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The Effect of Thyroid Hormone Hyperfunction on Cardiac Activity

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Abstract: This article analyzes the impact of thyroid hormone hyperfunction on heart activity. In hyperthyroidism, an increased heart rate, changes in blood pressure, increased myocardial oxygen demand, and the development of arrhythmias are observed. In the long term, these processes can lead to heart failure. Therefore, it is crucial to timely identify the effects of thyroid hormones on cardiac function and take appropriate measures.

Keywords: thyroid hormones, hyperthyroidism, cardiac activity, tachycardia, T3 and T4 hormones, calcium channels, pulse pressure, ischemic heart disease, atrial fibrillation, thrombosis, metabolic processes, dilated cardiomyopathy, myocardial ischemia, angina pectoris.

Introduction. Thyroid hormones – triiodothyronine (T3) and thyroxine (T4) – are among the main biological substances that regulate the body's metabolic processes. These hormones play an important role in the functioning of the cardiovascular system and affect heart rate, blood pressure, and the force of contraction of the heart muscle (Klein & Danzi, 2007). Hyperthyroidism, or hyperthyroidism, is characterized by the excessive production of these hormones. Hyperthyroidism can significantly affect cardiac function, causing an increase in heart rate (tachycardia), an increase in cardiac output, and the development of arrhythmias (Osuna, Udovcic, & Sharma, 2017). Hyperthyroid patients also have increased systolic blood pressure and increased cardiac oxygen demand, which can lead to the development of heart failure in the long term (Biondi & Kahaly, 2010).

Research objective: To study the effect of thyroid hormone hyperfunction on cardiac function.

Research material and methods. The main objective of this study is to study the effect of thyroid hormone hyperfunction on cardiac function, to identify the main mechanisms of this process, and to analyze the clinical significance of cardiac diseases associated with hyperthyroidism.

Main part. Thyroid hormones play an important role in the functioning of the heart muscle. They increase heart rate, myocardial contractility, and cardiac output by increasing the number of beta-adrenergic receptors. In addition, T3 increases the activity of calcium channels, which increases the contraction of the heart muscle (Klein & Danzi, 2007). In hyperthyroidism, the sensitivity of the heart to beta-adrenergic receptors increases, which leads to an increase in heart rate (tachycardia). Studies show that in patients with hyperthyroidism, the heart rate can reach 90-100 beats / min, which causes an overload of the heart (Osuna, Udovcic, & Sharma, 2017). Hyperthyroidism increases systolic arterial pressure, as the force of cardiac contraction increases and blood circulation accelerates. At the same time, diastolic pressure decreases, as peripheral vessels dilate. As a result, the pulse pressure increases, which leads to increased cardiovascular strain (Biondi & Kahaly, 2010). In hyperthyroidism, the heart's oxygen demand increases. If the patient has atherosclerosis, hyperthyroidism can aggravate ischemic heart disease. Studies show that patients with hyperthyroidism are at increased risk of

developing myocardial ischemia and angina (Kahaly & Dillmann, 2005). High levels of thyroid hormones can increase the electrical activity of the heart and lead to the development of various arrhythmias. In particular, atrial fibrillation is one of the most common arrhythmic conditions associated with hyperthyroidism. This increases the risk of blood clots forming in the heart, significantly increasing the likelihood of stroke (Osuna et al., 2017). The increased strain on the heart and metabolic demands of hyperthyroidism can lead to the development of heart failure. If the patient has pre-existing myocardial pathologies, hyperthyroidism aggravates their course. In the long term, hyperthyroidism can tire the heart and cause the development of dilated cardiomyopathy (Biondi & Kahaly, 2010). Thyroid hormones increase the number of beta-adrenergic receptors in the heart and increase their sensitivity. This leads to an increase in heart rate, tachycardia is observed even at rest (Zhidkih A.M.). T3 and T4 increase the force of contraction of the heart muscle, the volume of blood ejected with each heartbeat increases. This forces the heart to work under constant load (Fetisov V.A.). Atrial fibrillation has been detected in 10–25% of patients with hyperthyroidism. In this case, the upper chambers of the heart contract irregularly. The hormone T3 accelerates electrical impulses in the heart and causes fibrillation (Alimpiev A.V.). Hyperthyroidism increases systolic pressure, while diastolic pressure decreases. This is due to an increase in cardiac output and a decrease in vascular tone (Zhidkih A.M.). Prolonged hyperthyroidism leads to fatigue of the heart muscle, structural changes, and ultimately the development of heart failure (Fetisov V.A.).

Conclusion: Hyperthyroidism has a significant impact on cardiac function. If hyperthyroidism-related cardiac problems are not identified and treated in a timely manner, heart failure and other complications may develop. Therefore, it is important to check thyroid hormone levels in patients with heart disease.

There are experiments conducted on animals to study the effect of hyperfunction of thyroid hormones (hyperthyroidism) on cardiac function. For example, laboratory animals such as mice or rats were induced to hyperthyroidism and functional and morphological changes in the heart muscle were studied. As a result of these studies, changes such as increased heart rate, hypotrophy and fibrosis of the heart muscle were detected. Such experiments are of great importance in understanding the effect of hyperthyroidism on cardiac function and provide a better understanding of similar pathological processes observed in humans. (HD Khalilov, AA Namiddinov, OV Berdiev and OS Ortikov "Hyperthyroidism and Heart Failure" 2024)

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