

Understanding Hypothyroidism: Diagnosis and Treatment

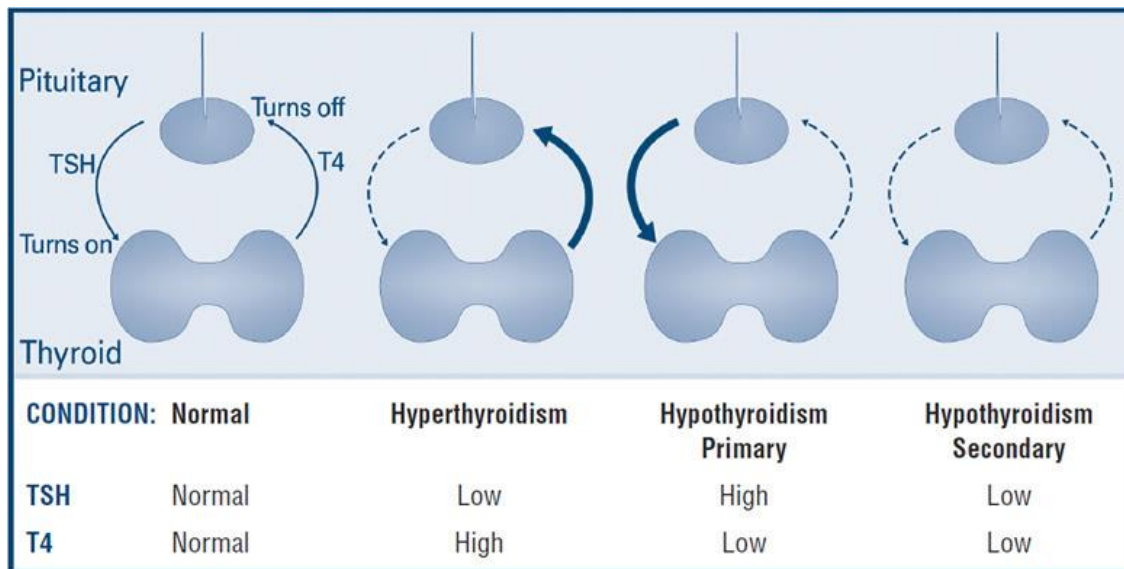
Hypothyroidism, a common endocrine disorder, occurs when the thyroid gland fails to produce sufficient thyroid hormones, primarily thyroxine (T4) and triiodothyronine (T3). These hormones play a crucial role in regulating metabolism, energy production, and overall physiological balance. Understanding the diagnosis and treatment of hypothyroidism is essential for managing this condition effectively.

What is Hypothyroidism?

The thyroid gland, located in the neck, is a small, butterfly-shaped gland that produces hormones crucial for various metabolic processes. Thyroid hormones help the body use energy, stay warm and keep the brain, heart, muscles, and other organs working as they should. Hypothyroidism occurs when the thyroid is underactive, leading to a deficiency in hormone production. This condition can have widespread effects on the body, causing symptoms such as fatigue, weight gain, cold intolerance, depression, and dry skin. Diagnosing and managing hypothyroidism involves understanding what the thyroid gland does.

How the Thyroid Gland Functions

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. In fact, the thyroid and pituitary act in many ways like a heater and a thermostat. When the heater (T4) is off and it becomes cold, the thermostat (TSH) reads the temperature and turns on the heater. When the heat (T4) rises to an appropriate level, the thermostat (TSH) senses this and turns off the heater. This is illustrated below.



Thyroid Tests

Blood tests to measure these hormones are readily available and widely used, but not all are useful in all situations. Tests to evaluate thyroid function include the following:

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. While TSH may be elevated due to pituitary tumors (adenomas), and by medications causing an over-active thyroid (hyperthyroidism), a high TSH level generally 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). Pituitary surgery and medications can also cause TSH to be low, however T4 is also low causing hypothyroidism. In most individuals, a normal TSH value means that the thyroid is functioning properly, while an elevated TSH indicates hypothyroidism, and a decreased TSH level indicates hyperthyroidism.

