CARDIOLOGY

ANALYSIS OF CORONARY ARTERY LESION DEGREE AND RELATED RISK FACTORS IN PATIENTS WITH CORONARY HEART DISEASE

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ABSTRACT

Background. *The study of the association of risk factors and atherosclerotic burden assessed by coronary angiography is promising in terms of both understanding the pathogenesis of the disease and predicting its development.*

The aim of the study *was to investigate the relationship between traditional risk factors and the severity of coronary atherosclerosis in patients with stable CHD.*

Materials and methods. *Risk factors were studied in 100 patients who underwent angiography. Based on the Gensini (GS) score, participants were divided into groups: patients with moderate lesion of coronary arteries (GS = 8–39), with severe lesion (GS ≥ 40), and control group (GS = 0). To verify the association between the variables, Pearson's chi-square test was used. The results were presented as relative risk (RR) and the confidence interval (95% CI).*

Results. *It was found that in patients with GS score less than 40 points, statistically significant factors were hypertension (RR = 2.6; 95% CI: 1.023–10.09; p = 0.018), family history (RR = 2.94; 95% CI: 1.501–5.762; p < 0.001), depression (RR = 1.81; 95% CI: 1.202–2.738; p = 0.028), In patients with GS ≥ 40, the most important factors were diabetes (RR = 1.72; 95% CI: 1.187–2.511; p = 0,017), family history (RR = 2.02; 95% CI: 1.233–3.315; p = 0.002), inactivity (RR = 1.85; 95% CI: 1.219–2.824; p = 0.005). The GS scores were significantly higher in smokers compared non-smokers (44.0 vs. 32.0; p = 0.043).*

Conclusion. *The most significant influence on the development of coronary atherosclerosis is exerted by a family history and physical inactivity. Arterial hypertension and depression are associated with moderate coronary artery disease. Severe atherosclerosis is associated with diabetes mellitus, long smoking history, low levels of high-density lipoprotein cholesterol.*

Key words: *coronary heart disease, coronarography, Gensini score, risk factors*

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ФАКТОРЫ РИСКА И СТЕПЕНЬ ПОРАЖЕНИЯ КОРОНАРНЫХ АРТЕРИЙ У БОЛЬНЫХ С ИШЕМИЧЕСКОЙ БОЛЕЗНЬЮ СЕРДЦА

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РЕЗЮМЕ

Обоснование. *Изучение взаимосвязи факторов риска со степенью поражения коронарного русла по данным шкалы Gensini является ещё одним подходом в понимании как патогенеза атеросклероза коронарных артерий (КА), так и прогнозирования заболевания.*

Цель исследования. *Проанализировать связь факторов риска с тяжестью поражения КА у больных ИБС и определить ведущие факторы, влияющие на выраженность атеросклероза. Материалы и методы. Изучены факторы риска у 100 больных, которым была выполнена плановая коронароангиография. Количественная оценка атеросклероза проведена с использованием шкалы Gensini (GS). Обследуемые разделены на группы по медиане GS = 40 баллов: умеренного поражения КА (GS = 8–39), тяжёлого поражения (GS ≥ 40), интактные сосуды (GS = 0, n = 30). Сравнение качественных признаков проводилось с помощью критерия χ^2 Пирсона. Для оценки влияния факторов на индивидуальный риск рассчитывались показатель относительного риска (ОР) и 95%-й доверительный интервал (95% ДИ).*

Результаты. *Установлено, что у лиц с GS менее 40 баллов статистически значимыми факторами были артериальная гипертензия (ОР = 2,6; 95% ДИ: 1,023–10,09; p = 0,018), семейный анамнез (ОР = 2,94; 95% ДИ: 1,501–5,762; p < 0,001), депрессия (ОР = 1,81; 95% ДИ: 1,202–2,738; p = 0,028), а у пациентов с GS более 40 баллов – сахарный диабет (ОР = 1,72; 95% ДИ: 1,187–2,511; p = 0,017), семейный анамнез (ОР = 2,02; 95% ДИ: 1,233–3,315; p = 0,002), гиподинамия (ОР = 1,85; 95% ДИ: 1,219–2,824; p = 0,005). Показатели GS были выше у лиц, имевших длительный стаж курения, по сравнению с никогда не курившими (Me 44,0 против 32,0; p = 0,043).*

Заключение. *Наиболее значимое влияние на развитие коронарного атеросклероза оказывают семейный анамнез и гиподинамия. Артериальная гипертензия и депрессия взаимосвязаны с умеренным поражением коронарных артерий. С тяжёлым атеросклерозом ассоциированы сахарный диабет, длительный стаж курения, пониженный уровень холестерина липопротеидов высокой плотности.*

Ключевые слова: *ишемическая болезнь сердца, коронароангиография, шкала Gensini, факторы риска*

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INTRODUCTION

Cardiovascular diseases (CVDs) are the leading cause of death worldwide, the most common of which is coronary heart disease (CHD). As reported by the World Health Organization (WHO), mortality from CHD has increased 4-fold since 2000, reaching 8.9 million cases in 2019. [1]. In Russia, mortality from CVDs keeps its leading position despite improvements in therapeutic and surgical treatment.

