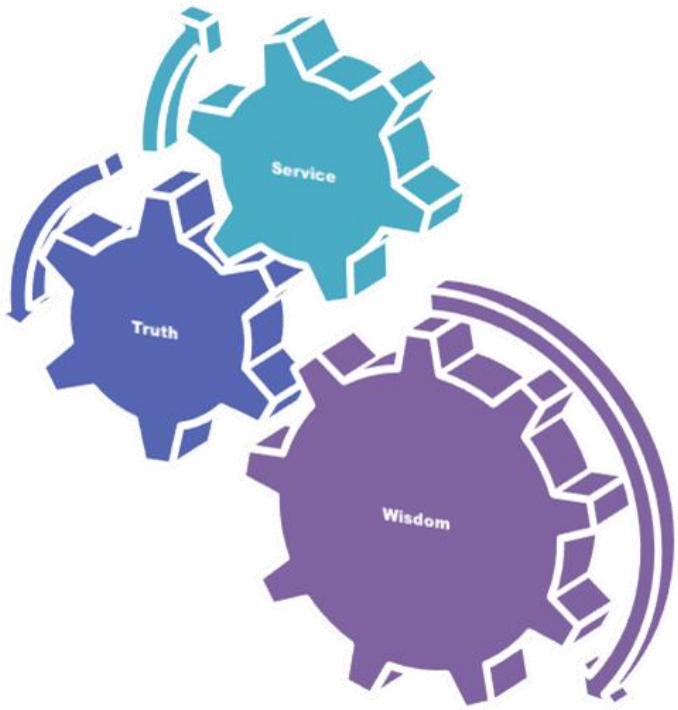
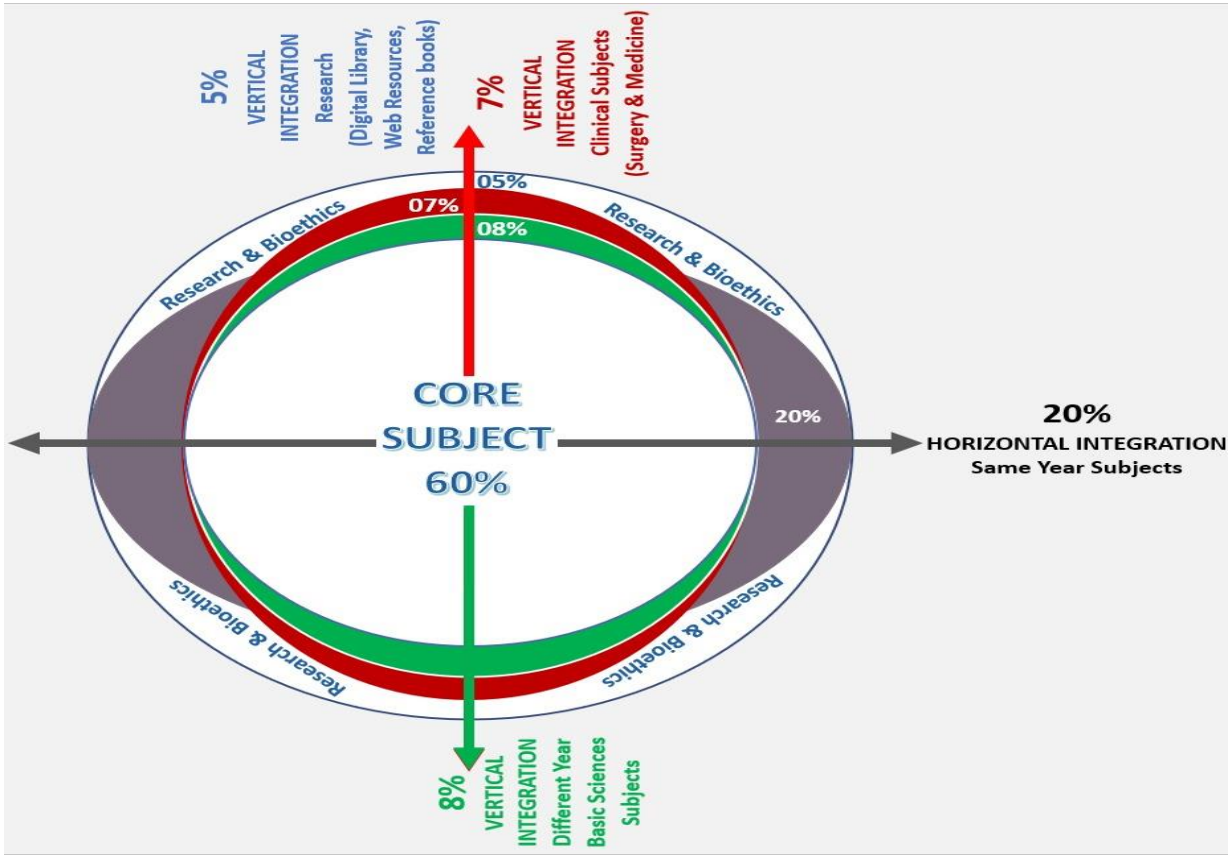

بسم الله الرحمن الرحيم

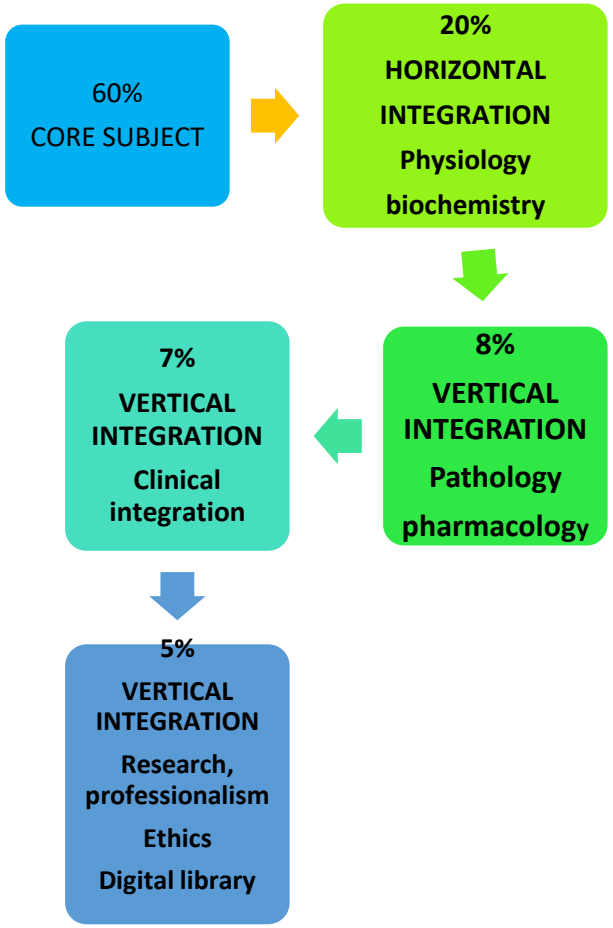
Motto Vision; The Dream/Tomorrow



- To impart evidence based research oriented medical education
- To provide best possible patient care
- To inculcate the values of mutual respect and ethical practice of medicine

