

Thyroid disorders

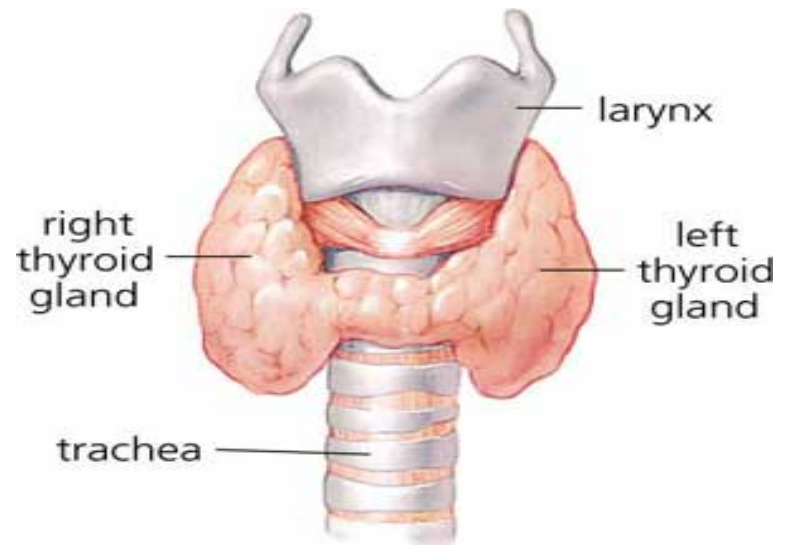
Dr. Aishah Ekhzaimy

Objectives

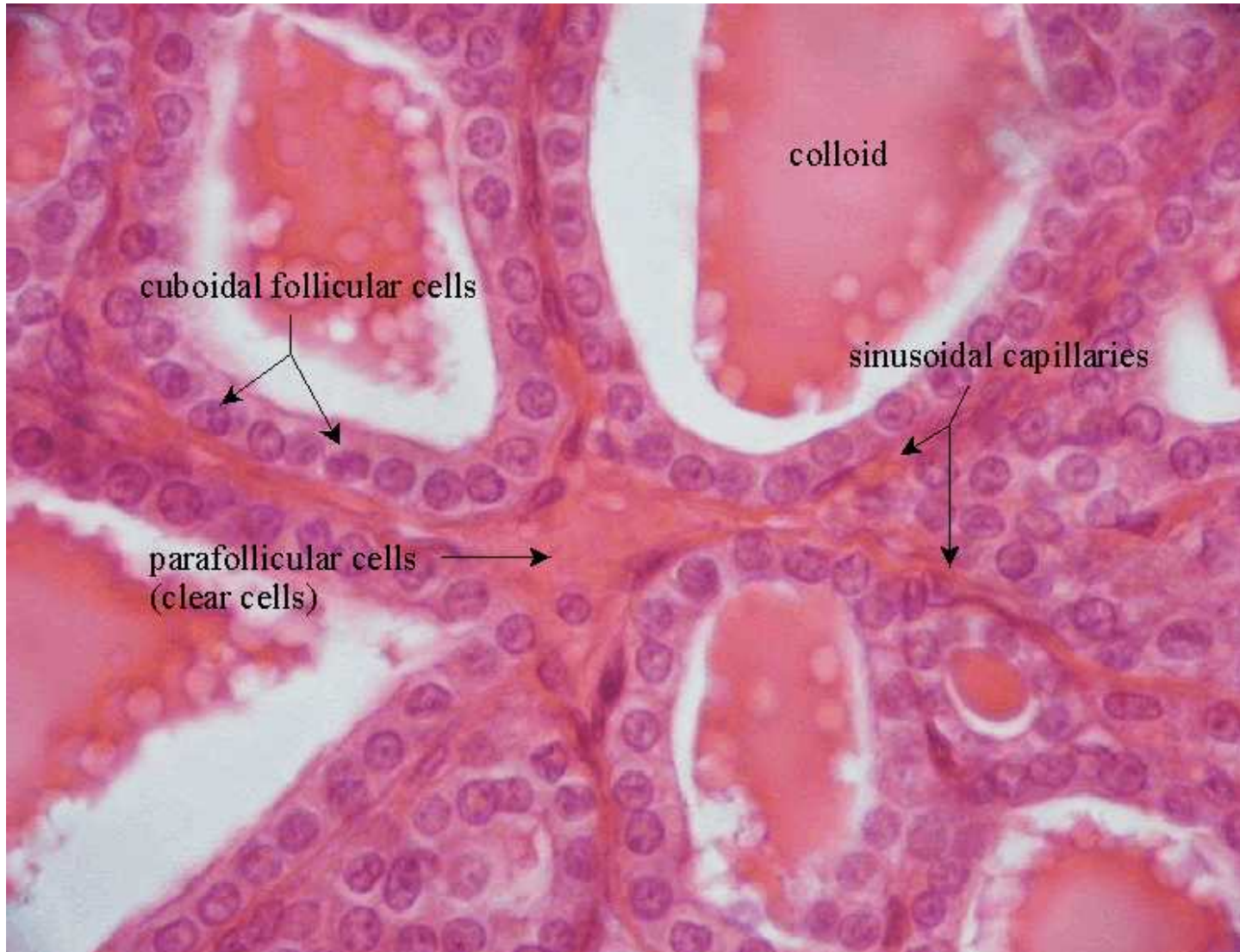
- Thyroid anatomy and physiology
- Action of thyroid hormones
- Thyroid function
- Thyroid disorders:
 - Goiter
 - Hyperthyroidism
 - Hypothyroidism

