Thyroid Function Test & Thyroid Disease

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Outline

- WHAT IS THE THYROID GLAND?
- HOW DOES THE THYROID GLAND FUNCTION?
- THYROID FUNCTION TESTS
- THYROID DISEASE

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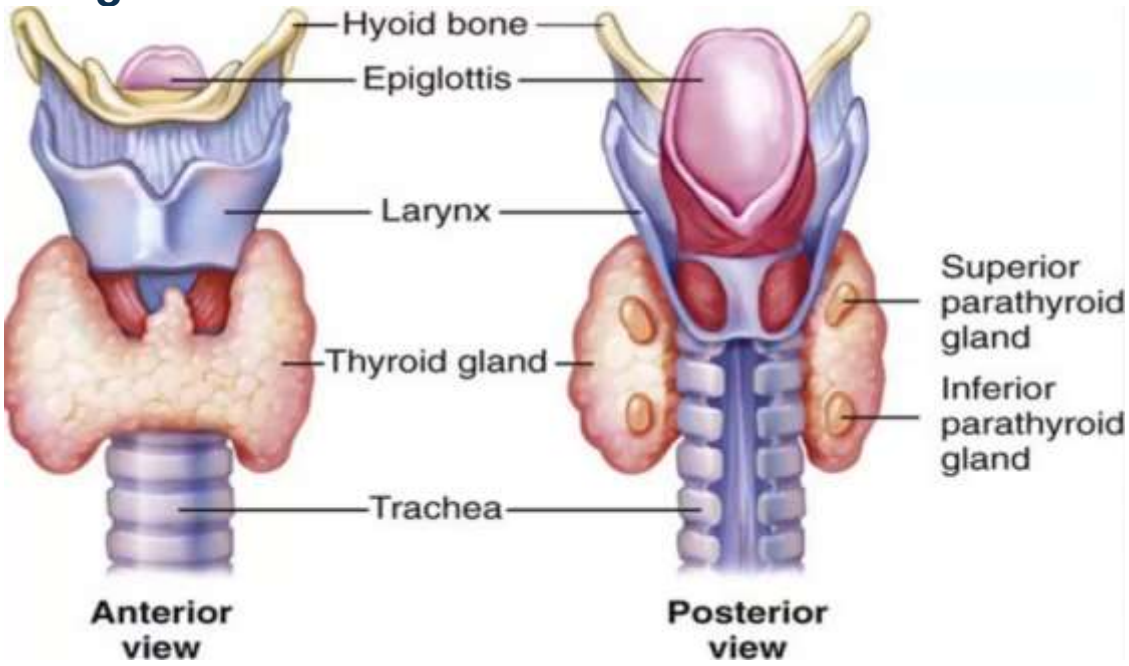
People caring for people

What is thyroid gland?

