

Understanding Hypothyroidism and Hyperthyroidism

The thyroid gland produces and secretes hormones which regulate metabolism and body temperature as well as promote normal growth and development in children. Disorders of thyroid function are among the most encountered endocrine abnormalities in primary care. Thyroid disease can also be a primary or contributing factor in critical illness and psychiatric disease. Both the states of low thyroid hormone concentrations (hypothyroidism) and thyroid hormone excess (hyperthyroidism) can be transient or permanent depending on the underlying cause.

The thyroid gland is part of the hypothalamus-pituitary-thyroid axis and is controlled by a negative feedback loop. The hypothalamus secretes thyroid releasing hormone (TRH) which stimulates the anterior pituitary gland to secrete thyroid stimulation hormone (TSH) which in turn stimulates the thyroid to release thyroid hormones, thyroxine (T₄) and triiodothyronine (T₃). These hormones control how the body uses energy, so they affect nearly every organ in your body. When blood levels of thyroid hormones increase, TRH and TSH are inhibited.

Hypothyroidism

Hypothyroidism is a state of low circulating thyroid hormones. Primary causes for this condition, which affect the thyroid gland directly, impair its ability to make enough hormone. Rarely, there may be a secondary cause such as a pituitary gland tumor, which blocks the pituitary production of TSH. Hypothyroidism results in the slowing down of many physical and mental processes. Myxedema coma, the decompensated severe form of hypothyroidism, is a medical emergency which warrants immediate treatment with thyroid hormone and intensive care unit admission.

Causes of Hypothyroidism

- Primary Hypothyroidism
 - Hashimoto disease (autoimmune thyroiditis)
 - Iodine deficiency
 - Surgical removal of the thyroid gland
 - Thyroid ablation with radioactive iodine
 - External radiation
 - Temporary inflammation of thyroid gland
 - Too little thyroid medication
 - Exposure to some pharmacologic agents (i.e., amiodarone, lithium, thalidomide)
- Secondary Hypothyroidism
 - Pituitary-based deficiencies of TRH-stimulating or TRH-releasing hormone
 - Rare disorders related to impaired stimulation of the thyroid gland at the pituitary level
 - Pituitary adenoma

Signs and Symptoms of Hypothyroidism

- General loss of energy
- Slowed metabolism
- Hypothermia

- Weight gain
- Bradycardia
- Dry skin and hair
- Constipation
- Cold intolerance
- Puffy skin
- Hyperlipidemia
- Hair loss
- Altered cognition
- Hyporeflexia
- Menstrual irregularities/infertility in women
- Stunted growth in children

Treatment of Hypothyroidism

Thyroid replacement, using a form of T₄ (levothyroxine sodium), is the preferred treatment. It is a more stable form of thyroid hormone and requires only once a day dosing. Thyroid replacement should be tailored for the individual patient because small changes in dose can rapidly shift a patient from a euthyroid state. Patients should be monitored closely until stable. After TSH is stabilized, maintenance therapy should be continued with annual or semiannual TSH testing.

Clinical Considerations

- Inform patient that thyroid replacement treatment will likely continue for life.
- If the brand of medication changes, recheck the patient's TSH level.
- Advise patient that medication should be taken at the same time each day on an empty stomach (at least one hour before other medications).
- Teach patient that significant interference with absorption can occur when taken with calcium, iron, vitamins, antacids, colestipol or other medications that bind bile acids or fiber supplements.
- Patients with depression, anxiety, and cognitive problems should be screened for thyroid disease.

Hyperthyroidism

Hyperthyroidism is a state of high circulating thyroid hormones, arising either from overproduction from the thyroid gland or extrathyroidal, including exogenous, sources. Thyrotoxicosis refers to the clinical syndrome that results from excess thyroid hormone. Thyroid storm is the most severe form of thyrotoxicosis, resulting in the extreme alteration of usual hyperthyroid signs and symptoms. The diagnosis can occur in patients with or without preexisting hyperthyroidism. It is a rare diagnosis and usually triggered by precipitants such as trauma, myocardial infarction, surgery (including thyroid surgery for hyperthyroidism or other surgeries in general), or infection. Thyroid storm is a medical emergency, warranting immediate administration of medications to block the production and release of thyroid hormone, and supportive management of systemic illness.

Causes of Hyperthyroidism

- Graves' Disease
- Thyroid tumor/nodule
- Excessive intake of thyroid hormones
- Abnormal secretion of TSH
- Thyroiditis
- Excessive iodine intake

Signs and Symptoms of Hyperthyroidism

- Hot flashes, sweating
- Tachycardia
- Hypertension
- Anxiety, nervousness
- Weight loss
- Hair loss
- Difficulty sleeping, restlessness
- Tremors in the hands
- Weakness
- Diarrhea
- Emotional instability, irritability or fatigue
- Goiter
- Moist, sweaty skin
- Exophthalmos, lid lag

Treatment of Hyperthyroidism

There are two main antithyroid drugs available: methimazole and propylthiouracil. It is important to note that these medications can cause occasional suppression of white blood cell production. Medications are also available to immediately treat the symptoms caused by excessive thyroid hormones, for example, a beta-blocker to manage tachycardia.

Radioactive iodine is another option to treat hyperthyroidism. A one-time oral treatment ablates the hyperactive gland. However, permanent hypothyroidism is the major complication of this form of treatment.

Surgical removal of the thyroid tissue that is producing the excessive thyroid hormone is another option. A major complication is disruption of the surrounding tissue, including accidental removal of the parathyroid glands, resulting in low calcium levels and thus requiring calcium replacement.

Special Populations

Pregnancy

Thyroid dysfunction in pregnancy is associated with preeclampsia, spontaneous abortion, abnormal fetal brain development, and fetal mortality. In general, increased dosage requirements of thyroid replacement medications should be anticipated, especially during first and second trimesters.

Children

Thyroid hormones play a critical role in neurologic development in children. Low or absent levels of thyroid hormone may result in cretinism, and neonatal hypothyroidism accounts for the most preventable cause of intellectual disability.

Elderly

Signs and symptoms of hypothyroidism may be very subtle and mistakenly attributed to normal aging changes. Taking a careful history is important to make the correct diagnosis and helps to avoid erroneous diagnoses of heart failure, dementia or depression.

Thyroid Function Tests (TFTs)

Thyroid function tests (TFTs) are used to screen thyroid activity. TSH is the gold standard for evaluating thyroid function.

When screening for thyroid dysfunction:

- If the TSH is normal, no further testing is required.
- If the TSH is high, check free T₄ to determine the degree of hypothyroidism.
- If the TSH is low, check free T₄ and T₃ to determine the degree of hyperthyroidism.
- If pituitary or hypothalamic disease is suspected, check both serum TSH and free T₄.
- If TSH is normal, but patient has convincing symptoms of thyroid dysfunction, check free T₄.

Normal Thyroid Test Values	
Laboratory Test	Normal Range (Adult)
TSH	0.4 to 5.0 mIU/L
Total T ₄	4.6 to 11.2 mcg/dL
Free T ₄	Varies with methodology used.
Total T ₃	75 to 195 ng/dL
Free T ₃	Varies among laboratories.

Note: TSH levels peak in the evening and are at their lowest in the afternoon. Also, levels may vary with severe stress, illness, trauma, and low energy intake.

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