Thyroid gland

- Thyroid gland is made up of follicles
- Has 2 lobes and connected by the isthmus
- Weigh 20 g, more volume in men, increase with age and bodyweight and decrease with iodine intake
- Located in front of larynx



Thyroid histology

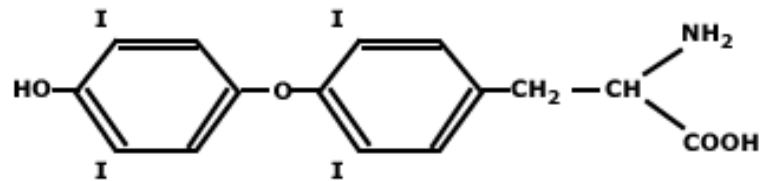


Thyroid hormone

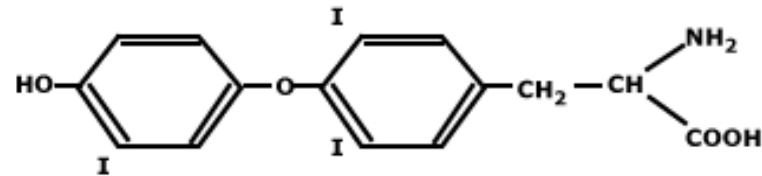
- Somatic development in adults
- Brain development in infants
- Fetal thyroid functions at 10-12 weeks of gestation
- Maternal T4 reaches the fetus during development
- if mother has hypothyroidism----- preterm delivery, miscarriage, cognitive impairment of infant
- Main action of thyroid hormones by T3 : 80 % from peripheral conversion and 20 % produced by the thyroid itself

Thyroid hormones

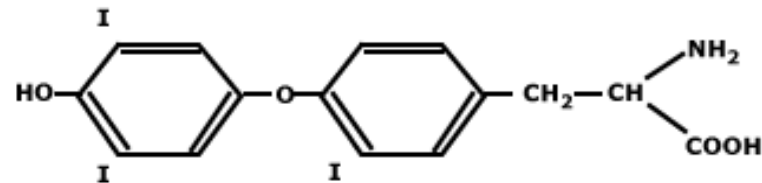
Thyroxine (T_4)



3,5,3 -Triiodothyronine (T_3)



