In the May 1997 continuing education feature, Dr Wills described the transsphenoidal surgical approach to removal of pituitary tumors. Pituitary gland tumors, which often cause abnormal secretions of endocrine hormones, can result in a variety of pathological conditions that manifest widespread symptoms. The following overview describes the various roles of the major endocrine hormones when secreted in normal amounts.

ENDERPHINS
Endorphins (or endogenous opioid peptides) found in the anterior lobe of the pituitary gland are opiate-like compounds that inhibit pain by suppressing the release of substance P. When the body is under acute stress, the pituitary gland secretes beta-endorphins, which bind to the brain’s opiate receptors and cause sedation, analgesia, and respiratory depression, which relieve untractable pain.

GROWTH HORMONE
Growth hormone, liberated by the anterior pituitary gland, regulates growth. It fosters lipolysis in fat deposits, increases free fatty acids in plasma, induces fat oxidation, and decreases fat synthesis. It also increases glucose metabolism through the anaerobic glycolytic pathway and indirectly affects carbohydrate, fat, and protein metabolism.

THYROID HORMONE
Thyroid hormone increases the basal metabolic rate of most cells and is essential for normal bone maturation and growth as well as for the maturation of neural tissue—especially brain tissue. Increased thyroid hormone increases the rate of glucose absorption from the small intestine. In states of hypothyroidism, myelination (development of a myelin sheath for nerve fibers) decreases. If untreated, this condition can lead to mental retardation. Thyroid hormone is also necessary for normal lactation. In addition, it creates a protein anabolic effect in normal doses while in large doses it causes a catabolic effect on protein and lipid metabolism, synthesis, mobilization, and utilization. High levels of thyroid hormone lead to decreased levels of triglycerides, phospholipids, and cholesterol, while increasing plasma levels of free fatty acids and glycerol.

PARATHYROID HORMONE, CALCITONIN, AND ACTIVATED D3
Three hormones—parathyroid hormone (PTH), calcitonin, and activated D3—control calcium usage in the body. PTH is the hypercalcemic hormone and calcitonin is the hypocalcemic hormone. Calcium contributes to the blood-clotting mechanism and activates the enzymes needed in the inflammatory response. The average adult body has approximately 3 pounds of calcium, 99% of which is used to form bones and teeth. The remaining 1%, found in the body fluids, promotes normal cellular activity. The recommended daily intake of calcium by adults is 100 mg—20% to 40% of which is absorbed. Pre- and post-menopausal women require additional calcium because they lack estrogen, which aids in calcium absorption.
GLUCAGON, INSULIN, AND SOMATOSTATIN

The pancreas is composed of three cell types: Alpha cells secrete glucagon; beta cells secrete insulin; and delta cells secrete somatostatin.

Glucagon stimulates the liver to transform glycogen into glucose. It also regulates nutrient mobilization; has a hyperglycemic action, causing increased concentration of glucose in the blood; and stimulates the release of free fatty acids from adipose tissue.

Insulin stimulates the liver to convert glucose to glycogen. It also promotes the movement of glucose across adipose and muscle cell membranes, thus reducing the concentration of glucose in the blood. Insulin-stimulated glucose uptake in human fat cells leads to the esterification of free fatty acids and promotes protein assimilation. Insulin increases body protein stores by increasing tissue uptake of amino acids, decreasing protein catabolism while increasing protein synthesis, and decreasing oxidation of amino acids.

Somatostatin inhibits alpha- and beta-cell secretion, resulting in hypoglycemia and inhibition of intestinal glucose absorption. It also inhibits the synthesis and secretion of growth hormone.

MINERALOCORTICOIDS AND GLUCOCORTICOIDS

The three adrenal gland layers include the outer zone, the zona glomerulosa, which produces mineralocorticoids; the middle zone, the zona fasciculata, which produces glucocorticoids; and the inner zone, the zona reticularis, which produces androgens (male sex hormones). The adrenal androgen androstenedione is also converted to estrogens, and the adrenal gland may secrete some estrogens.

Mineralocorticoids control electrolyte homeostasis—particularly the concentrations of sodium and potassium. Cortisol, a glucocorticoid, influences glucose, fat, and protein metabolism as well as the body's resistance to stress by stabilizing blood glucose and glycojen levels while simultaneously decreasing blood vessel dilation and edema associated with inflammation. Cortisol also has an inhibitory effect on protein synthesis, resulting in increased concentration of amino acids in the blood; stimulates the freeing of fatty acids from adipose tissue (thus providing an energy source); and promotes gluconeogenesis by the liver, thereby increasing the blood's glucose levels.

Aldosterone, the most active mineralocorticoid, is a steroid that serves to regulate the levels of mineral electrolytes, such as sodium, chloride, and potassium. Through its action in conserving sodium ions and water, aldosterone serves to increase the sodium concentration of the blood as well as increase blood volume and pressure.

TESTOSTERONE

Testosterone, produced by the testes, is stored in lipid droplets by a cholesterol ester, which is necessary for testosterone biosynthesis. This hormone controls spermatogenesis and the development of secondary sexual characteristics, and promotes accessory sexual-organ function. Accessory sexual organs include the excretory ducts and glands that transmit sperm cells.

ESTROGEN

Estrogens, which include estradiol, estrone, and estriol, are essential to the development of the vagina, uterus, fallopian tubes, ovaries, and external genitalia, and contribute to the maintenance of these organs throughout adulthood. They also encourage the development of mammary gland ducts and increase osteoblastic activity (bone growth), resulting in the growth spurt that occurs at puberty.

CATECHOLAMINES

Cells in the adrenal medulla, which contain either norepinephrine or epinephrine—collectively called catecholamines—lead to the formation of the autonomic nervous system and serve in the mobilization of agents that fuel metabolism. They also affect the cardiovascular system, the visceral smooth muscles, and many exocrine glands. Norepinephrine is mainly a vasconstrictor. Epinephrine has dual effects on cardiac muscle through stimulation of both the force and rate of cardiac muscle contractions. With increased states of anxiety, the release of epinephrine occurs. Angry and aggressive states are associated with increased norepinephrine secretion.

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SUGGESTED READING


