increased Rec of lipid on liver's membrane.

فقدان

e. Stimulate conversion of carotenes to vitamin A in the liver .

Thyroid قلة وظئته
تحويل الكاروتينات في الدم
β-carotene

فقدان الكاروتينات في الدم
فقدان الكاروتينات في الدم
β-carotene



2. Effect on growth and development

Thyroid hormones are necessary for growth and maturation of most tissues.

← بناء GH ، الة permissive reaction
on GH in normal level
تأثيره الذي
During [intra fetal life] ، ↓ [Thyroid hormone] lead to
example :- امرأة حامل عندها hypothyroidism
في - دخلت placenta وأثره يبين نقل [TH]
تأثيره من فترات الحمل
delayed milestones + cretinism.

3. On CNS

– Thyroid hormones are essential for normal brain development during fetal life and in children .

نقصانه يجعل عنده الطفل
mental retardation

– In adult , they increase response of brain to catecholamines and increase activity of reticular activating system (RAS).

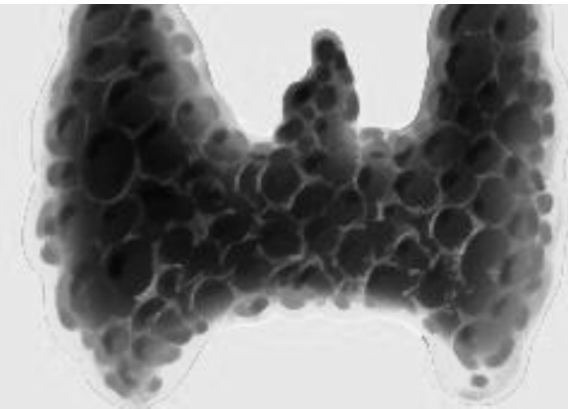
نشاطه ↑↑

hypothyroidism
↓
RAS
↓
نوم ، غفلة ، خمول

خلاصة:

في hypothyroidism:

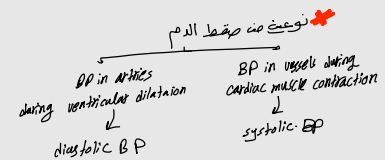
• استجابة الدماغ للكاتيكولامين تقل → خمول، اكتئاب، بطء في الانعكاسات
• عكس ما يحدث في hyperthyroidism، حيث يكون المريض مفرط النشاط وحساس جدًا للأدريالين



4. On CVS

a. They increase all cardiac properties by increasing number and affinity of β adrenergic receptors (to catecholamines) and by direct effect which lead to :

- Increase heart rate (H.R.) $\rightarrow \uparrow \text{force of contraction} \rightarrow \uparrow \text{S.V.}$
- Increase stroke volume (S.V.)
- Increase cardiac out put (COP)



Diastolic BP قلبي

- Increase systolic blood pressure .

↓ Diastolic BP ← peripheral resistance ← V.D of periphery ← زيادة المقاومة في الأوعية الطرفية

b. Cutaneous V.D occurs by the produced heat .

↓ peripheral resistance causes

decreased diastolic blood pressure .

c. Increased pulse pressure .

$\text{systolic} - \text{Diastolic} = \oplus \uparrow$



5. On **respiration**

↑ metabolic
↓ O₂
↑ CO₂

- shift of O₂ curve to Rt by increasing 2,3 DPG in RBCs
- Increase pulmonary ventilation due to increased metabolic rate with more O₂ utilization and more CO₂ formation (through activation of chemoreceptors).