T4 Tests

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 (see above). 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) or free T4 index (FTI) – more accurately reflect how the thyroid gland is functioning when checked with a TSH.

The finding of an elevated TSH and low FT4 or FTI indicates primary hypothyroidism due to disease in the thyroid gland. A low TSH and low FT4 or FTI indicate hypothyroidism due to a problem involving the pituitary gland. A low TSH with an elevated FT4 or FTI is found in individuals who have hyperthyroidism.

T3 Tests

T3 tests are often useful to diagnosis hyperthyroidism or to determine the severity of the hyperthyroidism. Patients who are hyperthyroid will have an elevated T3 level. In some individuals with a low TSH, only the T3 is elevated and the FT4 or FTI is normal. T3 testing rarely is helpful in the hypothyroid patient, since it is the last test to become abnormal. Patients can be severely hypothyroid with a high TSH and low FT4 or FTI but have a normal T3.

Free T3

Measurement of free T3 is possible but is often not reliable and therefore not typically helpful.

Reverse T3

Reverse T3 is a biologically inactive protein that is structurally very similar to T3, but the iodine atoms are placed in different locations, which makes it inactive. Some reverse T3 is produced normally in the body but is then rapidly degraded. In healthy, non-hospitalized people, measurement of reverse T3 does not help determine whether hypothyroidism exists or not and is not clinically useful.

Causes of Hypothyroidism

The most common cause of hypothyroidism in developed countries is Hashimoto's thyroiditis, an autoimmune disorder where the immune system attacks the thyroid gland. Other causes include:

- Iodine deficiency
- Thyroid surgery
- Radiation therapy
- Certain medications
- Congenital hypothyroidism (present at birth)

Hashimoto's Thyroiditis

Pathophysiology: Hashimoto's thyroiditis, also known as chronic lymphocytic thyroiditis, is an autoimmune condition where the immune system mistakenly targets the thyroid gland, causing inflammation and damage. Over time, this leads to the destruction of thyroid tissue and a decrease in hormone production. The exact cause of this autoimmune response is not entirely understood, but it is believed to involve a combination of genetic predisposition and environmental triggers.

Symptoms: The symptoms of Hashimoto's thyroiditis often develop gradually and may include:

- Fatigue and sluggishness
- Increased sensitivity to cold
- Constipation

- Pale, dry skin
- Puffy face
- Hoarse voice
- Elevated blood cholesterol levels
- Unexplained weight gain
- Muscle aches, tenderness, and stiffness
- Joint pain and stiffness
- Depression
- Memory lapses

Risk Factors: Several factors increase the risk of developing Hashimoto's thyroiditis, including:

- Gender: Women are more likely to develop Hashimoto's than men.
- Age: It commonly occurs in middle age but can affect people of any age.
- Genetics: A family history of thyroid disorders or other autoimmune diseases increases the risk.
- Other Autoimmune Diseases: Conditions such as rheumatoid arthritis, type 1 diabetes, and lupus can increase the likelihood of developing Hashimoto's thyroiditis.

Diagnosis: The diagnosis of Hashimoto's thyroiditis involves a combination of clinical evaluation, laboratory testing, and sometimes imaging studies:

- TSH (Thyroid-Stimulating Hormone) Test: Produced by the pituitary gland to regulate thyroid hormone production. Elevated TSH levels generally indicate the thyroid is not producing enough hormones. While uncommon, it can also be elevated due to tumors of the pituitary gland.
- Free T4 Test: Measures the level of free thyroxine in the blood. Low levels of free T4 confirm hypothyroidism.
- Anti-Thyroid Antibodies: Testing for antibodies, such as anti-thyroid peroxidase (anti-TPO) antibodies and anti-thyroglobulin antibodies, can help confirm Hashimoto's thyroiditis.
- Ultrasound: In some cases, an ultrasound of the thyroid gland may be performed to assess the extent of inflammation and damage.
- Radioactive Iodine Uptake: Because T4 contains iodine, the thyroid gland must pull a large amount of iodine from the bloodstream in order to make an appropriate amount of T4. The thyroid has developed a very active mechanism for doing this. Therefore, this activity can be measured by having an individual swallow a small amount of iodine, which is radioactive. The radioactivity allows the doctor to track where the iodine goes. By measuring the amount of radioactivity that is taken up by the thyroid gland (radioactive iodine uptake, RAIU), doctors may determine whether the gland is functioning normally. A very high RAIU is seen in individuals whose thyroid gland is overactive (hyperthyroidism), while a low RAIU is seen when the thyroid gland is underactive (hypothyroidism).