Professor Umar Model of Integrated Lecture

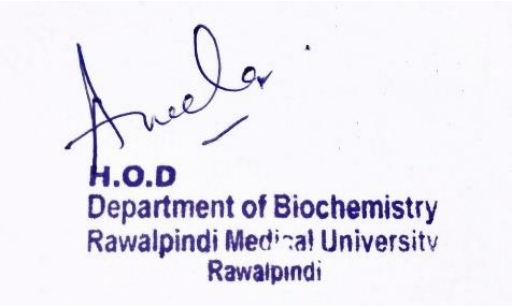




Endocrinology Module

2nd Year MBBS (CBL) - Biochemistry

Thyrotoxicosis



Presenter: Dr Nayab Ramzan
Deptt of Biochemistry
RMU

Date: 11-03-25

Learning Objectives

At the end of this session student should be ab

1. Discuss the Synthesis of Thyroid Hormone
2. Understand the Regulation of Plasma level of T3, T4
3. Describe the Mechanism of Action of Thyroxin
4. Explain the Functions of Thyroid Hormone in the body
5. Discuss Causes and Clinical Features of Hyperthyroidism
6. Practice the principles of bioethics & apply strategic use of A.I in the related clinical condition.
7. Read relevant research articles related to the Core Knowledge.

Clinical Scenario - Case

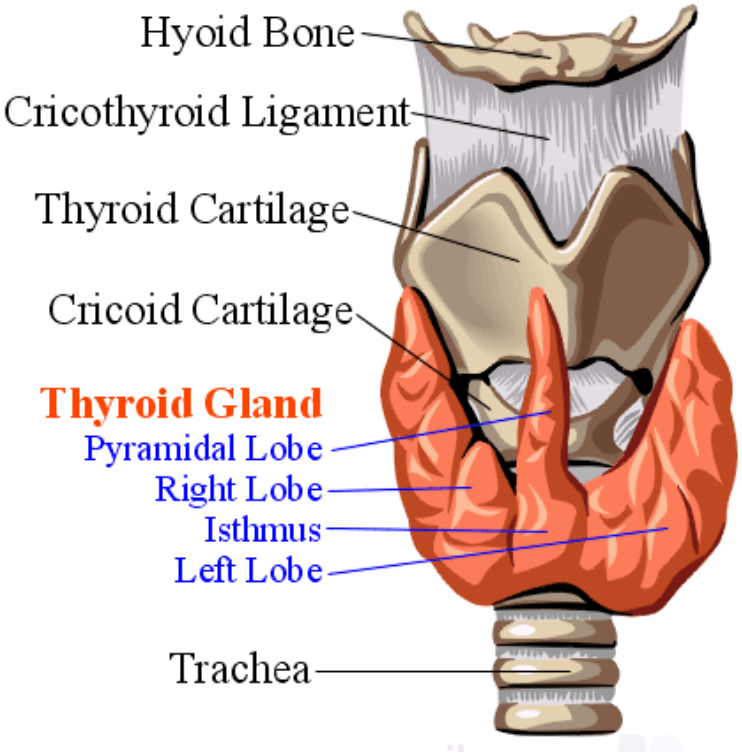
Clinical Scenario (Hyperthyroidism)

- A 20 year old unmarried female (previously healthy) presented to the OPD of DHQ Hospital Rawalpindi with a 2 months history of increased appetite, hair & weight loss, fatigue, difficulty in sleep, excessive sweating and altered menstrual cycle. Examination showed rapid pulse, warm hands and slightly enlarged thyroid gland. Serum TSH level was very low and free T3, T4 levels were raised. She was provisionally diagnosed as case of hyperthyroidism.

