THYROID.

- LARGEST GLAND IN THE BODY.

- FUNCTION =

1. Secretion of thyroxin.
2. Secretion of calcitonin.

SURGICAL ANATOMY.

- Weight---------20----25gm.
- Right and left lobe connected by isthmus.

- SITUATION= C5 to T1 vertebra.

- ISTHMUS = 2nd to 4th tracheal ring.

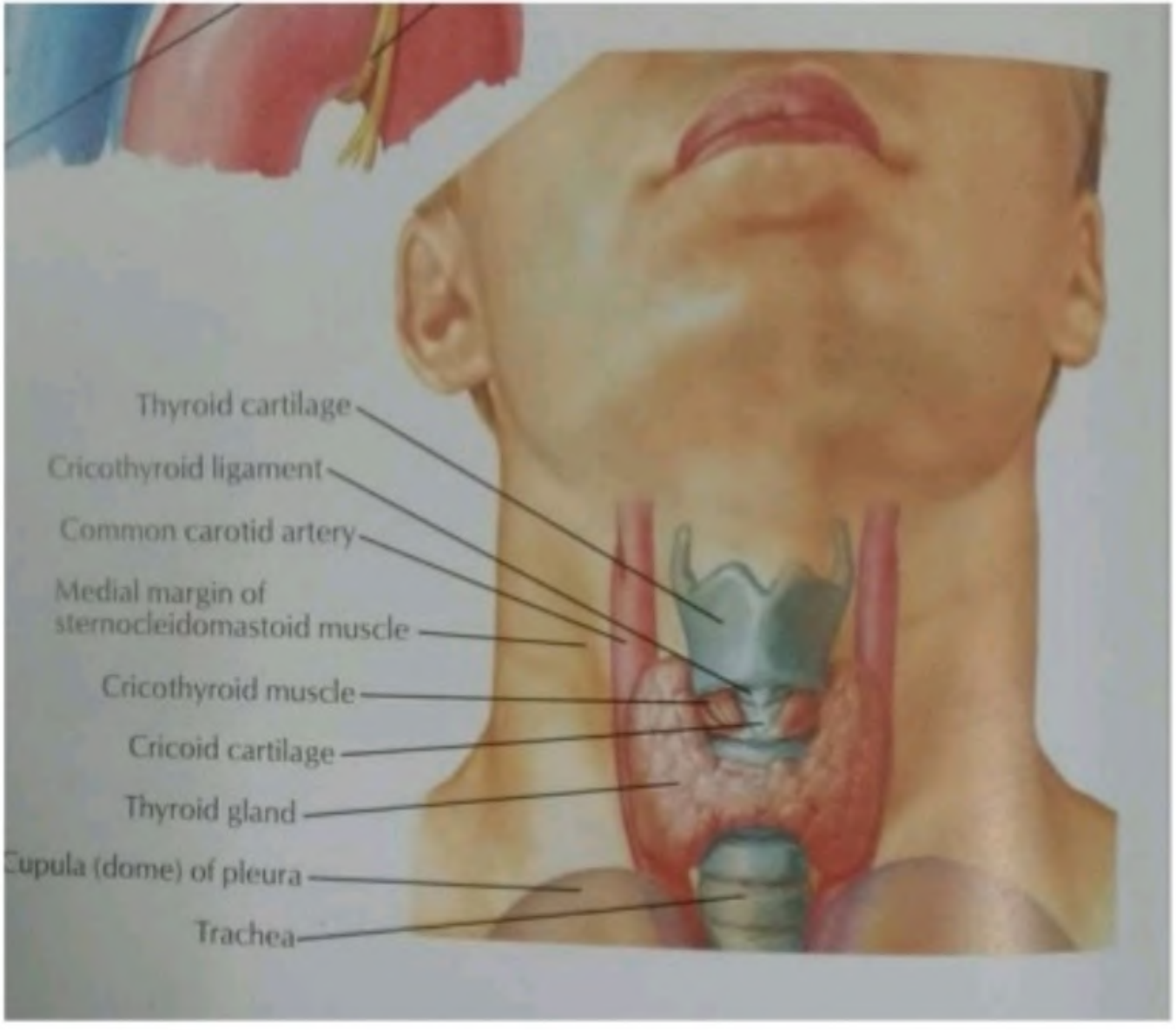
Thyroid disorders

Carcinoma thyroid

Metastatic Carcinoma thyroid

THYROID HORMONE.