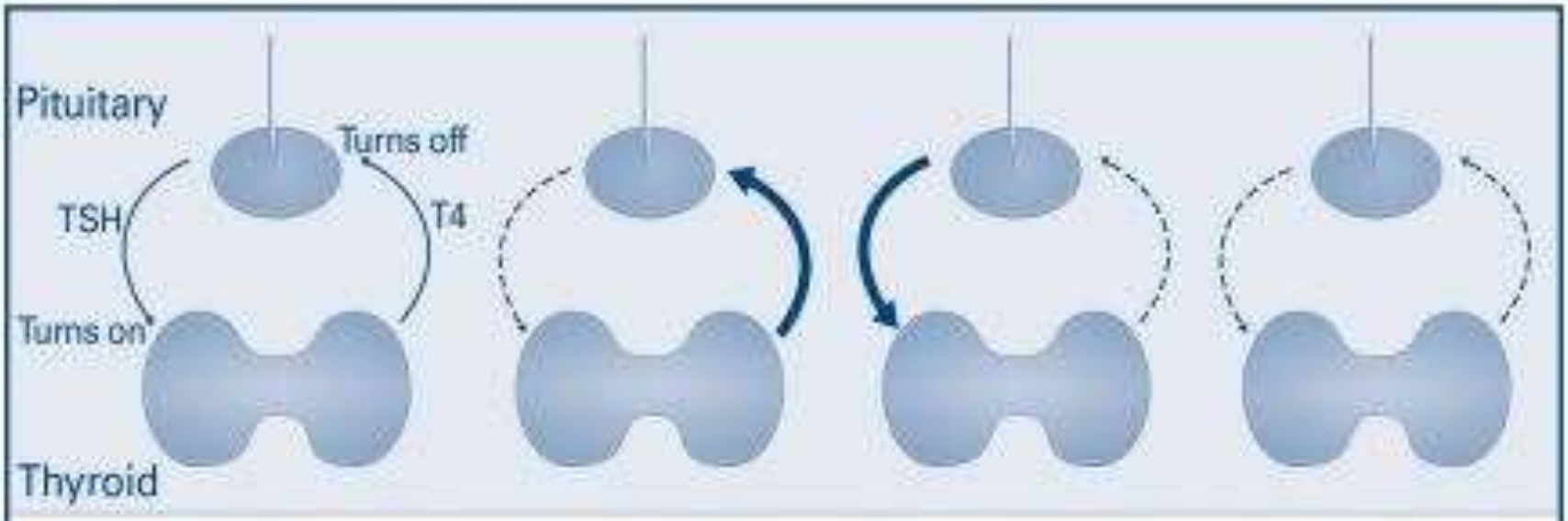


- The thyroid gland is a butterfly-shaped endocrine gland that is normally located in the lower front of the neck.
- The thyroid's job is to make thyroid hormones, which are secreted into the blood and then carried to every tissue in the body
- Thyroid hormones help the body use energy, stay warm and keep the brain, heart, muscles, and other organs working as they should.

How Does The Thyroid Gland Function

- The major thyroid hormone secreted by the thyroid gland is thyroxine, also called T4 because it contains four iodine atoms.
- To exert its effects, T4 is converted to triiodothyronine (T3) by the removal of an iodine atom. This occurs mainly in the liver and in certain tissues where T3 acts, such as in the brain.
- The amount of T4 produced by the thyroid gland is controlled by another hormone, which is made in the pituitary gland located at the base of the brain, called thyroid stimulating hormone (abbreviated TSH).
- The amount of TSH that the pituitary sends into the bloodstream depends on the amount of T4 that the pituitary sees.
- If the pituitary sees very little T4, then it produces more TSH to tell the thyroid gland to produce more T4.
- Once the T4 in the bloodstream goes above a certain level, the pituitary's production of TSH is shut off.

This is illustrated in the figure below



CONDITION:	Normal	Hyperthyroidism	Hypothyroidism Primary	Hypothyroidism Secondary
TSH	Normal	Low	High	Low
T4	Normal	High	Low	Low

Routine Thyroid Function Test

Test	Measurand	Normal Range
TSH	Thyroid stimulating hormone	0.27 –4.2 mU/L
T4	Serum Total thyroxine	65 –150 nmol/L
T3	Serum total triiodothyronine	1.8 –3 nmol/ L
fT4	free T4	12 –22 pmol/ L
fT3	free T 3	3.1 –6.8 pmol/ L

Thyroid Function Test - TSH

- The best way to initially test thyroid function is to measure the TSH level in a blood sample
- Changes in TSH can serve as an “early warning system” – often occurring before the actual level of thyroid hormones in the body becomes too high or too low.
- A high TSH level indicates that the thyroid gland is not making enough thyroid hormone (primary hypothyroidism).
- The opposite situation, in which the TSH level is low, usually indicates that the thyroid is producing too much thyroid hormone (hyperthyroidism).
- Occasionally, a low TSH may result from an abnormality in the pituitary gland, which prevents it from making enough TSH to stimulate the thyroid (secondary hypothyroidism)
- In most healthy individuals, a normal TSH value means that the thyroid is functioning properly.

T4 test and free T4 test

- T4 is the main form of thyroid hormone circulating in the blood. A Total T4 measures the bound and free hormone and can change when binding proteins differ.
- A Free T4 measures what is not bound and able to enter and affect the body tissues.
- Tests measuring free T4 – either a free T4 (FT4) more accurately reflect how the thyroid gland is functioning when checked with a TSH.
- The finding of an elevated TSH and low FT4 indicates primary hypothyroidism due to disease in the thyroid gland. A low TSH and low FT4 indicates hypothyroidism due to a problem involving the pituitary gland.
- A low TSH with an elevated FT4 or FT3 is found in individuals who have hyperthyroidism.

Measurement of Total triidothyronine(T3)

- Principal active thyroid hormone.
- •Only 99 % is bound but binding is weak
- •Useful in diagnosis and monitoring of T3 thyrotoxicosis

Thyroid Diseases

- Hypothyroidsm
- Hyperthroidism
- Goiter
- Thyroid Nodule
- Thyroid cancer

Hypothyroidism

- Hypothyroidism results from the thyroid gland producing an insufficient amount of thyroid hormone. It can develop from problems within the thyroid gland, pituitary gland, or hypothalamus.
- Symptoms of hypothyroidism can include:

❑ Fatigue
❑ Poor concentration or feeling mentally "foggy"
❑ Dry skin
❑ Constipation
❑ Feeling cold
❑ Fluid retention
❑ Muscle and joint aches
❑ Depression
❑ Prolonged or excessive menstrual bleeding in women

- Some common causes of hypothyroidism include:

❑ Hashimoto's thyroiditis (an autoimmune condition that causes inflammation of the thyroid gland)
❑ Thyroid hormone resistance
❑ Other types of thyroiditis (inflammation of the thyroid), such as acute thyroiditis and postpartum thyroiditis

What are the complications of hypothyroidism?

