Thyroid eye disease, Thyroid gland anatomy and physiology

Introduction

The thyroid gland is the largest endocrine gland in the body. Located in the anterior aspect of the neck and comprises two lobes connected through an isthmus." The gland originates from the endoderm, from the first and second pharyngeal pouches around the 3d week of gestation. Functionally, the gland produces three types of hormones: triiodothyronine (T3), tetra-iodothyronine (T4), and calcitonin. T3 and T4 (thyroid hormones [THs]) control metabolism, growth, and development, calcitonin has an important role in calcium metabolism.

Anatomy

The thyroid gland comprises

- A midline isthmus lying horizontally just below the cricoid cartilage.
- Two lateral lobes that extend upward over the lower half of the thyroid cartilage.

The gland lies deep to the strap muscles of the neck, enclosed in the pretracheal fascia, which anchors it to the trachea, so that the thyroid moves up on swallowing.

- Endocrine gland, situated in the lower part of the front and sides of the neck.
- **Extends:** from oblique line of thyroid cartilage to the 5th or 6th tracheal ring.
- Lie against C5, C6, C7 & T1.
- Consist Right & Left lobes, joined by isthmus.
- A 3rd pyramidal lobe may project upwards from the isthmus.
- **Capsules:** two; True & false.
- Larger in females than males.
- **Development:** from the endoderm of the floor of primitive oral cavity in the region of the future foramen caecum and ultimobranchial body.

- **Weight** = 25g
- **Shape** - pear or butterfly shape, each lobe conical
- 2poles - narrow upper pole broader lower pole
- Enlarges in pregnancy & menstruation

Physiology

- Thyroid hormone contains iodine. Iodine enters the thyroid in the form of inorganic or ionic iodide, which is organized by the thyroid peroxidase enzyme at the cell–colloid interface.
- Subsequent reactions result in the formation of iodothyronines.
- The thyroid is the only source of T4. The thyroid secretes 20% of circulating T3; the remainder is generated in extraglandular tissues by the conversion of T4 to T3 by deiodinases (largely in the liver and kidneys).
- In the blood, T4 and T3 are almost entirely bound to plasma proteins.
- T4 is bound in d order of affinity to T4 -binding globulin (TBG), transthyretin (TTR), and albumin.
- T3 is bound 10–20 times less avidly by TBG and not significantly by TTR.
- Only the free or unbound hormone is available to tissues. The metabolic state correlates more closely with the free than the total hormone concentration in the plasma.
- The relatively weak binding of T 3 accounts for its more rapid onset and offset of action.
- The concentration of free hormones does not necessarily vary directly with that of the total hormones; e.g., while the total T 4 level rises in pregnancy, the free T 4 (FT 4) level remains normal.

Thyroid eye disease

Thyroid eye disease (abbreviated as TED) is an autoimmune disease that affects some people with autoimmune thyroid disease. TED is most common in people with hyperthyroidism due to Graves' disease and rarely, may occur in patients with normal or low thyroid levels.

- About one in every three people with Graves' disease develop eye symptoms.
- While eye symptoms can occur at any time, they usually appear within the first year of diagnosis of Graves' disease .
- TED is usually mild and gets better on its own over time .
- Some cases can be quite severe and can require medications or surgery.
- In TED, the body makes antibodies which attack soft tissues (the cushion of fatty tissue and the eye muscles) around the eyeball and cause them to swell up and enlarge (thicken). This can result in changes to how the eyes look and feel and how well the patients see.

Symptoms of thyroid eye disease include :

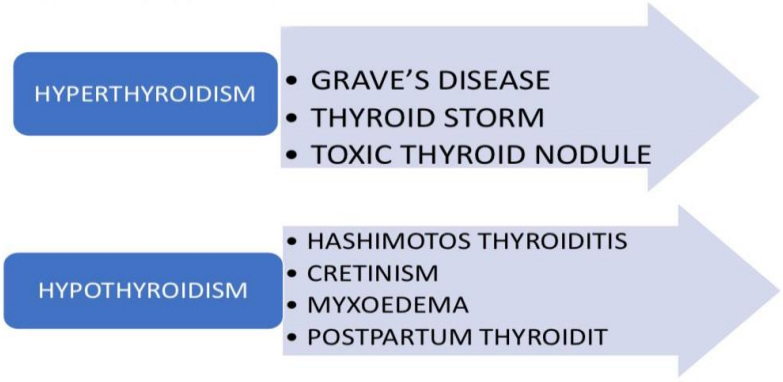
- Feeling of grittiness in your eyes (like "sand in your eyes") and sensitivity to light
- Pain behind your eyes or with eye movement
- Redness of the eyes due to swelling/irritation of the thin coating (conjunctiva) that covers the white part of the eyes
- Dry eyes
- Extra tearing of the eyes
- Puffy or red eyelids
- Forward bulging of your eyes (proptosis)
- Seeing double (Double vision)

Diagnosed

- Measurement of the amount of bulging of the eye
- Tests to check the visual field, and color vision
- A computed tomography (CT) scan or magnetic resonance imaging (MRI) scan of the eye sockets and eye muscles

Ocular manifestations associated with thyroid gland problems

- Smokers 7x
- 30-50 Years:



Hyperthyroidism

Hyperthyroidism is a condition involving excessive secretion of thyroid hormones (T3 & T4).

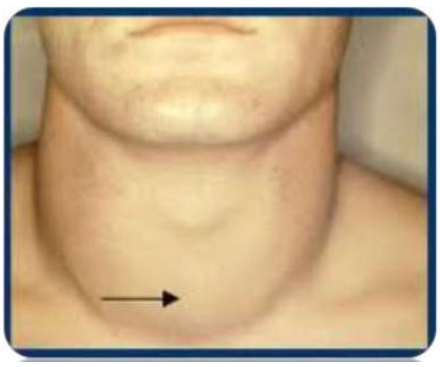
- **Graves' disease:** the most common form of hyperthyroidism. Only Graves' disease has eye abnormalities.
- It is more common in females.

