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HYPOTHYROIDISM AND CARDIOVASCULAR PATHOLOGY: RISK FACTORS, EARLY DIAGNOSIS, AND WAYS TO PREVENT COMPLICATIONS

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Annotation: This article examines the relationship between hypothyroidism and cardiovascular pathology, with particular emphasis on risk factors, early diagnosis, and prevention of complications. The review shows that thyroid hormone deficiency may contribute to dyslipidemia, bradycardia, impaired cardiac function, and a higher burden of cardiovascular risk factors, all of which can worsen patient outcomes if hypothyroidism is not recognized in time. The article also highlights the importance of laboratory confirmation using thyroid-stimulating hormone and free thyroxine for early detection, especially in patients with nonspecific symptoms or pre-existing cardiovascular disease. In addition, the review emphasizes that prevention of cardiovascular complications depends not only on diagnosis itself, but also on adequate long-term treatment and follow-up. Thus, the article supports the view that hypothyroidism should be considered not only as an endocrine disorder, but also as a clinically significant condition in cardiovascular medicine.

Keywords: hypothyroidism, cardiovascular pathology, cardiovascular risk factors, early diagnosis, thyroid-stimulating hormone, free thyroxine, dyslipidemia, bradycardia, prevention of complications, thyroid dysfunction

Introduction

Hypothyroidism is one of the most common endocrine disorders and is characterized by insufficient production of thyroid hormones, which are essential regulators of energy metabolism, vascular tone, lipid homeostasis, and cardiac performance. Because thyroid hormones influence nearly every organ system, reduced thyroid function can produce multisystem consequences, including clinically significant effects on the cardiovascular system. Even general patient guidance from the U.S. National Institute of Diabetes and Digestive and Kidney Diseases notes that thyroid hormones affect how the heart beats and that hypothyroidism can contribute to hypercholesterolemia and bradycardia. In recent years, increasing attention has been paid to the relationship between hypothyroidism and cardiovascular pathology. Contemporary reviews describe hypothyroidism as a condition associated with dyslipidemia, endothelial dysfunction, diastolic impairment, reduced cardiac output, accelerated atherosclerosis, and a higher burden of cardiovascular risk factors, especially in overt disease and in selected patients with subclinical hypothyroidism. A 2024 review specifically emphasizes the link between hypothyroidism and cardiovascular disease, while pooled cohort analyses have shown that subclinical thyroid dysfunction is associated with higher risk of coronary heart disease and related mortality, even when conventional cardiovascular risk factors do not fully explain that excess risk.[1,3]

The clinical relevance of this association is strengthened by the fact that hypothyroidism often develops gradually and may remain unrecognized for a long time. As a result,

cardiovascular manifestations may emerge before the endocrine disorder is diagnosed. Patients may present with fatigue, exercise intolerance, weight gain, slowed heart rate, elevated cholesterol levels, or nonspecific circulatory complaints that can obscure the underlying thyroid dysfunction. Since many of these findings overlap with common cardiovascular conditions, delayed recognition of hypothyroidism may contribute to progression of preventable complications. Official thyroid guidance therefore continues to emphasize laboratory confirmation using thyroid-stimulating hormone and free thyroxine testing rather than relying on symptoms alone.[2,4] From the standpoint of cardiovascular risk, hypothyroidism is important not only because of direct cardiac effects, but also because of its interaction with modifiable risk factors. Altered lipid metabolism, vascular stiffness, impaired endothelial reactivity, low-grade inflammation, and changes in blood pressure regulation may create a pathophysiological background favorable for coronary artery disease, heart failure, arrhythmia, and cerebrovascular complications. Moreover, evidence summarized by the American Thyroid Association suggests that both undertreatment and overtreatment of hypothyroidism may be associated with adverse cardiovascular outcomes, including increased cardiovascular mortality when thyroid hormone replacement intensity is not maintained within an appropriate range.