The morphologic basis of CHD is atherosclerotic narrowing of the coronary arteries (CA). Stenosis degree, localization, extent of atherosclerotic plaque and the number of affected arteries influence the severity of angina pectoris. Nevertheless, according to the literature, no significant CA lesions were found in 20 % of patients with typical angina, indicating a microvascular form of angina [2].

In order to prevent the development and progression of CHD, risk factors (RF) continue to be actively studied. Lifestyle, environmental exposures and genetic factors are known to influence the onset and development of CHD. The association of such factors as smoking, arterial hypertension (AH), diabetes mellitus (DM), obesity and hypercholesterolemia with the development of CHD was established as early as the 1960s in the Framingham Heart Study. Currently, there are more than 200 cardiovascular RFs, among which modifiable and non-modifiable RFs are distinguished. The main modifiable factors are dyslipidemia, smoking, AH, obesity, psychosocial stress and DM. Non-modifiable factors include male gender, age, and family history of CVD. High prevalence of RFs is registered in Russia, and often one person has several of them, with varying degrees of severity. According to national studies, the incidence of AH in working-age people is 47.3 %, obesity – 26.9 % [3]. Smoking, despite decreasing rates in recent decades, remains at a high level and is, according to some data, 39 % in men and 13.6 % in women [4]. Low physical activity leading to increased CVDs is found in 38.8 % of the population [5]. Such RF as dyslipidemia occurs in half of the population [6], DM in 5.4 %, and carbohydrate tolerance disorders in 19.3 % of the population [7]. In recent decades, the psychological status influence problem on the course of CVD has attracted much attention. A significant number of patients with CHD have symptoms of anxiety and depression, which negatively affects the course and prognosis of the disease. According to the Russian KOMETA (Comet) study, in patients with CHD and/or AH, clinically significant anxiety is diagnosed in 25.5 %, pronounced depressive symptoms – in 16.3 % [8]. At the same time, there are studies in the literature that indicate that 20 % of cardiovascular events occur in the absence of traditional RFs [9].

Despite widespread preventive work among the population and the use of drug therapy, including statins, in patients with CHD, morbidity and mortality from CVD remain at a high level. In this regard, the study of independent predictors of obstructive lesion development in epicardial arteries remains relevant [10, 11].

THE AIM OF THE STUDY

To analyze the relationship between cardiovascular risk factors and obstructive coronary artery disease in CHD patients and to determine the leading factors affecting the severity of coronary atherosclerosis.

MATERIALS AND METHODS

The study was performed at the Medical Center of the Far Eastern Federal University (Vladivostok) in the design of a prospective comparative study in the period from January to November 2021. The study included 100 patients with CHD who underwent routine coronary angiography (CAG) to confirm the diagnosis and decide on surgical methods of myocardial revascularization. The study population included 61 males and 39 females and the mean age was 60.88 ± 7.59 years. According to the CAG results, the main group consisted of 70 patients with CA lesions, the comparison group – 30 patients without atherosclerotic vascular changes. The main and control groups did not differ in age and gender.

Inclusion criteria: patients diagnosed with stable CHD, with indications for diagnostic CAG, who signed informed consent.

Patients with acute coronary syndrome in the last 6 months, severe valvular heart disease, patients with chronic heart failure, low left ventricular ejection fraction according to echocardiography (< 35 % as per Simpson), with signs of severe hepatic and renal failure, oncological and inflammatory diseases were not included in the study.

All patients underwent clinical, laboratory and instrumental examinations in accordance with the standards of CHD diagnostics [12]. Cardiovascular risks were assessed according to the criteria of the national recommendations of the Society of Cardiology of Russian Federation [13]. The following factors were taken into account: gender, age, obesity (BMI ≥ 30 kg/m^2), family history of CVD (myocardial infarction or unstable angina in men aged < 55 years, in women < 60 years), smoking, presence of arterial hypertension (blood pressure ≥ 140/90 mm Hg or constant intake of antihypertensives), diabetes mellitus (fasting glucose > 6.1 and 7.0 mmol/l in capillary and venous blood, respectively), physical activity < 3.5 hours/week, psychosocial factors (anxiety-depressive symptoms), hypercholesterolemia (total cholesterol (TC) > 5 mmol/l or taking statins). The Hospital Anxiety and Depression Scale (HADS) questionnaire was used to identify anxiety and depressive symptomatology. The degree of symptom severity was expressed in scores: a total score within 8-10 points indicated subclinical anxiety/depression, more than 10 points – clinically pronounced anxiety/depression.

Coronary angiographic study was performed using radial access according to the Judkins technique and a Philips Allura Xper FD 20 machine (Philips Healthcare, USA). Angiograms were analyzed by two independent physician (X-ray surgeons) visually and automatically using Xcelera software (Philips Healthcare, USA). Hemodynamically signifi-

cant stenoses were considered to be narrowing of ≥ 50 % of the lumen diameter of the basilar arteries and/or the left main artery.