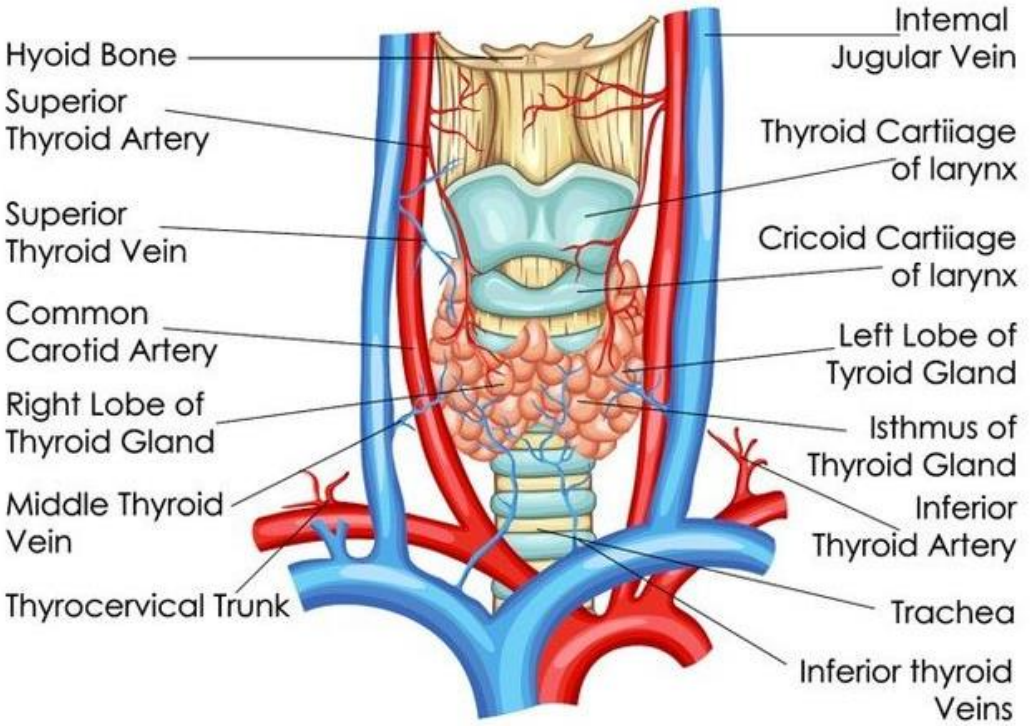
Horizontal Integration

Anatomical Aspects

Parts & Relations of the Thyroid Gland

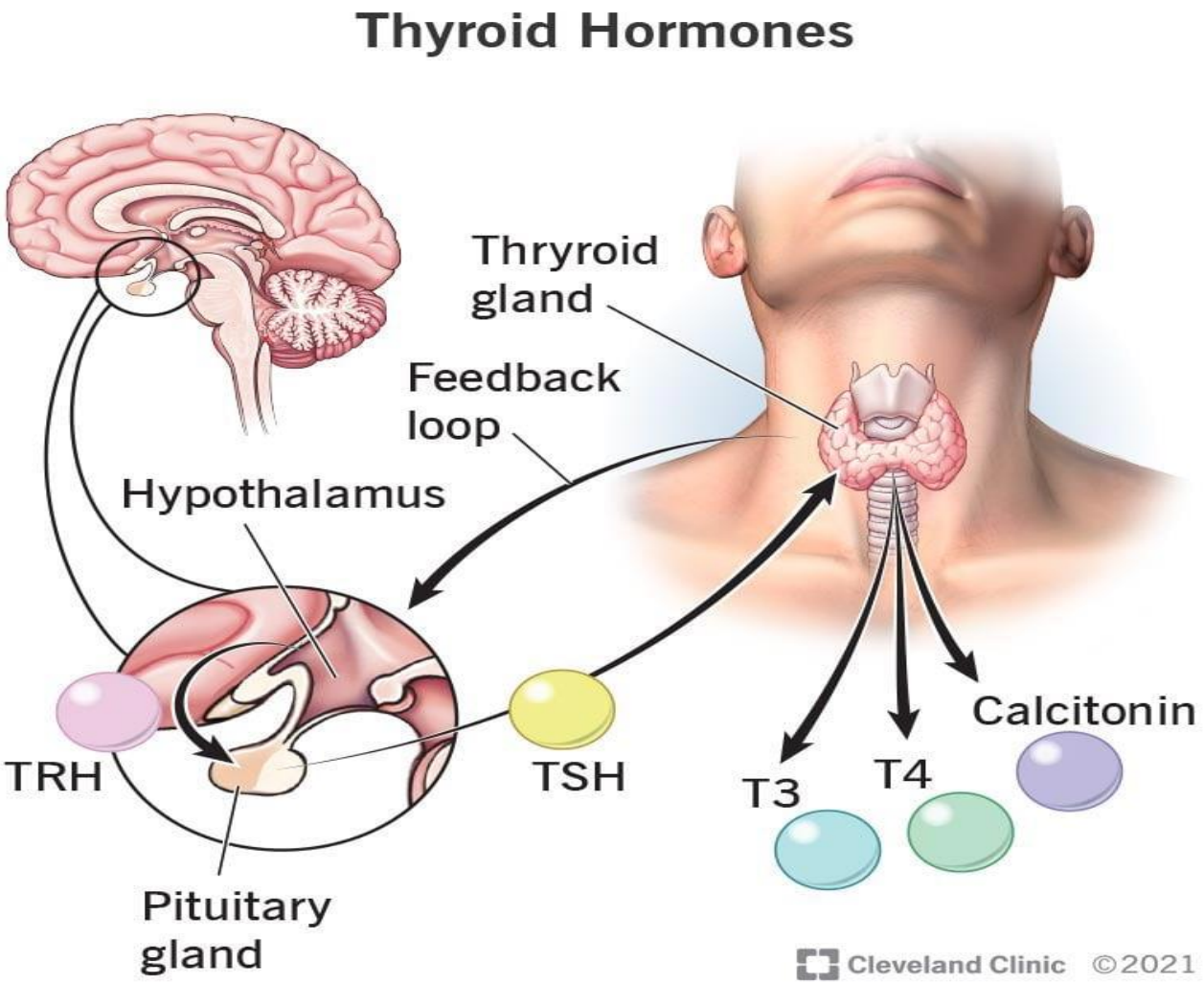


Blood Supply of the Thyroid Gland



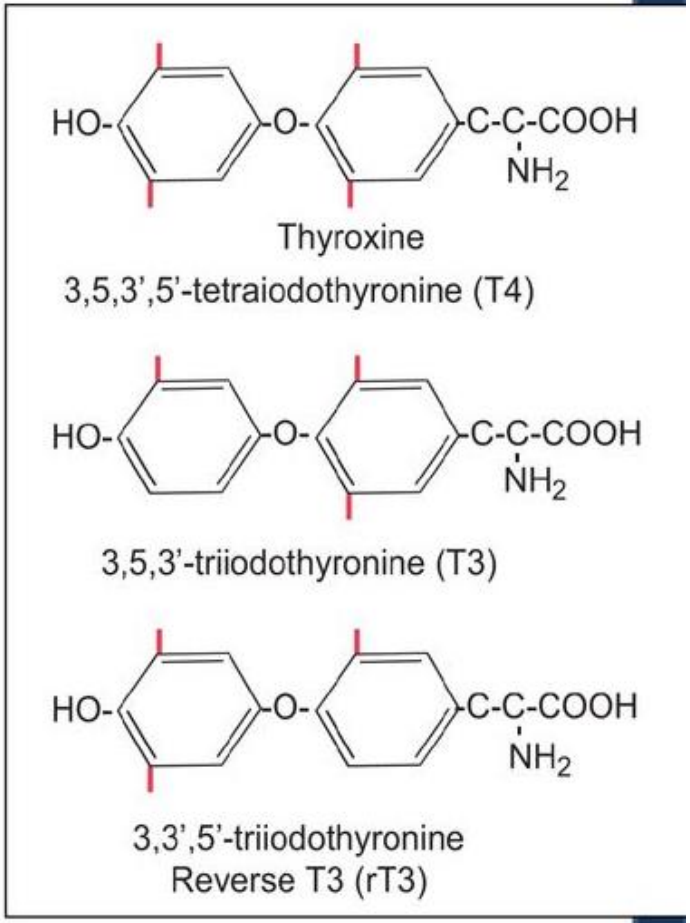
Horizontal Integration

PHYSIOLOGICAL ASPECTS



Thyroid Hormones

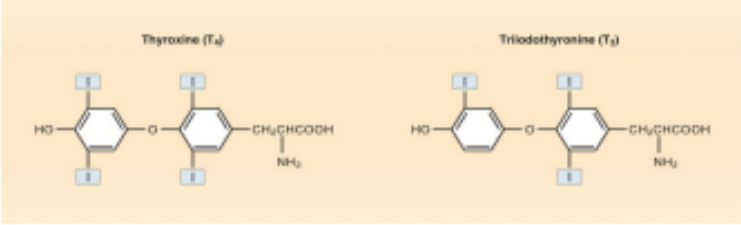
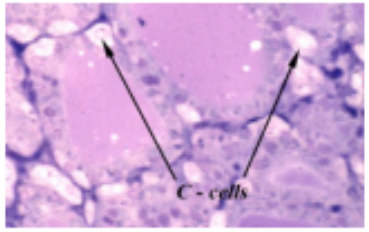
- The thyroid hormones are α-amino acid derivatives of tyrosine
- Thyroxine & Triiodothyronine are exceptionally rich in iodine, which comprises more than half of their molecular weight
- Thyroxine contains four atoms of iodine and is abbreviated as T4
- Triiodothyronine, which has three atoms of iodine, is abbreviated as T3



Core Knowledge

Thyroid gland hormones

الكمية عكس الاكتفتي يعني كلما زادت الكمية قل نشاط الهرمون (أقلهم كمية أكثرهم نشاطاً)

Hormones	T3 (Triiodothyronine) *Contains 3 iodine* Most potent	T4 Thyroxine (Tetraiodiothyronine) *Contains 4 iodine* When it reaches the tissue its majority will be converted to T3	Calcitonin Hormone ↓ Ca++ blood levels (Humoral stimulation) #L1 (For Ca^{++} metabolism)	Reverse T3 (not important) Biologically inactive, but it appears in chemical reactions
Amount	10% Less but has stronger action than T4	90%	-	-
Site of synthesis	Apical and basal membrane in follicular cells		Parafollicular cells C -cell	-
Site of stores	In colloid			-
Structure				Mirrored image of T3 having 3 Iod, but the problem is the mispositioning of iod, making it inactive.

