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ENDOCRINE GLANDS AND DISEASES IN THE CIS

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ANNOTATION

A plethora of hormones regulate many of the body's functions, including growth and development, metabolism, electrolyte balances, and reproduction. Numerous glands throughout the body produce hormones. The hypothalamus produces several releasing and inhibiting hormones that act on the pituitary gland, stimulating the release of pituitary hormones. Of the pituitary hormones, several act on other glands located in various regions of the body, whereas other pituitary hormones directly affect their target organs. Other hormone-producing glands throughout the body include the adrenal glands, which primarily produce cortisol; the gonads (i.e., ovaries and testes), which produce sex hormones; the thyroid, which produces thyroid hormone; the parathyroid, which produces parathyroid hormone; and the pancreas, which produces insulin and glucagon. Many of these hormones are part of regulatory hormonal cascades involving a hypothalamic hormone, one or more pituitary hormones, and one or more target gland hormones.

Keywords: endocrine function; hormones; hypothalamus; pituitary gland; gonad function; thyroid; parathyroid; pancreas; biochemical mechanism; biological feedback; biological regulation; hypothalamus-pituitary axis; pituitary-adrenal axis; pituitary-thyroid axis; literature review.

INTRODUCTION

For the body to function properly, its various parts and organs must communicate with each other toensure that a constant internal environment (i.e., homeostasis) is maintained. For example, neither the body temperature nor the levels of salts and minerals (i.e., electrolytes) in the blood must fluctuate beyond preset limits. Communication among various regions of the body also is essential for enabling the organism to respond appropriately to any changes in the internal and external environments. Two systems help ensure communication: the nervous system and the hormonal (i.e., neuroendocrine) system. The nervous system generally allows rapid transmission (i.e., within fractions of seconds) of information between different body regions.Conversely, hormonal communication, which relies on the production and release of hormones from various glands and on the transport of those hormones via the bloodstream, is better suited for situations that require more widespread and longer lasting regulatory actions. Thus, the two communication systems complement each other. In addition, both systems interact: Stimuli from the nervous system can influence the release of certain hormones and vice versa. Generally speaking, hormones control the growth, development, and metabolism of the body; the electrolyte composition of bodily fluids; and reproduction. This article provides an overview of the hormone systems involved in those regulatory processes. The article first summarizes some of the basic characteristics of hormonemediated communication within the body, then reviews the various glands involved in those processes and the major hormones they

produce. For more in-depth information on those hormones, the reader should consult endocrinology textbooks (e.g., Constanti et al. 1998; Wilson et al. 1998). Finally, the article presents various endocrine systems in which hormones produced in several organs cooperateto achieve the desired regulatory effects. The discussions focus primarily on the system responses in normal, healthy people. For information regarding alcohol's effects on some of the hormone systems, the reader is referred to subsequent articles in this issue of Alcohol Health & Research World.

Hormones are molecules that are produced by endocrine glands, including the hypothalamus, pituitary gland, adrenal glands, gonads, (i.e., testes and ovaries), thyroid gland, parathyroid glands, and pancreas (see figure 1). The term "endocrine"implies that in response to specific stimuli, the products of those glands are released into the bloodstream. The hormones then are carried via the blood to their target cells. Some hormones have only a few specific target cells, whereas other hormones affect numerous cell types throughout the body. The target cells for each hormone are characterized by the presence of certain docking molecules (i.e., receptors) for the hormone that are located either on the cell surface or inside the cell. The interaction between the hormone and its receptor triggers a cascade of biochemical reactions in the target cell that eventually modify the cell's function or activity. Mechanisms of Action Several classes of hormones exist, including steroids, amino acid derivatives, and polypeptides and proteins. Those hormone classes differ in their general molecular structures (e.g., size and chemical properties). As a result of the structural differences, their mechanisms of action (e.g., whether they can enter their target cells and how they modulate the activity of those cells) also differ. Steroids, which are produced by the gonads and part of the adrenal gland (i.e., the adrenal cortex), have a molecular structure similar to that of cholesterol. The molecules can enter their target cells and interact with receptors in the fluid that fills the cell (i.e., the cytoplasm) or in the cell nucleus. The hormonereceptor complexes then bind to certain regions of the cell's genetic material (i.e.,the DNA), thereby regulating the activity of specific hormone-responsive genes. Amino acid derivatives are modified versions of some of the building blocks of proteins. The thyroid gland and another region of the adrenal glands (i.e., the adrenal medulla) produce this type of hormone (i.e., the amino acid derivatives). Like steroids, amino acid derivatives can enter the Conversely, exocrine glands (e.g., sweat glands and salivary glands) release their secretions to the outside of the body (e.g., sweat) or into a hollow space that is open to the outside (e.g., saliva released into the mouth). Hypothalamus cell, where they interact with receptor proteins that are already associated with specific DNA regions. The interaction modifies the activity of the affected genes. Polypeptide and protein hormones are chains of amino acids of various lengths (from three to several hundred amino acids). These hormones are found primarily in the hypothalamus, pituitary gland, and pancreas. In some instances, they are derived from inactive precursors, or pro-hormones, which can be cleaved into one or more active hormones. Because of their chemical structure, the polypeptide and protein hormones cannot enter cells. Instead, they interact with receptors on the cell surface. The interaction initiates biochemical changes in either the cell's membrane or interior, eventually modifying the cell's activity or function.

The major estrogen is estradiol, which, in addition to small amounts of estrone and estriol, is produced primarily in the ovaries. Other production sites of estrogens include the corpus

luteum, 2 the placenta, and the adrenal glands. In men and postmenopausal women, most estrogens present in the circulation are derived from the conversion of testicular, adrenal, and ovarian androgens. The conversion occurs in peripheral tissues, primarily adipose tissue and skin. The main role of estrogens is to coordinate the normal development and functioning of the female genitalia and breasts. During puberty, estrogens promote the growth of the uterus, breasts, and vagina; determine the pattern of fat deposition and distribution in the body that results in the typical female shape; regulate the pubertal growth spurt and cessation of growth at adult height; and control the development of secondary sexual characteristics. In adult women, the primary functions of estrogens include regulating the menstrual cycle, contributing to the hormonal regulation of pregnancy and lactation, and maintaining female libido. During menopause, estrogen production in the ovaries ceases. The resulting reduction in estrogen levels leads to symptoms such as hot flashes, sweating, pounding of the heart (i.e., palpitations), increased irritability, anxiety, depression, and brittle bones (i.e., osteoporosis). The administration of estrogens (i.e., hormone replacement therapy) can alleviate those symptoms and reduce therisk of osteoporosis and coronary heart disease in postmenopausal women. At the same time, however, hormone replacement therapy may increase the risk of certain types of cancer (e.g., breastcancer and uterine [i.e., endometrial] cancer). Alcohol consumption has been shown to increase estrogen levels in the blood and urine, even in premenopausal women who drink two drinks or less per day (Reichman et al. 1993) and in postmenopausal women who drink less than one drink per day (Gavaler and Van Thiel 1992). These findings suggest that moderate alcohol consumption may help prevent osteoporosis and coronary heart disease in postmenopausal women.

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