The Gensini score (GS) was used to quantify coronary atherosclerosis. The GS score was calculated according to the degree and localization of stenosis. Vessel diameter stenosis of 25 %, 50 %, 75 %, 90 %, 99 %, and complete occlusion were graded as 1, 2, 4, 8, 16, and 32 points, respectively. Further, the scores were multiplied by a coefficient calculated depending on the stenosis localization: the left main artery – 5; proximal segment of the left anterior descending artery (LAD) and proximal segment of the circumflex artery (Cx) – 2.5; middle segment of the left anterior descending artery – 1.5; right coronary artery, distal segment of the left anterior descending artery, posterior descending artery (PDA) and obtuse marginal artery – 1.0; other segments – 0.5. The GS index was calculated as the sum of severity productions of each stenosis expressed in points multiplied by the coefficient calculated for each CA segment [14].

Laboratory studies included determination of lipid spectrum parameters and glucose level in blood serum using Randox enzyme kits (Ireland) and Sapphire-500 biochemical analyzer.

The study was conducted in accordance with the requirements of the WMA Declaration of Helsinki (revision 2013), approved by the local ethical committee (minutes No. 10 of 28.12.2020). All subjects signed a voluntary informed consent.

Statistical processing of materials was performed using IBM SPSS Statistics 26.0 software (StatSoft Inc., USA). Quantitative variables are presented in the text as: $M \pm \sigma$, where M is the mean, σ is the standard deviation (in case of normal data distribution), and *Me* (Q1; Q3), where *Me* is the median, Q1 is the lower quartile, Q3 is the upper quartile (in case of non-normal distribution). Normality of distribution of quantitative signs was assessed using Kolmogorov – Smirnov, Shapiro – Wilk tests and graphical representation of histograms. Nominal (qualitative) values are given in absolute numbers (*n*) and percentages (%). The Kruskal – Wallis test was used for comparison of three independent samples of quantitative indicators, and the Bonferroni-corrected Mann – Whitney test was used for pairwise post hoc groups comparisons. Differences between the qualitative attributes of the two groups were determined using Pearson's chi-square test (χ^2). Assessment of the studied factors influence on the individual risk of coronary lesions was calculated as relative risk score (RR) and 95 % confidence interval (95% CI). Informative features with a CI value greater than 1.0 were considered to be the most statistically significant factors. Differences were considered statistically significant at $p < 0.05$.

RESULTS

In the study cohort, coronary atherosclerosis was assessed using the GS score and the number of affected vessels was considered. Hemodynamically significant stenoses were diagnosed in 70 patients. The nature of CA lesions in the subjects is shown in Table 1.

The lesion in one artery system was detected in 23 (32.9 %) patients, two arteries – in 21 (30.0 %) and three arteries – in 26 (37.1 %) patients. The GS index ranged from 8 to 160 points, the median was 40.0 (20.0; 62.5) points, the value obtained was taken as a cut-off point to divide patients into moderate and severe coronary atherosclerosis groups. According to the obtained angiographic data, three study groups were formed: Group 1 (comparison group) – GS = 0 points ($n = 30$), Group 2 (group of moderate CA lesions) – GS = 8–39 points ($n = 33$), group 3 (group of severe CA changes) – GS ≥ 40 points ($n = 37$).

The moderate CA lesion group (GS = 8-39) was mainly represented by patients with single- and double-vessel changes, having stenoses of 50–90 %. The group with severe lesions (GS ≥ 40) included patients with two- and three-vessel lesions, with ≥ 91 % stenoses.

The incidence of cardiovascular factors in the subjects is presented in Table 2. Comparative analysis showed a high

TABLE 1

CORRELATION BETWEEN THE DEGREE OF CORONARY ARTERY STENOSIS, THE SEVERITY OF CORONARY ATHEROSCLEROSIS ACCORDING TO THE GENSINI SCORE, AND THE NUMBER OF AFFECTED ARTERIES

Coronary artery stenosis degree, %	Gensini index, Me (Q1; Q3)			
	40.0 (20.0; 62.5)	16.0 (12.0; 24.0)	35.5 (24.5; 42.5)	63.0 (47.5; 84.5)
	Main cohort ($n = 70$)	Single-vessel disease ($n = 23$)	Double vessel disease ($n = 21$)	Three-vessel disease ($n = 26$)
50–75	1 (1.4 %)	1 (4.3 %)	–	–
76–90	51 (74.3 %)	21 (91.3 %)	14 (66.7 %)	16 (61.5 %)
≥ 91	18 (24.3 %)	1 (4.3 %)	7 (33.3 %)	10 (38.5 %)

TABLE 2

THE PREVALENCE OF RISK FACTORS IN PATIENTS WITH CORONARY ARTERY DISEASE DEPENDING ON THE SEVERITY OF CORONARY ARTERIES LESION