In addition to the radioactive iodine uptake (RAIU), a thyroid scan may be obtained, which shows a picture of the thyroid gland and reveals what parts of the thyroid have taken up the iodine

The Role of Thyroid Hormones: T4 and T3

Thyroid hormones, thyroxine (T4) and triiodothyronine (T3), are essential for regulating numerous physiological processes:

T4 (Thyroxine):

- Production: T4 is the primary hormone produced by the thyroid gland.
- Function: While T4 is less active than T3, it serves as a precursor, being converted into the more active T3 in peripheral tissues.
- Regulation: The secretion of T4 is regulated by the thyroid-stimulating hormone (TSH) from the pituitary gland. Elevated TSH levels usually indicate the thyroid is not producing enough T4, prompting increased production.
- Measurement: Free T4 (unbound and active) levels are measured to assess thyroid function, with low levels indicating hypothyroidism.

T3 (Triiodothyronine):

- Production: T3 is produced both directly by the thyroid gland and through the conversion of T4 in the liver and other tissues.
- Function: T3 is the more active thyroid hormone, exerting significant effects on metabolism, heart rate, digestion, and brain function. It binds to thyroid hormone receptors in cells, influencing gene expression and cellular activity.
- Regulation: The body tightly regulates T3 levels to ensure metabolic homeostasis.
- Measurement: Total T3 levels can be measured in certain cases to provide additional information about thyroid function, especially when symptoms persist despite normal T4 levels. Free T3 levels are generally less accurate than Total T3.

Treatment of Hypothyroidism

The primary treatment for hypothyroidism is hormone replacement therapy, aiming to normalize thyroid hormone levels and alleviate symptoms. T4 replacement is generally used alone, as T4 is converted to T3 by the liver and other tissues.

Levothyroxine: The most prescribed medication, levothyroxine is a synthetic form of T4. It is taken orally, usually once a day. The dosage is tailored to the individual based on factors such as age, weight, severity of hypothyroidism, and the presence of other health conditions. Regular monitoring and adjustment are necessary to maintain optimal thyroid hormone levels.

Thyroid Extract: Desiccated thyroid extract (Armour Thyroid) is a thyroid product containing T4 and T3 in a ratio of 4:1. It is made from animal (Armour hot dog) by-products and is not FDA approved due to lack of evidence that it is safe and effective. Therefore, it is not usually covered by insurance.

Liothyronine: Liothyronine (Cytomel) is a thyroid product consisting of T3.

Lifestyle and Dietary Considerations

- Diet: A balanced diet rich in fruits, vegetables, lean proteins, and whole grains supports overall health. Adequate iodine intake is essential, although excessive iodine can exacerbate hypothyroidism.
- Exercise: Regular physical activity helps manage weight and improve energy levels.
- Medication Adherence: Consistent use of prescribed medication is crucial for managing hypothyroidism effectively.

Monitoring and Follow-Up

Regular follow-up with a healthcare provider is essential to monitor thyroid hormone levels and adjust treatment as needed. TSH levels are typically checked every 6-12 months once stable, with more frequent monitoring during initial treatment or dosage changes.

Conclusion

Hypothyroidism, while a chronic condition, can be effectively managed with appropriate diagnosis and treatment. Understanding the causes, recognizing symptoms, and adhering to prescribed treatment regimens are key to maintaining a healthy and balanced life. If you suspect you have hypothyroidism or are experiencing symptoms, consult a healthcare provider for proper evaluation and management.