

Chapter 13: Thyroid Hormones

Lecture 12

Growth

- I. Thyroid Hormones
- II. Growth Hormones
- III. Insulin
- IV. Androgens
- V. Estrogens

Solubility

- 1. hydrophilic
 - A. peptide hormones
 - B. catecholamines
- 2. lipophilic
 - A. thyroid hormone
 - B. steroid hormones

I. Thyroid hormone (TH)

- 1. basal metabolic rate
- 2. protein synthesis
- 3. body's sensitivity to catecholamines (e.g. cortisol by permissiveness)
- 4. proper cellular development & differentiation
- 5. regulate protein, fat & carbohydrate metabolism
- 6. thyronamines function ?? mechanism to inhibit neuronal activity
 - e.g. mammalian hibernation cycles ?
 - administering thyronamines: ↓↓body temperature

II. Growth Hormone

A. growth indirectly: stimulating liver \uparrow somatomedin production

B. somatomedin: insulin-like growth factor (IGF-1)

1. acts directly on bone & soft tissues:

- a) protein synthesis
- b) cell division
- c) lengthening & thickening of bones

2. exerts metabolic effects unrelated to growth

- a) \uparrow blood fatty acid:
breakdown triglyceride fat stored in adipose tissue
- b) \uparrow blood glucose: \downarrow glucose uptake by muscles

Other Hormones Essential for Normal Growth

III. Insulin

- A. deficiency often blocks growth
- B. hyperinsulinism often spurs excessive growth

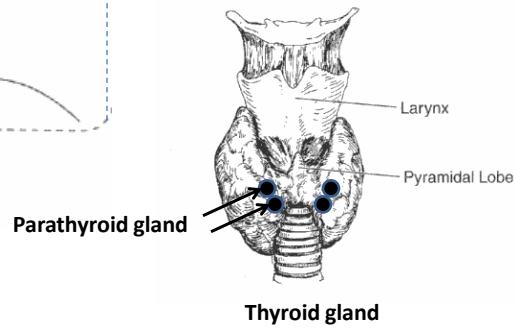
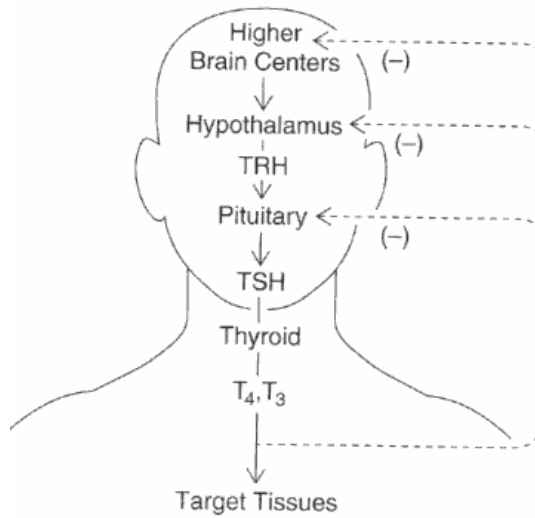
IV. Androgens

- A. \uparrow pubertal growth spurt:
- B. \uparrow protein synthesis effects depend on presence of GH

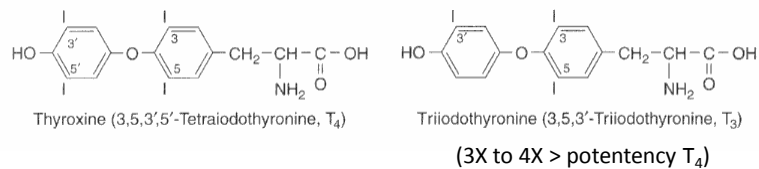
V. Estrogens

growth prior to bone maturation ???