Risk factors	GS index, points			Statistical significance level, *p*
	Group 1: GS = 0 (*n* = 30)	Group 2: GS = 8–39 (*n* = 33)	Group 3: GS ≥ 40 (*n* = 37)	
Male gender, *n* (%)	18 (60 %)	18 (54.5 %)	26 (70.3 %)	$p_{1-2} = 0.490$ $p_{1-3} = 0.945$ $p_{2-3} = 0.177$
Age, $M \pm \sigma$	60.5 ± 9.78	61.48 ± 5.63	60.32 ± 7.78	$p_{1-2} = 0.490$ $p_{1-3} = 0.945$ $p_{2-3} = 0.319$
Obesity, *n* (%)	9 (30.0 %)	11 (33.3 %)	15 (40.5 %)	$p_{1-2} = 0.111$ $p_{1-3} = 0.371$ $p_{2-3} = 0.536$
Family history of CVD, *n* (%)	9 (30 %)	25 (75.8 %)	25 (67.6 %)	**$p_{1-2} < 0.001$** **$p_{1-3} = 0.003$** $p_{2-3} = 0.452$
Smoking, *n* (%)	6 (20.0 %)	8 (24.2 %)	6 (16.2 %)	$p_{1-2} = 0.796$ $p_{1-3} = 0.690$ $p_{2-3} = 0.405$
Previously smoking, *n* (%)	8 (26.7 %)	7 (21.2 %)	18 (48.6 %)	$p_{1-2} = 0.615$ $p_{1-3} = 0.068$ **$p_{2-3} = 0.022$**
Low physical activity, *n* (%)	6 (20 %)	15 (45.9 %)	20 (54.1 %)	**$p_{1-2} = 0.026$** **$p_{1-3} = 0.005$** $p_{2-3} = 0.474$
AH, *n* (%)	20 (66.7 %)	30 (90.9 %)	32 (86.5 %)	**$p_{1-2} = 0.018$** $p_{1-3} = 0.055$ $p_{2-3} = 0.564$
DM, *n* (%)	3 (10 %)	5 (15.2 %)	13 (35.1 %)	$p_{1-2} = 0.543$ **$p_{1-3} = 0.017$** $p_{2-3} = 0.058$
Anxiety, *n* (%)	6 (20 %)	8 (24.2 %)	9 (24.3 %)	$p_{1-2} = 0.688$ $p_{1-3} = 0.675$ $p_{2-3} = 0.994$
Depression, *n* (%)	2 (6.7 %)	9 (27.3 %)	5 (13.5 %)	**$p_{1-2} = 0.028$** $p_{1-3} = 0.366$ $p_{2-3} = 0.153$
RF number, *Me* (Q1; Q3)	4.0 (3.0; 4.25)	6.0 (5.0; 6.5)	6.0 (4.5; 7.0)	**$p_{1-2} < 0.001$** **$p_{1-3} < 0.001$** $p_{2-3} = 0.772$

Note. Statistical significance of differences between groups was performed by Mann – Whitney and Pearson's chi-square test (χ^2); p_{1-2}, p_{1-3}, p_{2-3}, statistical significance of differences between groups.

prevalence of factors in patients with obstructive vascular lesions. In Group 2 (GS = 8–39), the occurrence of CVD family history was 2.5 times ($p < 0.001$), hypodynamia – 1.5 times ($p = 0.026$), AH – 1.4 times ($p = 0.018$), and depressive disorders – 4.1 times ($p = 0.028$) higher than in the experimental (comparison) group. In Group 3 (GS ≥ 40), there was a 2.25-fold ($p = 0.003$) increase in the prevalence of family history, 2.7-fold ($p = 0.005$) increase in hypodynamia, and 3.5-fold ($p = 0.017$) increase in DM relative to the comparison group. The number of RFs per patient in the groups with CA lesions (Groups 2 and 3) was 1.5 times higher than in the experimental group ($p < 0.001$).

RF analysis of Groups 2 and 3 revealed statistical differences in the number of patients who quit smoking. Thus, the group with a GS score of ≥ 40 had 2.3 times more individuals who quit smoking relative to the group with GS = 8–39 points ($p = 0.022$). In addition, patients with a history of smoking had statistically significantly higher GS index scores than never smokers (median GS score – 44.0 vs. 32.0; $p = 0.043$).

In the study, there were no statistically significant differences between groups in the prevalence of a factor such as obesity. Nevertheless, the incidence of this factor was high, in the groups with CA lesions (Groups 2 and 3) it was 33.3 % and 40.5 %, respectively, and in the comparison group it was 30 %.

Evaluation of blood biochemical parameters in the subjects revealed differences in blood glucose and high-density lipoprotein (HDL) cholesterol levels. Glucose levels were higher in Group 3 relative to the comparison group ($p < 0.001$) and Group 2 ($p = 0.008$). HDL cholesterol values were statistically significantly lower in Group 3 than in Group 2 ($p = 0.025$) and the comparison group ($p = 0.003$). Lipid profile and carbohydrate metabolism data of patients are given in Table 3.