- Cardiac (heart) problems: Hypothyroidism increases the risk of heart disease and causes irregular heart rate and heart failure. Hypothyroidism increases the levels of low-density lipoprotein (LDL) cholesterol, known as the “bad” cholesterol, leading to cardiovascular complications.
- Mental health issues: Depression, slow mental function, lethargy, and poor memory can occur and may worsen over time.
- Peripheral neuropathy: Long-term untreated hypothyroidism can cause damage to your peripheral nerves (in the arms and legs). Patients present with pain, numbness, and tingling in affected areas.
- Myxedema: This is a rare, life-threatening complication of long-term, untreated hypothyroidism. Its signs and symptoms include swelling of the face including the lips, eyelids, and tongue, and swelling and thickening of the skin and underlying tissues anywhere in the body having a waxy texture. Patients also have intense cold intolerance and drowsiness followed by profound lethargy and unconsciousness.
- Infertility: Low levels of thyroid hormone can interfere with ovulation presenting with irregular periods.
- Birth defects: Babies born to women with untreated thyroid disease may have a higher risk of being born with birth defects. The children also have a risk of serious developmental problems.
- Infants: Infants with untreated hypothyroidism present at birth are at risk for serious problems with both physical and mental development.
- Pregnant women: Untreated hypothyroidism during pregnancy increases the risk of miscarriage, premature delivery preeclampsia (high blood pressure in the last trimester of pregnancy), and birth defects in the developing baby.

Hyperthyroidism

- Hyperthyroidism describes excessive production of thyroid hormone, a less common condition than hypothyroidism.
- Symptoms and signs of hyperthyroidism can include:

❑ Tremor
❑ Nervousness
❑ Fast heart rate
❑ Fatigue
❑ Intolerance for heat
❑ Increase in bowel movements
❑ Increased sweating
❑ Concentration problems
❑ Unintentional weight loss

- Some of the most common causes of hyperthyroidism are:

❑ Graves' disease
❑ Toxic multinodular goiter
❑ Thyroid nodules that overexpress thyroid hormone (known as "hot" nodules)
❑ Excessive iodine consumption

What are the complications of hyperthyroidism?

- Cardiac (heart) complications: Cardiac complications of hyperthyroidism can be serious and life-threatening. Cardiac complications include a rapid heart rate and altered heart rhythm called atrial fibrillation that can increase the risk of stroke and heart failure.
- Brittle bones: Untreated hyperthyroidism can lead to osteoporosis (weak, brittle bones) causing the bones to fracture easily. Increased thyroid hormones impair the body's ability to incorporate calcium into the bones.
- Eye complications: Those with Graves' ophthalmopathy develop eye problems, including bulging, red or swollen eyes, photophobia (sensitivity to light), blurry vision or double vision, and even loss of vision/blindness.
- Skin complications: Those with Graves' disease develop Graves' dermopathy, which is characterized by redness and swelling of the skin, usually on the shins and feet.
- Thyrotoxic crisis: Thyrotoxic crisis is a sudden intensification of symptoms, causing fever, palpitations, and altered mental status. This requires emergency medical attention.

Goiter

- A goiter simply describes enlargement of the thyroid gland, regardless of cause.
- A goiter is not a specific disease per se.
- A goiter may be associated with hypothyroidism, hyperthyroidism, or normal thyroid function.

Thyroid nodules

- Nodules are lumps or abnormal masses within the thyroid.
- Nodules can be caused by benign cysts, benign tumors, or, less commonly, by cancers of the thyroid.
- Nodules may be single or multiple and can vary in size.
- If nodules are excessively large, they may cause symptoms related to compression of nearby structures.

