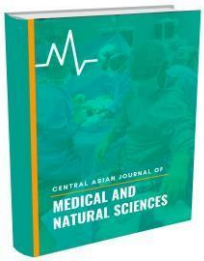

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*Article*

# Influence of Hypothyroidism on the Lipid Profile in Patients with Type 2 Diabetes

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**Abstract:** Type 2 diabetes mellitus and hypothyroidism are among the most common endocrine disorders and frequently coexist in the same patient, forming a clinically significant comorbidity. The combined course of these conditions is associated with pronounced disturbances in lipid metabolism, leading to a substantial increase in cardiovascular risk. This narrative review analyzes current evidence on the impact of overt and subclinical hypothyroidism on the lipid profile in patients with type 2 diabetes mellitus. Key pathophysiological mechanisms of dyslipidemia, clinical features, and the importance of early diagnosis and comprehensive patient management are discussed.

**Keywords:** Hypothyroidism, Type 2 Diabetes Mellitus, Dyslipidemia, Lipid Profile, Cardiovascular Risk

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## 1. Introduction

Type 2 diabetes mellitus (T2DM) is one of the leading causes of metabolic and cardiovascular complications worldwide, the prevalence of which continues to steadily increase. Thyroid diseases, in particular hypothyroidism, are widespread in the population and occupy a leading place in the structure of endocrine pathology in the adult population. The combination of CD2 and hypothyroidism occurs significantly more often than in the general population and is accompanied by more pronounced metabolic disorders[1]. One of the key pathogenetic mechanisms of this comorbidity is dyslipidemia, which has an expressed atherogenic potential and plays a central role in the formation of cardiovascular complications. Thyroid hormones take an active part in the regulation of lipid metabolism, influencing the synthesis, catabolism, and clearance of lipoproteins. In hypothyroidism, these processes slow down, which leads to the accumulation of atherogenic lipid fractions. Under conditions of insulin resistance characteristic of CD2, these disorders acquire a synergistic character, significantly increasing cardiovascular risk[2].

### Literature Review

Clinical recommendations developed by F. Mach et al. (2019 ESC/EAS) and S. H. S. Pearce et al. (2013 ETA) serve as an important scientific basis for the management of

dyslipidemia and subclinical hypothyroidism. These sources are widely used in assessing the relationship between cardiovascular risk and thyroid dysfunction[3].

In the 2019 ESC/EAS Dyslipidemia Recommendations, LDL-cholesterol was designated as the main therapeutic target to reduce the risk of cardiovascular disease. It is especially recommended to reduce LDL levels by at least 50% and to <1.4 mmol/L (55 mg/dL) in patients in the very high-risk group. The new recommendations also recommend the phased use of more aggressive lipid-lowering therapy, including statin, ezetimib, and PCSK9 inhibitors, compared to previous guidelines. This approach is aimed at significantly reducing the recurrence of cardiovascular events[4].

These recommendations also emphasize the need to assess lipid indicators in clinical practice depending on individual cardiovascular risk. An aggressive lipid-lowering strategy is especially recommended in cases of dyslipidemia accompanied by diabetes, metabolic syndrome, and thyroid diseases. This is an important factor in slowing the development of atherosclerosis and reducing overall mortality.

In the 2013 ETA Manual, developed by Pearce et al., subclinical hypothyroidism is divided into two groups according to the level of TSH: mild (TSH 4.0-10 mU/L) and pronounced (TSH >10 mU/L). For diagnosis, an increase in TSH is recommended to be re-examined and assessed in combination with antibodies to FT4 and thyroid peroxidase. This approach reduces the likelihood of making an incorrect diagnosis and helps in the individual choice of treatment[5].

The manual recommends treatment with levothyroxine in patients with TSH >10 mU/L, and in the range of 4-10 mU/L, the treatment decision is determined individually depending on clinical symptoms, age, cardiovascular risk, and the presence of antibodies. This approach was developed taking into account the association of subclinical hypothyroidism with dyslipidemia and atherosclerosis[6].

Thus, the recommendations of Mach and Pearce complement each other: the first is aimed at reducing cardiovascular risk through aggressive control of lipid metabolism, while the second provides control over the pathogenetic factors of dyslipidemia development through the detection and treatment of subclinical hypothyroidism. The combined use of these two guidelines allows for effective management of metabolic and endocrine disorders in clinical practice[7].