To identify the most statistically significant factors in CHD patients influencing the development of coronary atherosclerosis, the relative risk (RR) was calculated. Table 4 shows only the RRs with lower and upper confidence interval values greater than 1.

In patients with CHD the risk of moderate atherosclerosis increases 2.9 times in the presence of family history of CVD, 2.6 times in the presence of AH, 1.7 times in the presence of low physical activity, 1.8 times in the presence of depression in relation to individuals without these factors. In addition to family history and hypodynamia, DM increases the risk of severe CA lesions by 1.7 times. In addition, the combination of ≥ 5 RFs in one patient indicates a high probability of obstructive coronary lesions.

TABLE 3

LIPID PROFILE AND BLOOD GLUCOSE LEVEL IN PATIENTS WITH CORONARY ARTERY DISEASE DEPENDING ON CORONARY ARTERIES LESION, *ME* (Q1; Q3)

Blood values	GS index, points			Statistical significance level, *p*
	Group 1: GS = 0 (*n* = 30)	Group 2: GS = 8–39 (*n* = 33)	Group 3: GS ≥ 40 (*n* = 37)	
Glucose, mmol/L	5.2 (4.9; 5.8)	5.9 (5.25; 6.65)	6.7 (5.65; 9.05)	**$p_{1-2} = 0.018$** **$p_{1-3} < 0.001$** ***$p_{2-3} = 0.008$***
TC, mmol/L	4.9 (4.4; 5.72)	4.59 (3.77; 5.07)	4.23 (3.47; 5.27)	$p_{1-2} = 0.205$ $p_{1-3} = 0.064$ $p_{2-3} = 0.533$
TG, mmol/L	1.35 (1.05; 2.43)	1.3 (0.94; 1.85)	1.26 (0.89; 1.87)	$p_{1-2} = 0.397$ $p_{1-3} = 0.228$ $p_{2-3} = 0.737$
HDL cholesterol, mmol/L	1.26 (1.11; 1.53)	1.36 (1.02; 1.46)	1.09 (1.0; 1.25)	$p_{1-2} = 0.804$ **$p_{1-3} = 0.003$** **$p_{2-3} = 0.025$**
LDL cholesterol, mmol/L	2.9 (2.26; 3.57)	2.64 (2.12; 3.1)	2.58 (1.93; 3.28)	$p_{1-2} = 0.259$ $p_{1-3} = 0.177$ $p_{2-3} = 0.707$
The Atherogenic Index (AI), c.u.	3.90 (3.4; 4.72)	3.59 (2.77; 4.07)	3.23 (2.47; 4.19)	$p_{1-2} = 0.173$ **$p_{1-3} = 0.034$** $p_{2-3} = 0.437$

TABLE 4

INFLUENCE OF RISK FACTORS ON VARYING DEGREES OF CORONARY ARTERY DISEASE

Risk factors	GS index, points	Statistical significance level, p	RR	95% CI
Family history of CVD	8–39	< 0.001	2.94	1.501–5.762
	≥ 40	0.002	2.02	1.233–3.315
Low physical activity	8–39	0.026	1.72	1.095–2.711
	≥ 40	0.005	1.85	1.219–2.824
Arterial hypertension	8–39	0.018	2.6	1.023–10.09
Depression	8–39	0.028	1.81	1.202–2.738
Diabetes mellitus	≥ 40	0.017	1.72	1.187–2.511
Number of risk factors	8–39	< 0.001	3.28	1.50–7.14
	≥ 40	< 0.001	3.47	1.55–7.78

Note. Only statistically significant associations between factors and outcome are presented (confidence interval of at least 1).

DISCUSSION

To study the relationship between CVD factors and the severity of coronary atherosclerosis lesions, CAG data were analyzed using GS score and determination of cut-off point by the median of the study sample, which allows more accurately distinguishing patients with different degrees of coronary lesions. This approach of dividing groups by median is widely used in clinical trials [15].

According to the data obtained, independent predictors of hemodynamically significant CA stenoses were determined in CHD patients. One of the main factors is family history of CVD, which increases the probability of coronary atherosclerosis in CHD patients more than 2 times. According to various sources, the contribution of genetic factor to the development of CVD is from 30 to 80 % [16]. However, its role is not fully clear. A number of researchers have pointed out the need to use genetic risk scales to predict the development of CHD. Researchers' opinions on this issue are contradictory. For example, it is known that in individuals with increased genetic risk of CVD development prophylactic correction of traditional modifiable RFs (smoking, AH, dyslipidemia) reduces the total risk of CHD. The study of hereditary factors is of practical interest in terms of individualized prevention.

One of the most common risk factors in the world is AH, which is associated with a high risk of cardiovascular complications: myocardial infarction and cerebral stroke. According to the study, it was found that patients with AH have a 2.5-fold increased risk of developing CA lesions. Persistently elevated BP is known to contribute to the development of atherosclerosis through autonomic dysregulation of vascular endothelial function. The presence of common pathogenetic mechanisms has a mutual influence and leads to the progression of CHD and the development of cardiovascular complications. For instance, myocardial hypertrophy and elevated BP cause coronary insufficiency even in moderate atherosclerotic lesions of CA.