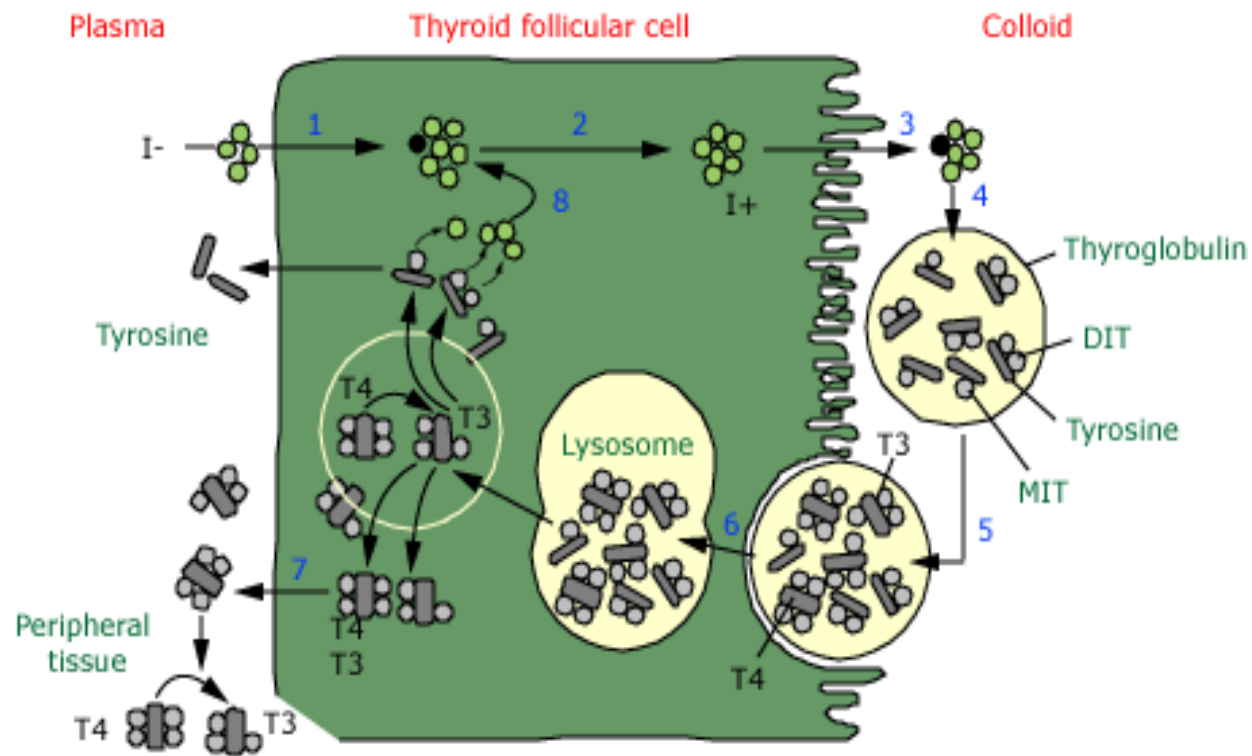
3,3,5 -Triiodothyronine (rT_3)



Thyroid hormones

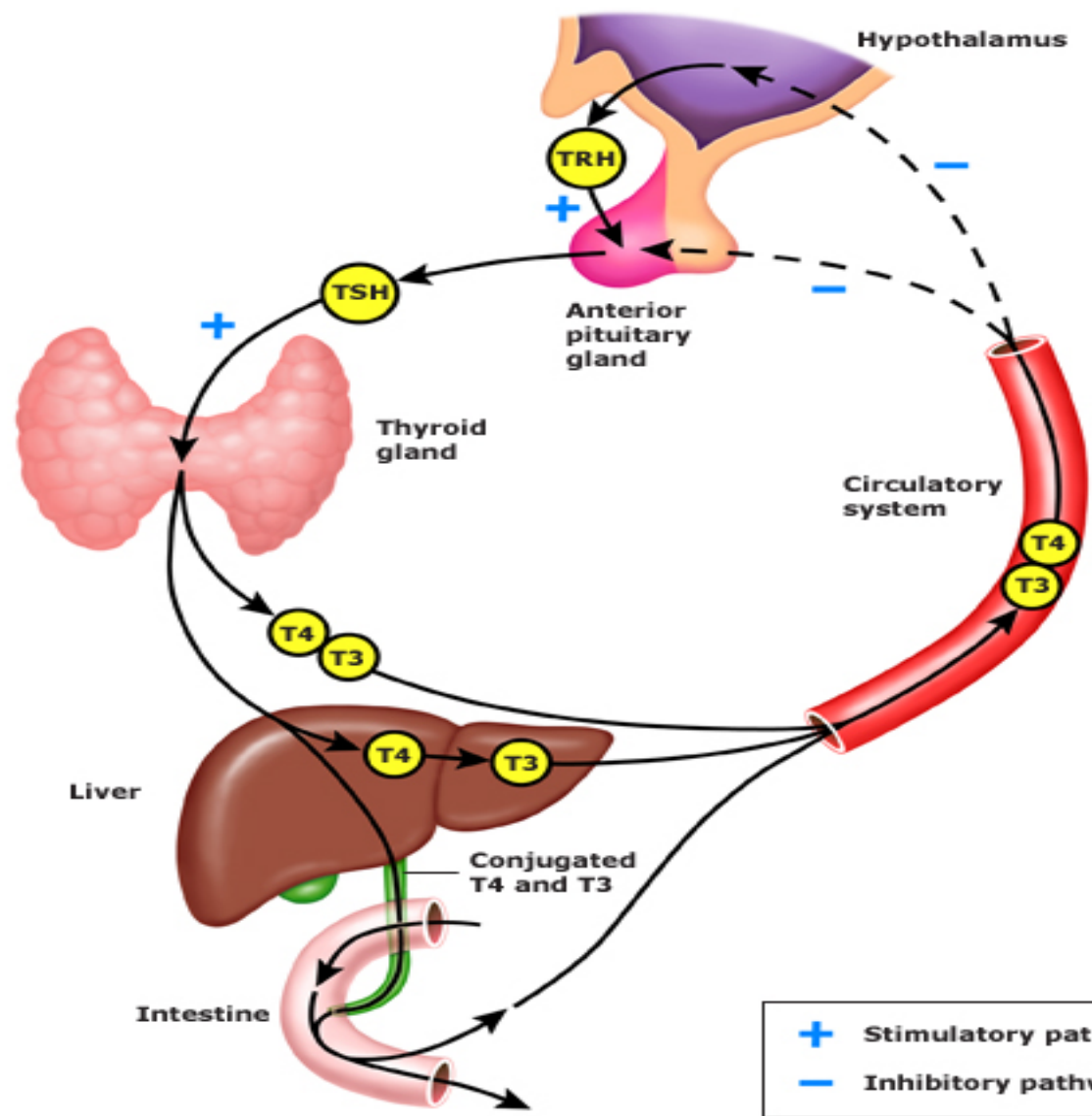
- Follicular cells of the thyroid is the main site of hormones synthesis
- Mainly T4 and small amount of T3
- Iodine is needed to produce thyroid hormones
- Average adult requirement of iodine is 150 mcg a day, 220 mcg for pregnant, 290 mcg for lactating
- Source of iodine: dairy and seafood products