Transport of thyroid hormones in blood

Thyroid hormones are transported in blood in two forms

1-Bound forms:

- Thyroid hormones are transported in plasma bound to plasma proteins:
  - **Thyroid Binding Globulin** (TBG) binds 70% of plasma T4 & 80% of plasma T3
  - Others: **Pre-albumin** & **Albumin**

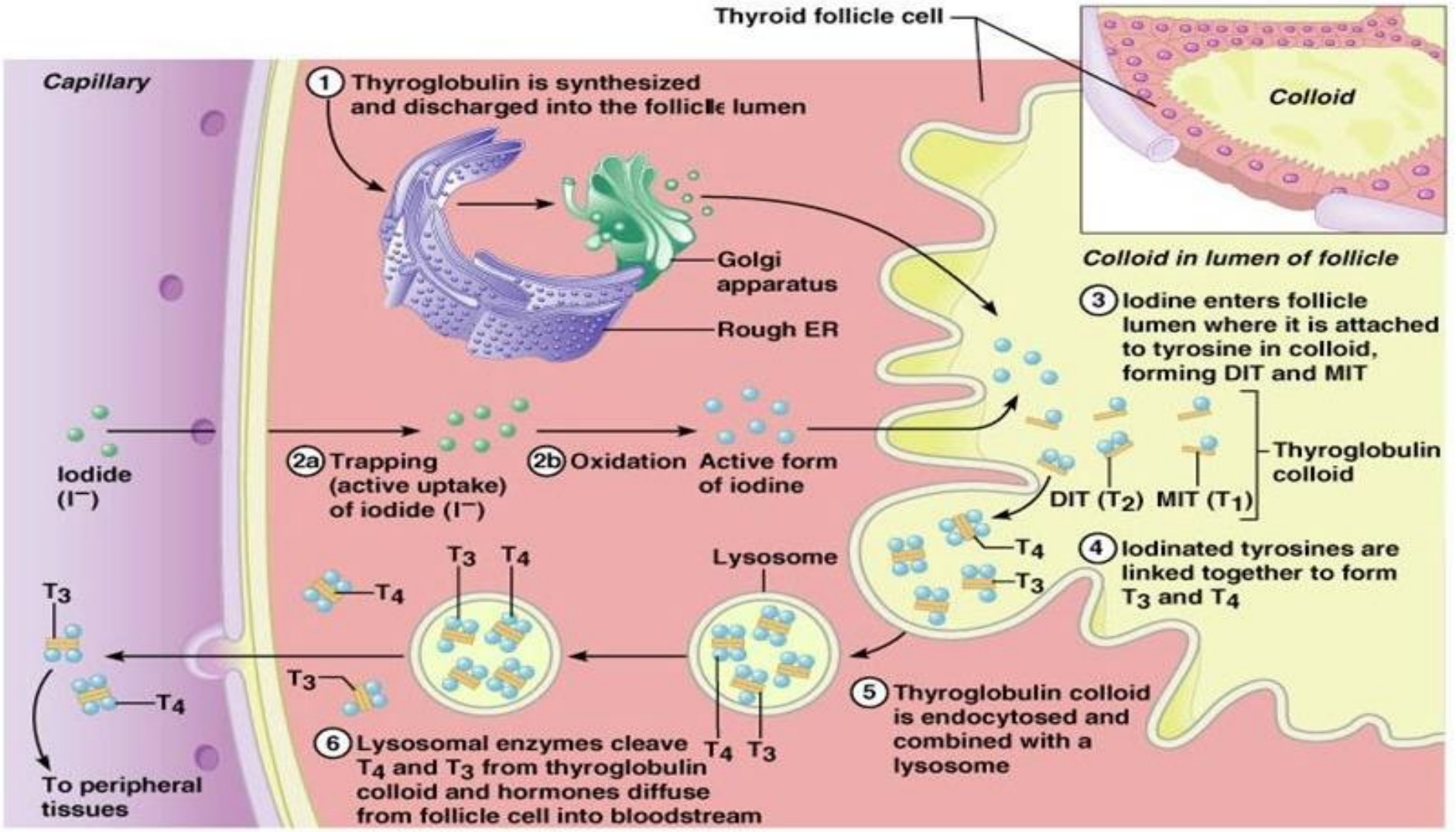
2- Free form:

- 0.05% of plasma T4 & 0.02% of plasma T3 are free (<u>not</u> bound to plasma proteins)

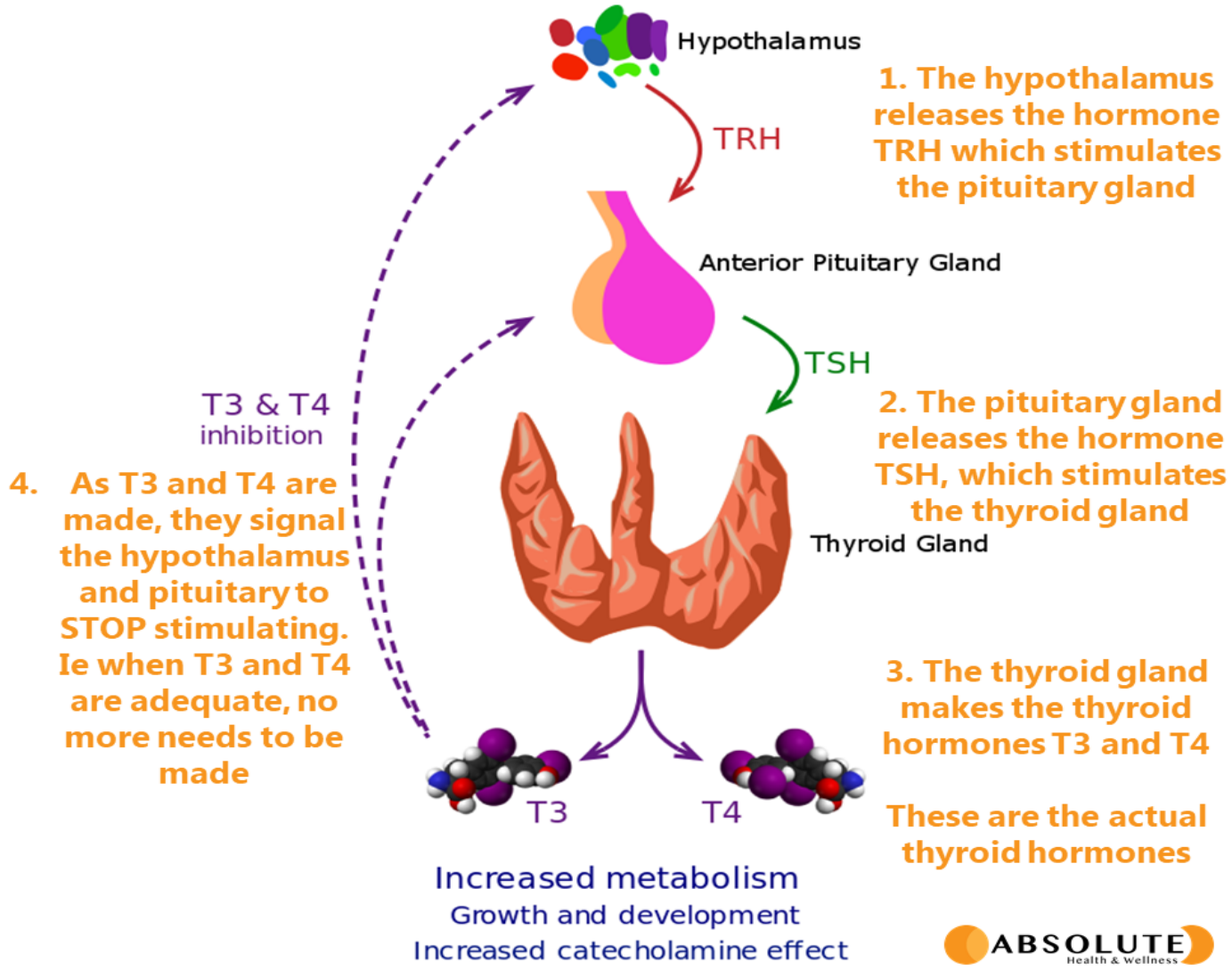
Only the <u>free</u> fraction can cross the cell membrane & affect intracellular metabolism

