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POSTCOVID CARDIOMETABOLIC DISORDERS IN RESIDENTS OF YAKUTSK

A pilot single-stage study of residents of Yakutsk, attached to the YSC CMP Clinic, with a history of new coronavirus infection COVID-19 in the period from March to December 2020 (1st and 2nd waves of the pandemic) was conducted. 2 groups of 80 people from 30 to 59 years old were formed, which were divided according to the time of infection with COVID-19. The 1st group included patients with a postcovid period from 3 to 6 months, in the 2nd - from 7 to 11 months. The analysis revealed a high frequency of cardiometabolic disorders, in particular hypertension, obesity and metabolic syndrome. Men had a more severe course of infection, both in the first and in the second wave of the pandemic. The relationship between blood pressure, body mass index, waist circumference and blood triglyceride levels with the severity of the disease is presented.

Keywords: COVID-19, Yakutsk residents, obesity, arterial hypertension, metabolic syndrome.

Metabolic syndrome, described in the second half of the 20th century, increases the risk of death from cardiovascular pathology and has been named by WHO experts as a "pandemic of the 21st century" [11]. Since the end of 2019, the whole world has been gripped by the protracted pandemic of the new coronavirus infection COVID-19. During the first studies of COVID-19, scientists have already proven the risk of developing more severe manifestations and deaths from it in combination with cardiovascular pathology, including metabolic syndrome [4; 7;9;10;12;17;20;23]. Our study covered the period of the first and second waves of the COVID-19 pandemic. The analysis of the epidemiological situation during the second wave of the pandemic showed a significant increase in morbidity and mortality both worldwide and in the Russian Federation [1;15;18]. During this period, the Eurasian International Registry ACTIVE noted an increase in newly detected cardiovascular pathology after 4-6 months [3]. An earlier study of cardiovascular pathology in residents of Yakutsk who had a new coronavirus infection showed a high incidence of arterial hypertension (AH) (59.6%), coronary heart disease (CHD) (16.8%), type 2 diabetes mellitus (14.3%) [2]. The state of health of people who have had COVID-19 requires detailed monitoring, because the infection, acting on the proinflammatory and prothrombotic status of patients, caused the appearance or progression of the existing pathology. The study of the

state of health in the postcovid period, in particular the detection of cardiometabolic disorders, is relevant and requires detailed study and monitoring.

The aim of the research was to study cardiometabolic disorders in residents of Yakutsk who suffered a new coronavirus infection COVID-19.

Materials and methods of research.

In March 2021, a pilot single-stage study of residents of Yakutsk, attached to the Clinic of the YSC CMP with a history of new coronavirus infection COVID-19 in the period from March to December 2020 (1st and 2nd waves of the pandemic) was conducted. A total of 161 people were studied. The response rate was 76%. Out of these, 2 groups of 80 people from 30 to 59 years old were formed, which were divided according to the time of infection with COVID-19. The median age was 43 [39, 55] years in men, 47 [41, 54] years in women.

The 1st group included patients with a postcovid period from 3 to 6 months - 20 men and 20 women comparable in age, that were infected during the second wave of the COVID-19 pandemic;

In the 2nd group - 20 men and 20 women comparable in age, with a postcovid period from 7 to 11 months, that were infected during the first wave of the COVID-19 pandemic;

Inclusion criteria: adult population of Yakutsk from 30 to 59 years old, attached to the Clinic of the YSC CMP, a history of COVID-19 disease, informed consent to the study.

Exclusion criteria: malignant neoplasms, acute infectious diseases, exacerbations of chronic diseases, acute myocardial infarction, acute cerebrovascular accident, type 2 diabetes mellitus.

The examination program included: a questionnaire survey to assess symptoms and quality of life, an anthropometric study measuring height, weight, waist (WC) and hips circumference, rest ECG, spirometry, blood sampling from the ulnar

vein in the morning on an empty stomach for clinical, biochemical and immunological studies, clinical examination by a cardiologist and a hospitalist. The measurement of blood pressure (BP) was carried out by an automatic tonometer "OMRON M2 Basic" (Japan) twice in while sitting with the calculation of average blood pressure with a limit of permissible measurement error of ± 3 mm Hg. Informed consent was obtained from all participants of the study to conduct an examination, questionnaire, and blood collection for further analysis of the results according to the protocol of the Ethics Committee of the YSC CMP (Protocol No. 52 of 03/24/2021).

The body mass index (BMI) or Quetelet II index was calculated using the formula: $BMI (kg/m^2) = \text{body weight (kg)} / \text{height (m)}^2$. BMI values of ≥ 25 and < 30 kg/m^2 were taken as overweight, obesity was recorded at a BMI of ≥ 30 kg/m^2 [6].

