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THE INFLUENCE OF VITAMIN D ON THE DEVELOPMENT AND PROGRESSION OF HASHIMOTO'S GOITER: A COMPREHENSIVE ANALYSIS OF CLINICAL AND IMMUNOLOGICAL ASPECTS

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ABSTRACT: This article presents a descriptive review of the literature on the role of vitamin D in the pathogenesis of autoimmune thyroiditis (Hashimoto's goiter). The mechanisms of extrarenal calcitriol synthesis by immune cells and its effect on T-lymphocyte differentiation are discussed. The results of epidemiological and interventional clinical studies demonstrating an inverse relationship between serum 25(OH)D levels and antithyroid autoantibody titers are analyzed. The clinical significance of monitoring vitamin D status and its targeted supplementation as a pathogenetic adjuvant therapy for this disease is substantiated.

Keywords: autoimmune thyroiditis, Hashimoto's thyroiditis, vitamin D, calcitriol, immunomodulation, T-helper cells, autoantibodies.

ВЛИЯНИЕ ВИТАМИНА D НА РАЗВИТИЕ И ТЕЧЕНИЕ ЗОБА ХАШИМОТО: КОМПЛЕКСНЫЙ АНАЛИЗ КЛИНИЧЕСКИХ И ИММУНОЛОГИЧЕСКИХ АСПЕКТОВ

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АННОТАЦИЯ: В статье представлен описательный обзор литературы, посвященный роли витамина D в патогенезе аутоиммунного тиреоидита (зоба Хашимото). Рассматриваются механизмы экстраренального синтеза кальцитриола клетками иммунной системы и его влияние на дифференцировку Т-лимфоцитов. Проанализированы

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результаты эпидемиологических и интервенционных клинических исследований, демонстрирующих обратную связь между уровнем 25(OH)D в сыворотке крови и титром антитиреоидныхаутоантител. Обосновывается клиническая значимость мониторинга статуса витамина D и его таргетной сапплементации как патогенетической адъювантной терапии данного заболевания.

Ключевые слова: аутоиммунный тиреоидит, зоб Хашимото, витамин D, кальцитриол, иммуномодуляция, Т-хелперы, аутоантитела.

RELEVANCE: Autoimmune thyroiditis (AIT, Hashimoto's thyroiditis) is the most common organ-specific autoimmune disorder of the endocrine system and the leading cause of hypothyroidism in regions with adequate iodine intake. The disease is characterized by T-cell-mediated destruction of thyrocytes and the production of autoantibodies to specific thyroid antigens.

Traditionally, vitamin D (calciferol) was considered exclusively in the context of phosphorus-calcium metabolism. However, the discovery of the expression of vitamin D receptors (VDRs) and the 1a-hydroxylase enzyme in immune cells radically changed the paradigm, allowing it to be classified as a potent secosteroid hormone with pronounced immunomodulatory properties [1, 2]. Given the pandemic nature of vitamin D deficiency in the global population and the high prevalence of Hashimoto's thyroiditis, understanding the role of vitamin D in the pathogenesis of AIT opens new prospects for targeted therapy of this disease.

The purpose of this article is to analyze current clinical research and fundamental mechanisms linking vitamin D status with the development and course of autoimmune thyroiditis.

MATERIALS AND METHODS: This study was designed as a descriptive narrative review aimed at analyzing the role of vitamin D in the development and progression of autoimmune thyroiditis (Hashimoto’s disease). A comprehensive literature search was conducted using electronic databases including PubMed, Scopus, Web of Science, and Google Scholar. Relevant publications from 2010 to 2024 were identified using keywords such as “vitamin D,” “autoimmune thyroiditis,” “Hashimoto’s thyroiditis,” “25(OH)D,” “calcitriol,” “immune regulation,” and “thyroid autoantibodies.”

Inclusion criteria comprised original clinical studies (randomized controlled trials, cohort and case-control studies), meta-analyses, and systematic reviews evaluating the association between vitamin D status and autoimmune thyroid diseases. Experimental studies exploring immunological mechanisms were also included. Articles not available in full text, studies with insufficient methodological quality, and non-peer-reviewed sources were excluded.

Data extraction focused on study design, sample size, serum 25(OH)D levels, antibody titers (anti-TPO, anti-TG), and reported immunological effects of vitamin D. The collected data were qualitatively analyzed and synthesized to identify consistent patterns, mechanisms, and clinical implications.