Core Knowledge

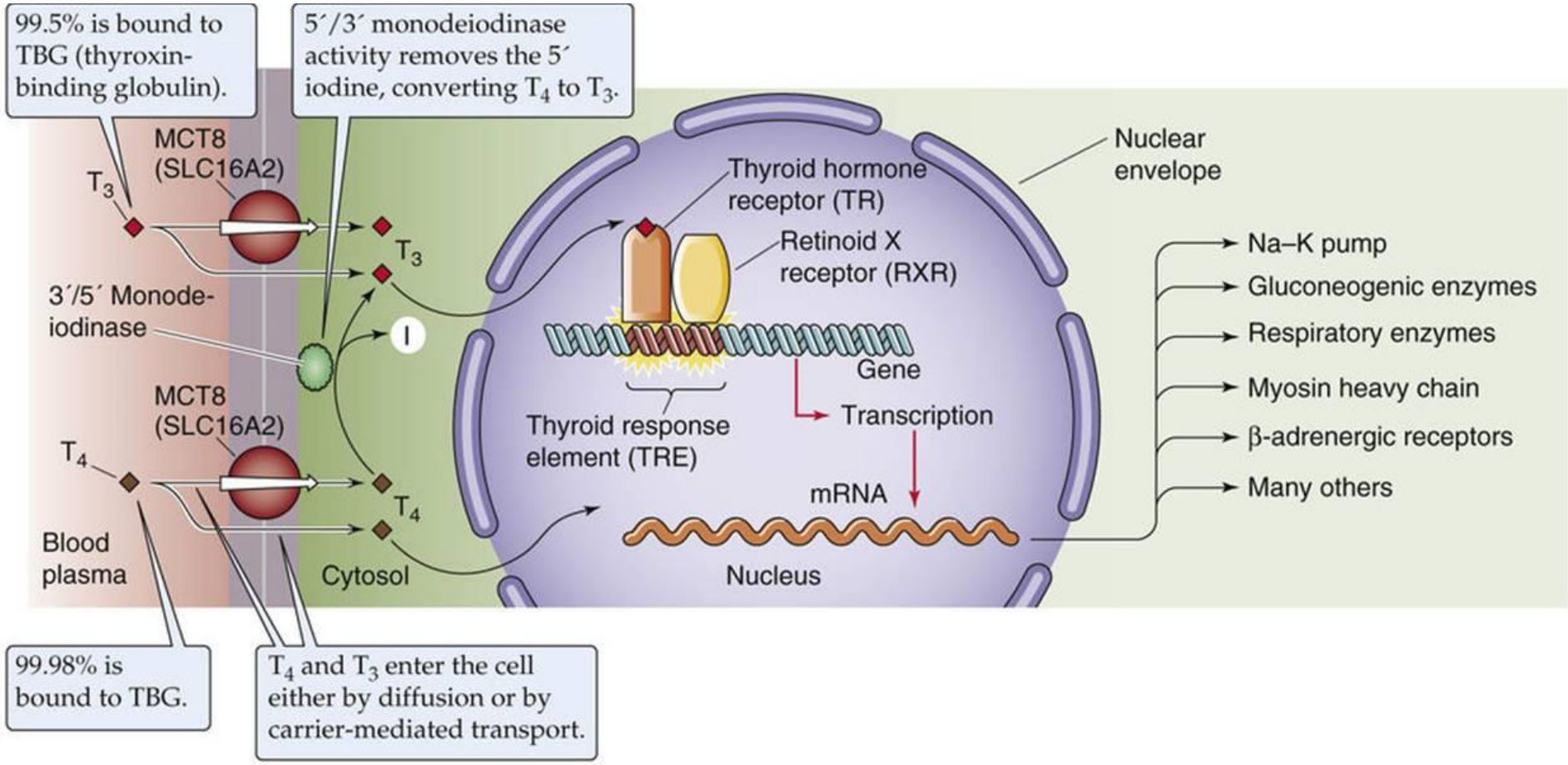
SYNTHESIS OF THYROID HORMONES



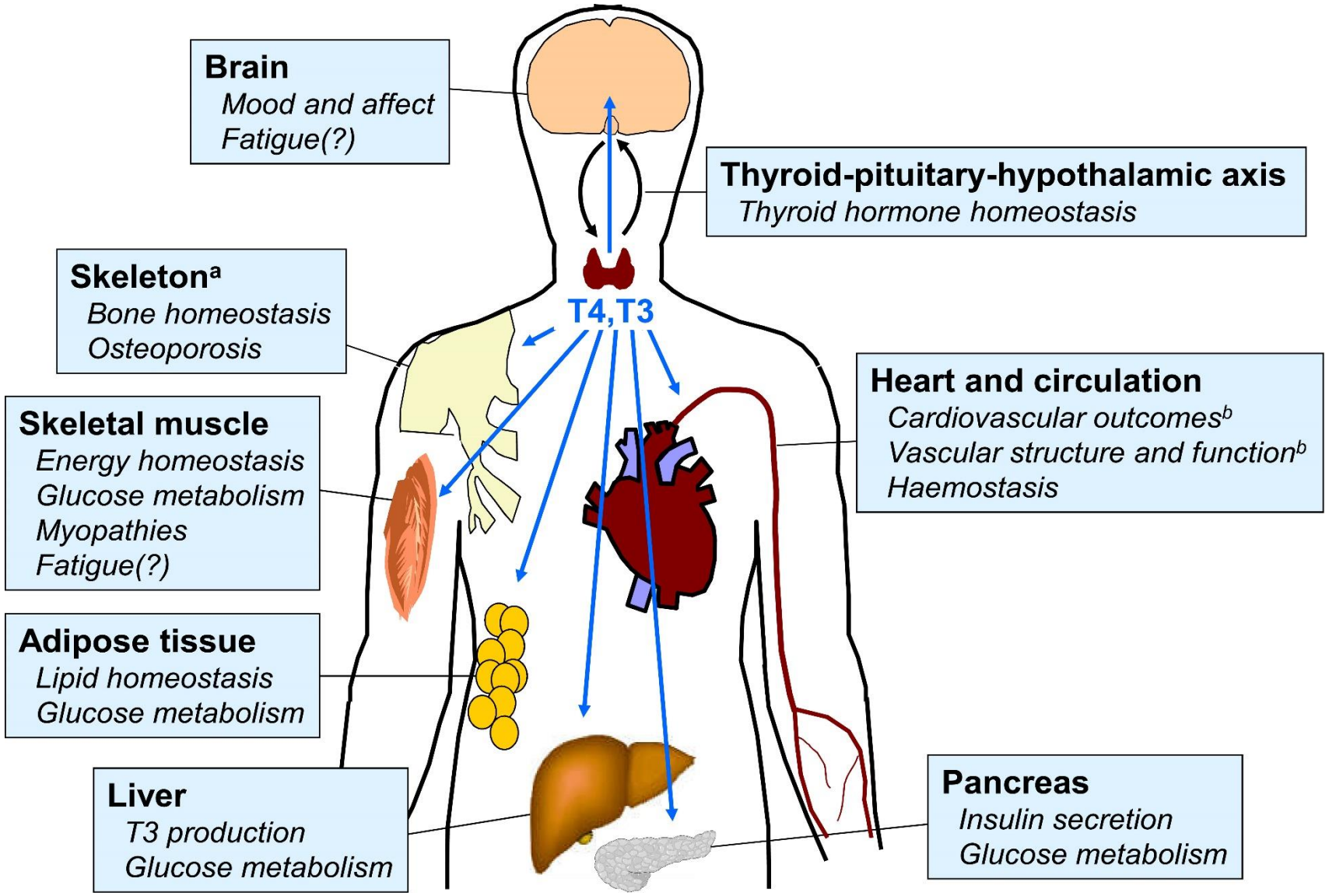
Regulation of Plasma level of T3, T4



Mechanism of Action of Thyroxin

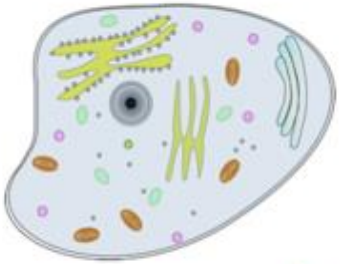


Functions of Thyroid Hormone in the body



Core Knowledge

Thyroid Effects on the Body



↑ Protein Synthesis and Metabolic Activity in Cells

↑ Body Metabolism
Body Heat

↑ Beta-1 Receptors

↑ Heart Rate
Stroke Volume

↑ Cardiac Output
Blood Pressure

↑ GI Motility
GI Secretions

↑ Neurogenesis
Myelination
Synaptogenesis
Dendrite Formation
Sympathetic Activity

↑ Proliferation of Skin Cells
Sweat & Skin Secretions
Hair Growth
Nail Growth

Actions of thyroid hormones:

T_3 and T_4 have the following effects:

1- General metabolism: Thyroid hormones increase the metabolic rate and O_2 consumption of all tissues of the body except the adult brain, lungs, lymphoid tissues, retina and anterior pituitary gland.

