

Lab.5

Thyroid & Parathyroid Glands

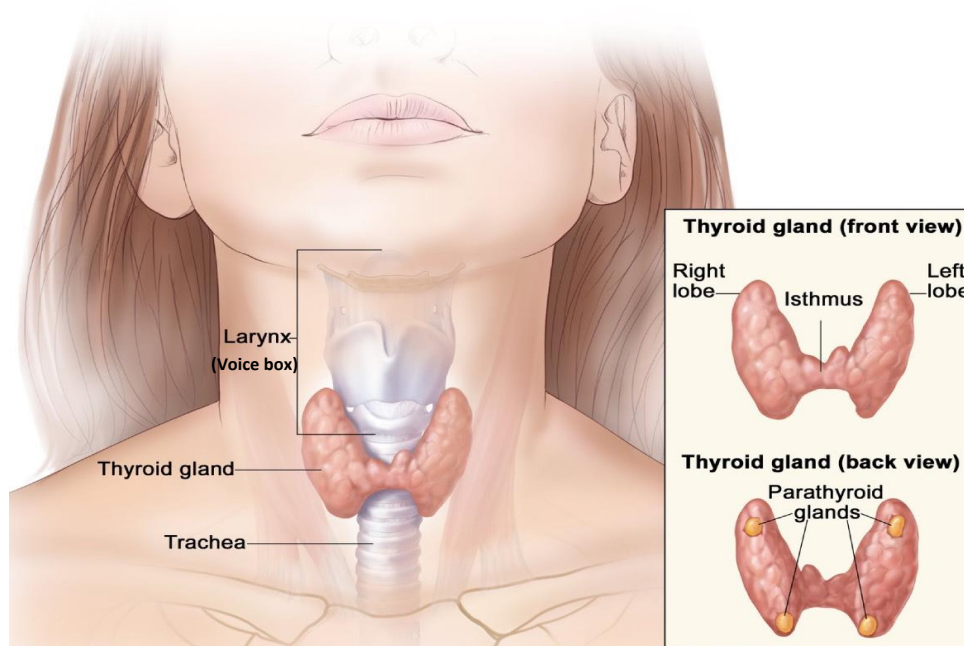
The thyroid gland is a very vascular organ, butterfly-shaped gland located above the trachea in the neck. It consists of two lobes, one on each side of the trachea, just below the larynx or voice box. The two lobes are connected by a narrow band of tissue called the isthmus. Internally, this gland produce Thyroxine (T4), Triiodothyronine (T3) and Calcitonin hormones.

The amount of thyroxine (T4) hormone produced by the thyroid gland is approximately 95% higher than the amount of triiodothyronine (T3) hormone produced. Both of these hormones require iodine for their synthesis.

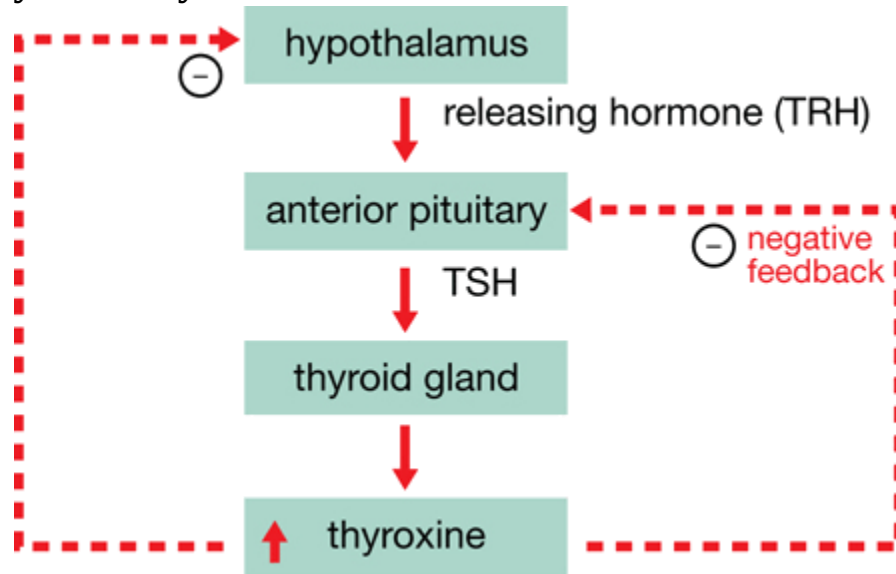
These hormones play an important role in regulation of the weight, energy levels, internal temperature, skin, hair, nail growth, metabolism and is an important part of the endocrine system.

Thyroid hormone secretion is regulated by a negative feedback mechanism that involves the amount of circulating hormone, hypothalamus, and adenohypophysis. The feedback loop signals to the hypothalamus in to release thyrotropin-releasing hormone, which then stimulates the pituitary gland to release the thyroid stimulating hormone.

Anatomy of the Thyroid and Parathyroid Glands



Regulation of thyroxine synthesis



Thyroxine secretion is governed by the anterior lobe of the pituitary gland, which produces thyroid-stimulating hormone (TSH). The two hormones, thyroxine and thyroid-stimulating hormone, interact to adjust the levels of thyroxine in response to the body's constantly changing needs. In the thyroid gland, thyroid-stimulating hormone stimulates an increase in iodine uptake from the blood, and the synthesis and secretion of thyroxine hormone.

