ISSN: 2692-5206
AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES

PHYSIOLOGY AND CLINICAL SIGNIFICANCE OF THE SOMATOTROPIC HORMONE

Musliman Abdulvosidovna Madaminjonova

Kokand University Andijan branch

Faculty of Medicine treatment direction group
Scientific Advisor: **Nabijon Alijonovich Razzakov**

Abstract: The somatotropic hormone (STH), or growth hormone, is one of the key peptide hormones that regulates growth and metabolic processes in the human body. This article provides an in-depth analysis of the biosynthesis, secretion mechanisms, physiological effects, clinical significance, and pathological conditions associated with STH. Disorders such as gigantism, acromegaly, and pituitary dwarfism, as well as diagnostic and treatment methods, are reviewed on a scientific basis. The article also highlights the role and prospects of STH in modern clinical medicine.

Keywords: Somatotropin, growth hormone, gigantism, acromegaly, dwarfism, insulin-like growth factor (IGF-1)

Introduction. The somatotropic hormone (STH), or growth hormone, is a polypeptide hormone consisting of 191 amino acids, produced by the anterior pituitary gland. It regulates growth, cell proliferation, and regeneration processes in the body. The effects of STH are exerted both directly and indirectly through insulin-like growth factor 1 (IGF-1). In recent years, it has been demonstrated that STH not only influences growth but also has significant effects on metabolic, immune, and cognitive systems. The aim of this article is to analyze the physiology, clinical significance, and treatment approaches of the somatotropic hormone.

Definition and importance. Somatotropic hormone (GH) is a peptide hormone produced by the anterior pituitary (adenohypophysis), essential for growth, cell regeneration, and metabolism in humans and other vertebrates. Adequate production ensures normal physical development in children and adolescents, and in adults, it helps maintain muscle and bone tissue.

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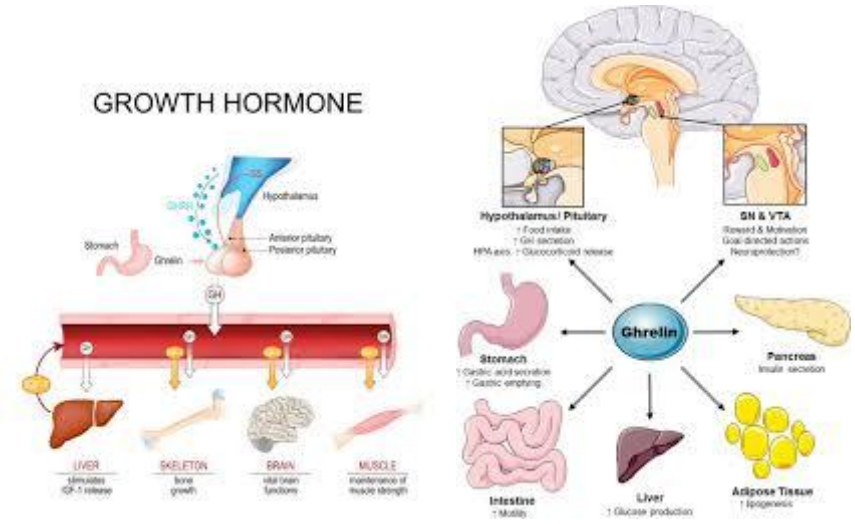
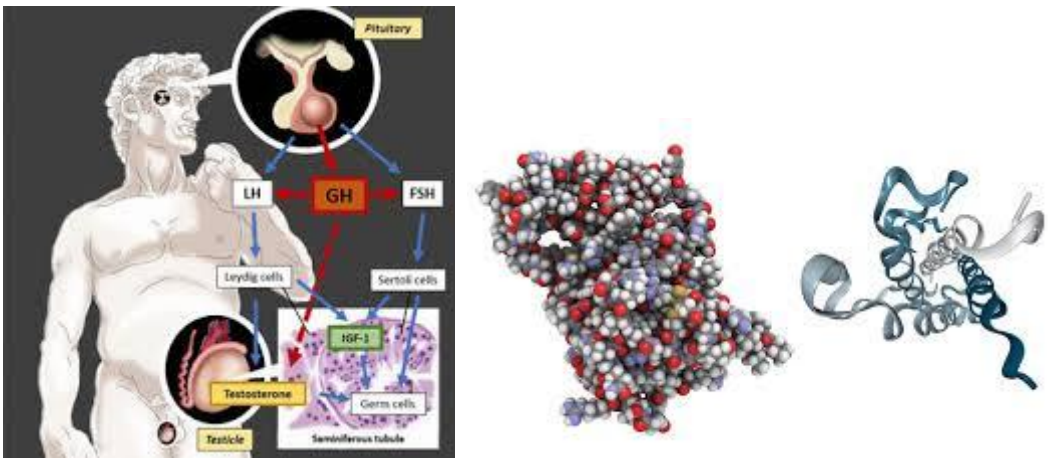