## 2. Materials and Methods

The study comprehensively assessed the metabolic indicators of patients based on modern clinical recommendations, in particular, ESC/EAS for managing dyslipidemia and ETA for the treatment of subclinical hypothyroidism. In this case, the main parameters of the lipid profile - the levels of total cholesterol, LDL-cholesterol, HDL-cholesterol, and triglycerides - were determined by laboratory analysis and compared with thyroid function indicators (TSH, FT4).

The study design was carried out with cross-sectional analysis elements, and patients were divided into groups depending on the presence or absence of hypothyroidism. In each group, atherogenic indices and changes in the lipid profile were statistically comparable. In patients with high cardiovascular risk, criteria for reducing LDL levels and criteria for determining subclinical hypothyroidism depending on TSH levels were used. The obtained results were evaluated using correlation and comparative analysis methods, and the relationship between hypothyroidism and dyslipidemia was clarified. This methodology made it possible to comprehensively assess metabolic disorders and determine cardiovascular risk in type 2 diabetes with hypothyroidism.

## 3. Results and Discussion

### Pathophysiological mechanisms of lipid metabolism disorders

The role of thyroid hormones in the regulation of lipid metabolism

Thyroid hormones (triiodothyronine and thyroxine) regulate the expression of low-density lipoprotein receptors on hepatocytes, the activity of lipoprotein lipase and liver lipase, as well as the processes of cholesterol excretion with bile. Thyroid hormone deficiency leads to a decrease in cholesterol clearance and a slowdown in triglyceride hydrolysis, which is manifested by an increase in the levels of total cholesterol and triglycerides in blood serum[8].

Metabolic features in combination with type 2 diabetes mellitus

CD2 is characterized by pronounced insulin resistance, contributing to increased lipolysis in adipose tissue and increased intake of free fatty acids into the liver, which stimulates the synthesis of triglycerides and very low-density lipoproteins. Against the background of hypothyroidism, these processes are aggravated by a decrease in lipid catabolism and a decrease in hepatic clearance of lipoproteins[9]. An additional unfavorable factor is chronic hyperglycemia, which leads to glycosylation of lipoproteins and a decrease in their receptor capture, which contributes to the formation of atherogenic dyslipidemia with an increase in triglycerides and LDL cholesterol with a decrease in HDL cholesterol[10].

**Subclinical hypothyroidism and lipid profile**

Subclinical hypothyroidism, characterized by an increase in the level of thyrotropic hormone at normal concentrations of free thyroxine, is widespread among patients with CD2. Despite minimal clinical symptoms, this condition is associated with unfavorable changes in the lipid profile, especially in patients with obesity and pronounced insulin resistance. A number of studies demonstrate a positive correlation between the level of thyroid-stimulating hormone and the concentration of triglycerides, as well as atherogenic indices, which emphasizes the clinical significance of subclinical hypothyroidism as a factor of additional cardiovascular risk[11].

Clinical significance of dyslipidemia in the combination of hypothyroidism and CD2[12].

Atherogenic dyslipidemia in combination with hypothyroidism and CD2 is an important factor in increasing cardiovascular morbidity and mortality. A decrease in the level of HDL cholesterol weakens the antiatherogenic defense of the vascular wall, while an increase in the concentration of triglycerides and LDL cholesterol contributes to the accelerated formation and progression of atherosclerotic changes[13]. Clinical studies show that patients with this comorbidity, as a rule, have a higher body mass index, worse glycemic control, and more pronounced lipid profile disorders compared to patients with isolated CD2[14].

**Principles of patient management**

Modern recommendations emphasize the need for regular screening of thyroid function in patients with CD2, especially in the presence of dyslipidemia or insufficient effect from standard hypolipidemic therapy. Early diagnosis of hypothyroidism allows timely start of hormone replacement therapy, which contributes to improvement of the lipid profile and reduction of cardiovascular risk. Comprehensive management of patients should include optimization of glycemic control, correction of lipid metabolism disorders, and individual selection of hormone replacement therapy, taking into account the clinical situation[15].

## 4. Conclusion

The combination of hypothyroidism and type 2 diabetes mellitus is accompanied by pronounced lipid metabolism disorders caused by the interaction of thyroid hormone deficiency and insulin resistance. The developing atherogenic dyslipidemia significantly increases the cardiovascular risk and worsens the prognosis for patients. Early diagnosis of thyroid dysfunction and a comprehensive pathogenetically justified approach to

treatment allow for effective response to the key mechanisms of the disease and improve clinical outcomes.

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