So, Thyroxine (T₄) is produced by the thyroid gland under regulation from the hypothalamus and pituitary gland.

T₃ is produced by the thyroid gland, but also in other tissues through deiodination (enzymatic conversion) of T₄. T₃ helps maintain muscle control, brain function and development, heart and digestive functions. It also plays a role in the body's metabolic rate and the maintenance of bone health.

Thyroxine is a hormone the thyroid gland secretes into the bloodstream. Once in the bloodstream, thyroxine travels to the organs, like the liver and kidneys, where it is converted to its active form of triiodothyronine.

If there is an iodine deficiency, the thyroid cannot make sufficient hormone. This stimulates the anterior pituitary to secrete thyroid-stimulating hormone, which causes the thyroid gland to increase in size in a vain attempt to produce more hormones. But it cannot produce more hormones because it does not have the necessary raw material, iodine. This type of thyroid enlargement is called simple goiter or iodine deficiency goiter.

Problems Associated with Thyroxine

Having too little thyroxine or too much thyroxine can cause health problems. If having too much thyroxine in the bloodstream this condition is called thyrotoxicosis. This condition often results from overactivity in the thyroid gland, or hyperthyroidism. Hyperthyroidism occurs in conditions such as Graves' disease, inflammation of the thyroid or a benign tumor. Signs of thyrotoxicosis include weight loss, increased appetite, palpitations, irregular menstrual cycle, tiredness, irritability, and hair thinning. Hyperthyroidism can also occur when supplements with T3 are ingested.

Hypothyroidism is a condition that occurs if the thyroid gland does not produce enough of the thyroxine. This may be due to autoimmune conditions, such as Hashimoto's thyroiditis or certain medications. Hypothyroidism can also occur in pituitary dysfunction, such as pituitary tumors or inflammation.

Hypothyroidism tends to run in families and is more common in adults, as well as women. Symptoms may include tiredness, mental depression, feeling cold, weight gain, dry skin, constipation, and menstrual irregularities.

Calcitonin is a hormone that the C-cells in the thyroid gland produce and release. It opposes the action of the parathyroid hormone, helping to regulate the blood's calcium and phosphate levels. Calcitonin works to control calcium and potassium levels. It does this by inhibiting the activity of the osteoclasts, the cells that break down bone. When the osteoclasts break down bone tissue, the calcium enters the bloodstream. By preventing the breakdown of bone, calcitonin lessens the amount of calcium in the blood. The hormone also seems to decrease the amount of calcium the kidneys can re-absorb, lowering levels further.

Secretion of this hormone is controlled directly by the blood's calcium levels. When the levels start to increase, the body responds with increased calcitonin levels. When calcium levels drop, so do calcitonin levels.

The Parathyroid Gland are four small masses of epithelial tissue are embedded in the connective tissue capsule on the posterior surface of the thyroid glands, and they secrete Parathormone (Parathyroid hormone, PTH, parathyrin). Parathyroid hormone is the most important regulator of blood calcium levels. The hormone is secreted in response to low blood calcium levels, and its effect is to increase those levels, helping the body maintain adequate calcium stores in the bloodstream to protect bone health.

Hypoparathyroidism, or insufficient secretion of parathyroid hormone, leads to increased nerve excitability. The low blood calcium levels trigger spontaneous and continuous nerve impulses, which then stimulate muscle contraction.

Parathyroid hormone helps prevent low calcium levels by acting on the bones, intestine, and kidneys. In the bones, the hormone triggers the release of calcium stores from the bones to the blood. This can lead to bone destruction. In the intestines, parathyroid hormone helps with vitamin D metabolism. This, in turn, allows the body to absorb more of the calcium it digests from food. In the kidneys the hormone stops the release of calcium through the urine, while also increasing vitamin D production.

Potential Problems with Parathyroid Hormone Function

Because the function of parathyroid hormone directly impacts blood calcium levels, improper balance of parathyroid hormone can cause an imbalance of calcium levels in the blood.

Having too much of the hormone can cause a condition known as hypercalcaemia, which increases blood calcium levels. This does not cause obvious symptoms in mild cases, but if levels rise too high, it can cause digestive upset, constipation, depression, lethargy, weakness, joint pain, and excessive thirst. Hypercalcaemia is typically discovered during routine blood testing. Too little parathyroid hormone causes a rare condition called hypoparathyroidism, which leads to low blood calcium levels. This is fairly easy to treat using vitamin D and oral calcium tablets, once it is discovered.

Calcitonin and Parathyroid hormone in the regulation of blood calcium levels

Calcium levels in the blood are regulated by calcitonin, a hormone which is produced by the thyroid gland, and parathyroid hormone (PTH), which is made by the parathyroid glands.

Calcitonin and parathyroid have opposite effects on blood calcium levels.

The opposing effects of parathyroid hormone and calcitonin on calcium ion levels in body fluids