The study found that individuals with low physical activity have more than a 1.5-fold increased risk of developing CHD. In modern living conditions, physical activity is drastically reduced, especially in the developed countries. Hypodynamia is associated with obesity, impaired carbohydrate and lipid metabolism. The issue of considering the inclusion of low physical activity as a significant RF in prognostic scores for risk stratification is relevant.

Among the investigated factors with moderate atherosclerotic lesions of CA, statistically and clinically significant were found to be an aggravated family history of CVD, AH and hypodynamia. DM and hyperglycemia are asso-

ciated with severe coronary lesions. As is known, against the background of chronic hyperglycemia there is a violation of oxidation process in cells, accumulation of free radicals leading to endothelial dysfunction, which leads to a more severe course of CHD. Numerous studies support the association between chronic hyperglycemia and the development of adverse cardiovascular outcomes. According to the results of this study, patients with DM are 1.7 times more likely to develop severe vascular damage to the heart.

Smoking is one of the key RFs influencing the development of multivessel coronary artery disease. Nicotine is known to negatively affect the sympathoadrenal system, increases platelet aggregation, and raises blood lipids. Smoking cessation is the most effective secondary prevention intervention that leads to reduced risk of CVD progression and mortality. According to M.S. Duncan et al., 5 years after quitting smoking, the risk is significantly reduced compared to those who continue to smoke, but approaches the level of never smokers only after 10–15 years. [17]. According to the results of this study, the GS index scores of past smokers were statistically significantly higher than those of never smokers. Despite smoking cessation, a long history of the habit was associated with multivessel severe arterial heart disease.

Dyslipidemia plays a key role in CA atherosclerosis development. When analyzing the blood lipid spectrum in the study in patients with severe CA lesions, HDL cholesterol indices were statistically significantly lower than in the group with moderate lesions. Low HDL levels are known to contribute to accelerated development of atherosclerosis and are associated with high cardiovascular risk. Their favorable role in protecting the endothelium from damage has been shown. However, the influence of such factors as smoking, AH, DM, age, and hypercholesterolemia leads to reduction of their protective properties [18]. The further investigation of factors leading to HDL biological function changes shall help in the field of prognostic evaluation of cardiovascular risks.

A high prevalence of anxiety-depressive symptomatology in CHD patients was determined. However, only depression has an impact on the development of moderate severity coronary atherosclerosis. In this study, depressive disorders were more common in women over 65 years of age and were associated with low physical activity and obesity. The results can be compared with the Russian KOMETA (Comet) study data, in which a high prevalence of depression, mostly in women, has been shown. Unfavorable psychological background was associated with such RF as hypodynamia and higher BMI values.

One important finding of the study is the association between the presence of coronary atherosclerosis and the number of combined RFs. The presence of five or more RFs in one patient has the greatest impact on coronary lesions. RF combination should be considered as a cumulative effect that has an unfavorable impact on the CHD course and prognosis. Various scores for calculation total risk are used nowadays, with different prognostic value for risk stratification in patients with CHD.

CONCLUSION

Thus, the cardiovascular risk factors analysis in CHD patients showed that family history of CVD and low physical activity are independent predictors of obstructive coronary atherosclerosis development. AH and depression are correlated with moderate coronary lesions. The main factors that have the strongest influence on the development of diffuse severe coronary atherosclerosis are DM, hyperglycemia, a long history of smoking, and a reduced HDL cholesterol level. The cumulative effect of several cardiovascular risk factors increases 3-fold the likelihood of developing obstructive coronary atherosclerosis. The obtained data indicate that the risk of CHD should be reduced both with the use of drug therapy and preventive measures taking into account cardiovascular and psychosocial factors.

Conflict of interest

The authors of this article declare the absence of a conflict of interest.

REFERENCES

1. World Health Organization. *The top 10 causes of death*. 2018. URL: https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death [date of access: 15.03.2019].

2. Neglia D, Rovai D, Caselli C, Pietila M, Teresinska A, Aguadé-Bruix S, et al.; EVINCI Study Investigators. Detection of significant coronary artery disease by non-invasive anatomical and functional imaging. *Circ Cardiovasc Imaging*. 2015; 8(3): e002179. doi: 10.1161/CIRCIMAGING.114.002179

3. Shalnova SA, Deev AD, Balanova YuA, Kapustina AV, Imaeva AE, Muromtseva GA, et al. Twenty years trends of obesity and arterial hypertension and their association in Russia. *Cardiovascular Therapy and Prevention*. 2017; 16(4): 4-10. (In Russ.). doi: 10.15829/1728-8800-2017-4-4-10

4. Balanova YuA, Shalnova SA, Deev AD, Kapustina AV, Konstantinov VV, Boytsov SA. Smoking prevalence in Russia. What has changed over 20 years? *Profilakticheskaya meditsina*. 2015; 18(6): 47-52. (In Russ.). doi: 10.17116/profmed201518647-52

5. Balanova IuA, Kontsevaia AV, Shalnova SA, Deev AD, Artamonova VG, Gatagonova TM, et al. Prevalence of behavioral risk factors for cardiovascular diseases in the Russian population: Results of the ESSE-RF epidemiological study. *Profilakticheskaya meditsina*. 2014; 17(5): 42-52. (In Russ.).