Causes:

Autoimmune disease

Signs and symptoms

- Weight loss
- Diarrhea
- Sweating
- Heat intolerance,
- Nervousness
- Palpitations,
- May be enlargement of the thyroid gland,
- Tremor

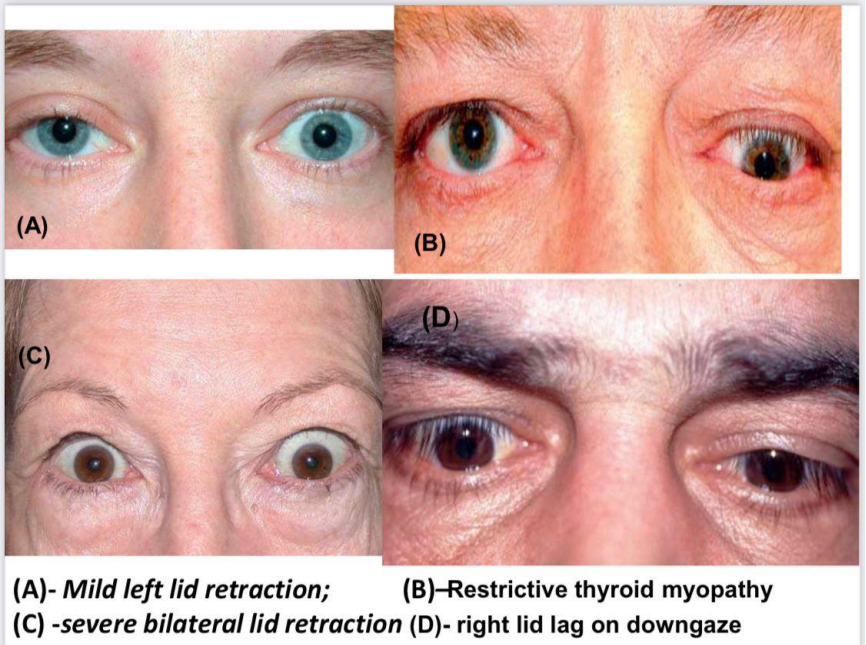


• Increased reflexes

Eye signs

- Eyes are red and painful lacrimation
- Lid lag.
- Proptosis.
- Optic neuropathy.
- Restrictive myopathy.
- Decreased frequency of blinking.
- Lid retraction exposing the upper sclera.
- Diplopia Proptosis in thyroid eye disease.

Proptosis in thyroid eye disease.



(A)- *Mild left lid retraction;* (B)–Restrictive thyroid myopathy
(C) -*severe bilateral lid retraction* (D)- right lid lag on downgaze

Investigations

- **T3 (triiodothyronine) & thyroxine (T4)** levels. Have an elevated T4 level.
- **Thyroid stimulating hormone (TSH)**-Low
- Thyroid uptake of radio iodine.
- Presence of antibodies: **TSH** receptor antibody
- **CT** orbits
- Thyroid scans.

Treatment

- Propranolol
- Anti-thyroid drugs – Carbimazole
- Radio iodine (Graves' disease)
- Surgery

Graves Ophthalmopathy

- Steroids are the best, radiation in those not responding to steroids, severe cases may need surgery.

HYPOTHYROIDISM

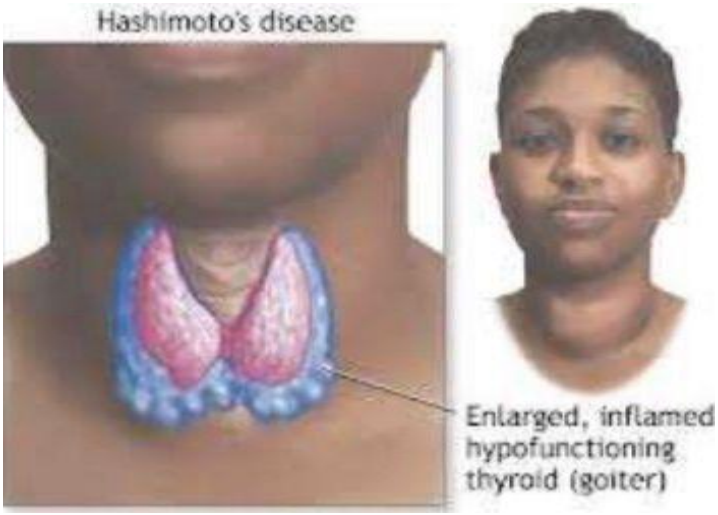
- Insufficiency synthesis of thyroid hormones.
- Female: Male ratio is 6:1.

Causes:

- Hashimoto's thyroiditis
- Thyroid failure following radio iodine.
- Surgical treatment of thyrotoxicosis.
- Drugs like carbimazole, amiodarone.
- Iodine deficiency.

Signs and symptoms

- Weight gain .
- Enlarged thyroid gland .
- Depression .
- Fatigue .
- Bradycardia
- Constipation
- Decreased reflexes
- Cold intolerance



Ophthalmologic features

- Periorbital swelling (part of the generalized nonpitting skin edema of myxedema).
- Characteristic loss of the outer third of the eyebrow.
- Open-angle glaucoma (deposition of a mucopolysaccharide within the trabecular meshwork).

Diagnosis

- TSH ---elevated
- T3 & T4 levels-----low.
- Presence of antibodies

Treatment

- Thyroxine.