AMERICAN Journal of Pediatric Medicine and Health Sciences
Volume 01, Issue 10, 2023 ISSN (E): 2993-2149

The Role of Vitamin D in the Reproductive System of Women (Literature Review)

A. B. Nazarova
Bukhara State Medical Institute, Department of Endocrinology

Abstract: Vitamin D plays a huge role in the life of the female body:

- vitamin D regulates the synthesis and secretion of progesterone, as well as sensitivity to follicle-stimulating hormone;
- the optimal level of vitamin D in the blood of 30ng/25(OH)D ensures optimal endometrial thickness for embryo implantation;
- the optimal level of vitamin D in the blood ensures local immunity and is a measure for the prevention of bacterial vaginosis and increases the effectiveness of its treatment;
- an optimal level of vitamin D in the blood is necessary for the normal reproductive function of a woman..

Keywords: Vitamin D, reproductive age, infertility, PCOS, endometriosis, leiomyoma.

The effect of vitamin D on the female reproductive system

Along with its influence on many vital processes in the human body, vitamin D plays a very important role in regulating reproductive function in both women and men.

D-hormone is able to act on the reproductive organs directly, through binding to its receptor (VDRs in women are detected in the ovarian tissue, endometrium, fallopian tubes, as well as in the decidua and placenta; in men, VDRs are expressed in the smooth muscles of the epididymis, spermatogonia, Sertoli cells, seminiferous tubules, prostate gland and seminal vesicles), and indirectly, through stimulation of the synthesis of steroid hormones (estrogens, progesterone, testosterone), which are necessary for the proper maturation of follicles and endometrium in women and normal spermatogenesis in men [1-3] . Currently, there is convincing evidence of the effect of vitamin D on the course of a number of gynecological diseases.

Obesity and vitamin D deficiency

The pathogenetic relationship between obesity and vitamin D deficiency appears to be due to several mechanisms.

Firstly, in obesity, vitamin D, which is fat-soluble, is distributed in a large volume of adipose tissue, which leads to a decrease in its concentration in the blood plasma.

Secondly, it can be assumed that in obesity, the natural production of vitamin D in the skin under the influence of sunlight is reduced, since obese people wear more covered clothing and spend less time in the sun. To clarify the mechanisms leading to vitamin D deficiency in obesity, Worthman J. et al. studied the serum concentrations of D2, D3 and 25(OH)D in obese and normal weight individuals in response to ultraviolet irradiation and oral ergocalciferol [4].

The study involved 19 healthy individuals (BMI≤25) and 19 obese individuals (BMI>30). All patients were Caucasians and had skin types II and III. Normally, the peak serum concentration of vitamin D3 is observed 24 hours after exposure to ultraviolet radiation, so blood samples were taken one hour before ultraviolet irradiation and one day later. Changes in the concentration of vitamin D3 during this period characterize the synthesis of the vitamin in the skin and its transport from the skin into the bloodstream. Basal concentrations of vitamin D3 in obesity and in the control group did not differ significantly. However, in obesity, the increase in vitamin D3 concentration after ultraviolet irradiation was significantly lower than in the control group (6.7±1.4 ng/ml vs 15.3±2.1 ng/ml, p=0.0029). That is, despite the fact that obesity has a larger body surface area, the increase in vitamin D3 concentration after UV irradiation in obesity was 57% lower than in non-obese individuals. Since the body surface area is larger in obesity, one would expect a higher production of vitamin D3 and, accordingly, a more pronounced increase in its concentration in the blood after UV irradiation compared to the control group.

A number of studies conducted in the 80–90s showed that the content of the vitamin D3 precursor 7-dehydrocholesterol in the skin does not change in obesity, just as the process of formation of the vitamin itself does not suffer. That is, transport from the skin to the blood decreases. It can be assumed that in obesity, subcutaneous fat dissolves a greater amount of the vitamin produced in the skin. The hypothesis that a decrease in serum concentration of 25(OH)D in obesity is a consequence of tissue redistribution in a large volume of adipose tissue is confirmed by the results of the work carried out by Arunabh S. et al. [8,9].

This study examined the relationship between 25(OH)D levels and the mass fraction of adipose tissue in healthy women. As a result of a survey of 410 women with a BMI from 17 to 30, an inverse correlation was established between the percentage of adipose tissue and the level of 25(OH)D.