Thyroid hormones synthesis



Thyroid hormones

- Stored in the thyroglobulin in follicular cells of the thyroid gland
- 99.9 % of T4 and T3 are bound to protein in the blood: TBG, albumin, lipoprotein
- T4 and T3 synthesis and secretion is regulated by pituitary TSH.
- TSH is inhibited by T4 and T3, stimulated by TRH
- Extrathyroidal conversion of T4 to T3 is regulated by nutrition, illness, hormonal factors



Thyroid hormone action

- Thyroid hormones act on the bone and bone development
- In children: delayed growth and epiphyseal growth
- In brain: cognitive impairment
- Act on cardiac muscle: tachy and bradycardia
- Regulate metabolic rate and little change in bodyweight

Thyroid function

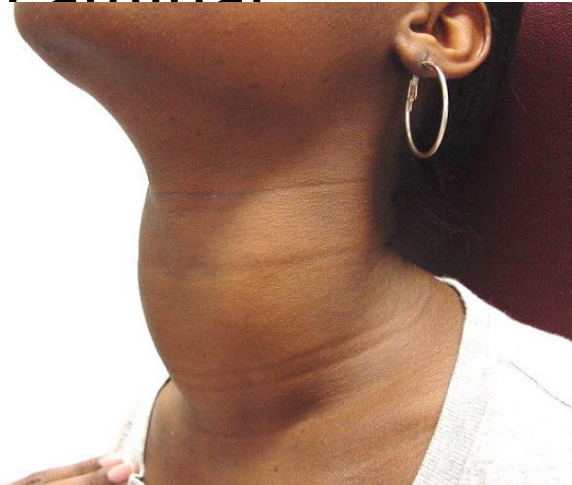
- TSH
- Free T4, FreeT3
- TRH
- TBG
- Thyroid antibodies: microsomal antibodies, TSH receptor antibodies, thyroglobulin antibodies

Radiological imaging of thyroid function

- US neck
- Radioactive uptake scan
- CT neck sometimes for retrosternal goiter

Common thyroid disorders

- Goiter: chronic enlargement of thyroid gland not due to neoplasm
- Endemic Goiter: common in china and central africa
- Sporadic Goiter: multinodular goiter
- Familial



Goiter

- Hashimoto's thyroiditis: in early stage
- Graves' disease: due to chronic stimulation of TSH receptor
- Diet: cabbage, Cauliflower
- Chronic iodine excess
- Medication: lithium in 6%
- neoplasm