6. On **GIT**

- Increase appetite and food intake .
- Increase GIT motility .

in case of hyperthyroidism
الطبخ وكثير ومانع

7. On **sex functions** :

- Thyroid hormone are essential for normal menstrual cycle & Spermatogenesis (normal fertility)



Regulation of thyroid hormone

1. Hypothalamic regulation

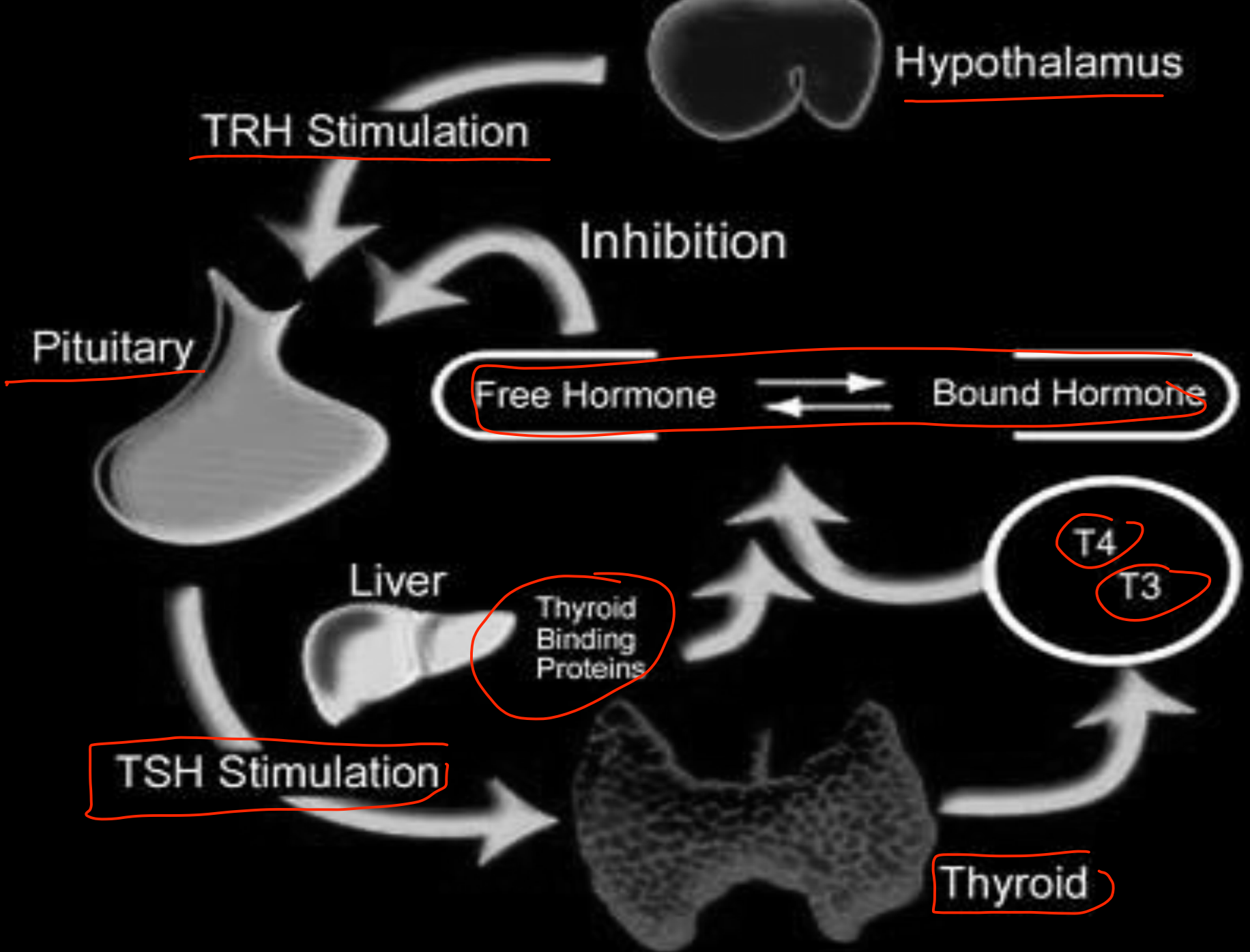
1. TRH (thyrotropin releasing hormone)

- Exposure to cold increase TRH release
- Stress , emotions and warmth decrease TRH

2. Somatostatin

- It inhibit TSH secretion thus it inhibit thyroid hormone secretion .





