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HORMONAL BALANCE AND BREAST HEALTH: THE ROLE AND IMPORTANCE OF THE ENDOCRINE SYSTEM

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Abstract
This article analyzes the role of the endocrine system in the development, physiological activity and health of the mammary gland based on scientific sources. The anatomical and functional state of the mammary gland is closely related to the activity of the hypothalamic-pituitary-ovarian axis, thyroid gland, adrenal glands and metabolic hormones. The effect of estrogen, progesterone, prolactin, oxytocin, thyroid hormones, insulin and other biologically active substances on the development and function of the mammary gland is analyzed.

Keywords: Mammary gland, endocrine system, hormonal balance, estrogen, progesterone, prolactin, oxytocin, mammology, endocrinology, hyperprolactinemia, diagnostics, prevention.

GORMONAL MUVOZANAT VA SUT BEZI SALOMATLIGI: ENDOKRIN TIZIMNING O‘RNI VA AHAMIYATI

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O’zbekkston Respublikasi

Annotatsiya
Ushbu maqolada endokrin tizimning sut bezi rivojlanishi, fiziologik faoliyati va salomatligini ta'minlashdagi o‘rni ilmiy manbalar asosida tahlil qilingan. Sut bezining anatomik va funksional holati gipotalamus–gipofiz–tuxumdon o‘qi, qalqonsimon bez, buyrak usti bezlari hamda metabolik gormonlar faoliyati bilan uzviy bog‘liqligi yoritilgan. Estrogen, progesteron, prolaktin, oksitotsin,

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qalqonsimon bez gormonlari, insulin va boshqa biologik faol moddalarning sut bezi rivojlanishi hamda faoliyatiga ta'siri tahlil qilingan.

Kalit so‘zlar: sut bezi, endokrin tizim, gormonal muvozanat, estrogen, progesteron, prolaktin, oksitotsin, mammologiya, endokrinologiya, giperprolaktinemiya, diagnostika, profilaktika.

Introduction

The mammary gland is an important component of the female reproductive system, and its anatomical structure, physiological development and functional activity are controlled by the endocrine system of the body. Changes in the mammary gland are formed depending on the characteristics of hormonal balance at different stages of life, including puberty, reproductive age, pregnancy, lactation and menopause. The coordinated activity of the hypothalamic-pituitary-ovarian axis, thyroid gland, adrenal glands and pancreas is one of the main physiological mechanisms determining the morphological and functional state of the mammary gland. Therefore, any functional or organic disorders in the endocrine system can lead to the development of various pathological changes in the mammary gland.

According to the World Health Organization (WHO), mammary gland diseases are among the most common pathologies among women. In particular, breast cancer is the most common oncological disease among women today and is an urgent medical and social problem in terms of morbidity and mortality. At the same time, fibrocystic mastopathy, fibroadenoma, mastalgia, galactorrhea and other benign diseases also have a high incidence among women of reproductive age. In most of these diseases, hormonal imbalance is considered the leading etiopathogenetic factor. The physiological development and function of the mammary gland is regulated by a complex interaction of many hormones. Estrogen stimulates the development of the mammary ducts (ductal system), while progesterone promotes the differentiation of the glandular lobes and alveoli. Prolactin plays a key role in the initiation and continuation of lactation, and oxytocin promotes milk ejection. In addition, thyroid hormones, insulin, growth hormone, cortisol and insulin-like growth factor (IGF-1) have a

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significant effect on the metabolism, proliferation and differentiation of mammary gland cells. When the physiological balance between hormones is disturbed, cell proliferation and apoptosis processes are disrupted, and benign or malignant changes can develop.

In recent years, scientific advances in molecular biology, genomics, and endocrinology have provided a deeper understanding of the pathogenesis of breast diseases. Studies on estrogen and progesterone receptors (ER and PR), HER2 receptor, Ki-67 proliferation index, and BRCA1 and BRCA2 genes have further clarified the role of hormonal factors in the development of breast diseases. In addition, the assessment of individual risk factors, molecular diagnostics, and the introduction of personalized treatment strategies have expanded the possibilities for early detection and effective treatment of breast diseases.

Maintaining breast health is not limited to the activities of a mammologist or oncologist. Collaboration between endocrinologists, gynecologists, radiologists, pathologists, and primary care physicians is essential for early detection of diseases, assessment of risk factors, correction of hormonal disorders, and effective organization of preventive measures. Regular monitoring of the condition of the breast, especially in women with obesity, metabolic syndrome, diabetes, thyroid diseases, and diseases of the reproductive system, is one of the priorities of modern medicine.