Structure and synthesis of growth hormone. GH is a single-chain peptide composed of 191 amino acids, with a molecular weight of approximately 22 kDa. It is synthesized by somatotroph cells in the pituitary gland and regulated by the hypothalamus. Growth hormone-releasing hormone (GHRH) from the hypothalamus stimulates GH secretion, whereas somatostatin inhibits it.



Synthesis stages: Somatotrophs synthesize the hormone as preprosomatotropin. Preprosomatotropin is transferred to the endoplasmic reticulum, where it is processed into the propeptide form. Prosomatotropin is cleaved by proteolytic enzymes into active GH and secreted into the bloodstream.

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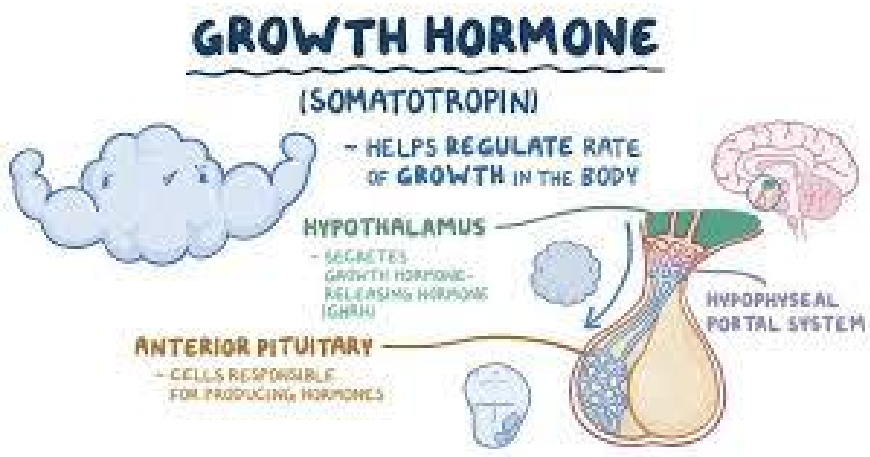

Physiological functions of growth hormone. GH exerts both direct and indirect effects (via IGF-1). Its functions include:
Growth stimulation Stimulates the production of IGF-1 in the liver and other tissues. Enhances the retention of water and minerals in bone and cartilage tissues. Increases proliferation and differentiation of chondrocytes.
*Effects on metabolism***.** Carbohydrate metabolism: Antagonizes insulin action, increases glycogenolysis and gluconeogenesis. Lipid metabolism: Stimulates lipolysis, increasing the release of free fatty acids from adipose tissue. Protein metabolism: Promotes protein synthesis, shifts nitrogen balance towards positive.
Mineral metabolism **.** Enhances calcium and phosphate absorption, strengthening bone tissue.
Regulation of Growth Hormone Secretion
Stimulants: Sleep (especially deep sleep), physical activity, stress, fasting, low blood glucose levels.
Inhibitors: High glucose and fatty acid levels, IGF-1 (negative feedback), somatostatin. GH secretion follows a circadian rhythm, peaking between 23:00 and 2:00 AM.

Hypersecretion
Gigantism: Excess GH secretion in children and adolescents leads to excessive growth of body parts.
Acromegaly: Excess GH secretion in adults causes abnormal enlargement of hands, feet, facial bones, and soft tissues.
Causes: Pituitary adenoma, hypothalamic disorders.
Clinical features: Coarse facial features (hyperostosis), enlargement of hands and feet, thickening of the neck, diabetes, arterial hypertension.
Hyposecretion. Pituitary dwarfism (growth hormone deficiency): GH deficiency in children leads to slow growth and short stature.
Causes: Congenital pituitary anomalies, brain trauma, infections.
Clinical features: Short neck, normal body proportions, delayed sexual maturation.