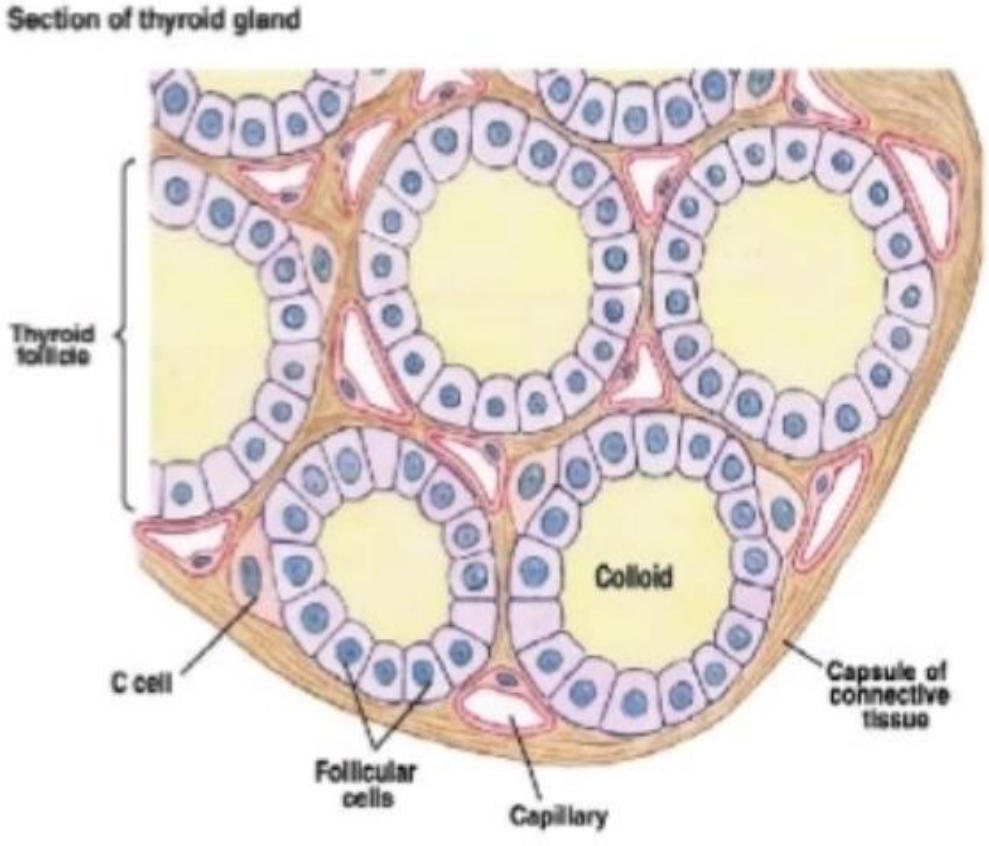
- 1. THYROXINE (T4).
- 2.TRIIODOTHYRONINE (T3).
- 3.TSH.
- 4.Free T3.
- 5.Free T4.