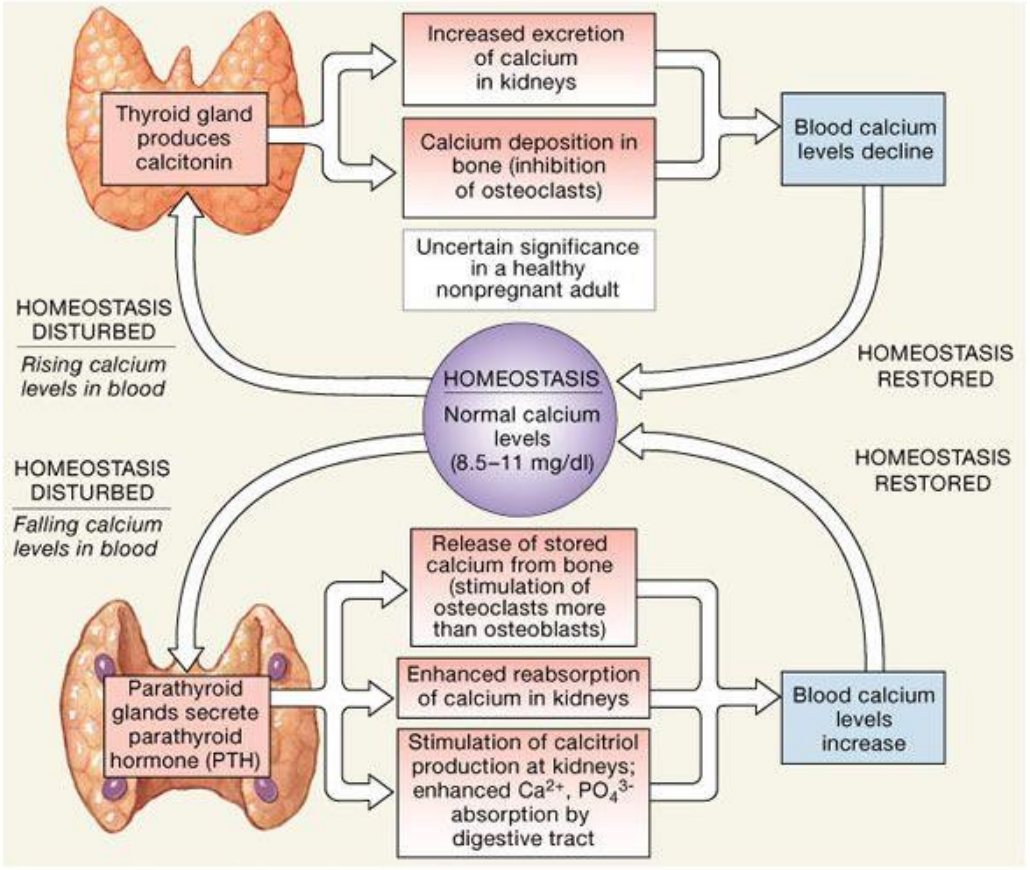
2- Protein metabolism: Normal levels of thyroid hormones stimulate protein synthesis (anabolic effect) whilst excess Thyroid hormones secretions cause protein catabolism (breakdown of protein molecules).

3- Carbohydrate metabolism: Thyroid hormones stimulate glucose uptake and utilization by tissues, insulin hormone secretion, liver glycogenolysis and intestinal absorption of glucose.

4- Lipid metabolism: Thyroid hormones decrease the level of lipid and cholesterol in the blood (i.e. increased cholesterol catabolism than lipogenesis)

Core Knowledge

Calcitonin



Vertical Integration

THYROTOXICOSIS

DEFINITION

- Thyrotoxicosis is any syndrome caused by excess thyroid hormone and can be related to excess hormone production (hyperthyroidism).

