

UDC 616-092.19-02:577.161.2:612.017
DOI <https://doi.org/10.32782/health-2023.2.13>

VITAMIN D DEFICIENCY AS A TRIGGER OF THE DEVELOPMENT OF AUTOIMMUNE DISEASES

Poyasova Olga-Rozaria Sergiivna,
4th year student of the Faculty of Medicine and Pharmacy
Dnipro State Medical University
ORCID: 0009-0004-8626-3166

Sharapova Olena Mikolaivna,
Candidate of Medical Sciences, Lector,
Lector of the Department of Human Anatomy, Clinical Anatomy and Operative Surgery
Dnipro State Medical University
ORCID: 0000-0002-5323-8616

The article discusses the pathogenetic changes that occur in the body against the background of vitamin D deficiency and their impact on the possible development of autoimmune diseases. The relationship between the occurrence of autoimmune processes in the body and a deficiency of vitamin D has been clarified. The relevance of the topic of the article is that vitamin D plays an important role in maintaining the good health of the human body. Vitamin D deficiency exists in every region of the world. In the European population, vitamin D insufficiency is greater in the south than in the north and is more likely in women than in men; women with osteoporosis are vitamin D deficient in 50% of cases. More than 80% of Ukrainians are deficient in vitamin D. According to the WHO, this figure reaches 88% in the world.

Today, WHO considers 25(OH)D insufficiency and deficiency to be a pandemic, affecting a large part of the general population, including children and adolescents, pregnant and lactating women, adults, menopausal women, and the elderly. In the presence of an osteoporotic fracture, the prevalence of vitamin D deficiency can reach 100%.

The reasons for the occurrence and development of the autoimmune process in the body against the background of a lack or deficiency of vitamin D were considered. The authors found out exactly which changes caused by the lack or deficiency of cholecalciferol in the body are favourable factors for the development of autoimmune diseases or the worsening of the course of already existing autoimmune diseases with the development of complications. The authors of the article came to the conclusion that the lack and deficiency of vitamin D, currently a global problem for all mankind, is a so-called "pandemic," leads to violations of the normal functioning of all organs and systems of the body, and also acts as a trigger in the development of autoimmune diseases and contributes to the deterioration course with the development of complications of already existing diseases.

Key words: deficiency/insufficiency of cholecalciferol, autoimmune process, autoimmune disease, immune response.

Поясова О.-Р.С., Шарапова О.М. Дефіцит вітаміну Д як тригер розвитку аутоімунних хвороб

У статті розглянуто патогенетичні зміни, які виникають в організмі на тлі дефіциту вітаміну D, та їхній вплив на можливий розвиток аутоімунних хвороб. З'ясовано взаємозв'язок виникнення аутоімунних процесів в організмі при дефіциті вітаміну D. Актуальність теми статті полягає в тому, що вітамін D відіграє важливу роль у підтримці міцного здоров'я організму людини. Дефіцит вітаміну D наявний у кожному регіоні світу. Серед населення в Європі недостатність вітаміну D більша на півдні, ніж на півночі, та більш ймовірна в жінок, ніж у чоловіків, а в жінок з остеопорозом дефіцит вітаміну D відзначається в 50% випадків. Понад 80% українців мають дефіцит вітаміну D. За даними ВООЗ, у світі цей показник сягає 88%.

На сьогодні ВООЗ розглядає недостатність та дефіцит 25(OH)D як пандемію, що охоплює велику частину загальної популяції, включаючи дітей і підлітків, вагітних і жінок, які годують, дорослих, жінок у менопаузі та літніх людей. За наявності остеопоротичного перелому поширеність дефіциту вітаміну D може досягати 100%.

Розглянуто причини виникнення та розвитку аутоімунного процесу в організмі на тлі нестачі або дефіциту вітаміну D. Автори з'ясували, які саме зміни, зумовлені нестачею або дефіцитом холекальциферолу, в організмі виступають сприятливим чинником для розвитку аутоімунних хвороб або погіршення перебігу уже наявних аутоімунних хвороб з розвитком ускладнень. Автори статті дійшли висновку, що нестача та дефіцит вітаміну D наразі є глобальною проблемою всього людства, виступають так званою «пандемією» і призводять до порушень нормального функціонування всіх органів та систем організму, а також виступають тригером у розвитку аутоімунних хвороб та сприяють погіршенню перебігу з розвитком ускладнень уже наявних хвороб.

Ключові слова: дефіцит/недостатність холекальциферолу, аутоімунний процес, аутоімунна хвороба, імунна відповідь.

Introduction. Vitamin D enters the human body in the form of ergocalciferol (D2) with plant foods (bread, yeast, broccoli, etc.) and cholecalciferol (D3), which is contained in products of animal origin (cod liver, mackerel, milk, eggs, butter, poultry liver etc). Cholecalciferol is also synthesized under the action of ultraviolet rays (275–310 nm) in skin cells from provitamin 7-dihydrocholesterol [1, 2, p. 268]. It is the main source of vitamin D3 – up to 80% of a person's daily requirement. The synthesis of vitamin D3 in the skin is quite active and amounts to 18 IU/cm/year [3, 4, p. 2740]. This amount of D3 is able to fully satisfy the body's need for it. However, seasonally with a change in the length of the daylight hours and a decrease in the activity of ultraviolet rays; the presence of inflammatory diseases of the gastrointestinal tract with impaired absorption of nutrients and vitamins; a long working day in a closed room; age (women after menopause); insufficient consumption of foods rich in vitamin D; lactose intolerance; obesity and other factors contribute to the development of vitamin D insufficiency with further development of its deficiency [5, 6, p. 1710].