Goiter

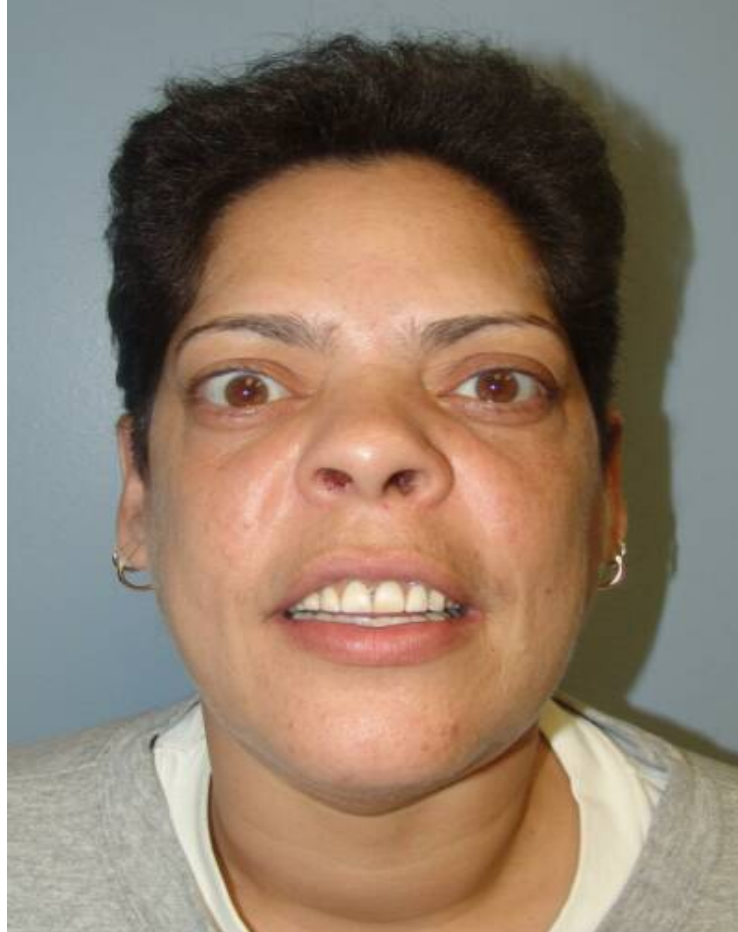
- Assess thyroid function by :
 - Free T4, FT3
 - TSH
 - Ultrasound neck

Goiter-non Toxic

- Thyroxine suppression therapy: not useful
- Surgery:
 - If pressure symptoms
 - Malignancy
 - Lymphadenopathy
- Radioactive iodine therapy

Hyperthyroidism

- Hypermetabolic state caused by increased availability of thyroid hormones



Causes of hyperthyroidism

| |
|--|
| Hyperthyroidism with a normal or high radioiodine uptake |
| Autoimmune thyroid disease |
| Graves' disease |
| Hashitoxicosis |
| Autonomous thyroid tissue (uptake may be low if recent iodine load led to iodine-induced hyperthyroidism) |
| Toxic adenoma |
| Toxic multinodular goiter |
| TSH-mediated hyperthyroidism |
| TSH-producing pituitary adenoma |
| Non-neoplastic TSH-mediated hyperthyroidism |
| Human chorionic gonadotropin-mediated hyperthyroidism |
| Hyperemesis gravidarum |
| Trophoblastic disease |
| Hyperthyroidism with a near absent radioiodine uptake |
| Thyroiditis |
| Subacute granulomatous (de Quervain's) thyroiditis |
| Painless thyroiditis (silent thyroiditis, lymphocytic thyroiditis) |
| Postpartum thyroiditis |
| Amiodarone (also may cause iodine-induced hyperthyroidism) |
| Radiation thyroiditis |
| Palpation thyroiditis |
| Exogenous thyroid hormone intake |
| Excessive replacement therapy |
| Intentional suppressive therapy |
| Factitious hyperthyroidism |
| Ectopic hyperthyroidism |
| Struma ovarii |
| Metastatic follicular thyroid cancer |

Clinical features of hyperthyroidism

- Skin: warm, excessive sweating
- Onycholysis, hyperpigmentation
- Pruritus, vitiligo, alopecia, thinning of the hair
- Pretibial myxedema



Hyperthyroidism

- Eyes: sympathetic overactivity
- Common in graves' disease
- Extraocular muscles dysfunction: diplopia, proptosis, lid retraction, corneal ulceration, optic neuropathy and blindness
- Periorbital and conjunctival edema