The issue of early diagnosis is therefore of particular importance. Identifying hypothyroidism at an early stage may allow timely correction of thyroid hormone deficiency, reduction of metabolic and vascular disturbances, and more effective prevention of cardiovascular complications. This is especially relevant in older adults, women, and patients with pre-existing cardiovascular disease, in whom thyroid dysfunction may worsen prognosis or complicate management. At the same time, current evidence indicates that the relationship between thyroid status and cardiovascular outcomes is complex, especially in subclinical disease, where risk may depend on age, sex, thyroid-stimulating hormone level, and coexisting comorbidities. Prevention of complications in such patients should therefore be based on an integrated approach that includes assessment of thyroid function, identification of cardiovascular risk factors, rational interpretation of symptoms, and careful therapeutic follow-up. In clinical practice, this means that hypothyroidism should not be viewed only as a metabolic disorder; it should also be recognized as a condition with important cardiovascular implications. Better understanding of this relationship may improve screening strategies, support earlier intervention, and reduce the burden of cardiovascular morbidity in endocrine patients.[4,5]

Thus, the present article is devoted to hypothyroidism and cardiovascular pathology, with special attention to risk factors, possibilities for early diagnosis, and preventive strategies aimed at reducing cardiovascular complications. The topic remains highly relevant because both hypothyroidism and cardiovascular disease are common in routine clinical practice, and their coexistence may significantly influence patient outcomes.

Materials and Methods

This article was designed as a narrative literature review devoted to the relationship between hypothyroidism and cardiovascular pathology, with particular emphasis on risk factors, early diagnosis, and prevention of complications. The study was based on the analysis and synthesis of scientific, educational, and clinically oriented sources addressing the endocrine and cardiovascular consequences of thyroid hormone deficiency. The review approach was selected because the topic requires integration of pathophysiological, diagnostic, and preventive aspects rather than presentation of a single experimental dataset.[6] The materials used in the study

included official clinical information resources and review-based medical sources describing hypothyroidism, thyroid function testing, cardiovascular risk, and outcomes associated with thyroid dysfunction. Particular attention was given to sources explaining the diagnostic role of thyroid-stimulating hormone and free thyroxine, the systemic effects of hypothyroidism, and the association between thyroid dysfunction and cardiovascular morbidity.

The methodological basis of the article consisted of descriptive, comparative, and analytical approaches. The descriptive method was used to summarize the main cardiovascular manifestations of hypothyroidism and to outline the mechanisms through which thyroid hormone deficiency may influence lipid metabolism, vascular reactivity, myocardial function, and hemodynamic status. The comparative approach was applied to examine how different sources interpret overt and subclinical hypothyroidism in relation to cardiovascular risk and diagnostic strategy. The analytical approach was used to synthesize information on early recognition and preventive management of complications in patients with thyroid dysfunction. During source selection, priority was given to materials with direct relevance to the topic, including thyroid disease overviews from recognized medical organizations and review sources discussing cardiovascular consequences of hypothyroidism. Information was selected according to three main thematic groups: cardiovascular risk factors associated with hypothyroidism, methods of early diagnosis based on clinical and laboratory assessment, and approaches aimed at prevention of adverse cardiovascular outcomes through timely recognition and treatment monitoring.[7]

The collected data were systematized and interpreted in a structured sequence. First, the general endocrine and cardiovascular effects of hypothyroidism were summarized. Second, the diagnostic significance of thyroid function tests, especially TSH and T4-based assessment, was considered in relation to early detection. Third, the literature was examined for evidence linking inadequate control of hypothyroidism with increased cardiovascular risk, including the potential consequences of undertreatment or prolonged abnormal thyroid status. No original clinical observations, laboratory measurements, or experimental procedures were performed in this study. The article is based entirely on the review and critical interpretation of available medical literature and official educational resources relevant to hypothyroidism and cardiovascular disease. For that reason, the present work should be considered a literature-based analytical article rather than an interventional or observational clinical study. [5]

Results

The reviewed sources showed a consistent association between hypothyroidism and several major cardiovascular risk domains, including lipid abnormalities, bradycardia, reduced cardiac performance, and the risk of adverse cardiovascular outcomes. Official patient guidance notes that hypothyroidism can slow heart rate and contribute to elevated cholesterol, while thyroid function testing guidance emphasizes the central role of TSH and free T4 in confirming thyroid dysfunction. The analysis also indicated that cardiovascular risk is not limited to overt hypothyroidism. A recent endocrine review source includes a dedicated section on cardiovascular risk factors in subclinical thyroid dysfunction, and the article text identifies subclinical hypothyroidism with TSH above 4.50 mU/L and normal free T4 as a clinically relevant category for risk evaluation.[5]

In addition, the reviewed materials suggest that inadequate control of hypothyroidism may worsen long-term cardiovascular prognosis. The American Thyroid Association summary cites

evidence linking thyroid hormone treatment intensity with cardiovascular mortality, supporting the importance of timely diagnosis and appropriate follow-up.

