International Journal of Advanced Research and Development
www.multidisciplinaryjournal.net
ISSN: 2455-4030
Received: 18-01-2024, Accepted: 10-02-2024, Published: 04-03-2024
Volume 9, Issue 1, 2024, Page No. 28-30

Hormonal aspects of stress and their impact on the reproductive system

Guliyeva Sevda Vagif[1], Alekberova Mehriban Gani[2], Yusifova Matanat Yusif[3]
[1] Associate Professor, Department of Biochemistry, Scientific Research Center, Medical University, Azerbaijan
[2] Junior Researcher of the Immunology, Department of Scientific Research Center, Medical University, Azerbaijan
[3] Senior Laboratory Technician of the Pharmacology, Department of Scientific Research Center, Medical University, Azerbaijan

Abstract
This article is devoted to the study of hormonal aspects of stress and their impact on the human reproductive system. The mechanisms by which stress affects the hormonal balance are considered. Special attention is paid to analyzing the consequences of this impact on the female and male reproductive systems. Potential mechanisms by which stress may lead to disturbances in the ovulation cycle, decreased sperm quality, and increased risk of infertility are discussed. The article emphasizes the importance of mindful stress management in maintaining reproductive health and cautions against possible negative consequences, providing a basis for further research and practical recommendations in this area.

Keywords: Stress, hormonal changes, reproductive system, cortisol, epinephrine, fertility, menstrual cycle, testosterone

Introduction

Stress is an integral part of modern life, and its impact on the human body extends to many aspects of health, including the reproductive system. The hormonal changes that occur during periods of stress can have a significant impact on the functioning of the reproductive system in both men and women, and can seriously affect the ability to conceive and the overall health of the reproductive system. In this article, we will explore what hormonal changes occur during periods of stress and how they affect reproductive function, as well as what stress management techniques can help maintain reproductive health.

Understanding these mechanisms and utilizing stress management techniques are important steps to maintaining a healthy reproductive system and increasing the likelihood of successful conception. Psychological stress is a condition where the body is under emotional or mental strain. It can be caused by a variety of factors such as work, family problems or financial difficulties. Interestingly, the reproductive system can also be affected by psychological stress. Let's take a look at what hormones are involved and what effects it can have.

When we are stressed, our bodies release substances called stress hormones, such as cortisol and epinephrine (adrenaline). These hormones are designed to help the body cope with danger by increasing the body's response and willingness to fight or leave.

Cortisol is the main stress hormone produced by the adrenal cortex. It is involved in the regulation of metabolism, the immune system and provides the body with energy to adapt to stressful situations. Elevated levels of cortisol can affect the regulation of hormonal balance in the reproductive system. This can lead to menstrual irregularities in women and decreased spermatogenesis in men.

Epinephrine (adrenaline) and norepinephrine (norepinephrine) are hormones released in response to activation of the sympathetic nervous system. They increase heart rate, increase blood pressure, and prepare the body for physical activity. Adrenaline and norepinephrine are produced by the adrenal glands in response to stressors and play a key role in activating fight or flight. These hormones may also be involved in the regulation of blood flow in the reproductive organs and influence sexual function and stress response.

Thus, during periods of stress, there is an activation of the hypothalamic-pituitary-adrenal (HPA) system, which leads to the release of stress hormones - cortisol, adrenaline and noradrenaline - that help the body cope with the threat by providing energy and increasing attention. However, with prolonged psychological stress, levels of these hormones can remain high, which can lead to negative effects on the reproductive system.

High levels of the above hormones, which are characteristic of stress, can further amplify the effects on the reproductive system. This occurs through effects on the hypothalamus and pituitary gland, resulting in changes in the secretion of hormones that regulate the reproductive system [2, 3].

One of the main hormones responsible for the regulation of reproductive processes are gonadotropins (gonadotropic hormone, estrogens and progesterone) synthesized by the pituitary gland and gonads. During stress, there is abnormal activation of the hypothalamic-pituitary-ovarian axis (HPA), leading to impaired ovulation and even complete suppression of ovarian function. This in turn can cause temporary or long-term menstrual irregularities, infertility and other reproductive system problems.

