

Abstract

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**PECULIARITIES OF HORMONAL HOMEOSTASIS IN WOMEN
WITH DEFICIENT BODY WEIGHT**

Currently, among young women, the prevailing concept of female beauty is a slender figure with a poor subcutaneous fat layer. In this connection, many young girls use various diets and visit fitness clubs in order to lose body weight. After marriage, a significant number of them apply to family planning offices due to the failure to get pregnant after a year and more of regular sex life without contraception. The purpose of the research was to show the correlation between the levels of pituitary and ovarian hormones during the menstrual cycle and body weight deficit in women planning pregnancy.

The study was carried out at the City Clinical Maternity House during 2014–2019. The information was gathered by interviewing women with body weight deficit, who were planning pregnancy, and by analysis of hormone levels. We examined 327 patients. The content of follicle-stimulating hormones (FSH), luteinizing hormones (LH), prolactin, progesterone, estradiol, cortisol was studied. The subjects were divided into 4 groups depending on the body weight deficit: 1st group – a decrease in body weight of up to 5%, 2nd group – a decrease in body weight from 5 to 10%, 3rd group – from 10 to 15%, 4th group – more than 15%. The studied groups were also stratified according to the main etiological factor, namely: a) insufficient nutrition in quantitative and qualitative terms (starvation, some vitamin deficiencies, etc.); b) long-term physical exertion; c) long-term psycho-emotional stress; d) asocial lifestyle (alcoholism, substance abuse).

The results of the study showed changes in the level of hormones in response to the influence of these factors.

It was concluded that the most important factor that changed the level of hormones in the body was a causal relationship that caused weight loss. The most significant factors were: prolonged psycho-emotional stress and malnutrition, while prolonged physical exertion and unhealthy lifestyle were milder predisposing causes that led to changes in hormonal levels in case of underweight. To relieve psycho-emotional stress and optimize nutrition, it is necessary to manage patients together with a psychotherapist and a nutritionist.

Keywords: follicle-stimulating hormone, luteinizing hormone, progesterone, estradiol, prolactin, cortisol, prolonged psycho-emotional stress, malnutrition.

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Резюме

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ОСОБЛИВОСТІ ГОРМОНАЛЬНОГО ГОМЕОСТАЗУ У ЖІНОК З ДЕФІЦИТОМ МАСИ ТІЛА

В даний час серед молодих жінок переважають уявлення про жіночу красу як струнку фігуру зі слабвираженим підшкірним жировим шаром. У зв'язку з чим багато молодих дівчат використовують різні дієти, заняття у фітнес-клубі з метою зниження маси тіла. Після одруження значна кількість з них звертається до кабінетів планування сім'ї у зв'язку з відсутністю вагітності після року та більше регулярного статевого життя без контрацепції. Метою дослідження було показано зв'язок між рівнями гормонів гіпофіза та яєчників під час менструального циклу та дефіцитом маси тіла жінок, які планують вагітність.

Дослідження проводилось на базі КНП "Сумський міський клінічний пологовий будинок Пресвятої Діви Марії" СМР протягом 2014–2019 років. Нами обстежено 327 пацієнток. Досліджено вміст гормонів фолікуло-стимулюючого (ФСГ), лютеїнізуючого (ЛГ), пролактину, прогестерону, естрадіолу, кортизолу. Обстежені залежно від дефіциту маси тіла розділені на 4 групи: 1-а – зниження маси тіла до 5 %, 2-а – зниження маси тіла від 5 до 10 %, 3-я від 10 до 15 %, 4-а – зниження маси тіла більше 15 %. Досліджувані групи були також розділені за основним етіологічним фактором, а саме: а) недостатнє харчування в кількісному та якісному відношенні (голодування, деякі авітамінози тощо); б) тривалі фізичні навантаження; в) тривала психоемоційна напруга; г) асоціальний спосіб життя (алкоголізм, токсикоманія).

Результати дослідження показали зміни рівня гормонів у відповідь на вплив зазначених чинників.

Зроблено висновок, що найважливішим фактором, що змінює рівень гормонів в організмі, є причинний зв'язок, що викликає втрату маси тіла. Найбільш значущими є: тривале психоемоційне напруження і недостатнє харчування, тоді як тривалі фізичні навантаження і ведення нездорового життя є більш м'якими причинами, що викликають зміни гормонального фону при дефіциті маси тіла. Для зняття психоемоційної напруги та оптимізації харчування необхідне спільне ведення пацієнток із психотерапевтом та дієтологом.

Ключові слова: фолікуло-стимулюючий гормон, лютеїнізуючий гормон, прогестерон, естрадіол, пролактин, кортизол, тривала психоемоційна напруга, недостатнє харчування.