Table 1. Main findings on hypothyroidism and cardiovascular pathology

Parameter	Findings from reviewed sources	Clinical significance
Definition of hypothyroidism	Hypothyroidism is a state in which the thyroid does not make enough hormones; these hormones affect how the body uses energy and influence nearly every organ, including the heart.	Explains why cardiovascular manifestations may be part of the disease picture.
Heart rate changes	Slowed heart rate is listed among common manifestations of hypothyroidism.	May contribute to reduced exercise tolerance and delayed recognition in cardiac patients.
Lipid abnormalities	Hypothyroidism can contribute to high cholesterol; subclinical hypothyroidism is also discussed in relation to lipid parameters and hypercholesterolemia.	Supports the role of hypothyroidism as a contributor to atherosclerotic risk.
Diagnostic markers	TSH is a key test, and free T4 more accurately reflects thyroid gland function when checked with TSH.	Early laboratory diagnosis is essential because symptoms are often nonspecific.
Subclinical disease	Subclinical hypothyroidism is defined in the reviewed endocrine source as elevated TSH with free T4 in the reference range.	Indicates that cardiovascular risk assessment should include mild thyroid dysfunction, not only overt cases.
Cardiovascular risk factors	The endocrine review includes cardiovascular risk factors as a major analytical category in thyroid dysfunction.	Reinforces the link between thyroid status and cardiovascular prevention strategies.
Treatment balance	The American Thyroid Association summary references an association between thyroid hormone treatment intensity and cardiovascular mortality.	Suggests that both undertreatment and poor control may increase cardiovascular harm.

The reviewed evidence indicates that hypothyroidism affects the cardiovascular system through both direct and indirect mechanisms. Directly, reduced thyroid hormone activity is reflected in slowed heart rate and lower metabolic drive. Indirectly, the condition contributes to

lipid abnormalities that may promote atherosclerotic change over time. The results also show that early diagnosis depends heavily on laboratory confirmation rather than symptoms alone. This is especially important because symptoms such as fatigue, weight gain, and reduced tolerance to exertion may overlap with common cardiovascular complaints and delay recognition of the endocrine disorder. TSH-based assessment, together with free T4 measurement, remains the main diagnostic approach in the reviewed materials. Another important result is that subclinical hypothyroidism should not be ignored in cardiovascular assessment. The reviewed endocrine literature treats it as a defined biological state with relevance to lipid metabolism and cardiovascular risk profiling. Overall, the findings support three practical conclusions: first, hypothyroidism should be considered in patients with unexplained dyslipidemia or bradycardia; second, early thyroid function testing can improve recognition of risk; and third, long-term cardiovascular prevention in hypothyroid patients requires not only diagnosis but also adequate treatment monitoring.[4-6]

Discussion

The findings of this review support the view that hypothyroidism should be regarded not only as an endocrine disorder, but also as a clinically relevant contributor to cardiovascular pathology. The reviewed sources consistently indicate that reduced thyroid hormone activity affects cardiac rhythm, lipid metabolism, and overall cardiovascular risk profile. This is important because the cardiovascular effects of hypothyroidism may develop gradually and can remain underrecognized when symptoms are interpreted only within a cardiologic framework. Official patient guidance notes that hypothyroidism can slow the heart rate and raise cholesterol levels, which already suggests two major pathways through which thyroid dysfunction may influence cardiovascular health.[2,4] One of the central issues highlighted by the results is the role of hypothyroidism in metabolic cardiovascular risk. Elevated cholesterol is one of the most reproducible findings in thyroid hormone deficiency, and this creates favorable conditions for atherosclerotic progression. From a clinical standpoint, this means that hypothyroidism can act as a hidden modifier of cardiovascular risk in patients who present with dyslipidemia but do not initially appear to have overt endocrine disease. In such cases, failure to evaluate thyroid function may delay correction of an important reversible factor. The reviewed materials therefore support the inclusion of thyroid assessment in selected patients with otherwise unexplained lipid disturbances.

Another important point concerns the diagnostic complexity of hypothyroidism in cardiovascular practice. Many common manifestations of thyroid hormone deficiency, such as fatigue, reduced exercise tolerance, cold intolerance, and slowed pulse, are nonspecific and may overlap with symptoms seen in cardiovascular disease itself. This overlap is clinically significant because it increases the chance that hypothyroidism will be missed, especially in older patients and in those who already have established cardiac pathology. For this reason, the reviewed evidence strongly supports laboratory-based diagnosis rather than reliance on symptoms alone. Current thyroid guidance emphasizes thyroid-stimulating hormone as the best initial test, with free thyroxine used to clarify and confirm thyroid functional status. [6] The discussion is further complicated by the issue of subclinical hypothyroidism. The reviewed endocrine literature shows that cardiovascular assessment should not be limited to overt disease. Even when free thyroxine remains within the reference range, elevated TSH may still have clinical relevance, particularly in relation to lipid changes and long-term cardiovascular risk stratification. At the same time, the effect size and clinical importance of subclinical hypothyroidism are not identical in all patients.

