

# The Role Of Metabolic Syndrome In The Origin Of Endocrine And Cardiovascular Diseases

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**Abstract.** Metabolic syndrome is a dangerous complex of metabolic disorders characterized by insulin resistance (decreased tissue sensitivity to insulin). This condition greatly increases the risk of developing type 2 diabetes, heart attack, and stroke. The aim of the study was to investigate the impact of metabolic syndrome on the development of endocrine and cardiovascular diseases. Clinical and laboratory parameters of patients with metabolic syndrome were analyzed. The findings demonstrated that the presence of metabolic syndrome is associated with a high prevalence of type 2 diabetes mellitus, arterial hypertension, and coronary heart disease. Statistically significant correlations were identified between body mass index, waist circumference, blood glucose levels, and indicators of cardiovascular risk.

**Keywords:** metabolic syndrome, obesity, insulin resistance, type 2 diabetes mellitus, arterial hypertension, cardiovascular diseases, dyslipidemia, endocrine disorders.

**Introduction.** Metabolic syndrome is characterized by increased waist circumference (due to excess abdominal fat), hypertension, abnormal fasting plasma glucose concentrations or abnormal insulin resistance, and dyslipidemia.

The incidence of metabolic syndrome often coincides with the incidence of obesity and type 2 diabetes. The prevalence of metabolic syndrome increases with age; in one USA study, it was approximately 23% in the general population, 44% for individuals aged 60 to 69 years, and 42% for individuals aged 70 years or older (1). Metabolic syndrome can develop in children and adolescents, but a precise definition has not been established in these age groups.

The development of metabolic syndrome depends on the distribution and amount of fat tissue. Excessive central obesity (the so-called apple shape), especially when it leads to a high waist-to-hip ratio (reflecting a relatively low muscle-to-fat ratio), increases the risk. The syndrome is less common among people with excess subcutaneous fat around the hips (the so-called pear shape) and a low waist-to-hip ratio (reflecting a high muscle-to-fat ratio).

Excess abdominal fat leads to excess free fatty acids in the portal vein, increasing fat accumulation in the liver. Fat also accumulates in muscle cells. Insulin resistance develops, accompanied by hyperinsulinemia. Glucose metabolism deteriorates, leading to dyslipidemia and hypertension. Serum uric acid levels are typically elevated (increasing the risk of gout), leading to the development of a prothrombotic state (with elevated fibrinogen and plasminogen activator inhibitor I levels) and chronic inflammation.

The combination of endocrine and cardiovascular disorders creates a high risk of complications, which determines the need for early identification of risk factors and the development of effective preventive measures.

**Purpose of the study.** To study the impact of metabolic syndrome on the development of endocrine and cardiovascular diseases by assessing clinical, anthropometric and biochemical parameters of patients.

**Material and research methods.** The study included 240 patients aged 30 to 65 years. The study group consisted of 120 patients diagnosed with metabolic syndrome according to the International Diabetes Federation (IDF) criteria, and the control group consisted of 120 apparently healthy individuals without signs of metabolic syndrome.

All subjects underwent anthropometric measurements, including height, weight, waist circumference, and body mass index (BMI) calculation. Blood pressure, fasting blood glucose, glycated hemoglobin (HbA1c),

total cholesterol, high-density lipoprotein (HDL), and low-density lipoprotein (LDL) levels, as well as triglyceride levels, were measured.

Statistical data processing was performed using SPSS Statistics 26.0. Quantitative indicators are presented as the arithmetic mean and standard error (M±m). Student's t-test was used to compare indicators. Correlation analysis was performed using the Pearson r-test. Differences were considered statistically significant at p<0.05.

**Results and discussion.** The study found that patients with metabolic syndrome were characterized by significantly more pronounced disturbances in anthropometric, hemodynamic and biochemical parameters compared to individuals in the control group (Table 1).

Table 1  
**Clinical and laboratory characteristics of the examined patients (M±m)**

Indicator	Control group (n=120)	Metabolic syndrome (n=120)	p
BMI, kg/m <sup>2</sup>	23,8±0,4	32,7±0,7	<0,001
Waist circumference, cm	82,4±1,3	104,6±1,7	<0,001
Systolic blood pressure, mmHg	118,5±2,1	146,8±2,5	<0,001
Blood glucose, mmol/l	4,9±0,2	7,3±0,3	<0,001
HbA1c, %	5,1±0,1	7,2±0,2	<0,001
Triglycerides, mmol/l	1,3±0,1	2,7±0,2	<0,001
LDL cholesterol, mmol/l	2,8±0,1	4,4±0,2	<0,001

As can be seen from Table 1, the obtained results showed a significant increase in all the studied parameters in patients with metabolic syndrome compared to the control group. Analysis of the obtained data showed that the average body mass index in patients of the main group was 32.7 ± 0.7 kg / m<sup>2</sup>, which corresponded to obesity of I-II degree and was significantly higher than the similar indicator in the control group (23.8 ± 0.4 kg / m<sup>2</sup>; p < 0.001). At the same time, an increase in waist circumference to 104.6±1.7 cm was noted versus 82.4±1.3 cm in the comparison group (p<0.001), which indicates severe abdominal obesity as one of the key components of metabolic syndrome.