HISTOLOGY

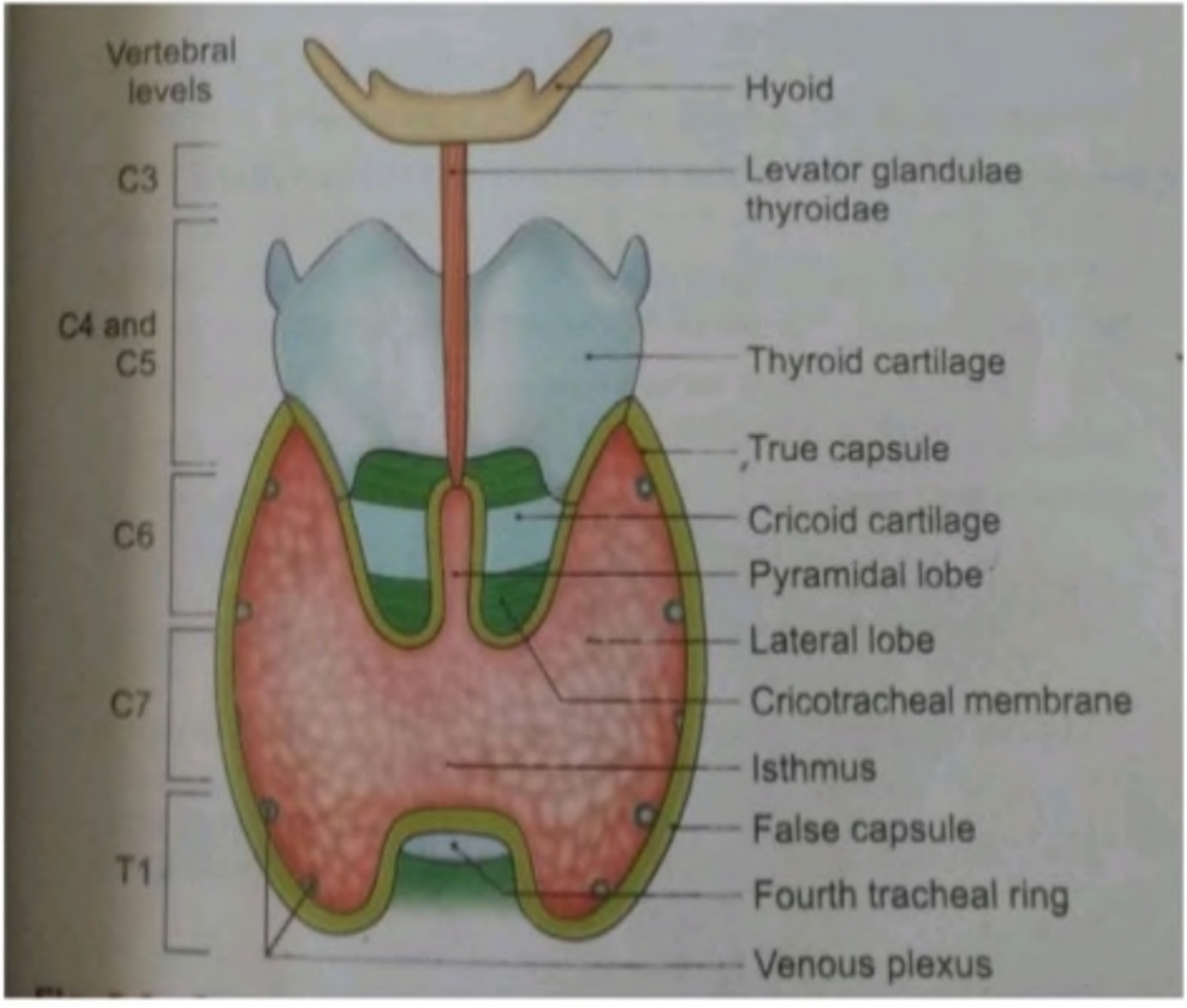
- FOLLICULAR CELLS------
- Lining the follicles and secretes T3 and T4.
- Active phase---columnar
- Resting phase ---cuboidal.
- Follicles contains COLLOID.