Vitamin D and polycystic ovary syndrome (PCOS) is one of the most common endocrine disorders in women of reproductive age and has a significant genetic component. It is characterized by ovarian dysfunction and its clinical manifestations may include obesity, increased insulin resistance and compensatory hyperinsulinemia, oligoanovulation and infertility. Studies regarding vitamin D status in patients with PCOS have shown an inverse correlation between vitamin D levels and metabolic risk factors, insulin resistance, BMI, triglycerides, total testosterone and DHEA, and a positive correlation with insulin sensitivity.

It can be assumed that VDR and vitamin D levels are associated with endocrine parameters in women with polycystic ovary syndrome. It is quite possible to influence luteinizing hormone, which links sexual polymorphism and the development of PCOS, as well as insulin resistance [5,6].

Research is currently being conducted on the genes involved in the synthesis, hydroxylation and transport of vitamin D in PCOS.

Clinical trials of vitamin D supplementation or vitamin D analogues have shown positive effects on insulin secretion, lipid profile, glucose and C-peptide reduction, menstrual cycle and follicular development.

One of the significant factors in these studies was the presence of obesity. An association between vitamin D levels and insulin resistance was observed only in obese patients. Lower serum levels of 25(OH)D3 were found in obese patients with PCOS (13.1 ± 3.9 ng/ml), whereas in non-obese patients they were slightly higher (20.2 ± 8.4 ng/ml). Perhaps it is obesity, but not the presence of PCOS, that determines this deficiency [7].

Vitamin D and endometriosis

Endometriosis has significant socioeconomic and public health implications. It can reduce quality of life due to severe pain, fatigue, depression, anxiety and infertility. Some people with endometriosis experience debilitating pain that interferes with their ability to work or study.

Endometriosis is a complex disease that affects some women from the start of their first period (menarche) until menopause, regardless of ethnic origin or social status. The exact origin of endometriosis is considered polyetiological (multifactorial), meaning that many different factors contribute to its development. Low vitamin D levels are associated with an increased risk of endometriosis [10].

Plasma 25(OH)D levels were inversely correlated with the incidence of this disease, according to data obtained from a large prospective cohort study conducted in the United States (Nurses' Health Study II), which included 70,566 women. Women with 25(OH)D levels in the top quartile had a 24% lower incidence of endometriosis than those with 25(OH)D levels in the bottom quartile (RR 0.76; 95% CI 0. 60—0.97; p=0.004) . The disease is certainly associated with dysfunction of the immune system and a pronounced inflammatory reaction. Various genetic disorders are also of great importance. Recent data have shown that women with endometriosis have higher serum levels of 25(OH)D3 and VDR expression in the endometrium compared with controls, with increased production of vitamin D binding protein in serum and decreased production in peritoneal tissue. It is this protein that is directly related to the stimulation of macrophage activity. This finding may explain the effect of vitamin D on the local activity of immune cells and cytokines that support endometriosis and insufficient stimulation of macrophage function[10].

Vitamin D and leiomyoma

Leiomyoma is a benign, well-circumscribed, encapsulated tumor that develops from mesenchymal smooth muscle tissue and is of monoclonal origin. Some studies suggest that vitamin D deficiency is associated with the development of uterine leiomyomas.

Studies demonstrate low 25(OH)D levels in patients at high risk for uterine masses and infertility. The potential therapeutic effect of vitamin D in this group of patients, which is to inhibit the growth of fibroids, has been confirmed in both animal and human studies [11].

Vitamin D and the results of assisted reproductive technologies (ART)

Assisted reproductive technologies (ART) is a collective name for medical technologies, treatment methods and procedures aimed at achieving pregnancy in a patient, in which some or all stages of conception are carried out outside the body of the expectant mother. Used for infertility.

To date, a number of studies have been conducted studying the effect of vitamin D on the results of ART. Vitamin D deficiency is associated with low pregnancy and birth rates and high miscarriage rates in patients after ART.

A prospective study examining the effect of serum 25(OH)D concentrations on the outcome of in vitro fertilization (IVF) included 173 women.

The level of 25(OH)D≥30ng/ml (75nmol/l) was regarded as sufficient, lower serum concentrations of 25(OH)D were considered insufficient. The end point of the study was clinical pregnancy. Women with adequate 25(OH)D levels had a significantly higher pregnancy rate compared with women with vitamin D deficiency (52.5% vs. 34.7%; p<0.001).

