

Regulation of Thyroxine Levels and its Functions

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DESCRIPTION

Thyroxine, also known as T_4 , is a critical hormone produced by the thyroid gland, a small butterfly-shaped organ located in the neck. It plays a central role in regulating metabolism and various bodily functions. In this article, we will delve into the significance of thyroxine, exploring its synthesis, functions, regulation, and the implications of its imbalance in the human body.

The thyroid gland produces thyroxine as part of a complex process involving multiple steps. The process begins with the intake of iodine from the diet, as iodine is an essential component of thyroxine molecules. The thyroid gland traps iodine from the bloodstream and combines it with an amino acid called tyrosine to create thyroxine and its counterpart, triiodothyronine (T_3). The majority of the hormone produced is in the form of thyroxine, with T_3 being a more potent but less abundant variant. The synthesis of thyroxine is finely regulated by the Hypothalamus-Pituitary-Thyroid (HPT) axis. The hypothalamus secretes Thyrotropin-Releasing Hormone (TRH), which signals the pituitary gland to release Thyroid-Stimulating Hormone (TSH). TSH, in turn, stimulates the thyroid gland to produce and release thyroxine into the bloodstream. This delicate feedback loop ensures that thyroxine levels remain within the narrow range required for optimal physiological functioning.

Primary functions and regulations of thyroxine

Thyroxine is often referred to as the "master regulator" of metabolism due to its profound impact on the body's energy expenditure and various organ systems. Its primary functions include:

Metabolism regulation: Thyroxine directly influences the Basal Metabolic Rate (BMR), the rate at which the body consumes energy at rest. Elevated thyroxine levels increase BMR, leading to increased calorie consumption and heat production.

Temperature regulation: By modulating BMR, thyroxine helps maintain core body temperature within a narrow range, ensuring that vital biochemical reactions occur optimally.

Growth and development: Thyroxine is crucial for normal growth and development, especially during the childhood and the

adolescence. It supports bone growth, brain development, and the maturation of various organ systems.

Cardiovascular function: Thyroxine has a significant impact on the cardiovascular system. It increases heart rate and stroke volume, facilitating the circulation of oxygen and nutrients to body tissues.

Gastrointestinal function: It influences gastrointestinal motility, ensuring efficient digestion and absorption of nutrients.

Brain function: Thyroxine is essential for normal brain function and cognition. An imbalance in thyroxine levels can lead to cognitive impairments and mood disturbances.

Skin and hair: Thyroxine affects skin health and hair growth. An underactive thyroid (hypothyroidism) can lead to dry skin and hair loss, while an overactive thyroid (hyperthyroidism) can result in excessive sweating and hair thinning.

Regulation of thyroxine levels

The regulation of thyroxine levels is a tightly controlled process. Several factors influence this regulation:

Feedback loop: The HPT axis, involving the hypothalamus, pituitary gland, and thyroid gland, ensures that thyroxine levels remain within a narrow range. When thyroxine levels are low, the hypothalamus releases TRH, which stimulates the pituitary gland to release TSH. Elevated TSH then prompts the thyroid gland to increase thyroxine production.

Iodine availability: Adequate dietary iodine is essential for thyroxine synthesis. A deficiency in iodine can lead to an underactive thyroid, causing hypothyroidism.

Autoimmune conditions: Autoimmune diseases like Hashimoto's thyroiditis and Graves' disease can disrupt the regulation of thyroxine. Hashimoto's thyroiditis results in the destruction of thyroid tissue, leading to hypothyroidism, while Graves' disease causes an overproduction of thyroxine, resulting in hyperthyroidism.

Medications: Certain medications, such as thyroid hormone replacement therapy or antithyroid drugs, can influence thyroxine levels. Hormone replacement therapy is used to treat

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Received: 01-Sep-2023, Manuscript No. JTDT-23-27284; **Editor assigned:** 04-Sep-2023, PreQC No. JTDT-23-27284 (PQ); **Reviewed:** 18-Sep-2023, QC No. JTDT-23-27284; **Revised:** 25-Sep-2023, Manuscript No. JTDT-23-27284 (R); **Published:** 02-Oct-2023, DOI: 10.35841/2167-7948.23.12.308

Citation: Sunyi E (2023) Regulation of Thyroxine Levels and its Functions. *Thyroid Disorders Ther.* 12:308.

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hypothyroidism, while antithyroid drugs are used in managing hyperthyroidism.

CONCLUSION

Thyroxine, also known as T₄, is a vital hormone that serves as the key element of metabolism and regulates numerous physiological functions in the human body. Its delicate balance

is maintained through the hypothalamus-pituitary-thyroid axis, ensuring that metabolic processes occur optimally. Imbalances in thyroxine levels can lead to significant health issues, including hypothyroidism and hyperthyroidism, but with proper diagnosis and management, individuals with thyroid disorders can lead healthy and fulfilling lives. Understanding the role of thyroxine in the body underscores its importance and highlights the significance of maintaining thyroid health.