Thyroid cancer

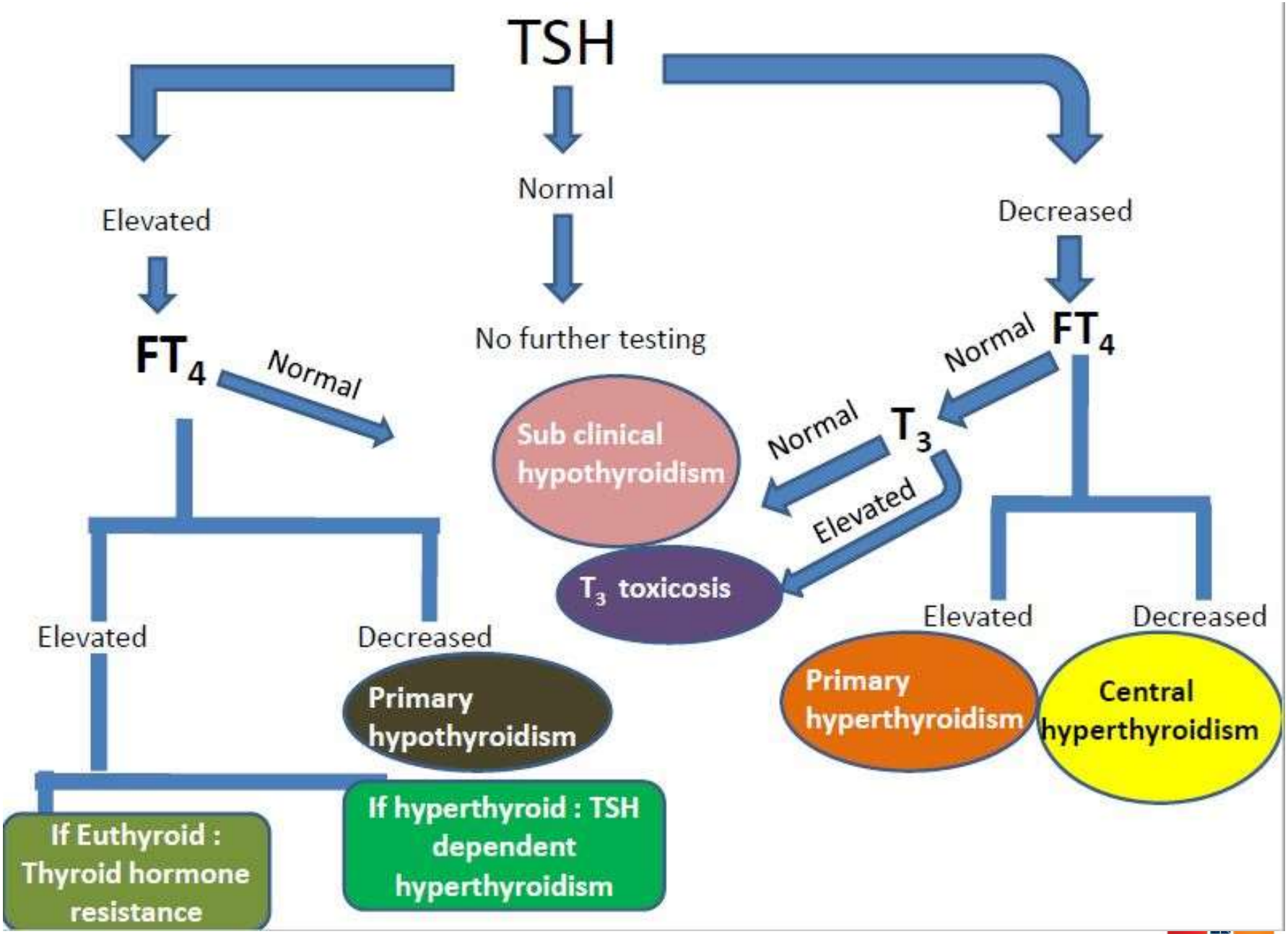
- Thyroid cancer is far more common among adult women than men or youth.
- About 2/3 of cases occur in people under age 55.
- There are different kinds of thyroid cancer, depending upon the specific cell type within the thyroid that has become cancerous.
- Most cases of thyroid cancer have a good prognosis and high survival rates, especially when diagnosed in its early stages.

Lab finding in Hyperthyroidism

	Plasma total T3 and T4	fT4	Plasma TSH
Grave's Disease	Increase	High Increase	Decrease
Toxic Goiter	Increase	High Increase	Decrease
T3 Toxicosis	T3 Increase T4 Normal	Increase	Decrease
Excess intake of thyroxin	Increase	Mild Increase	Decrease

Lab Findings in Hypothyroidism

	T3 and T4in blood	TSH in blood
Primary Hypothyroidism	Decreased	Increased
Secondary Hypothyroidism	Decreased	Decreased


TSH
Elevated
Normal
Decreased
FT4
Normal
No further testing
Normal
FT4
Sub clinical hypothyroidism
Normal
T3
Elevated
T3 toxicosis
Elevated
Decreased
Elevated
Decreased
Primary hypothyroidism
Primary hyperthyroidism
Central hyperthyroidism
If Euthyroid : Thyroid hormone resistance
If hyperthyroid : TSH dependent hyperthyroidism

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Thank you