This study demonstrates that women with high levels of vitamin D are more likely to become pregnant through IVF. It is noteworthy that the results of ART vary depending on the time of year. Thus, higher pregnancy rates were achieved in spring and summer, and low ones in autumn.

An American study conducted in groups of women participating in ART programs with donor egg transfer demonstrated that 25(OH)D levels > 30 ng/ml (75 nmol/l) were associated with a higher rate of pregnancies in recipients, as well as a higher number of children born (31% in patients with vitamin D deficiency compared to 59% in patients with normal vitamin D levels). This study was interesting because it improved natural fertility in both infertile and fertile women (egg donors). The results of the study allowed the authors to conclude that vitamin D realizes its potential effect on fertility through its influence on the endometrium (its structure and receptivity), since the biological material (egg) belonged to the donor [12].

Vitamin D is a regulator of endometrial expression of the HOXA10 gene (critical for the implantation process), participates in the interaction between the embryo and the endometrium, improving embryo implantation through various molecular and cytokine mechanisms. Studies demonstrate that adequate levels of vitamin D (25(OH)D more than 30 ng/ml) improve the results of ART in terms of the number of clinical pregnancies [12].

Thus, numerous studies confirm the enormous influence of vitamin D on the reproductive function of women. That is why timely correction of vitamin D deficiency and subsequent systematic prevention is of great importance when solving reproductive problems. In addition to classic diseases such as rickets, osteoporosis and osteomalacia, vitamin D deficiency in women is beginning to be associated with lower fertility, infertility and an increased risk of adverse pregnancy outcomes.

The data obtained will help determine the leading factors of infertility in women of reproductive age against the background of overweight and obesity, and will also allow the development of principles of primary prevention. The introduction of research results into practical healthcare will reduce infertility among women of reproductive age. [8].

Literature:

1. Merhi Z, Doswell A, Krebs K, Cipolla M. Vitamin D alters genes involved in follicular development and steroidogenesis in human cumulus granulosa cells. J Clin Endocrinol Metab. 2014;99(6):E1137-E1145.
2. Buggio L, Roncella E, Somigliana E, Vercellini P. Vitamin D and benign gynaecological diseases: A critical analysis of the current evidence. Gynecol Endocrinol. 2015;16:1-5.
3. Lerchbaum E, Rabe T. Vitamin D and female fertility. Curr Opin Obstet Gynecol. 2014;26(3):145-150.
4. Worthman J., Matsuoka L., Chen T. et al. Decreased bioavaillability of vitamin D in obesity // Am J Clin Nutr. – 2000, 72. – P. 690–693.
5. Aquila S, Guido C, Middea E, et al. Human male gamete endocri-nology: 1alpha, 25-dihydroxyvitamin D3 (1,25(OH)2D3) regulates different aspects of human sperm biology and metabolism. Reprod Biol Endocrinol. 2009;7:140.
6. Anagnostis P, Karras S, Goulis DG. Vitamin D in human repro-duction: a narrative review. Int J Clin Pract. 2013;67(3):225-235. 24. Abnormal 1,25-dihydroxyvitamin D metabolism in preeclampsia / P. August [et al.] // Am J Obstet Gynecol. — 1992. — Vol. 166, № 4. — P. 1295-1299.
7. Role of vitamin D treatment in glucose metabolism in polycystic ovary syndrome / K. Kotsa [et al.] // Fertil Steril. — 2009. — Vol. 92, № 3. — P. 1053-1058.
8. Nazarova A.B. Features of vitamin D metabolism in women of reproductive age against the background of obesity. BOSHQARUV VA ETIKA QOIDALARI ONLAYN ILMIY JURNALI 3 (11), 29-32, 2023.
9. Ismailova Sh.S. Effect of Vitamin D Deficiency on Metabolic Parameters in Obese Women. Research Journal of Trauma and Disability Studies, 2(7), 51–60. (2023).
10. Jurakulova Z. A. Current Issues of Infertility Diagnosis and Treatment in Women with Internal Genital Endometriosis//SYNERGY: JOURNAL OF ETHICS AND GOVERNANCE. Volume: 01 Issue: 06 | 2021 ISSN: 2181-2616.

11. Tikhomirov A.L. Uterine fibroids. Pathogenetic rationale for organ-preserving treatment: Monograph. M. 2013.
12. Lerchbaum E, Rabe T. Vitamin D and female fertility. Curr Opin Obstet Gynecol. 2014;26(3):145-150.