CNS-Pituitary-Thyroid Axis



Thyroid Hormones



1. major form of blood TH: thyroxine (T₄)
2. ratio of T₄ to T₃ released in blood: ~ 20 to 1

mostly bound to transport proteins

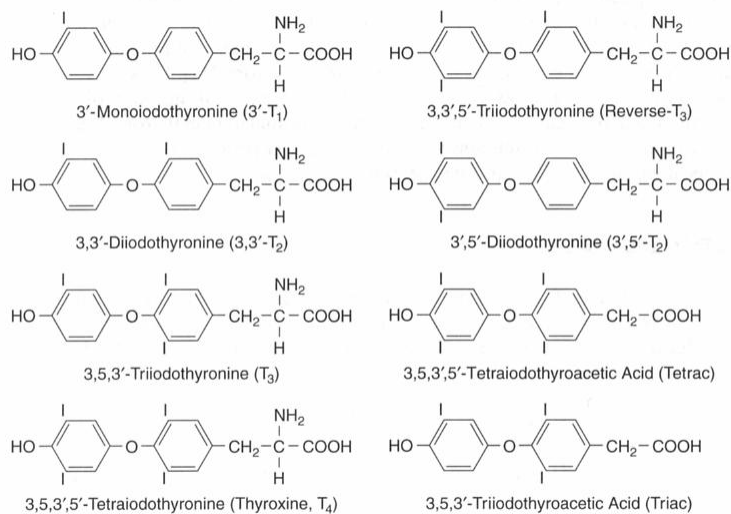
- A. 70% thyroxine binding globulin (TBG)
- B. 10-15% thyroxine-binding prealbumin (TBPA)
- C. 15-20% albumin

small fraction free (unbound) & biologically active

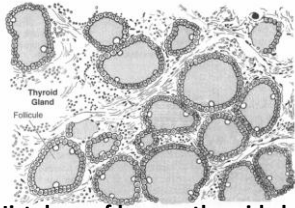
0.03% T₄ *titers free T₃/T₄ important diagnostic value*
 0.30% T₃

total blood thyroxine can be misleading

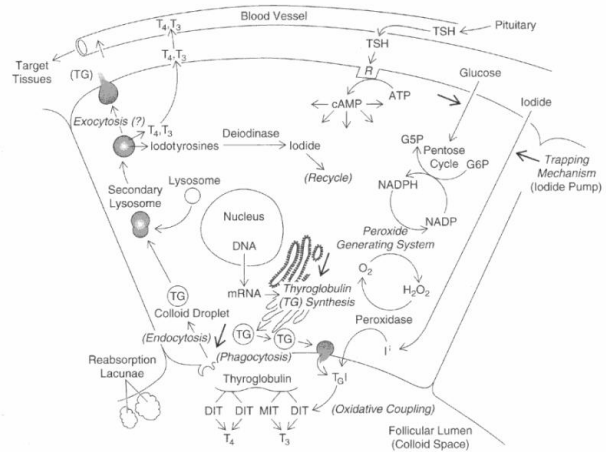
3. T_4 (precursor) to T_3 (active hormone) within cells by
deiodinases (5'-iodinase)
cross cell membranes via amino acid importins
nuclear envelopes through receptors
4. further processed by decarboxylation & deiodination
iodothyronamine (T_{1a}) & thyronamine (T_{0a})



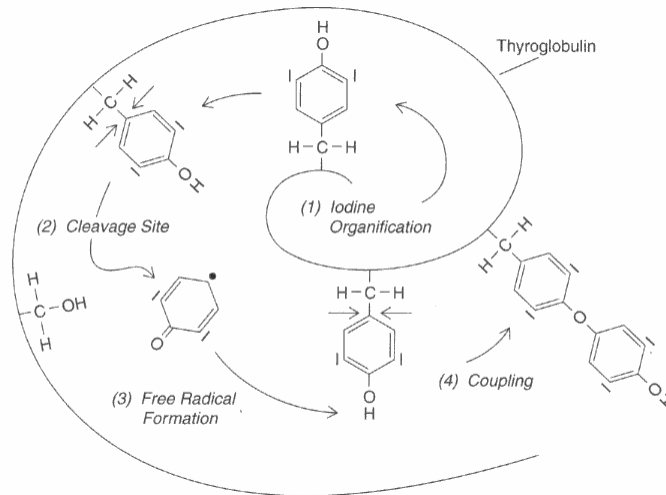
Structural formulas of iodothyronines in human plasma