The methodological approach allowed for an integrated assessment of both clinical and experimental evidence, ensuring a comprehensive understanding of vitamin D’s immunomodulatory role in Hashimoto’s thyroiditis

RESULTS AND DISCUSSION: Physiology and Metabolism of Vitamin D at the Cellular Level The classical pathway of vitamin D synthesis begins in the skin under the influence of ultraviolet rays, after which it undergoes hydroxylation in the liver to form 25(OH)D (calcifediol). The second stage of hydroxylation was historically associated only with the kidneys, where the active form 1,25(OH)2D (calcitriol) is formed.

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A decisive discovery for immunology was the discovery of the enzyme CYP27B1 (1a-hydroxylase) in extrarenal locations: in macrophages, dendritic cells (DCs), and T and B lymphocytes [3, 4]. This confirms the ability of immune cells to locally synthesize calcitriol. The biological effect is realized when calcitriol binds to the intracellular receptor VDR, which forms a heterodimer with the retinoid X receptor (RXR). This complex translocates into the nucleus, binding to specific response elements (VDRE) in gene promoters, thereby regulating the transcription of genes responsible for cellular proliferation, differentiation, and the immune response [6].

2.2. Immunopathogenesis of Hashimoto's goiter. Hashimoto's goiter is based on a breakdown of peripheral immunological tolerance. A key factor is an imbalance in T-helper cell subpopulations. The predominance of Th1 lymphocytes leads to hyperproduction of interferon-gamma (IFN-γ) and tumor necrosis factor (TNF-α), which stimulates thyrocyte apoptosis via the Fas/FasL system.

In parallel, Th17 cells are activated, secreting proinflammatory interleukin-17 (IL-17). Against this background, a functional deficiency of regulatory T cells (Treg) is observed, which should normally restrain autoimmune aggression and limit the activity of B lymphocytes that produce autoantibodies to thyroid peroxidase (anti-TPO) and thyroglobulin (anti-TG).

2.3. Vitamin D as an Endogenous Immunomodulator Vitamin D has a pronounced inhibitory effect on inflammatory processes:

Effect on antigen-presenting cells: Calcitriol suppresses the maturation of dendritic cells by reducing the expression of MHC class II molecules and costimulatory molecules (CD40, CD80, CD86), forming a tolerogenic (non-aggressive) phenotype of DCs.

Shift in T-cell profile: Vitamin D directly suppresses the transcription of proinflammatory Th1 (IL-2, IFN-Y) and Th17 (IL-17) cytokine genes, while stimulating the development of anti-inflammatory Th2 cells (IL-4, IL-10) and the induction of Treg cells through increased expression of the transcription factor FoxP3 [4, 6].

2.4. The role of vitamin D in the pathogenesis of Hashimoto's goiter. The integration of the described immunological effects in thyroid tissue explains the protective effect of vitamin D in AIT [5, 6]:

1. Enhancement of suppressor function: An increase in the Treg cell pool is critical for restoring tolerance to thyroid antigens.

2. Decreased lymphocytic infiltration: Inhibition of dendritic cell maturation makes them less capable of presenting autoantigens, which reduces the infiltration of the glandular parenchyma by cytotoxic lymphocytes.

3. Suppression of antibody production: The direct inhibitory effect of calcitriol on autoreactive B lymphocytes leads to a potential decrease in the titers of organ-specific autoantibodies (anti-TPO, anti-TG).

2.5. Review of clinical studies

Association studies: evidence of a link Numerous epidemiological data demonstrate a strong inverse correlation between serum 25(OH)D levels and AIT markers.

Kivity S. et al. (2011) [5, 10] found that vitamin D deficiency is statistically significantly more common in patients with AIT (72%) than in the control group (30.6%).

A case-control study by Bozkurt N.C. et al. (2013) [7, 8] demonstrated a direct relationship between the severity of vitamin D deficiency, thyroid volume, and antibody levels.

A large study by Choi Y.M. et al. (2014) [3, 9] confirmed that low 25(OH)D levels are an independent predictor Autoimmune thyroid disease in premenopausal women.

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Interventional studies and meta-analyses. Attempts to correct the immune status with cholecalciferol preparations are of greatest clinical interest. In a rigorous randomized controlled trial, Krysiak R. et al. (2017) [12] examined the effect of vitamin D on thyroid autoimmunity in women with AIT receiving levothyroxine. It was shown that vitamin D supplementation (in doses sufficient to achieve optimal blood levels) led to a significant and significant reduction in anti-TPO and anti-TG titers compared to placebo. It is important to emphasize that the clinical effect depended specifically on achieving the target 25(OH)D level in serum.

