37.3E: Hormonal Regulation of Growth

Body growth is controlled by growth hormone (GH), produced by the anterior pituitary, and IGF-1, whose production is stimulated by GH.

Learning Objectives

• Describe the hormonal regulation of growth

Key Points

• Growth hormone binds to receptors on target cells, causing mature cartilage cells to divide, creating new cartilage tissue.

• Growth hormone stimulates the production of IGF-1, a hormone that increases the uptake of amino acids when they are at high levels in the blood, so that they can be formed into new proteins.

• Growth hormone-releasing hormone stimulates the production of GH by the anterior pituitary, while growth hormone-inhibiting hormone inhibits its production.

• When growth hormone production is abnormally low in children, it can result in pituitary dwarfism, in which individuals can be less than 30 inches tall; when growth hormone production is high in children, it can result in gigantism, in which individuals can be over 8 feet tall.

Key Terms

• growth hormone: any polypeptide hormone secreted by the pituitary gland that promotes growth and regulates the metabolism of carbohydrates, proteins, and lipids
- **somatostatin**: a polypeptide hormone, secreted by the pancreas, that inhibits the production of certain other hormones
- **gigantism**: a condition caused by an over-production of growth hormone, resulting in excessive bone growth

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**Hormonal Regulation of Growth**

Hormonal regulation is required for the growth and replication of most cells in the body. Growth hormone (GH), produced by the anterior portion of the pituitary gland, accelerates the rate of protein synthesis, particularly in skeletal muscle and bones. Effects of growth hormone on the tissues of the body can generally be described as anabolic (building up). Like most other protein hormones, GH acts by interacting with a specific receptor on the surface of cells. Increased height during childhood is the most widely-known effect of GH. Height appears to be stimulated by at least two mechanisms: Because polypeptide hormones are not fat-soluble, they cannot penetrate cell membranes. Thus, GH exerts some of its effects by binding to receptors on target cells, where it activates a pathway that directly stimulates division and multiplication of chondrocytes of cartilage.

GH also stimulates, through another pathway, the production of insulin-like growth factor 1 (IGF-1), a hormone homologous to proinsulin. The liver, a major target organ of GH for this process, is the principal site of IGF-1 production. IGF-1 has growth-stimulating effects on a wide variety of tissues. IGFs stimulate the uptake of amino acids from the blood, allowing the formation of new proteins, particularly in skeletal muscle cells, cartilage cells, and other target cells. This is especially important after a meal, when glucose and amino acid concentration levels are high in the blood. GH levels are regulated by two hormones produced by the hypothalamus. GH release is stimulated by growth hormone-releasing hormone (GHRH) and is inhibited by growth hormone-inhibiting hormone (GHIH), also called somatostatin. IGF-1 also has stimulatory effects on osteoblast and chondrocyte activity to promote bone growth.

A balanced production of growth hormone is critical for proper development. Underproduction of GH in adults does not appear to cause any abnormalities, but in children it can result in pituitary dwarfism, in which growth is reduced. Pituitary
dwarfism is characterized by symmetric body formation. In some cases, individuals are under 30 inches in height. Oversecretion of growth hormone can lead to gigantism in children, causing excessive growth. In some documented cases, individuals can reach heights of over eight feet. In adults, excessive GH can lead to acromegaly, a condition in which there is enlargement of bones in the face, hands, and feet that are still capable of growth.