6. Metelskaya VA, Shalnova SA, Deev AD, Perova NV, Gomyranova NV, Litinskaya OA, et al. Analysis of atherogenic dyslipidemia prevalence among population of Russian Federation (results of the ESSE-RF Study). *Profilakticheskaya meditsina*. 2016; 19(1): 15-23. (In Russ.). doi: 10.17116/profmed201619115-23

7. Dedov II, Shestakova MV, Galstyan GR. The prevalence of type 2 diabetes mellitus in the adult population of Russia (NATION study). *Diabetes Mellitus*. 2016; 19(2): 104-112. (In Russ.). doi: 10.14341/DM2004116-17

8. Pogosova NV, Boitsov SA, Oganov RG, Kostyuk GP, Sokolova OYu, Yufereva YuM, et al. Psychosocial risk factors in ambulatory patients with arterial hypertension and ischemic heart disease of 30 cit-

ies in Russia: Data from the KOMETA (Comet) Study. *Kardiologiia.* 2018; 58(11): 5-16. (In Russ.). doi: 10.18087/cardio.2018.11.10193

9. Roth GA, Johnson C, Abajobir A, Abd-Allah F, Abera SF, Abyu G, et al. Global, regional, and national burden of cardiovascular diseases for 10 causes, 1990 to 2015. *J Am Coll Cardiol.* 2017; 70(1): 1-25. doi: 10.1016/j.jacc.2017.04.052

10. Korok EV, Sumin AN. Challenges of diagnosis of obstructive coronary artery disease: The role of non-invasive testing. *Complex Issues of Cardiovascular Diseases*. 2019; 8(1): 70-79. (In Russ.). doi: 0.17802/2306-1278-2019-8-1-70-79

11. Geltser BI, Tsivanyuk MM, Shakhgeldyan KI, Emtseva ED, Vishnevskiy AA. Cardiometabolic risk factors in predicting obstructive coronary artery disease in patients with non-ST-segment elevation acute coronary syndrome. *Russian Journal of Cardiology*. 2021; 26(11): 4494. (In Russ.). doi: 10.15829/1560-4071-2021-4494

12. Russian Cardiological Society. Clinical practice guidelines for stable coronary artery disease. *Russian Journal of Cardiology*. 2020; 25(11): 4076. (In Russ.). doi: 10.15829/1560-4071-2020-4076

13. Cardiovascular prevention 2017. National guidelines. *Russian Journal of Cardiology.* 2018; 6: 7-122. (In Russ.). doi: 10.15829/1560-4071-2018-6-7-122

14. Gensini GG. A more meaningful scoring system for determining the severity of coronary heart disease. *Am J Cardiol.* 1983; 51(3): 606. doi: 10.1016/s0002-9149(83)80105-2

15. Gavrilova NE, Metelskaya VA, Petrova NV, Yarovaya EB, Boytsov SA, Mazaev VP. Selection for the quantitative evaluation method of coronary arteries based upon comparative analysis of angiographic scales. *Russian Journal of Cardiology*. 2014; 19(6): 24-29. (In Russ.). doi: 10.15829/1560-4071-2014-6-24-29

16. Mayer B, Erdmann J, Schunkert H. Genetics and heritability of coronary artery disease and myocardial infarction. *Clin Res Cardiol*. 2007; 96(1): 1-7. doi: 10.1007/s00392-006-0447-y

17. Duncan MS, Freiberg MS, Greevy RA Jr, Kundu S, Vasan RS, Tindle HA. Association of smoking cessation with subsequent risk of cardiovascular disease. *JAMA*. 2019; 322(7): 642-650. doi: 10.1001/jama.2019.10298

18. Kratzer A, Giral H, Landmesser U. High-density lipoproteins as modulators of endothelial cell functions: alterations in patients with coronary heart disease. *Cardiovasc Res*. 2014; 103(3): 350-361. doi: 10.1093/cvr/cvu139

ЛИТЕРАТУРА

1. World Health Organization. *The top 10 causes of death.* 2018. URL: https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death [date of access: 15.03.2019].