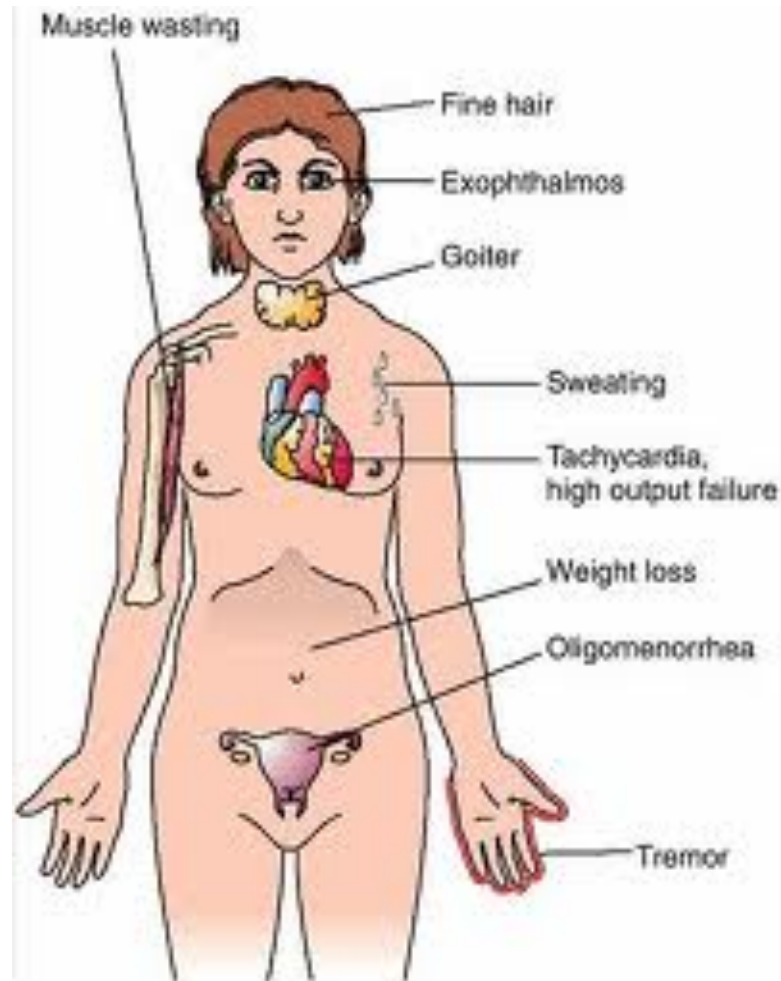
Hyperthyroidism

- **Cardiac:**
 - Atrial fibrillation in 10-20 %
 - High output cardiac failure
 - Wide pulse pressure, hypertension
- **Respiratory:**
 - Dyspnoea
- **GI:**
 - Weight loss, diarrhoea, increase liver enzyme

Hyperthyroid

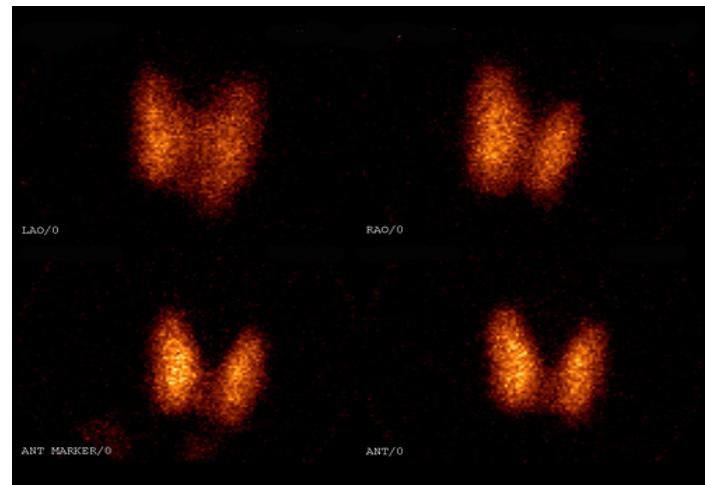
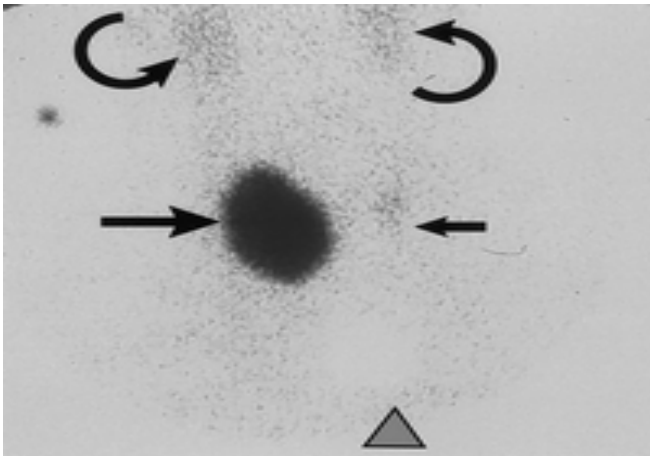
- Bone:
 - Bone turnover increased: osteoporosis
- Neuropsychiatry:
 - Behavioral and personality changes: irritability, depression
- Hyperactivity increased

Hyperthyroidism




Lab-hyperthyroidism

- Increased Free T4
- Increased Free T3
- Low TSH
- TSH-receptor antibodies
- Increased radioactive iodine uptake on