FOLLICLES: THE FUNCTIONAL UNITS OF THE THYROID GLAND

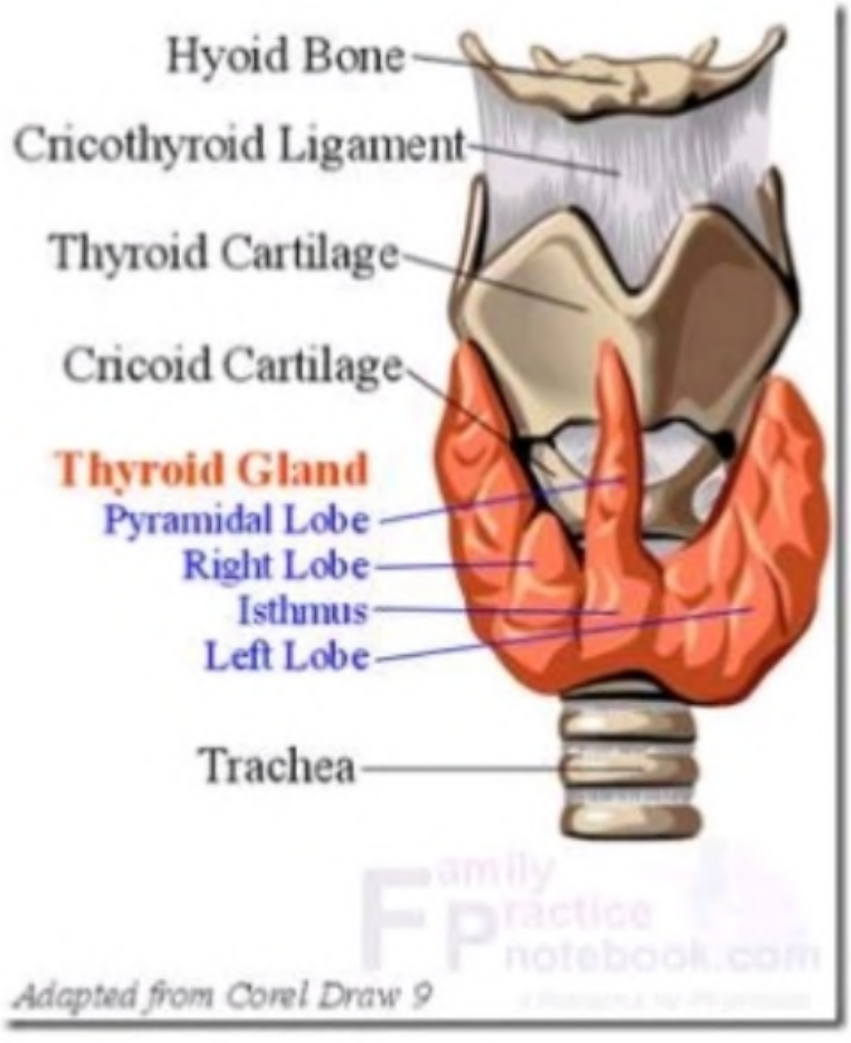


Follicles Are the Sites Where Key Thyroid Elements Function:

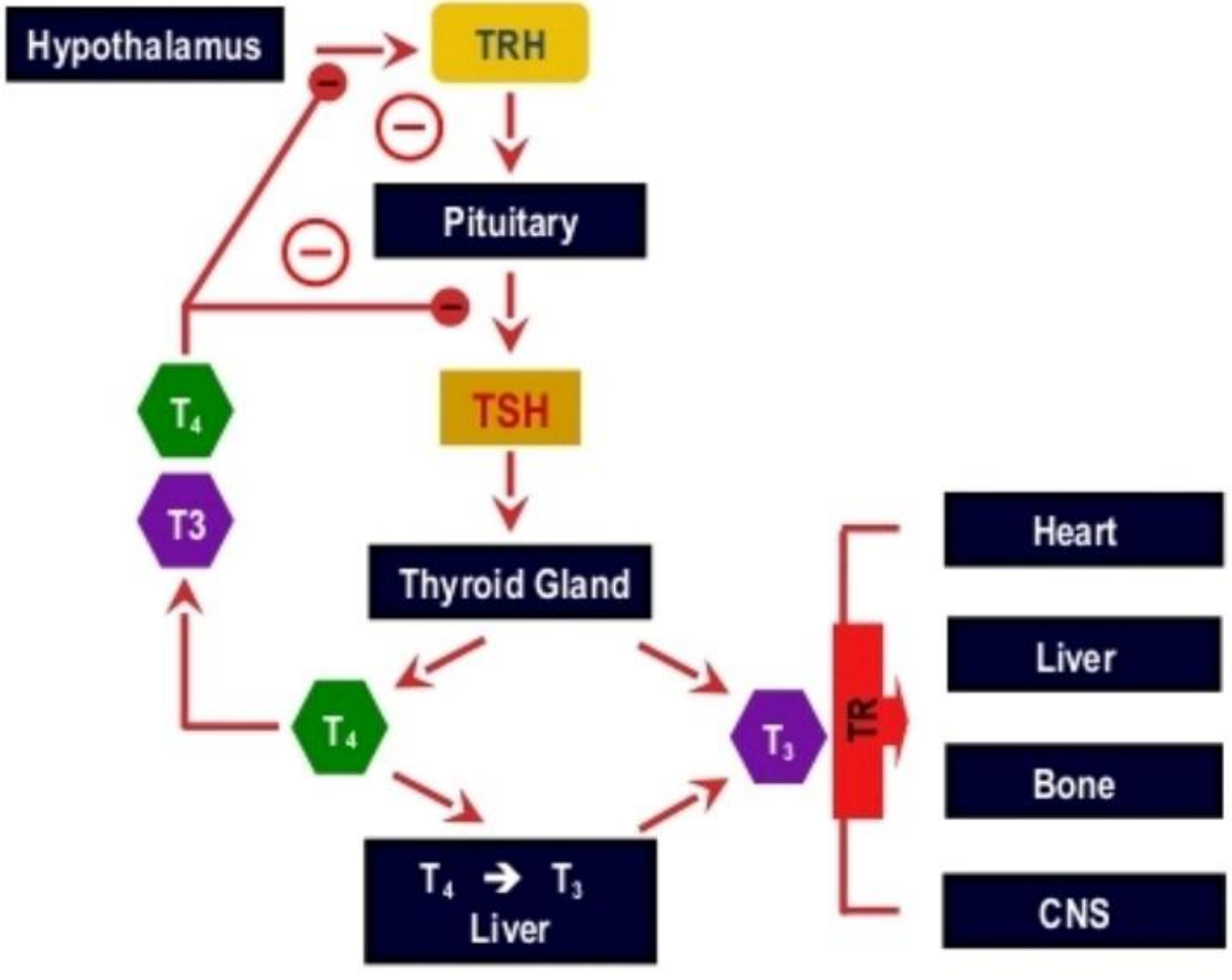
- Thyroglobulin (Tg)
- Tyrosine
- Iodine
- Thyroxine (T_4)
- Triiodotyrosine (T_3)