A global assessment of the data is systematized in meta-analyses.

Wang J. et al. (2015) [11, 14, 16] analyzed observational data, confirming that patients with AIT have consistently lower 25(OH)D levels.

A meta-analysis of interventional studies by Zhang Y. et al. (2021) [13, 17, 19] provided a convincing conclusion: vitamin D supplementation causes a statistically significant decrease in the level of antibodies to TPO and TG after 6 months of therapy.

A review by Botelho I.M.B. et al. (2018) [4, 18] summarizes that vitamin D should be considered as an effective adjuvant therapeutic agent for reducing the autoimmune burden in Hashimoto's disease.

Cause, Consequence, or Bystander? The nature of the relationship between vitamin D deficiency and AIT ("Cause, Consequence, or Bystander?") remains one of the main controversial topics in endocrinology [3]. On the one hand, genetic studies of VDR gene polymorphisms (BsmI, FokI, ApaI, TaqI) indicate that innate characteristics of vitamin D metabolism predispose to AIT (the underlying cause). On the other hand, there is a "reverse causality" hypothesis: the systemic inflammatory process in AIT can lead to increased clearance of 25(OH)D, making deficiency a consequence of the disease. Regardless of the underlying cause, exogenous deficiency compensation breaks this vicious cycle and demonstrates proven clinical efficacy in suppressing autoimmune inflammation.

3. Practical recommendations and clinical perspectives

Based on the principles of evidence-based medicine, the management of patients with Hashimoto's thyroiditis should include:

1. Biochemical screening: Mandatory determination of baseline serum 25(OH)D levels in all patients with newly diagnosed AIT or elevated antithyroid antibody titers.

2. Targeted supplementation: Prescribe cholecalciferol at therapeutic doses when deficiency is detected. Therapy should be monitored until the target immunomodulatory level is achieved (the recommended range is 40-60 ng/ml, which exceeds the standard minimum bone mineral density).

3. Integrated approach: Vitamin D supplementation does not replace hormone replacement therapy with levothyroxine in established hypothyroidism, but it does act as a powerful pathogenetic adjuvant therapy capable of slowing further destruction of thyroid tissue.

CONCLUSIONS: Vitamin D is a critical endogenous regulator of immune tolerance. A thorough analysis of the literature demonstrates that its deficiency is closely integrated into the pathogenesis of Hashimoto's thyroiditis, promoting Th1/Th17-mediated inflammation and autoantibody hyperproduction. Epidemiological data and randomized clinical trials provide compelling evidence that correction of vitamin D deficiency is associated with a significant reduction in thyroid autoimmune activity. Integrating vitamin D status monitoring into routine clinical management of patients with AIT is an evidence-based, safe, and necessary strategy.

Literature

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1. Mazokopakis EE, Kotsiris DA. Hashimoto's autoimmune thyroiditis and vitamin D deficiency. Current Aspects of Autoimmune Thyroid Disease. 2011; 5: 109-120.
2. Muscogiuri G, et al. Vitamin D and thyroid disease: to D or not to D? European Journal of Clinical Nutrition. 2015; 69(3): 291-296.
3. Choi YM, et al. Low levels of serum vitamin D3 are associated with autoimmune thyroid disease in premenopausal women. Thyroid. 2014; 24(4): 655-661.
4. Botelho IMB, et al. Vitamin D in Hashimoto's thyroiditis: a systematic review and meta-analysis. Frontiers in Endocrinology. 2018; 9:1-9.
5. Kivity S, et al. Vitamin D and autoimmune thyroid diseases. Cellular & Molecular Immunology. 2011; 8(3): 243-247.
6. Łacka K, Maciejewski A. The role of vitamin D in autoimmune thyroid diseases. Nutrients. 2023; 15(14): 3174.
7. Bozkurt NC, et al. The association between severity of vitamin D deficiency and Hashimoto's thyroiditis. Endocrine Practice. 2013; 19(3): 479-484.
8. Wang J, et al. Meta-analysis of the association between vitamin D and autoimmune thyroid disease. Nutrients. 2015; 7(4): 2485-2498.
9. Krysiak R, et al. The effect of vitamin D on thyroid autoimmunity in levothyroxine-treated women with Hashimoto's thyroiditis. Journal of Clinical Endo