A study of carbohydrate metabolism parameters revealed a significant increase in fasting blood glucose levels in patients with metabolic syndrome to 7.3±0.3 mmol/L compared to 4.9±0.2 mmol/L in the control group (p<0.001). A similar trend was observed when analyzing the level of glycated hemoglobin, which was 7.2±0.2% versus 5.1±0.1%, respectively (p<0.001). The obtained results indicate the presence of severe insulin resistance and a high risk of developing type 2 diabetes mellitus.

When assessing cardiovascular parameters, a significant increase in systolic blood pressure was found in patients in the study group. The average value of this indicator reached 146.8 ± 2.5 mm Hg, while in the control group it was 118.5 ± 2.1 mm Hg (p < 0.001). Most of the examined patients with metabolic syndrome were diagnosed with arterial hypertension of varying severity, indicating a high risk of cardiovascular complications.

Lipid profile analysis revealed significant lipid metabolism disturbances. Triglyceride levels in the study group were 2.7±0.2 mmol/L, more than twice as high as those in the control group (1.3±0.1 mmol/L; p<0.001). Low-density lipoprotein concentrations were also significantly higher in patients with metabolic syndrome, reaching 4.4±0.2 mmol/L versus 2.8±0.1 mmol/L, respectively (p<0.001). These findings confirm the presence of atherogenic dyslipidemia as a leading factor in the development of coronary heart disease.

Correlation analysis revealed a close relationship between the main components of metabolic syndrome and indicators of endocrine and cardiovascular pathology (Table 2).

Table 2

**Correlation between metabolic syndrome indicators and endocrine and cardiovascular disorders**

The indicators studied	r	p
BMI and blood glucose levels	0,71	<0,001

Waist circumference and HbA1c	0,68	<0,001
BMI and systolic blood pressure	0,65	<0,001
Triglycerides and the risk of coronary heart disease	0,62	<0,01
Blood glucose and the risk of type 2 diabetes	0,79	<0,001
Waist circumference and cardiovascular risk	0,73	<0,001

As can be seen from Table 2, correlation analysis revealed a strong positive relationship between the components of metabolic syndrome and the risk of developing endocrine and cardiovascular pathology.

The strongest positive correlation was found between blood glucose levels and the risk of developing type 2 diabetes ( $r=0.79$ ;  $p<0.001$ ). A significant association was also found between waist circumference and cardiovascular risk ( $r=0.73$ ;  $p<0.001$ ), as well as between body mass index and blood glucose levels ( $r=0.71$ ;  $p<0.001$ ).

In addition, a statistically significant correlation was established between waist circumference and glycated hemoglobin levels ( $r=0.68$ ;  $p<0.001$ ), as well as between body mass index and systolic blood pressure ( $r=0.65$ ;  $p<0.001$ ). The identified positive relationship between triglyceride concentrations and the risk of developing coronary heart disease ( $r=0.62$ ;  $p<0.01$ ) confirms the significant role of lipid metabolism disorders in the development of cardiovascular complications.

The study results demonstrate the significant impact of metabolic syndrome on the development of endocrine and cardiovascular diseases. Patients with metabolic syndrome showed significant increases in blood glucose levels, HbA1c, and lipid metabolism parameters, indicating significant disturbances in carbohydrate and fat metabolism.

It has been established that increased body weight and waist circumference are closely associated with the development of insulin resistance and impaired glucose tolerance. The positive correlation found between BMI and blood glucose levels ( $r=0.71$ ) confirms the role of obesity as a key factor in the development of type 2 diabetes.

Furthermore, elevated blood pressure and dyslipidemia in patients with metabolic syndrome contribute to the accelerated development of atherosclerotic vascular changes and an increased risk of coronary heart disease. These findings are consistent with current research showing that the presence of metabolic syndrome increases the risk of cardiovascular complications by 2-3 times.

Thus, the study results demonstrated that metabolic syndrome is accompanied by a complex of interrelated endocrine and cardiovascular disorders, including obesity, hyperglycemia, dyslipidemia, and hypertension. The statistically significant correlations identified indicate a leading role for metabolic syndrome in the development of type 2 diabetes and cardiovascular disease, highlighting the need for early detection and timely correction of risk factors.

#### **Выводы:**

1. Metabolic syndrome is a significant risk factor for endocrine and cardiovascular diseases;
2. Patients with metabolic syndrome have significantly higher BMI, waist circumference, blood pressure, blood glucose levels, and lipid profiles;
3. A strong positive correlation has been found between the components of metabolic syndrome and the risk of developing type 2 diabetes mellitus and cardiovascular diseases;
4. Insulin resistance and abdominal obesity are key factors in the pathogenesis of metabolic syndrome;
5. Early detection and correction of risk factors can reduce the likelihood of severe endocrine and cardiovascular complications.

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