Treatment of Graves' hyperthyroidism

| Therapy | Advantages | Disadvantages |
|-------------|--|--|
| Thionamides | <p>Chance of permanent remission</p> <p>Some patients avoid permanent hypothyroidism</p> <p>Lower cost</p> | <p>Minor side effects: rash, hives, arthralgias, transient granulocytopenia, gastrointestinal symptoms</p> <p>Major side effects: agranulocytosis, vasculitis (lupus-like syndrome), hepatitis</p> <p>Risk of fetal goiter and hypothyroidism if pregnant</p> <p>Requires more frequent monitoring</p> |
| Radioiodine | <p>Permanent resolution of hyperthyroidism</p> | <p>Permanent hypothyroidism</p> <p>Patient must take radiation precautions for several days after treatment, avoiding contact with young children and pregnant women</p> <p>Rare radiation thyroiditis</p> <p>Patient concerns about long-term oncogenic effects of radiation</p> |
| Surgery | <p>Rapid, permanent cure of hyperthyroidism</p> | <p>Permanent hypothyroidism</p> <p>Risk of hypoparathyroidism, recurrent laryngeal nerve damage, and general anesthesia</p> <p>High cost</p> |

Summary of the advantages and disadvantages of the three major therapeutic modalities used in the treatment of Graves' hyperthyroidism. 

Hypothyroid

- Causes
- Clinical features
- management

Major causes of hypothyroidism

| |
|---|
| Primary hypothyroidism |
| Chronic autoimmune thyroiditis |
| Iatrogenic |
| Thyroidectomy |
| Radioiodine therapy or external irradiation |
| Iodine deficiency or excess |
| Drugs - thionamides, lithium, amiodarone, interferon-alfa, interleukin-2, perchlorate |
| Infiltrative diseases - fibrous thyroiditis, hemochromatosis, sarcoidosis |
| Transient hypothyroidism |
| Painless (silent, lymphocytic) thyroiditis |
| Subacute granulomatous thyroiditis |
| Postpartum thyroiditis |
| Subtotal thyroidectomy |
| Following radioiodine therapy for Graves' hyperthyroidism |
| Following withdrawal of suppressive doses of thyroid hormone in euthyroid patients |
| Congenital thyroid agenesis, dysgenesis, or defects in hormone synthesis |
| Central hypothyroidism |
| TSH deficiency |
| TRH deficiency |
| Generalized thyroid hormone resistance |

Drugs affecting thyroid function or function tests

| Drugs causing hypothyroidism |
|---|
| Inhibition of thyroid hormone synthesis and/or release - thionamides, lithium, perchlorate, aminoglutethimide, thalidomide, and iodine and iodine-containing drugs including amiodarone, radiographic agents, expectorants (Organidin, Combid), kelp tablets, potassium iodine solutions (SSKI), Betadine douches, topical antiseptics |
| Decreased absorption of T4 - cholestyramine, colestipol, colesevelam, aluminum hydroxide, calcium carbonate, sucralfate, iron sulfate, raloxifene, omeprazole, lansoprazole, and possibly other medications that impair acid secretion, sevelemer, lanthanum carbonate, and chromium; malabsorption syndromes can also diminish T4 absorption |
| Immunes dysregulation - interferon-alfa, interleukin-2 |
| Suppression of TSH - dopamine |
| Possible destructive thyroiditis - sunitinib |
| Increased T4 clearance and suppression of TSH - bexarotene |
| Drugs causing hyperthyroidism |
| Stimulation of thyroid hormone synthesis and/or release - iodine, amiodarone |
| Immunes dysregulation - interferon-alfa, interleukin-2, denileukin diftitox |
| Drugs causing abnormal thyroid function tests without thyroid dysfunction |
| Low serum TBG - androgens, danazol, glucocorticoids, slow-release niacin (nicotinic acid), l-asparaginase |
| High serum TBG - estrogens, tamoxifen, raloxifene, methadone, 5-fluouracil, clofibrate, heroin, mitotane |
| Decreased T4 binding to TBG - salicylates, salsalate, furosemide, heparin (via free fatty acids), certain NSAIDs |
| Increased T4 clearance - phenytoin, carbamazepine, rifampin, phenobarbital |
| Suppression of TSH secretion- dobutamine, glucocorticoids, octreotide |
| Impaired conversion of T4 to T3 - amiodarone, glucocorticoids, contrast agents for oral cholecystography (eg, iopanoic acid), propylthiouracil, propranolol, nadol |