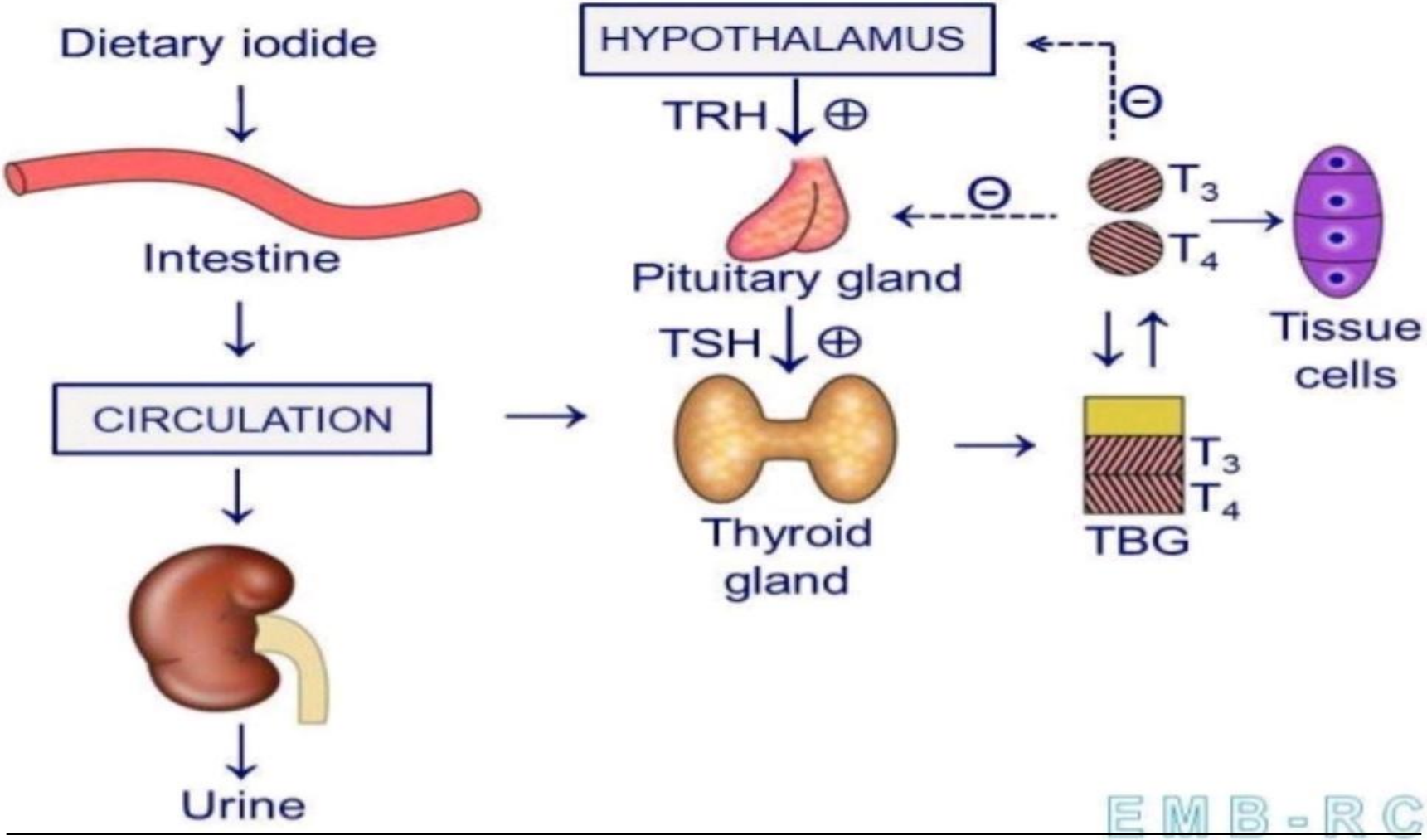
- Parafollicular cells= secrete CALCITONIN.
- Promote hypocalcaemia and calcium deposition in bone.
- opposite to PTH.



HYPOTHALAMIC-PITUITARY-THYROID AXIS PHYSIOLOGY



Hormone synthesis.



HORMONE BIOSYNTHESIS.

IODINE TRAPING

Iodide transport across the thyrocyte

- ★ Iodine is an essential raw material for thyroid hormone synthesis.
- ★ Dietary iodide is absorbed by the intestine and enters the circulation.
- ★ The basolateral membrane of thyrocytes facing the capillaries contain *Na^+ / I^- symporter (NIS)* that transports two Na + ions and one I^- ion into the cell with each cycle, against the electrochemical gradient for I^-.
- ★ The process involved is *secondary active transport*, with the energy provided by Na^+ K^+ ATPase.
- ★ Cl^- / I^- exchanger known as Pendrin is present on the apical membrane of thyrocytes.
- ★ It mediates transport of iodide out of thyrocyte into the lumen, where colloid (Thyroglobulin - TG) is located.

Synthesis & secretion of thyroid hormone

- ★ As soon as iodide reaches apical membrane of thyrocyte, it undergoes a two step process called organification.
- ★ First, it is oxidized to iodine.
- ★ Next step is incorporation of iodine into tyrosine residues of thyroglobulin.
- ★ DUOX2 (Dual Oxidase-2) located in the apical membrane generates H_2O_2, which utilized by thyroid peroxidase (TPO) for oxidation of iodide into iodine.
- ★ Thyroid peroxidase (TPO) also catalyzes incorporation of iodine into tyrosine residues of thyroglobulin.
- ★ The thyroid hormones so produced remain part of the thyroglobulin molecule (colloid) until needed.
- ★ Colloid represents a reservoir of thyroid hormones, which can serve body requirements up to 2 months.