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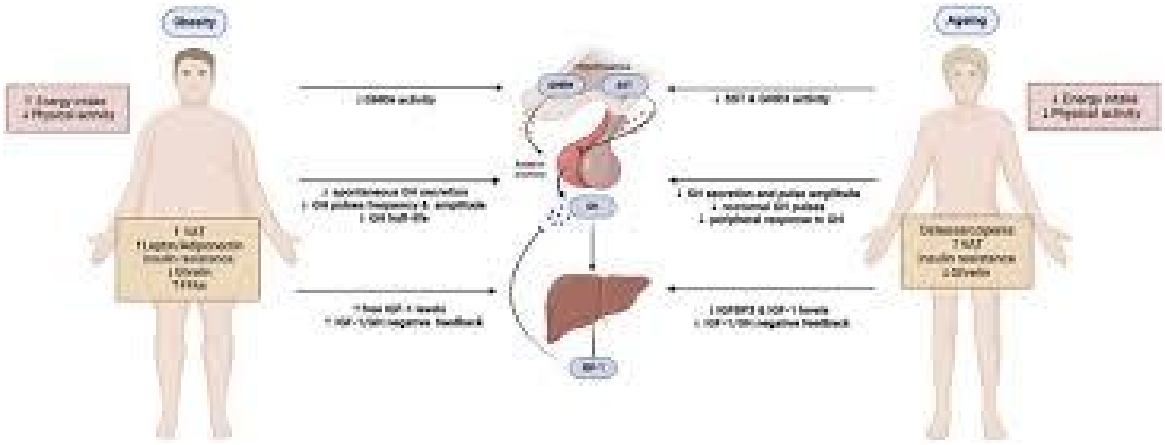

Diagnosis and Treatment

Diagnosis. Blood tests: GH and IGF-1 levels. Stimulation and suppression tests: Insulin-induced hypoglycemia test, oral glucose suppression test. Radiological studies: Pituitary MRI/CT, bone X-ray (hands and wrists).

Treatment . Hyposecretion: Replacement therapy with recombinant growth hormone (somatotropin).

Hypersecretion: Surgery (removal of pituitary adenoma)**.** Radiotherapy Pharmacotherapy (somatostatin analogues — octreotide, lanreotide; dopamine agonists)

Conclusion

The growth hormone (GH), also known as somatotropin, plays a fundamental role in maintaining human health, extending far beyond merely stimulating linear growth during childhood and adolescence. It is intricately involved in regulating various metabolic processes, including carbohydrate, protein, lipid, and mineral metabolism, and contributes to the regeneration and maintenance of multiple tissues, particularly muscle and bone. Adequate secretion of GH during childhood ensures normal physical development, while its continued function in adulthood supports muscle mass preservation, bone density, and overall metabolic balance. Disruptions in GH secretion, whether in the form of deficiency or excess, can lead to significant and sometimes life-altering pathological conditions. GH deficiency in children causes growth retardation and short stature (pituitary dwarfism), potentially impacting psychosocial well-being. In adults, GH deficiency may contribute to decreased muscle mass, increased adiposity, osteoporosis, and diminished quality of life. Conversely, GH hypersecretion results in disorders such as gigantism in children and acromegaly in adults, both of which are associated with disfiguring physical changes, increased cardiovascular risk, diabetes mellitus, and reduced life expectancy if untreated. The regulation of GH secretion is complex, governed by hypothalamic hormones (GHRH and somatostatin), metabolic factors, circadian rhythms, and feedback mechanisms mediated by IGF-1. Advances in diagnostic methods — including sensitive hormonal assays, dynamic stimulation and suppression tests, and neuroimaging — have enhanced the accuracy of diagnosing GH-related disorders. Likewise, modern therapeutic strategies — such as recombinant GH replacement therapy, surgical interventions, radiotherapy, and pharmacologic treatments with somatostatin analogs and dopamine agonists — have significantly improved clinical outcomes and quality of life for affected individuals.

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In summary, growth hormone is a key regulator of growth, metabolism, and tissue maintenance throughout the human lifespan. Continued research and progress in diagnostic and therapeutic technologies offer promising prospects for earlier detection, better management, and improved long-term prognosis of GH-related disorders.

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