Major symptoms and signs of hypothyroidism

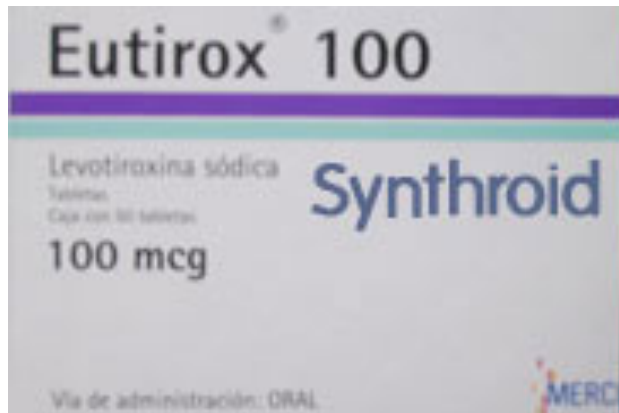
| Mechanism | Symptoms | Signs |
|-----------------------------------|--|--|
| Slowing of metabolic processes | Fatigue and weakness Cold intolerance Dyspnea on exertion Weight gain Cognitive dysfunction Mental retardation (infant) Constipation Growth failure | Slow movement and slow speech Delayed relaxation of tendon reflexes Bradycardia Carotenemia |
| Accumulation of matrix substances | Dry skin Hoarseness Edema | Coarse skin Puffy facies and loss of eyebrows Periorbital edema Enlargement of the tongue |
| Other | Decreased hearing Myalgia and paresthesia Depression Menorrhagia Arthralgia Pubertal delay | Diastolic hypertension Pleural and pericardial effusions Ascites Galactorrhea |

Hypothyroid-Diagnosis

- High TSH
- Low Free T4 and T3
- Positive TPO antibodies
- Low Na
- Anemia
- High cholesterol

Hypothyroidism- treatment

- Thyroxine replacement



Patterns of thyroid function tests during assessment of thyroid function

| Serum TSH | Serum Free T4 | Serum T3 | Assessment |
|---|-------------------|----------------|-------------------------------------|
| Normal hypothalamic-pituitary function | | | |
| Normal | Normal | Normal | Euthyroid |
| Normal | Normal or high | Normal or high | Euthyroid hyperthyroxinemia |
| Normal | Normal or low | Normal or low | Euthyroid hypothyroxinemia |
| Normal | Low | Normal or high | Euthyroid: triiodothyronine therapy |
| Normal | Low normal or low | Normal or high | Euthyroid: thyroid extract therapy |
| High | Low | Normal or low | Primary hypothyroidism |
| High | Normal | Normal | Subclinical hypothyroidism |
| Low | High or normal | High | Hyperthyroidism |
| Low | Normal | Normal | Subclinical hyperthyroidism |
| Abnormal hypothalamic-pituitary function | | | |
| Normal or high | High | High | TSH-mediated hyperthyroidism |
| Normal or low* | Low or low-normal | Low or normal | Central hypothyroidism |

* In central hypothyroidism, serum TSH may be low, normal or slightly high.

Hypo and hyperthyroidism

KNOW MORE

HYPOTHYROIDISM

It is a disease affecting humans and vertebrates, caused by insufficient production of thyroid hormones by the thyroid gland

- Poor muscle tone (muscle hypotonia)
- Fatigue
- Cold intolerance, greater sensitivity to cold
- Constipation
- Depression
- Muscle cramps and joint pain
- Goiter
- Thin, brittle fingernails
- Coarse hair
- Paleness
- Decreased sweating
- Poor muscle tone (muscle hypotonia)



HYPERTHYROIDISM

It is a condition in which an overactive thyroid gland produces excessive amount of thyroid hormones that circulate in the blood

- Palpitation
- Heat intolerance
- Nervousness
- Insomnia
- Breathlessness
- Increased bowel movements
- Light or absent menstrual periods
- Fatigue
- Fast heart rate
- Trembling hands
- Weight loss
- Muscle weakness
- Hair loss



HYPO

thyroidism

HYPER

thyroidism

DRY, COARSE HAIR

LOSS OF EYEBROW HAIR

PUFFY FACE

ENLARGED THYROID (GOITER)

SLOW HEARTBEAT

ARTHRITIS

COLD INTOLERANCE

DEPRESSION

DRY SKIN

FATIGUE

FORGETFULNESS

HEAVY MENSTRUAL PERIODS

INFERTILITY

MUSCLE ACHES

WEIGHT GAIN

CONSTIPATION

BRITTLE NAILS

HAIR LOSS

BULGING EYES

SWEATING

ENLARGED THYROID (GOITER)

RAPID HEARTBEAT

DIFFICULTY SLEEPING

HEAT INTOLERANCE

INFERTILITY

IRRITABILITY

MUSCLE WEAKNESS

NERVOUSNESS

SCANT MENSTRUAL PERIODS

WEIGHT LOSS

FREQUENT BOWEL MOVEMENTS

WARM, MOIST PALMS

TREMOR OF FINGERS

SOFT NAILS

This diagram is to be used for informational purposes only. Please consult your physician for proper diagnosis and treatment.

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