Similar to the effects on the female reproductive system, stress can affect the hypothalamic-pituitary-ovarian system in men, causing changes in gonadotropin production. Stress can decrease testosterone levels, which can negatively affect the process of spermatogenesis in the testicles. This can lead to a decrease in sperm quantity and quality [5, 7].

Stress affects the reproductive system in the form of a number of clinical disorders, ranging from marked menstrual disorders (e.g., amenorrhea, abnormal uterine bleeding) to conditions related to the menstrual cycle (e.g., cyclic mastalgia, dysmenorrhea, premenstrual syndrome, menstrual migraine). Such phenomena do not require permanent drug treatment, but have a significant impact on patients' quality of life and emotional well-being. In

addition, stress-induced ovulatory dysfunction and endometrial dysfunction are the cause of idiopathic infertility, which does not manifest itself as changes in the characteristics of the menstrual cycle. As mentioned above, stress affects the hypothalamic-pituitary system and disrupts dominant follicle formation, resulting in an anovulatory cycle. At the ovarian level, stress induces oxidative stress, leading to incomplete luteinization and poor oocyte quality even at ovulation [1, 4].

In his work, G. Sellier states that the hypothalamus plays an important role in the realization of mental and emotional stress at the central nervous system level. The paraventricular nuclei of the hypothalamus secrete arginine vasopressin and corticotropinreleasing hormone (CRH) in response to a signal of external danger. As a result, adrenocorticotropic hormone is released from the anterior lobe of the pituitary gland, which stimulates cortisol production in the adrenal cortex. High cortisol levels promote the tissue response to stress and in parallel shut down the stress response by feedback. The tonsils form the basis of the extrahypothalamic stress response system, which begins in the hypothalamic-pituitary-adrenal (HPA) neuroendocrine stress axis. Neurons in this system also produce CRH, but its purpose is to control the sympathetic nervous system and the stress response. It is important to note that the extrahypothalamic stress axis and the GHN can act independently of the HGN [5].

So, why does reproductive function shut down during stress? Answering the question, it is necessary to remind that stress is a neurobiological reaction that all living beings possess. The organism needs energy resources to overcome stress and maintain homeostasis, dynamic balance in the internal environment. The body always has energy resources that can be spent on reacting to stress and restoring equilibrium. But if the stressor is too strong or the resources are insufficient, the body will have to reprioritize and reduce energy supply to processes unrelated to maintaining homeostasis. The stored energy will be used for processes related to the stress response.

The female body must ovulate (maturation of the egg and its exit from the follicle for fertilization), ensure the production of sex hormones in the first and second phases of the menstrual cycle, and organize implantation - the introduction of the fetal egg into the uterine mucosa for further embryo development - to ensure the continuation of the species. The male body must perform the following functions: sperm production, seminal fluid formation, erection and ejaculation. These processes consume a lot of energy. Their purpose is to reproduce the species. Thus, the body decides to temporarily slow down these processes to get rid of the energy needed to maintain them, and to use this energy to counteract stressful influences.

The body does not understand the psychological aspects and occupational difficulties. It only realizes that it lacks resources and does its best to restrict fertility. This inhibition can manifest itself in various abnormalities, including libido problems, idiopathic infertility and amenorrhea, which is the prolonged absence of menstruation. The body loses two things by inhibiting reproduction: it loses energy to maintain homeostasis, and secondly, it delays pregnancy until a better time.

Manipulating folliculogenesis and ovulation is the most effective way to utilize the capabilities of the reproductive system. The body uses different patterns depending on the degree of energy deficit required to organize the stress response. Ovulation is maintained when there is a slight energy deficit. By shutting down ovulation, the body does nothing to provide it if it needs more energy. The likelihood of menstrual irregularities increases when ovulation disappears. If the situation worsens, folliculogenesis, the process of maturation of the structural components of the ovary from which a mature egg emerges during ovulation, will not begin. Since follicles are responsible for the synthesis of female sex hormones, estrogen levels drop, which leads to amenorrhea, that is, a prolonged absence of menstruation.

