

Thyroid Gland

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INTRODUCTION

The thyroid gland secretes thyroxine (T_4) and triiodothyronine (T_3), both of which modulate energy utilization and heat production and facilitate growth. The gland consists of two lateral lobes joined by an isthmus (E-Fig. 63-1). The weight of the adult gland is 10 to 20 g. Microscopically, the thyroid is composed of several follicles that contain colloid surrounded by a single layer of thyroid epithelium. The follicular cells synthesize thyroglobulin, which is stored as colloid. Biosynthesis of T_4 and T_3 occurs by iodination of tyrosine molecules in thyroglobulin.

THYROID HORMONE PHYSIOLOGY

Thyroid Hormone Synthesis

Dietary iodine is essential for synthesis of thyroid hormones. Iodine, after conversion to iodide in the stomach, is rapidly absorbed from the gastrointestinal tract. After active transport from the bloodstream across the follicular cell basement membrane, iodide is enzymatically oxidized by thyroid peroxidase, which also mediates the iodination of the tyrosine residues in thyroglobulin, to form monoiodotyrosine and diiodotyrosine. The iodotyrosine molecules couple to form T_4 (3,5,3',5'-tetraiodothyronine) or T_3 (3,5,3'-triiodothyronine). Once iodinated, thyroglobulin containing newly formed T_4 and T_3 is stored in the follicles. Secretion of free T_4 and T_3 into the circulation occurs after proteolytic digestion of thyroglobulin, which is stimulated by thyroid-stimulating hormone (TSH). Deiodination of monoiodotyrosine and diiodotyrosine by iodotyrosine deiodinase releases iodine, which then re-enters the thyroid iodine pool

(E-Fig. 63-2).

Thyroid Hormone Transport

T_4 and T_3 are tightly bound to the serum carrier proteins thyroxine-binding globulin (TBG), thyroxine-binding prealbumin, and albumin. The unbound or free fractions are the biologically active fractions; they represent only 0.04% of the total T_4 and 0.4% of the total T_3 .

Peripheral Metabolism of Thyroid Hormones

The normal thyroid gland secretes T_4 , T_3 , and reverse T_3 , a biologically inactive form of T_3 . Most of the circulating T_3 is derived from deiodination of circulating T_4 in the peripheral tissues. Deiodination of T_4 can occur at the outer ring (5'-deiodination), producing T_3 (3,5,3'-triiodothyronine), or at the inner ring (5-deiodination), producing reverse T_3 (3,3,5'-triiodothyronine).

Control of Thyroid Function

Hypothalamic thyrotropin-releasing hormone (TRH) is transported through the hypothalamic-hypophyseal portal system to the thyrotrophs of the anterior pituitary gland, stimulating synthesis and release of TSH (Fig. 63-1). TSH, in turn, increases thyroidal iodide uptake and iodination of thyroglobulin, releases T_3 and T_4 from the thyroid gland by increasing hydrolysis of thyroglobulin, and stimulates thyroid cell growth. Hypersecretion of TSH results in thyroid enlargement (goiter). Circulating T_3 exerts negative feedback inhibition of TRH and TSH release.

Physiologic Effects of Thyroid Hormones

Thyroid hormones increase the basal metabolic rate by increasing oxygen consumption and heat production in several body tissues. Thyroid hormones also have specific effects on several organ systems (Table 63-1). These effects are exaggerated in hyperthyroidism and lacking in hypothyroidism, accounting for the well-recognized signs and symptoms of these two disorders.

THYROID EVALUATION

A careful thyroid examination is essential in evaluating a patient with thyroid disease (Video 63-1). Thyroid gland function and structure can be evaluated by (1) determining serum thyroid hormone levels, (2) imaging thyroid gland size and architecture, (3) measuring thyroid autoantibodies, and (4) performing a thyroid gland biopsy by fine-needle aspiration (FNA).

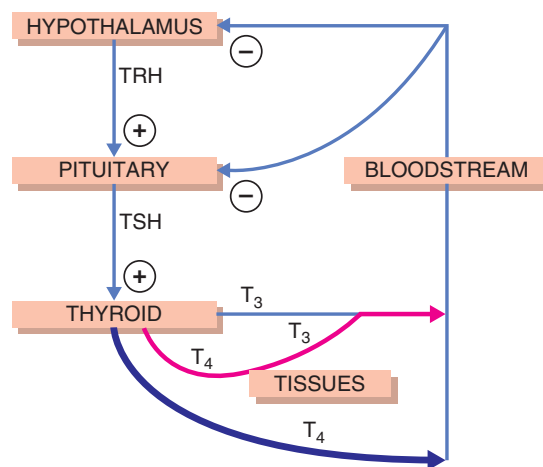


FIGURE 63-1 Hypothalamic-pituitary-thyroid axis. T_4 is converted to T_3 in peripheral tissues. T_3 , Triiodothyronine; T_4 , thyroxine; TRH, thyrotropin-releasing hormone; TSH, thyroid-stimulating hormone.