Diseases of the thyroid gland

Dr. Rafa G. Carretero
Internal Medicine Department
Hospital Universitario de Móstoles

March 27, 2025

Contents

1 Introduction

The thyroid gland is composed of thyroid follicles that synthesize and store thyroid hormone. The hypothalamus releases thyroid-releasing hormone (TRH), which stimulates the secretion of thyroid-stimulating hormone (TSH). The anterior pituitary then releases TSH and stimulates the thyroid follicular cells to release thyroxine, T4 (80%), and triiodothyronine or T3 (20%). The synthesis of thyroid hormones is dependent on the availability of iodide.

2 Issues of Concern

The two more common disorders are hypothyroidism and hyperthyroidism. In primary thyroid disorder, the disease originates in the thyroid gland. If the thyroid gland is secreting high levels of T3/T4, this will provide negative feedback on the anterior pituitary and thus, decrease the secretion of TSH. If the thyroid gland is secreting low levels of T3/T4, the absence of negative feedback on the anterior pituitary will increase TSH secretion from the anterior pituitary.

For secondary disease or central (either hyperthyroid or hypothyroid) disease, the disorder originates in the anterior pituitary. If a tumor in the anterior pituitary is secreting excessively high TSH, this will stimulate the thyroid follicular cells to secrete high levels of T3/T4. If the anterior pituitary is secreting low TSH levels, such as in pan-hypopituitarism, this lack of stimulation of thyroid follicular cells will cause them to secrete low levels of T4.

The thyroid functions to influence many organ systems, like promoting bone growth and maturation and the maturation of the central nervous system (CNS). The basal metabolic rate is increased, with an increase in the synthesis of sodium (Na^+)-potassium (K^+)-ATPase, an increase in oxygen consumption, and increased heat production. Metabolism becomes activated with an increase in glucose absorption, glycogenolysis, gluconeogenesis,

lipolysis, protein synthesis, and degradation (net catabolic). The hormones influence the cardiovascular system by increasing cardiac output, stroke volume, heart rate, and contractility of the heart by increasing the number of beta-1 receptors on the myocardium such that the myocardium is more sensitive to stimulation by the sympathetic nervous system, thereby increasing contractility.

3 Clinical Significance

3.1 Hypothyroidism

Hypothyroidism results from low levels of thyroid hormone with varied etiology and manifestations. Hypothyroidism has symptoms that include decreased basal metabolic rate, weight gain and nitrogen balance, reduced heat production, cold sensitivity, decreased cardiac output, hypoventilation, lethargy and mental slowness, drooping eyelids, myxedema, growth retardation, mental retardation in perinatal patients, and goiter. When a patient exhibits these symptoms, an increased TSH would indicate negative feedback if the primary defect is in the thyroid gland. Hypothyroidism can result from thyroiditis (that is, autoimmune destruction of the gland, also calles Hashimoto thyroiditis), surgery for hyperthyroidism, iodine-deficiency, congenital (cretinism).

In developed countries, autoimmune thyroid disease (Hashimoto thyroiditis) is the most common cause of hypothyroidism, but globally lack of iodine in the diet is the most common cause.

It is important to maintain a high index of suspicion for hypothyroidism since the signs and symptoms can be mild and nonspecific and different symptoms may be present in different patients. Typical features such as cold intolerance, puffiness, decreased sweating and skin changes may be present. Also it is typical to find dry skin, voice changes (hoarse voice), hair loss, constipation, fatigue, sleep disturbances, menstrual cycle abnormalities, and weight gain. In physical examination a physician can find enlarged thyroid gland, weight gain, slowness of speech and movements, dull facial expressions, macroglossia or bradycardia.

Serum TSH level is used to screen for primary hypothyroidism in most patients. In overt hypothyroidism, TSH levels are elevated, and free T4 levels are low.

Treatment for this should include thyroid hormone (T4) replacement, that is levothyroxine monotherapy.

3.2 Hyperthyroidism

Hyperthyroidism is a common thyroid disorder with multiple underlying etiologies. This disease is characterized by excess thyroid hormone production. Hyperthyroidism is defined as low or suppressed thyroid stimulating hormone (TSH) levels with elevated triiodothyronine (T3) levels and/or elevated thyroxine (T4) levels.

The three most common etiologies of hyperthyroidism include:

1. Graves disease (GD)
2. Toxic multinodular goiter (TMNG)
3. Toxic adenoma

Graves disease is the most common cause of hyperthyroidism in developed countries and it is autoimmune in etiology. Drug-induced thyroiditis (amiodarone, lithium) and other thyroiditis are less common causes of hyperthyroidism.

The pathophysiology of hyperthyroidism depends on the particular variant of hyperthyroidism.

Graves Disease

This is an autoimmune process with antibodies against the TSH receptor. The antibodies stimulate the TSH receptor (TSHR), leading to increased production and release of thyroid hormones. The trophic effects on the thyroid also lead to the growth of the thyroid gland (goiter).

Toxic Multinodular Goiter

It is the development of nodular disease. The patients present with nodules that develop autonomy for thyroid hormone production. The greater the nodule size, the more common prevalence of hyperthyroidism.

Toxic Adenoma

These are solitary nodules with autonomous thyroid hormone production.

Patients with overt hyperthyroidism will have decreased or suppressed TSH levels with elevated free T4 and total T3 levels.

3.3 Symptoms and treatment

Clinical manifestations are associated with a hyperadrenergic and hypermetabolic state. Common manifestations include unintentional weight loss, even with increased appetite, palpitations, tachycardia, tremors, heat intolerance, increased anxiety, irritability, increased frequency of bowel movements (some patients can have significant diarrhea), hair loss, loss of libido, and oligomenorrhea or amenorrhea in women.

Treatment of hyperthyroidism depends on the underlying etiology and can be divided into symptomatic and definitive therapy. The symptoms of hyperthyroidism, such as palpitations, anxiety, and tremor, can be controlled with a beta-adrenergic antagonist such as atenolol. antithyroid drugs such as methimazole are competitive inhibitors of the thyroid peroxidase enzyme, resulting in their ability to block thyroid hormone synthesis.

Definitive treatments for hyperthyroidism are radioactive iodine therapy, or subtotal thyroidectomy. The choice of which definitive treatment modality depends on the etiology, comorbidities, and patient preferences.