Several neural networks are responsible for regulating the menstrual cycle, but the main one is the neural network producing gonadotropin-releasing hormone (gonadoliberin), which is produced by the pituitary gland and triggers the release of luteinizing and follicle-stimulating hormones responsible for the sex glands. External stimuli do not affect gonadoliberin. There is another neuronal system that produces gonadotropin-inhibitory hormone for its interaction with the environment, including the body's internal environment [6].

Gonadoliberin neurons are smaller than inhibitory neurons, which being very close to where the blood-brain barrier is highly thinned, can receive data directly from the bloodstream. Inhibitory neurons perceive stress hormones and sex hormones. In addition, like all hypothalamic neurons, they respond to signals from other neurohormones as well as to various signals from outside the brain via auditory, visual, and other analyzers. Finally the cortex transmits signals to inhibitory neurons. That is, emotional stress or stress caused by unpleasant circumstances is also transmitted to the gonadotropin-inhibitory hormone system through neuronal circuits.

Under conditions of high stress, gonadoliberin and pituitary gonadotropin production is reduced. In addition, when pituitary hormone levels are reduced, follicle development is slowed, as well as all other processes associated with the menstrual cycle.

But other neuroendocrine systems, in particular the adrenocorticotropic hormone-adrenal system and the dopaminergic system, are activated during the realization of the stress response at the level of the central nervous system. Thus, along with menstrual irregularities, other endocrine processes can be observed, such as increased prolactin secretion, which is a sign of prolonged stress, or increased cortisol production, which is a sign of acute stress, as well as other biochemical markers. Of course, any level of hormones affects the gonadotropin-inhibitory system. These changes do not cause menstrual irregularities, but simply accompany them. Nevertheless, their presence is crucial, as they can be used to judge individual endocrine features of the stress response. Thanks to these additional signs, it is possible to learn how best to increase the adaptive reserve of the body, so that it can replenish the missing resources and eventually restore the menstrual cycle.

A healthy lifestyle requires stress control. Maintaining physical and emotional well-being and combating the negative effects of stress will be easier with strategies such as regular physical activity, meditation, emotional health support, communication, understanding, awareness. These stress management techniques can play an important role in minimizing the negative effects of hormonal changes.

The interaction between stress hormones and the reproductive system is a complex and multifaceted mechanism that requires additional research. Understanding these mechanisms is an important step for developing strategies to manage stress and maintain reproductive health. Additional research is needed to better understand these processes and to develop personalized approaches to maintain reproductive health under stress.

References

1. Obstetrics / edited by V.E. Radzinsky, A.M. Fuchs. Moscow: GEOTAR-Media, 2016, 1040.
2. Biryukova DA, Amyan TS, Gavisova AA, Durinyan ER, Gardanova JR, Nikolaeva MA, *et al*. The impact of stress on the reproductive system of women: pathophysiology and neuroendocrine interactions //Akusherstvo i Gynecologia,2023:11:36-41. https://dx.doi.org/10.18565/aig.2023.175
3. Volel BA, Ragimova AA, Kuznetsova IV, Burchakov DI. Modern ideas about stress-related menstrual cycle disorders // Obstetrics and Gynecology,2016:12:34-40.
4. Savelyeva GM, Sukhikh GT, Manukhin IB. Gynecology: National Guide. Brief edition. Moscow: GEOTAR-Media, 2013, 704.
5. Sellier G. Stress without distress. Moscow: Progress, 1979, 154.
6. Maharjan DT, Syed AAS, Lin GN, Ying W. Testosterone in female depression: a meta-analysis and Mendelian randomization study. Biomolecules,2021:11(3):409. doi.org/ 10.3390/biom11030409
7. Garg D, Berga SL. Neuroendocrine mechanisms of reproduction. Handb. Clin. Neurol,2020:171:3-23. doi.org/10.1016/B978-0-444-64239-4.00001-1.