Synthesis & secretion of thyroid hormones

- During incorporation of iodine into Tyrosine residues of Thyroglobulin, following molecules are formed:
  - 3-iodo tyrosine – Monoiodotyrosine (MIT)
  - 3,5-di-iodo tyrosine – Diiodotyrosine (DIT)
  - Condensation of two DITs - 3,5,3',5'-Tetraiodothyronine (T_4)
  - Condensation of MIT with DIT - 3,5,3'-Triodothyronine (T_3)
  - Condensation of DIT with MIT - 3, 3',5'-Triodothyronine (RT_3)

★ Whenever is a need for thyroid hormone secretion, colloid is internalized by endocytosis.

★ Lysosomal degradation of thyroglobulin occurs. T_4 (80 µg/day), T_3 (4 µg/day) & RT_3 (2 µg/day) are secreted into circulation.

★ MIT and DIT are not secreted, they are deiodinated by a microsomal iodotyrosine deiodinase and are reutilized.

FORMATION OF T3 AND T4.

ORGANIFICATION

- Binding of iodine with TGB.
- To form monoiodotyrosine and diodotyrosine.

COUPLING REACTION.

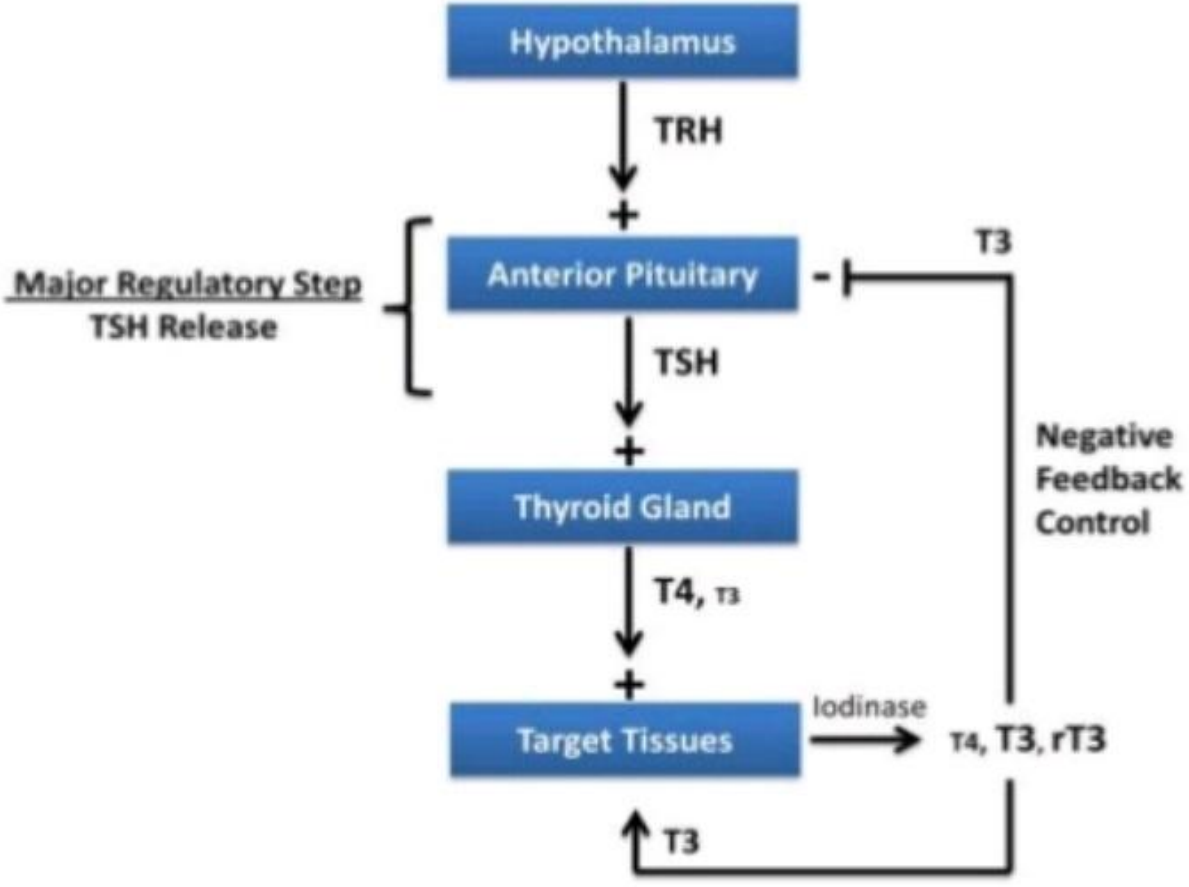
- MAJOR PRODUCT =
- THYROXINE
- 2 Molecules of diiodotyrosine
- DIT + DIT = THYROXINE(T4).