2. Neglia D, Rovai D, Caselli C, Pietila M, Teresinska A, Aguadé-Bruix S, et al.; EVINCI Study Investigators. Detection of significant coronary artery disease by non-invasive anatomical and functional imaging. *Circ Cardiovasc Imaging.* 2015; 8(3): e002179. doi: 10.1161/CIRCIMAGING.114.002179

3. Шальнова С.А., Деев А.Д., Баланова Ю.А., Капустина А.В., Имаева А.Э., Муромцева Г.А. и др. Двадцатилетние тренды ожирения и артериальной гипертонии и их ассоциации в России. *Кардиоваскулярная терапия и профилактика.* 2017; 16(4): 4-10. doi: 10.15829/1728-8800-2017-4-4-10

4. Баланова Ю.А., Шальнова С.А., Деев А.Д., Капустина А.В., Константинов В.В., Бойцов С.А. Распространённость курения в России. Что изменилось за 20 лет? *Профилактическая медицина.* 2015; 18(6): 47-52. doi: 10.17116/profmed201518647-52

5. Баланова Ю.А., Концевая А.В., Шальнова С.А., Деев А.Д., Артамонова В.Г., Гатагонова Т.М. и др. Распространённость поведенческих факторов риска сердечно-сосудистых заболеваний в российской популяции по результатам исследования ЭССЕ-РФ. *Профилактическая медицина*. 2014; 17(5): 42-52.

6. Метельская В.А., Шальнова С.А., Деев А.Д., Петрова Н.В., Горланова Н.В., Литинская О.А. и др. Анализ распространённости показателей, характеризующих атерогенность спектра липопротеинов у жителей Российской Федерации (по данным исследования ЭССЕ-РФ). *Профилактическая медицина.* 2016; 1(19): 15-23. doi: 10.17116/profmed201619115-23

7. Дедов И.И., Шестакова М.В., Галстян Г.Р. Распространённость сахарного диабета 2-го типа у взрослого населения России (исследование NATION). *Сахарный диабет*. 2016; 19(2): 104-112. doi: 10.14341/DM2004116-17

8. Погосова Н.В., Бойцов С.А., Оганов Р.Г., Костюк Г.П., Соколова О.Ю., Юферева Ю.М. и др. Психосоциальные факторы риска у амбулаторных пациентов с артериальной гипертонией и ишемической болезнью сердца в 30 городах России: по данным исследования КОМЕТА. Кардиология. 2018; 58(11): 5-16. doi: 10.18087/cardio.2018.11.10193

9. Roth GA, Johnson C, Abajobir A, Abd-Allah F, Abera SF, Abyu G, et al. Global, regional, and national burden of cardiovascular diseases for 10 causes, 1990 to 2015. *J Am Coll Cardiol.* 2017; 70(1): 1-25. doi: 10.1016/j.jacc.2017.04.052

10. Корок Е.В., Сумин А.Н. Сложности в диагностике обструктивных поражений коронарных артерий: роль неинвазивных тестов. *Комплексные проблемы сердечно-сосудистых заболеваний.* 2019; 8(1): 70-79. doi: 0.17802/2306-1278-2019-8-1-70-79

11. Гельцер Б.И., Циванюк М.М., Шахгельдян К.И., Емцева Е.Д., Вишневский А.А. Факторы кардиометаболического риска в прогнозировании обструктивного поражения коронарных артерий у больных с острым коронарным синдромом без подъёма сегмента ST. *Российский кардиологический журнал.* 2021; 26(11): 4494. doi: 10.15829/1560-4071-2021-4494

12. Российское кардиологическое общество (РКО). Стабильная ишемическая болезнь сердца. Клинические рекомендации 2020. *Российский кардиологический журнал*. 2020; 25(11): 4076. doi: 10.15829/1560-4071-2020-4076

13. Кардиоваскулярная профилактика 2017. Российские национальные рекомендации. *Российский кардиологический журнал.* 2018; 23(6): 7-122. doi: 10.15829/1560-4071-2018-6-7-122

14. Gensini GG. A more meaningful scoring system for determining the severity of coronary heart disease. *Am J Cardiol.* 1983; 51(3): 606. doi: 10.1016/s0002-9149(83)80105-2

15. Гаврилова Н.Е., Метельская В.А., Перова Н.В., Яровая Е.Б., Бойцов С.А., Мазаев В.П. Выбор метода количественной оценки поражения коронарных артерий на основе сравнительного анализа ангиографических шкал. *Российский кардиологический журнал*. 2014; 19(6): 24-29. doi: 10.15829/1560-4071-2014-6-24-29

16. Mayer B, Erdmann J, Schunkert H. Genetics and heritability of coronary artery disease and myocardial infarction. *Clin Res Cardiol*. 2007; 96(1): 1-7. doi: 10.1007/s00392-006-0447-y

17. Duncan MS, Freiberg MS, Greevy RA Jr, Kundu S, Vasan RS, Tindle HA. Association of smoking cessation with subsequent risk of cardiovascular disease. *JAMA*. 2019; 322(7): 642-650. doi: 10.1001/jama.2019.10298

18. Kratzer A, Giral H, Landmesser U. High-density lipoproteins as modulators of endothelial cell functions: alterations in patients with coronary heart disease. *Cardiovasc Res*. 2014; 103(3): 350-361. doi: 10.1093/cvr/cvu139

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