Causes of thyrotoxicosis

- Graves' disease
- Toxic multinodular goitre
- Toxic adenoma
- Thyroiditis
- Drugs (e.g. amiodarone, lithium)
- Gestational thyrotoxicosis
- Choriocarcinoma
- Hydatidiform mole
- Adenoma secreting thyroid-stimulating hormone
- Others (e.g. neuroendocrine tumour, thyroid cancer)

Vertical Integration

CAUSES OF THYROTOXICOSIS

Causes of Hyperthyroidism

PACE HOSPITALS

The causes of hyperthyroidism are mainly categorised into:

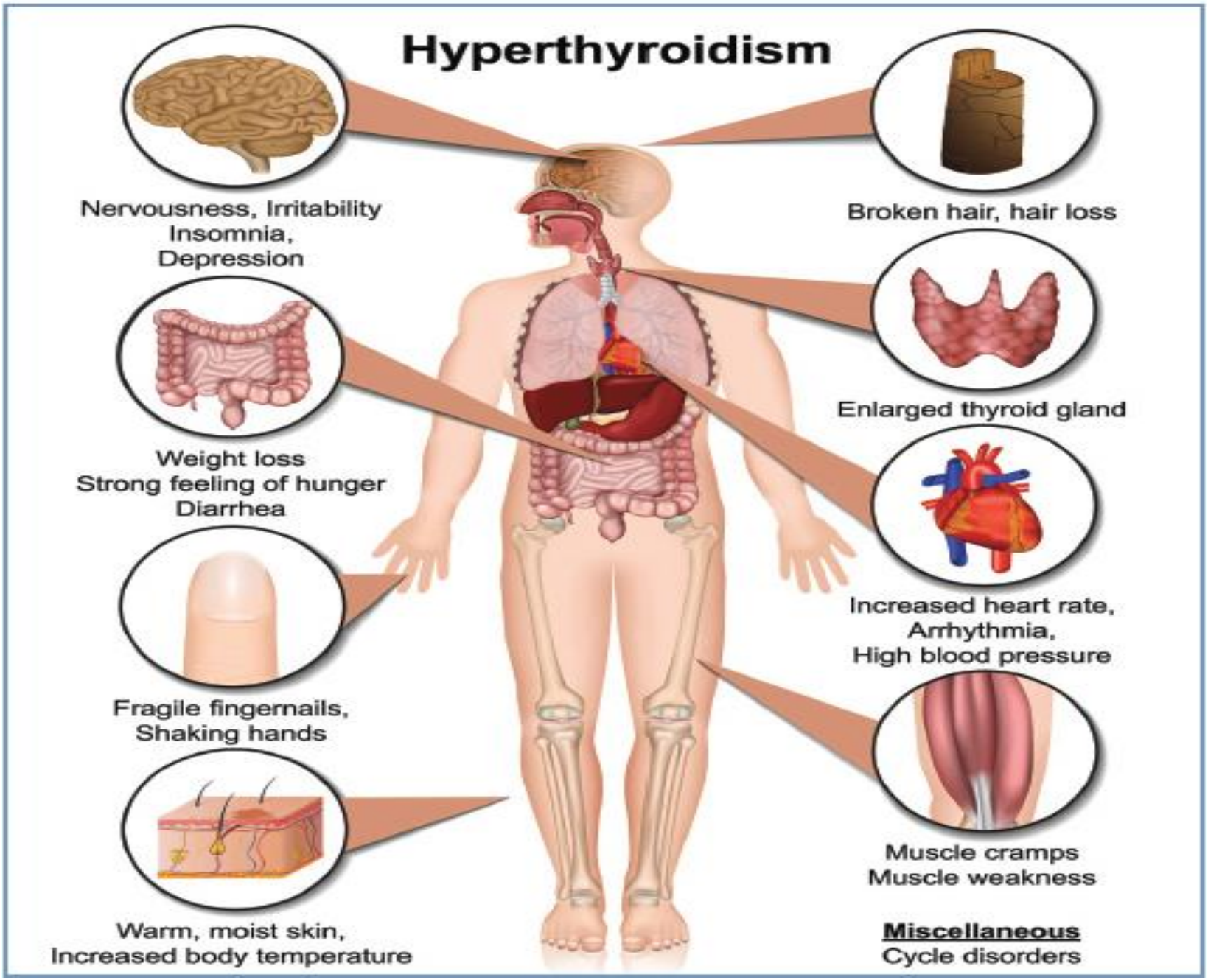
Primary Hyperthyroidism

- Graves' disease
- Toxic adenoma, toxic multinodular goiter or Plummer's disease
- Functioning thyroid carcinoma metastases
- Activating mutation of the TSH receptor
- Activating mutation of GSα (McCune-Albright syndrome)
- Struma ovarii
- Drugs: iodine excess (Jod-Basedow phenomenon)

Secondary Hyperthyroidism

- TSH-secreting pituitary adenoma
- Thyroid hormone resistance syndrome
- Chorionic gonadotropin-secreting tumours
- Gestational thyrotoxicosis