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Introduction/Вступ

Currently, a lot of research is devoted to the pathogenesis, the peculiarities of the obesity clinical picture and its connection with the functional disorders of the endocrine glands and metabolism [1, 4, 5, 6, 7]. At the same time, the question of the pathogenesis of body weight deficiency (BWD) and its influence on the reproductive function of women remains poorly understood [2, 3, 8]. The pathogenetic mechanisms of the development of menstrual dysfunction against the background of decreased body weight are associated with a disorder of the neurotransmitter metabolism of the central nervous system with a decrease in the release of GnRH. A certain role is played by a decrease in the amount of adipose tissue [9, 10, 11]. The body's response to weight loss is individual, and even a minor loss of body weight (3–10% decrease) can lead to the onset of the disease [12, 13, 14].

The objective of the study was to research the serum levels of pituitary and ovarian hormones during the menstrual cycle in underweight women planning pregnancy.

Materials and research methods

To determine prognosis of the reproductive potential in underweight women, we studied the state of hormonal balance during the menstrual cycle in 327 women. Standard body weight was calculated using Broca's index. Depending on the severity of underweight, we identified 4 degrees of BWD: 1st degree – a decrease in body weight of up to 5%, 2nd degree – a decrease in body weight from 5 to 10%, 3rd degree – from 10 to 15%, 4th degree – more than 15%.

The studied groups were also divided according to the main etiological factor, namely: a) insufficient nutrition in quantitative and qualitative terms (starvation, some vitamin deficiencies, etc.); b) long-term physical exertion; c) prolonged psycho-emotional stress; d) unhealthy lifestyle (alcoholism, substance abuse). The survey was carried out in connection with the absence of pregnancy in marriage for a year or more with regular sex life without contraception.

The content of estradiol, progesterone, follicle-stimulating and luteinizing hormones, prolactin, cortisol in the 1st and 2nd phases of the menstrual cycle was studied.

To characterize the reproductive function via the blood serum, the content of gonadotropic hormones follicle-stimulating (FSH), luteinizing

(LH) and prolactin, as well as sex steroids progesterone and estradiol in the follicular (on days 2–7) and luteal (on days 20–22) phases of menstrual cycle were studied.

Research results and discussion

When studying the content of estradiol in the 1st phase of the menstrual cycle in women, depending on the cause and degree of body weight deficiency, it was found that in the 1st study group, a significant decrease in the content of the hormone ($p < 0.05$) was observed only in patients with prolonged psycho-emotional stress (by 19.6%), while no significant changes were noted in other study subgroups. In the 2nd study group, there was a significant decrease in the hormone content ($p < 0.05$) in the subgroups with insufficient nutrition (by 21.6%) and with prolonged psycho-emotional stress (by 37.2%) with no significant changes in the long-term physical exertion and unhealthy lifestyle subgroups. In the third study group, as compared with the control group, a significant decrease in the level of the hormone was noted in the subgroups of insufficient nutrition (by 35.3%) and prolonged psycho-emotional stress (by 60.8%). A significant decrease was also found in the subgroup of long-term physical exertion (by 21.6%) and in the subgroup of patients leading an unhealthy lifestyle (by 19.6%). In the 4th study group, the content of estradiol in the subgroup with malnutrition as compared with the control group decreased by 58.8%, in prolonged physical exertion subgroup – by 27.5%, in prolonged psycho-emotional stress subgroup – by 68.6%, in unhealthy lifestyle subgroup – by 39.2%.

A similar picture was observed with the changes of progesterone content over time in the 1st phase of the menstrual cycle. Thus, in the 1st study group, a significant decrease in the content of this hormone was observed only in women with prolonged psycho-emotional stress (by 23.0%), while in the 2nd study group, the content of progesterone was significantly ($p < 0.05$) decreased in women with malnutrition (by 21.1%) and prolonged psycho-emotional stress (by 40.4%) with no significant changes in the subgroups with prolonged physical exertion and leading an unhealthy lifestyle. In the 3rd study group, a decrease in the content of progesterone in women in the 1st phase of the menstrual cycle was observed in all subjects: in women with malnutrition (by 37.2%), prolonged physical exertion (by 23.1%), prolonged psycho-emotional stress (by 59.6%), and those leading an unhealthy lifestyle (by 23.1%). Accordingly, in the

4th study group: progesterone content decreased in the insufficient nutrition subgroup by 56.9%, in long-term physical exertion subgroup – by 34.6%, in prolonged psycho-emotional stress subgroup – by 71.2%, in unhealthy lifestyle subgroup – by 42.3%.