The abdominal obesity (AO) is exposed to the value of the waist measurement (WM) ≥ 80 cm on women, ≥ 94 cm on (VNOK, 2009).

The blood pressure level of $\geq 140/90$ mmHg or the use of antihypertensive drugs was taken for hypertension. According to degrees of severity, they were divided into: stage 1 AH - BP 140-159/90-99 mm Hg, stage 2 AH - BP 160-179/100/109 mmHg, stage 3 AH - BP $\geq 180/\geq 110$ mmHg [4].

Laboratory methods of the research included analysis of total cholesterol (TC), triglycerides (TG), high density lipoprotein cholesterol (HDL Cholesterol), low-density lipoprotein cholesterol (LDL Cholesterol), very low-density lipoprotein cholesterol (VHDL Cholesterol), levels glucose.

When judging the incidence of disorders of the blood lipid profile in a population, we used the Russian recommendations of the VII revision of Society of cardiology of Russian Federation, 2020, into account the European recommenda-

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tions, 2019. Hypercholesterolemia (HCS) is the level of TC $\geq 5,0$ mmol/l (190 mg/dl) taking into account the risk of cardiovascular death on the SCORE scale, the high LDL Cholesterol level $>3,0$ mmol/l (115 mg/dl) with low, $> 2,6$ mmol/l with moderate, $>1,8$ mmol/l with high, $> 1,4$ mmol/l with very high and extreme risk, the low HDL Cholesterol level $<1,0$ mmol/l on men; $<1,2$ mmol/l on women, the hypertriglyceridemia (HTG) is the TG level is $>1,7$ mmol/l. A hyperglycemia (HG) on an empty stomach (a glucose in a blood plasma on an empty stomach $> 5,6$ mmol/l). Respondents with these disorders also included participants receiving specific medication for these conditions.

Metabolic syndrome (MS) was diagnosed according to the criteria of the RSC (second revision), 2009: the main feature: abdominal obesity (AO) (WC >80 cm in women, >94 cm in men); additional criteria: hypertension (BP $>130/85$ mmHg), TG level $\geq 1,7$ mmol/l; HDL-C level $<1,0$ mmol/l in men; $<1,2$ mmol/l in women; LDL-C level $>3,0$ mmol/l; fasting hyperglycemia (fasting plasma glucose $\geq 6,1$ mmol/L) or impaired glucose tolerance (glucose in blood plasma 2 hours after exercise glucose in the range $\geq 7,8$ and $\leq 11,1$ mmol/l). The presence of the main feature and 2 additional criteria serves as the basis for the diagnosis of MS.

The degree of lung damage and its severity were assessed according to the results of computer tomography (CT): CT-0 – absence of viral pneumonia, CT-1 lung lesions less than 25%, CT-2 – 25-50%, CT-3 – 50-75%, CT-4 $>75\%$ lung damage in the form of "ground-glass opacities".

Statistical processing of the results was carried out using the standard SPSS package version 26.0. To characterize the features, the arithmetic mean (M) and the standard error of the mean value of the feature (m), median (Me) and the 25th and 75th quartiles (Q1, Q3) were calculated. When comparing the groups, nonparametric criteria of Mann-Whitney, Kraskel-Wallis, and Pearson were used. To assess the relative risk, the odds ratio was used with a 95% confidence interval. The correlation analysis was carried out using the Spearman coefficient. The differences were considered statistically significant at $p < 0.05$.

Results and discussion. The severity of the new coronavirus infection was interpreted by us according to the CT of the lungs available in outpatient charts or extracts from the medical history.

Of the 80 examined persons, the largest number (41.3%) had a mild infection with CT-1 lung lesion. There were no re-

spondents in this age group with the most severe CT picture (CT-4). Their characteristics according to the severity of the disease (CT picture) are presented in Table.

Comparing the groups by the duration of the postcovid period, a more severe course of the disease in group 1 (wave II) was noted, there was an increase in the number of patients with more severe lung damage in this group up to 30% of the total. In group 2 (wave I), the largest number of patients underwent COVID-19 in a milder form (CT-1), accounting for 52.5% of the total number of study participants in this group.

A comparative analysis of the degree of lung damage by gender showed that men had more severe lung damage in COVID-19 compared to women, mainly due to group 1, patients with a postcovid period up to 6 months, infected in the second wave of the pandemic (Fig.). The women had a relatively mild course of the disease.

Of the total number of patients with COVID-19, 26 or 32.5% were hospitalized, 54 people (67.5%) were outpatient ($p=0.004$). Comparing the groups of the postcovid period, we obtained the following results. In group 1, the number of hospitalized patients was 37.5% of the total, in group 2 – 27.5%, no significant differences were found ($\chi^2=0.912$, $p=0.340$). The largest number of hospitalized patients in group 1 is probably due to the more severe course of infection and the more well-established work of the healthcare system during the second wave of the pandemic.