The purpose of this article is to analyze the role of the endocrine system in the development and physiological activity of the mammary gland based on scientific sources, to highlight the pathogenesis, diagnostics, treatment and prevention methods of the main diseases that occur as a result of hormonal imbalance, and to assess the practical significance of modern scientific approaches.

The endocrine system is a complex biological system that maintains a stable internal environment of the body, controls the processes of growth and development, reproductive activity, metabolism and homeostasis. This system consists of the hypothalamus, pituitary gland, thyroid gland, adrenal glands, ovaries, pancreas and other endocrine glands, the hormones produced by them are delivered to target cells through the bloodstream. The mammary gland, as an organ sensitive to hormones, is also closely related to this system, and its

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development, functional activity and physiological changes are mainly under endocrine control.

The anatomical structure of the mammary gland is complex, consisting of glandular tissue, adipose tissue, connective tissue, blood vessels, lymphatic vessels and nerve fibers. The glandular tissue consists of alveoli and milk ducts, which are the most sensitive structures to hormonal influences. The alveoli are made up of secretory cells that produce milk, and the milk ducts carry the produced milk to the nipple. The stromal part of the mammary gland supports, nourishes, and protects the glandular tissue.

The development of the mammary gland begins during embryogenesis, but its complete morphological formation occurs during puberty under the influence of the hormone estrogen. Estrogen stimulates the growth, branching of the mammary ducts, and the development of stromal tissue. Progesterone plays an important role in the differentiation of alveolar structures, the formation of glandular cells, and the secretory apparatus. Thus, the coordinated action of estrogen and progesterone ensures the normal morphological development of the mammary gland. The hypothalamic-pituitary-ovarian axis is the main neuroendocrine mechanism that controls the physiological activity of the mammary gland. Gonadotropin-releasing hormone (GnRH), produced by the hypothalamus, stimulates the anterior pituitary gland to increase the secretion of follicle-stimulating hormone (FSH) and luteinizing hormone (LH). These hormones control the production of estrogen and progesterone in the ovaries. As a result, cyclic changes occur in the mammary gland: during the follicular phase of the menstrual cycle, the effect of estrogen predominates, while in the luteal phase, the effect of progesterone increases.

During pregnancy, profound morphological and functional changes are observed in the mammary gland. High levels of estrogen and progesterone ensure the intensive development of the milk ducts and alveoli. At the same time, prolactin secretion from the pituitary gland increases. Prolactin stimulates the secretory cells of the mammary gland, ensuring the production of protein, fat and lactose necessary for milk synthesis. During pregnancy, progesterone inhibits the milk-secreting effect of prolactin to a certain extent, and after childbirth, as a result of

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a sharp decrease in progesterone levels, the lactogenic effect of prolactin is fully manifested.

During lactation, prolactin is the main hormone of milk production. As a result of the baby's sucking, nerve receptors in the nipple are stimulated and impulses are sent to the pituitary gland through the hypothalamus. As a result, prolactin secretion increases. At the same time, oxytocin is released from the posterior pituitary gland. Oxytocin contracts the myoepithelial cells surrounding the alveoli, allowing milk to flow out through the milk ducts. Thus, prolactin is the main hormone required for milk production, and oxytocin is the main hormone required for milk ejection. Thyroid hormones also play an important role in the normal functioning of the mammary gland. Thyroxine (T4) and triiodothyronine (T3) regulate cell metabolism, protein synthesis, and energy metabolism. In cases of hypothyroidism, increased prolactin levels, menstrual cycle disorders, and functional changes in the mammary gland may occur. In hyperthyroidism, accelerated metabolic processes can affect the sensitivity of the mammary gland. Therefore, disorders in the functioning of the thyroid gland play an indirect role in the development of mammary gland pathologies.

Cortisol, androgens, and other steroid hormones produced by the adrenal glands also affect the physiology of the mammary gland. Cortisol provides the metabolic needs of the mammary gland by regulating protein, fat, and carbohydrate metabolism. Insulin, in turn, participates in glucose metabolism and supports energy production in the secretory cells of the mammary gland. In cases of insulin resistance and metabolic syndrome, the risk of developing proliferative changes in the mammary gland may increase.