Age, sex, degree of TSH elevation, and coexisting disease appear to influence how meaningful this endocrine abnormality is in a given cardiovascular context. This suggests that early diagnosis must be interpreted individually rather than mechanically.

An especially practical observation from the reviewed sources is that prevention of cardiovascular complications in hypothyroidism depends not only on identifying the disorder, but also on maintaining appropriate treatment control. The American Thyroid Association summary referenced in the review indicates that abnormal treatment balance, particularly under-treatment over time, is associated with worse cardiovascular outcomes. This finding has important implications for prevention. It suggests that screening alone is insufficient if patients are not monitored carefully after diagnosis. In other words, cardiovascular prevention in hypothyroid patients includes both early detection and long-term therapeutic accuracy. From a broader preventive perspective, the reviewed data support an integrated model of care. Patients with hypothyroidism should be assessed not only for hormone deficiency, but also for associated cardiovascular risk factors such as hyperlipidemia, blood pressure abnormalities, reduced physical tolerance, and preexisting vascular disease. Likewise, patients with unexplained bradycardia, persistent dyslipidemia, or cardiovascular symptoms disproportionate to apparent cardiac findings may benefit from thyroid testing. This reciprocal approach improves the likelihood of early recognition and may help prevent avoidable complications.[7]

The reviewed evidence also suggests that hypothyroidism has significance for prognosis. When endocrine dysfunction coexists with cardiovascular disease, it may worsen symptom burden, complicate interpretation of clinical findings, and affect long-term risk if not corrected. This is particularly important in patients with preexisting coronary disease, heart failure, or multiple vascular risk factors, where even modest metabolic and hemodynamic disturbances may have amplified consequences. Although the precise level of risk may differ between overt and subclinical disease, the overall direction of the association supports careful endocrine evaluation in cardiovascular patients.[3] At the same time, this article has limitations. It is based on a narrative review rather than a systematic meta-analysis, and it does not include original patient data, laboratory measurements, or institutional observations. For that reason, the conclusions should be understood as an analytical synthesis of available educational and review-based sources rather than as primary clinical evidence. In addition, some aspects of cardiovascular risk in subclinical hypothyroidism remain context-dependent and may require individualized interpretation in practice. Overall, the discussion confirms that hypothyroidism is closely linked to cardiovascular pathology through metabolic, hemodynamic, and diagnostic mechanisms. Dyslipidemia, slowed cardiac activity, delayed recognition, and the consequences of inadequate treatment all contribute to this relationship. Therefore, the prevention of cardiovascular complications in hypothyroid patients should be based on early laboratory diagnosis, recognition of associated risk factors, and consistent follow-up aimed at maintaining appropriate thyroid hormone replacement. Such an approach is likely to improve both endocrine and cardiovascular outcomes.[2-6]

Conclusion

In conclusion, hypothyroidism is closely associated with cardiovascular pathology and should be regarded as an important endocrine condition with significant cardiometabolic implications. The reviewed evidence shows that thyroid hormone deficiency may contribute to dyslipidemia, bradycardia, impaired cardiovascular function, and a higher burden of

cardiovascular risk factors, which together can worsen patient outcomes if the disorder is not recognized in time. The analysis also demonstrates that early diagnosis plays a central role in reducing complications. Because the clinical manifestations of hypothyroidism are often nonspecific and may overlap with symptoms of cardiovascular disease, laboratory confirmation using thyroid-stimulating hormone and free thyroxine remains essential for timely detection. This is particularly important in patients with unexplained lipid abnormalities, reduced heart rate, or pre-existing cardiovascular disease. At the same time, prevention of cardiovascular complications depends not only on diagnosis itself, but also on appropriate long-term management. The reviewed materials suggest that inadequate control of hypothyroidism may be associated with worse cardiovascular outcomes, which highlights the importance of regular follow-up and balanced thyroid hormone replacement.

Thus, hypothyroidism and cardiovascular pathology are closely interconnected in both pathophysiological and clinical terms. An integrated approach based on risk factor assessment, early laboratory diagnosis, and careful preventive management may improve prognosis and help reduce cardiovascular morbidity in patients with thyroid dysfunction.

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