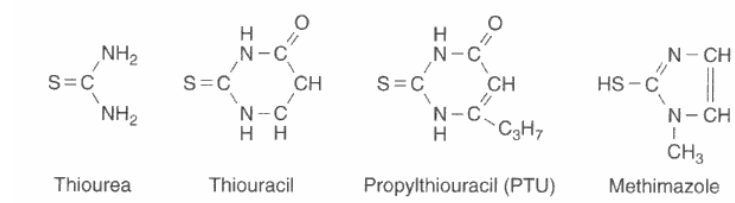
Histology of human thyroid gland



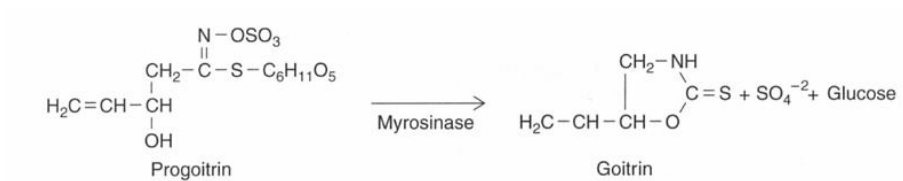
Thyroid hormone biosynthesis & secretion



Hypothetical coupling scheme for iodothyronine formation

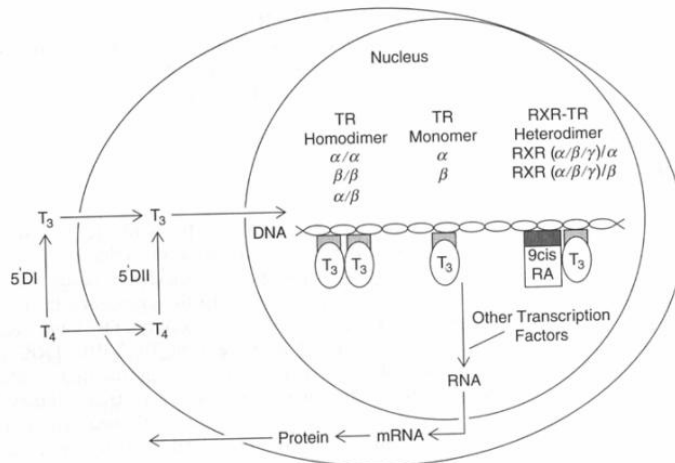


Thionamide type of antithyroid drugs



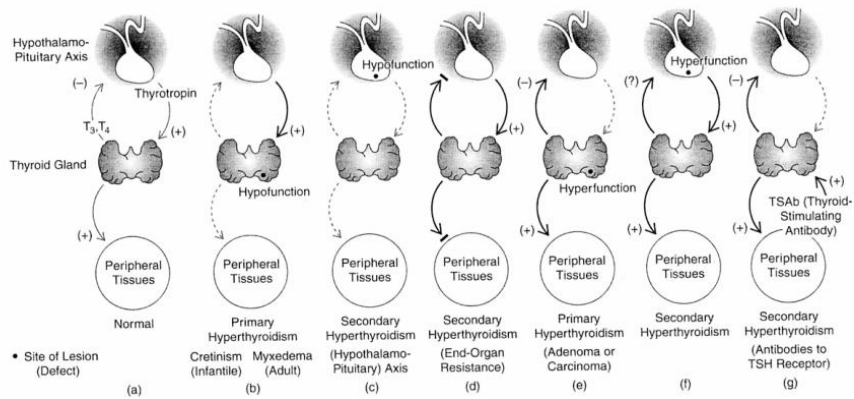
Synthesis & structure of goitrin

Goitrin: antithyroid compound → cabbage, rutabaga, turnip & brassicaceous weeds



Model for action of mechanism of thyroid hormone on target tissues

Pathophysiology



1. ↑ or ↓ production of TSH
2. inadequate thyroid gland or peripheral tissue response to TSH or TH

Pathophysiology



Goiter: swollen thyroid gland

↓titers of T_4 & T_3 : ↑titers of TSH