During menopause, as a result of decreased ovarian function, the production of estrogen and progesterone decreases. This leads to involutional changes in the mammary gland: glandular tissue is gradually replaced by adipose tissue, alveoli regress, and the density of the mammary gland decreases. Changes in hormonal balance in the postmenopausal period may affect the risk of mammary gland diseases, especially breast cancer.

Thus, the endocrine system is the main system that controls the development, morphological formation, functional activity, and physiological changes that occur throughout life of the mammary gland. The balanced action of estrogen,

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progesterone, prolactin, oxytocin, thyroid hormones, insulin and other hormones ensures the normal functioning of the mammary gland. Disruption of this balance can lead to the development of various pathological processes in the mammary gland. The development and functional activity of the mammary gland occurs as a result of the coordinated action of a number of hormones. Estrogen stimulates the growth of the mammary ducts and the development of stromal tissue, while progesterone plays an important role in the formation and differentiation of alveolar-lobular structures. Prolactin is the main hormone that ensures the synthesis of milk during pregnancy and lactation, while oxytocin stimulates the contraction of myoepithelial cells, ensuring the release of milk from the alveoli into the mammary ducts. In addition, thyroid hormones, insulin, growth hormone (GH), insulin-like growth factor (IGF-1) and cortisol regulate the metabolic activity, proliferation and regeneration of cells. Balanced secretion of these hormones is necessary to maintain the normal morphological structure and physiological function of the mammary gland. Disturbances in the functioning of the endocrine system contribute to the development of benign and malignant pathological processes in the mammary gland. Hyperestrogenemia, progesterone deficiency, hyperprolactinemia, thyroid diseases, metabolic syndrome and insulin resistance are recognized as risk factors for the development of fibrocystic mastopathy, fibroadenoma, mastalgia, galactorrhea and breast cancer. In particular, increased cell proliferation through estrogen receptors and inhibition of apoptosis play an important role in the mechanisms of oncogenesis. Therefore, early detection and correction of hormonal imbalance is an important component of the prevention and treatment of mammary gland diseases.

Diagnosis of breast diseases is based on a complex of clinical examination, instrumental and laboratory tests. In modern diagnostics, mammography, ultrasound (UTT), magnetic resonance imaging (MRI), elastography and biopsy are of high diagnostic value. Laboratory tests determine the level of estrogen, progesterone, prolactin, FSH, LH, TSH, T3, T4, insulin and other hormones. In recent years, immunohistochemical analysis has been widely used to assess estrogen (ER), progesterone (PR), HER2 receptors and Ki-67 proliferation index. Also, the detection of mutations in the BRCA1 and BRCA2 genes allows for individual screening and planning of preventive measures in women at high risk.

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Treatment of breast diseases is carried out in a comprehensive manner, taking into account the type, stage of the disease and the individual characteristics of the patient. The main areas of prevention are correction of hormonal disorders, treatment of thyroid and metabolic diseases, healthy nutrition, maintaining normal body weight, increasing physical activity and giving up bad habits. Hormonal therapy, conservative or surgical treatment methods are used as needed. Regular examinations by a mammologist and endocrinologist, development of self-examination skills, and participation in screening programs significantly increase the effectiveness of early detection and treatment of diseases.

The development of molecular biology, genomics and artificial intelligence technologies is creating new opportunities for the diagnosis and treatment of breast diseases. Genetic tests, molecular markers, liquid biopsy, proteomics and metabolomics methods allow detecting diseases before the onset of clinical symptoms. Based on the principles of personalized medicine, individual treatment strategies are being developed that take into account the state of hormonal receptors, genetic profile and metabolic indicators. Mammographic image analysis systems based on artificial intelligence are considered one of the promising areas for increasing diagnostic accuracy and improving screening efficiency.

Conclusion

The health of the breast is inextricably linked to the hormonal balance in the body and the activity of the endocrine system, and its development and functional state are ensured by the coordinated action of many hormones. Disorders in the endocrine system increase the risk of developing benign and malignant diseases of the breast, therefore, regular assessment of hormonal status is of great clinical importance. Modern diagnostic methods, molecular markers and personalized treatment approaches are expanding the possibilities of early detection and effective treatment of diseases. At the same time, adherence to a healthy lifestyle, reducing risk factors, regular screening examinations and comprehensive monitoring by an endocrinologist and mammologist are the most important areas of prevention of breast diseases. The integration of endocrinology, mammology

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and molecular medicine will further increase the effectiveness of managing breast diseases in the future.

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