A similar picture was also observed for the content of estradiol and progesterone in the 2nd phase of the menstrual cycle, although the changes in the content of progesterone were more clearly expressed while maintaining the above-described regularity. The emerging deficiency of estradiol and progesterone was noted in the 1st study group in women with malnutrition, which amounted to 13.6% and 29.2%, respectively, vs. women in the control group.

When studying the content of follicle-stimulating hormone in the 1st phase of the menstrual cycle, a decrease in the content of this hormone by 22.6% in the 1st study group in women with prolonged psycho-emotional stress ($p < 0.05$) was observed, while there were no significant difference in other subgroups compared with the controls. In the 2nd study group, a significant decrease in the content of follicle-stimulating hormone was observed in women with malnutrition and long-term psycho-emotional stress ($p < 0.05$). At the same time, in women of the 3rd study group, a decrease in the content of follicle-stimulating hormone was as follows: insufficient nutrition subgroup – by 31.4%, prolonged physical exertion subgroup – by 22.8%, prolonged psycho-emotional stress subgroup – by 46.5%, unhealthy lifestyle subgroup – by 14.3%. In the 4th study group, the content of follicle-stimulating hormone decreased in women with malnutrition by 40.6%, in women with prolonged physical exertion – by 30.5%, in women with long-term psycho-emotional stress – by 56.6% and in women with unhealthy lifestyle – by 22.6%.

The study of luteinizing hormone content in the 1st phase of the menstrual cycle showed a significant ($p < 0.05$) decrease by 24.7% in the 1st study group in patients with prolonged psycho-emotional stress vs. women in the control group, with no significant difference in other study subgroups. In the 2nd study group, the content of luteinizing hormone was significantly lower ($p < 0.05$) in women with malnutrition and prolonged psycho-emotional stress. In the 3rd study group, the content of luteinizing hormone in the subgroup of women with malnutrition decreased by 34.8% ($p < 0.05$), with long-term physical exertion – by 23.3%

($p < 0.05$), with long-term psycho-emotional stress – by 50.3% ($p < 0.05$), with unhealthy lifestyle – by 21.2%; in the 4th study group, the values decreased by 45.1%, 35.1%, 66.5%, 30.0%, respectively.

A similar picture was observed for the content of follicle-stimulating and luteinizing hormone in the 2nd phase of the menstrual cycle.

The study of cortisol content, depending on the cause and degree of body weight deficiency showed that in the 1st study group, a significant ($p < 0.05$) increase in the content of cortisol was found only in the subgroup of women with long-term psycho-emotional stress. At the same time, in the 2nd study group, there was an increase in the content of cortisol by 18.1% in women with malnutrition and by 21.9% in women with long-term psycho-emotional stress. In the 3rd study group, the cortisol content increased in the subgroup with insufficient nutrition – by 21.9%, with prolonged physical exertion – by 9.7%, with prolonged psycho-emotional stress – by 25.8%, with unhealthy lifestyle – by 8.4%; while in the 4th study group, the content of cortisol increased by 24.6%, 14.6%, 46.8%, 10.1%, respectively.

The study of prolactin content in women in the 1st phase of the menstrual cycle showed that in the 1st study group, a significant ($p < 0.05$) increase in the content of prolactin was observed only in the subgroup of women with long-term psycho-emotional stress.

In the 2nd study group, there was an increase in prolactin content by 19.8% in women with malnutrition and by 31.9% in women with prolonged psycho-emotional stress. In the 3rd study group, the prolactin content increased in the subgroup with insufficient nutrition by 17.9%, with prolonged physical exertion – by 39.7%, with prolonged psycho-emotional stress – by 42.8%, with unhealthy lifestyle – by 7.4%; in the 4th study group, the prolactin content increased by 12.6%, 11.7%, 42.1%, 12.2%, respectively.

Thus, a relationship was found between underweight and changes in hormone levels that influenced infertility in marriage (when other factors of infertility were excluded). When studying the causal relationship between a decrease in body weight and hormone level abnormalities, it was shown that the most important factor that changed the level of hormones in the body was a causal relationship that caused weight loss. The study can be used to develop an algorithm for the treatment of such patients together with a psychotherapist and nutritionist.

Conclusions/Висновки

In women with varying degrees of body weight deficiency, hormonal changes are observed, aggravated with the severity of metabolic disorders, and are a reflection of internal homeostasis disorder. The most important factor affecting pathological processes in the body is the causal

relationship that causes weight loss. The most significant factors are prolonged psycho-emotional stress and malnutrition, while long-term physical exertion and unhealthy lifestyle are milder predisposing causes leading to changes in homeostasis.

Prospects for future research/Перспективи подальших досліджень

Prospects for further research are related to the study of the effectiveness of psychotherapeutic effects on hormone levels.

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Conflict of interest/Конфлікт інтересів

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