2. Pituitary regulation (TSH)

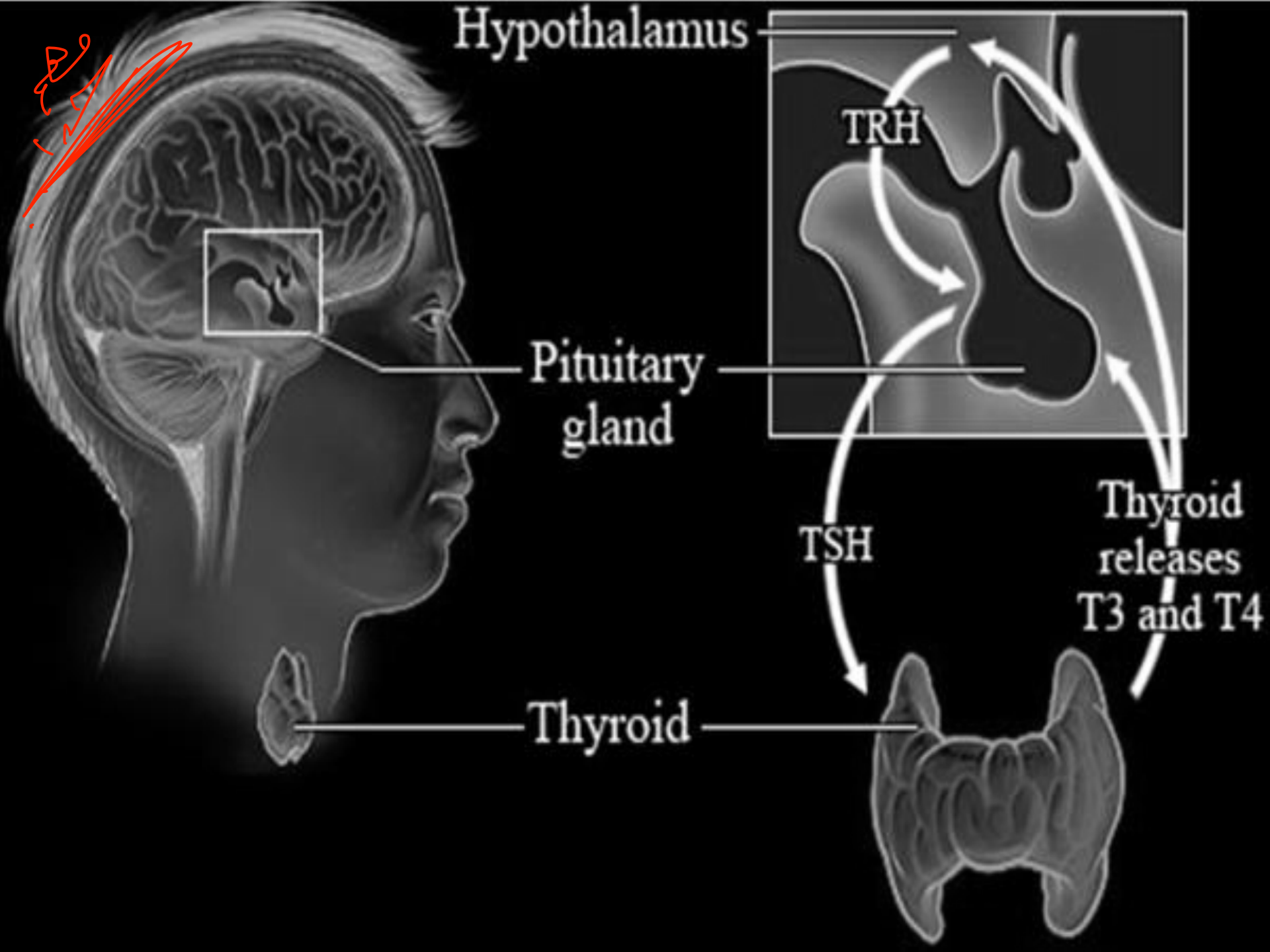
ففي
التحليل
داخلي يكون
TSH
T₄, T₃

3. Feedback regulation :

- ↑ free T₃ and T₄ in blood inhibit TSH secretion by negative feedback on anterior pituitary and hypothalamus .