Vertical Integration

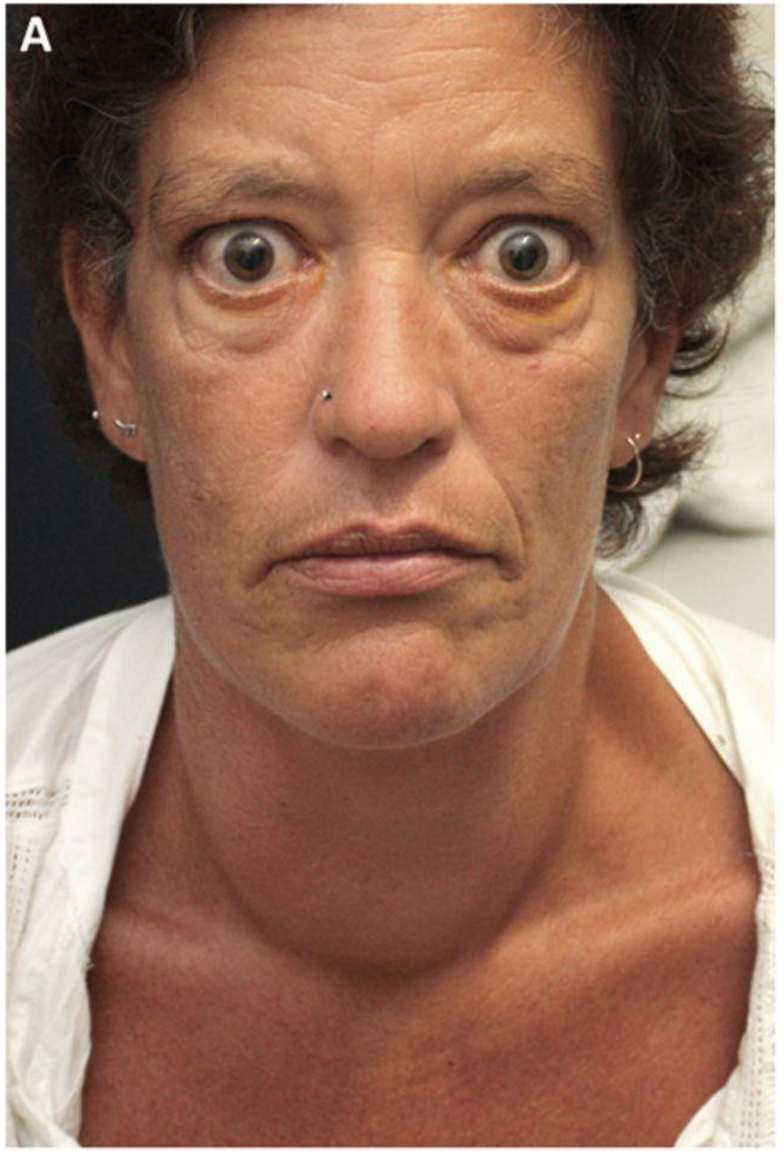


Clinical Features of Hyperthyroidism

HYPERTHYROIDISM SIGNS & SYMPTOMS

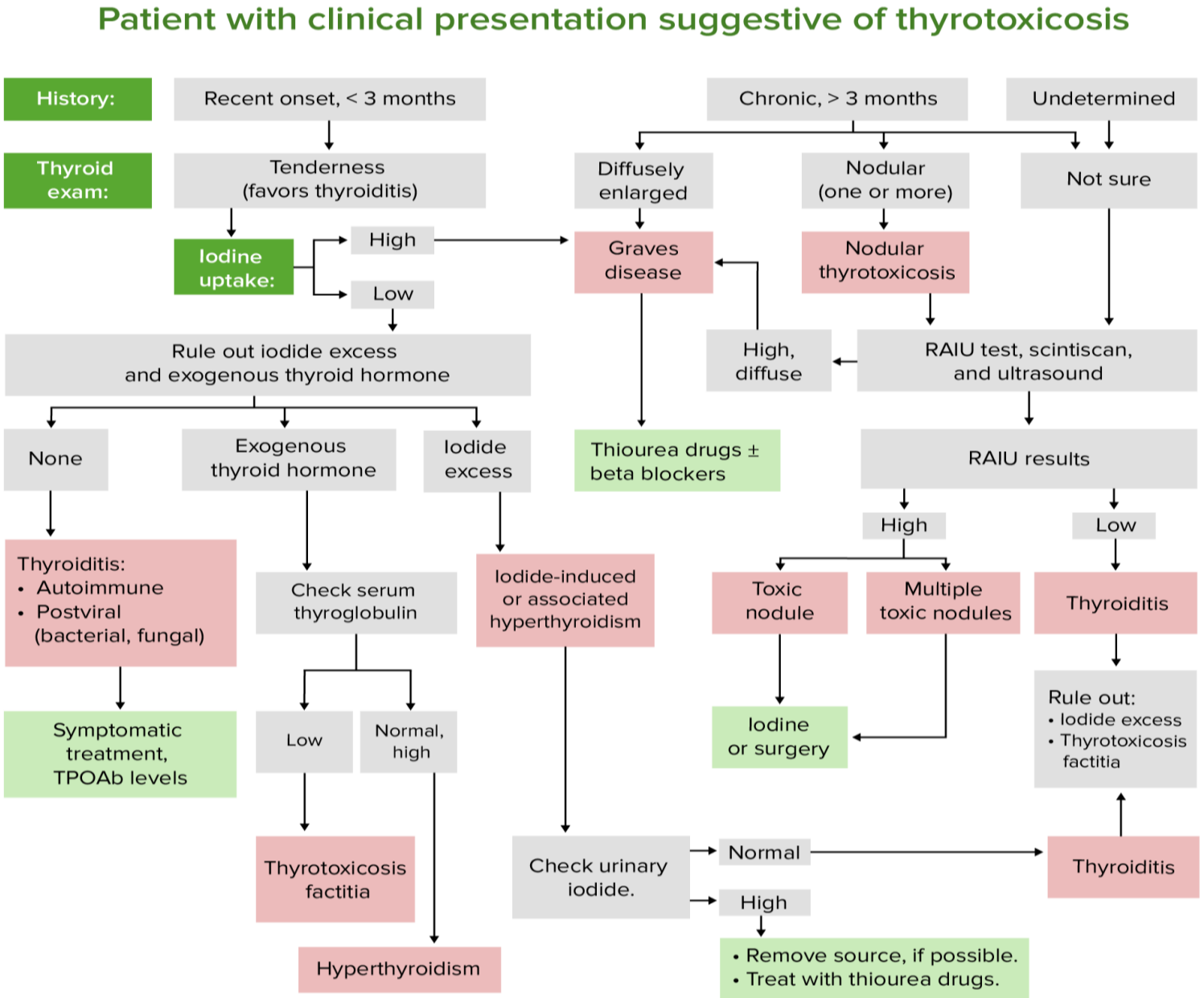
Mnemonic : THYROIDISM

- T - Tremor
- H - Heart rate up
- Y - Yawning (Fatigue)
- R - Restlessness
- O - Oligomenorrhoea
- I - Intolerance to heat
- D - Diarrhoea
- I - Irritability
- S - Sweating
- M - Muscle wasting



Vertical Integration

Management



Management of

Role of AI in Management of

- AI can potentially aid in **enhancing diagnostic accuracy and efficiency.**
- AI-powered decision support systems can also help clinicians in **selecting appropriate treatment modalities**
- AI-driven predictive models may help **anticipate the risk of complications of the Disease** in susceptible populations

Ethical Considerations

- From an ethical standpoint, the scenario raises considerations regarding **patient autonomy**, **informed consent**, and **confidentiality**
- The physician must ensure that patient fully understands her diagnosis, treatment options, and potential implications
- Discuss the necessity of a healthy lifestyle & treatment plan. This requires clear communication and understanding of risks and benefits.
- Additionally, the physician must respect patient's privacy and confidentiality throughout the diagnostic and treatment process

Suggested Research Article

- https://www.lecturio.com/concepts/thyrotoxicosis-and-hyperthyroidism/

- https://www.researchgate.net/figure/Production-and-action-of-thyroid-hormone-The-key-components-required-for-thyroid-hormone_fig1_264711792

CBL --- QUESTIONS

1. What is the role of thyroxin on protein metabolism?
2. Which of the two is more active, T3 or T4?
3. What is the chemical nature of thyroid hormone?
4. What is the effect of TSH on plasma T3 level?
5. How is thyroid hormone transported in plasma?

Learning Resources

- Lippincott Illustrated Reviews - BIOCHEMISTRY, Eighth Edition, chapter 29, pages 452 - 455.
- Harper's Illustrated Biochemistry 32nd Edition
- Google Scholar
- Google Images

How To Access Digital Library

1. Steps to Access HEC Digital Library

2. Go to the website of HEC National Digital Library.

3. On Home Page, click on the INSTITUTES.

4. A page will appear showing the universities from Public and Private Sector and other Institutes which have access to HEC National Digital Library HNDL.

5. Select your desired Institute.

6. A page will appear showing the resources of the institution

7. Journals and Researches will appear

8. You can find a Journal by clicking on JOURNALS AND DATABASE and enter a keyword to search for your desired journal.


Thank You!