Materials and methods. A review of literature data for the past 15 years in Google Scholar, Scopus, and Springer databases was conducted.

Discussion. Vitamin D is an important regulator of almost all metabolic processes in the body. It has a positive effect on the normal functioning of the nervous system, cardiovascular, immune, musculoskeletal, endocrine, and reproductive systems, and is responsible for the health of the skin. It takes part in the regulation of calcium and phosphate metabolism, in supporting the functioning of the immune and endocrine systems, in blood coagulation processes, in preventing the development of autoimmune and allergic diseases and the development of tumors.

Vitamin D deficiency contributes to the emergence and progression of autoimmune diseases. The effect of vitamin D on the immune system is confirmed by the fact that VDR receptors are present in almost all cells of the immune system, including CD8⁺ and CD4⁺ lymphocytes, B lymphocytes, neutrophils, APC (antigen-presenting cells), macrophages, as well as in chondrocytes and synoviocytes of the synovial membrane joints. It is important to note that vitamin D reduces the expression of pro-inflammatory and increases the expression of anti-inflammatory cytokines by macrophages through the regulation of MAPK-1 phosphatase and inhibition of p38 activation, which balances the immune system.

NK cells, stimulated through VDR, in a complex provide protection of the body not only against

intracellular pathogens, but also against autoimmune diseases. Vitamin D has an inhibitory effect on Th17 cells and the production of IL17, which contribute to the damage of own tissues in autoimmune diseases (multiple sclerosis, autoimmune uveitis, rheumatoid arthritis, Crohn's disease, autoimmune thyroiditis, systemic lupus erythematosus, etc.)

On the one hand, vitamin D in activated macrophages and dendritic cells reduces the transcription of interleukin (IL) 12, the production of inflammatory cytokines and chemokines (eg, IFN γ , IL17 and IL differentiation of Th0 cells into Th2–21), directing the cells to increase the production of IL 5 and IL10, cytokines. Induced IL-4, IL10 also suppresses Th1 and Th17 cells and, accordingly, the production of IFN γ , IL tolerance17 and IL2, which leads to immune tolerance. Thus, vitamin D has an immunomodulatory effect on the interleukin and cytokine balance, preventing excessive activation of the immune system, which is extremely important for inhibiting inflammation. As is known, inflammation plays a leading pathogenetic role in the emergence and progression of autoimmune diseases. And with a lack or deficiency of vitamin D, there is a high risk of developing systemic inflammation in the body, which leads to the activation of autoimmune processes in the body or the beginning of the progression of already existing autoimmune diseases, their severe course and deterioration of the general condition of the body with the possible addition of other pathological processes and diseases caused by vitamin D deficiency.

Also, vitamin D is an immunosuppressive hormone, calcitriol inhibits the proliferation and differentiation of T lymphocytes, but the production of calcitriol by dendritic cells «programs» the homing of T cells to the epidermis, which is important for long-term immune surveillance and maintaining the integrity of the barrier. Vitamin D suppresses the effector functions of T helpers and cytotoxic T cells, but promotes the development of regulatory T lymphocytes that suppress immune-mediated inflammation. Vitamin D inhibits the production of IL-2 and IFN γ . Calcitriol inhibits antibody production by cells stimulated by IL plays 2. Vitamin D promotes antigen processing, a role in the down-regulation of major histocompatibility complex type 2 (MHCII). Autoimmune diseases, in which autoantibodies are produced, are usually associated with MNSII and with vitamin D deficiency, the activity of the main histocompatibility complex of type 2 increases, which leads to the development of an autoimmune process in the body.

Results. Vitamin D deficiency is an acute and global problem of all mankind. Cholecalciferol participates in all metabolic processes of the body and has a positive effect on the normal functioning of all organs and systems of the body. With a deficiency of vitamin D, negative changes in the functioning of the immune system are observed, which leads to the emergence and progression of autoimmune pro-

cesses, the development of the inflammatory process, which is the basis of the pathogenesis of autoimmune diseases and their exacerbation. Therefore, vitamin D deficiency can rightfully be considered one of the triggers for the development of the autoimmune process in the body, the occurrence of autoimmune diseases, their severe course, progression and emergence of complications.

LITERATURE

1. Bikle D.D. (2016) Extraskelatal actions of vitamin D. *Annals of the New York Academy of Sciences*. 1376(1):29–52. DOI: 10.1111/nyas.13219.
2. Holick M.F. (2007) Vitamin D deficiency [Vitamin D deficiency]. *N. Engl. J. Med.* No 357/ P. 266–281.
3. Holick M.F. (2005) The vitamin D epidemic and its health consequences [The vitamin D epidemic and its health consequences]. *The Journal of nutrition*, P. 2739–2748.
4. Illescas-Montes R., Melguizo-Rodríguez L., Ruiz C., Costela-Ruiz VJ. (2019) Vitamin D and autoimmune diseases. *Life Sciences*. 233:116744. DOI: 10.1016/j.lfs.2019.116744.
5. Murdaca Tonacci A., Negrini S., Greco M., Borro M., Puppo F. et al. (2019) Emerging role of vitamin D in autoimmune diseases: An update on evidence and therapeutic implications. *Autoimmunity Reviews*. 18(9):102350. DOI: 10.1016/j.autrev.2019.102350.
6. Zhou C. (2006) Steroid and xenobiotic receptor and vitamin D receptor crosstalk mediates CYP24 expression and drug-induced osteomalacia [Steroid and xenobiotic receptor and vitamin D receptor crosstalk mediates CYP24 expression and drug-induced osteomalacia]. *J. Clin. Invest.*, No 116. P. 1703–1712.