- Thus , when free T₃ and T₄ decreased in blood TSH secretion will be increased .





4. Blood iodide level :

- Adequate dietary iodine intake is essential for normal thyroid function .
- Decreased iodine intake → ↓ T₃ and T₄ synthesis and release → ↑ TSH → ↑ size of the gland = thyroid enlargement (goiter)
- Excess iodide in blood → decreases thyroid hormone in blood as it inhibits thyroid hormone synthesis and release by blocking the action of TSH .

In case of Hyperthyroidism :-
سبب کمبود یا زیادتی ؟
بعض Iodide کمتر
عقلان ما یکنوع T₃/T₄



Goiter

Definition : **goiter** is **non-inflammatory** and **non-malignant thyroid enlargement** .



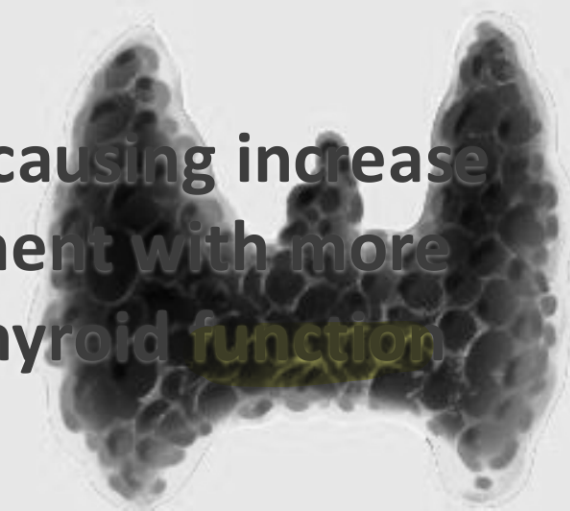
- Types :
 - simple
 - colloid
 - Toxic

1. Simple goiter :

It is associated with normal thyroid function

It is due to :

- Mild iodine deficiency
- During puberty and pregnancy , due to increase need for iodine .
- Thyroid hormone decreased at first causing increase in TSH which causes thyroid enlargement with more formation of thyroid hormone thus thyroid function remains normal .



2. Colloid Goiter :

Cause : severe iodine deficiency

Here , the enlarged thyroid gland can't synthesize excess thyroid hormone due to severe iodine deficiency .

It is associated with hypothyroidism .
with
colloid Goiter.



same Definitions

ما هي الغدة الكظرية (TSH) → مشكلة هورمون
enlargement, TSH, T₃, T₄ → ATS →

3. Toxic Goiter : This thyroid enlargement is associated with thyroid hyper function .

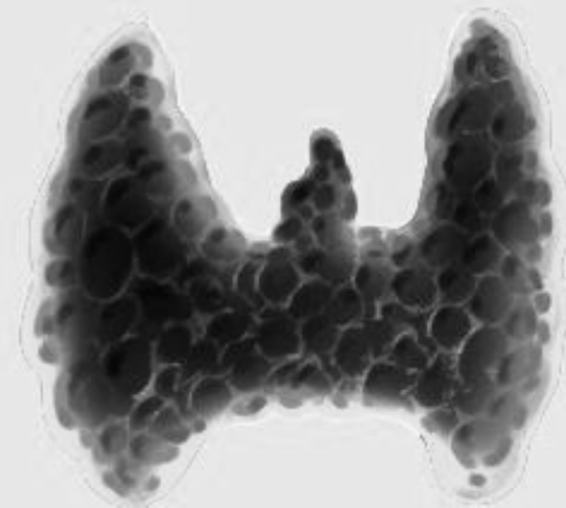
it is called Graves' disease .

it is an autoimmune disease in which the immune system secretes auto antibodies called long- acting thyroid stimulators (LATS) .

These antibodies activate TSH receptors producing hyperthyroidism due to increased formation of thyroid hormone .

▪ LATS have long duration of action .

Toxic Goiter
Graves
hyperthyroidism





THank you