- MIT + DIT = T3.

RELEASE OF T3 AND T4.

T3 and T4 DIFFUSES OUT OF THYROID CELL INTO SURROUNDING CAPILLARIES.

Thyroid regulation



PHYSIOLOGICAL ACTION.

1.CVS	INCREASES CO, HR, FORCE OF CONTRACTION.

REGULATION.

- Synthesis and liberation of thyroid hormone is controlled by TSH = From anterior Pituitary.
- Secretion of TSH depend on level of T3 and T4. = NEGATIVE FEEDBACK MECH.....
- Regulation of TSH ----- By TRH From HYPOTHALAMUS.

BLOOD test to evaluate thyroid disease:

TSH ,T_4 ,T_3

FT_4 , FT_3: Free hormone(Active metabolite)

rT_3 :(inactive metabolite)high in NTI , newborn, hyperthyroidism

Thyro globulin mesurement

Thyroid antibodies: AntiTPO antibodies, (microsomal)
TSH receptor Abs
Anti TG antibodies

Urinary iodine mesurement

Thyroxine binding globulin:

HYPERTHYROIDISM.

- A form of thyrotoxicosis due to inappropriately

High synthesis and secretion of thyroid hormones by thyroid.

- Grave's disease is the most common cause, it is due to IgG auto-antibodies to TSH called LATS- long acting thyroid stimulator. They bind to TSH receptor and continuously stimulate it leading to increased T3 and T4 secretion.
- Toxic nodular goitre usually due to adenoma or cancer of the thyroid.

*Hyperthyroidism

Causes:

Primary hyperthyroidism Low TSH, High T4	Secondary Hyperthyroidism High TSH, High T4 Pituitary/Para neo plastic syndrome	Factitious Hyperthyroidism
1. Grave's disease 2. Toxicity in Multi nodular goitre 3. toxicity in adenoma 4. Sub acute thyroiditis	1. TSH secreting pituitary adenoma 2. Tropho blastic tumours that secrete TSH (chorio carcinoma, H. mole)	Exogenous ingestion of large dose of thyroid hormone.

Hyperthyroidism –proptosis Periorbital edema and orbitopathy

COMMON SYMPTOMS.

- Excessive sweating
- Weight loss
- Heat intolerance
- Increased bowel movement
- Tremor
- Nervousness/agitation
- Rapid heart rate/palpitation.
- Insomnia
- Breathlessness
- Irregular or scant menstrual periods

Common signs

- Hyperactvity/hyperkinesis
- Sinus tachycardia
- Systolic hypertension
- Warm, moist, soft and smooth skin, warm hand.
- Excessive perspiration
- Lid lag and stare(sympathetic overactivity)
- Fine tremor

Lab. Finding in hyperthyroidism.

	PLASMA TOTAL T3 AND T4	FT4	TSH	RESPONSE TO TRH

DIAGNOSIS.

- 1.Typical clinical presentation
- 2.markedly suppressed TSH(< 0.05)
- 3.Elevated FT4 and FT3.
- 4.Thyroid antibodies
- 5.ECG to demonstrate cardiac manisfestation
- Nuclear scintigraphy to differentiate the cause.

[redacted]

- *Thyroid ultrasound*
- Colour doppler helpful.
- May reveal nodular disease or increased vascularity (seen in Grave's)
- Thyroid uptake and scan
- High uptake
- Grave's, toxic MNG, Toxic adenoma
- Low uptake
- Thyroditis, iodine induced hyperthyroidism.