In the postcovid period up to a year, newly diagnosed cardiovascular diseases were registered in 12 study participants, which was 15%, equally often, both in the group of up to 6 months (15%) and from 7 to 11 months (15%). According to the research data of the international registry "Analysis of the dynamics of comorbid diseases in patients infected with SARS-CoV-2 (ACTIVE SARS-CoV-2)", which included 7 countries besides the Russian Federation, "new" diseases were most often detected in patients aged 49-50 years [3]. Our data explain the high percentage of disease detection by the younger average age of the study participants.

Hypertension was registered in 43.8% of the examined individuals of both groups, its highest frequency was observed in hospitalized patients, hypertension was registered in almost half of the cases – 47.2%, in outpatient patients slightly less – 42.7%, there was no statistical difference (OR 1.15 [95% CI 0.45-2.96], $p=0.764$). Comparing the

occurrence of hypertension by groups, we found that in the 1st group of study participants, hypertension was recorded in almost half of the patients – 47.5%, in the 2nd – 40% ($\chi^2=0.457$, $p=0.499$). Our data are consistent with the data of the ACTIVE registry, which included 5808 patients from the Russian Federation, the republics of Belarus, Armenia, Kazakhstan and Kyrgyzstan [5]. The study of the relationship of systolic BP (SBP) with the severity of the infection by CT of the lungs showed a direct correlation ($r=0.400$, $p=0.000$), the higher the SBP indicators, the more severe the new coronavirus infection was. The indicators are lower than in the international registry ACTIVE, where the incidence of hypertension was 58.5%, due to the examination of mostly hospitalized older patients, where the average age was 57.9 [47.67] years [3;4].

The analysis of lipid metabolism disorders in the participants of the pilot study was carried out. In more than half, HCL was detected equally often – 62.5% in group 1 and 65.0% in group 2, there was no statistical difference ($p=0.816$). Atherogenic HCL was equally frequently registered in both groups – 82.5% and 85.0%, respectively ($p=0.762$), a reduced level of HDL cholesterol was also detected in more than half of the study participants (62.5% and 67.5%, respectively), there was no significant difference ($p=0.639$). TG concentrations in group 1 (22.5%) were statistically slightly higher than in group 2 (17.5%) ($p=0.576$). Fasting HG was equally unreliably frequent in both groups – 22.0% and 28.2%, respectively ($p=0.204$). The average values of lipids and blood glucose had no statistical difference between the groups.

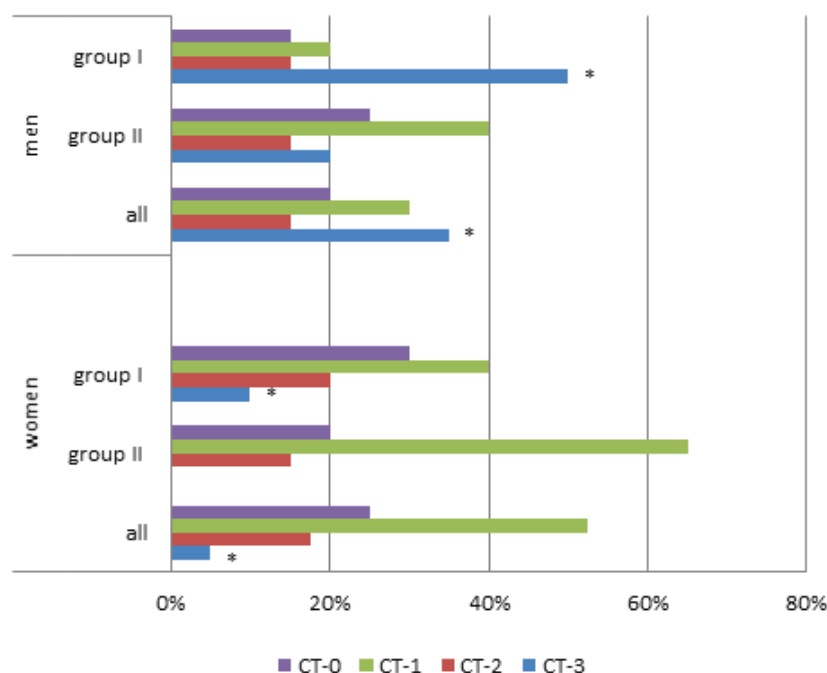
With the severity of the infection (by CT of the lungs) in the postcovid period, an average correlation was revealed only with TG ($r=0.314$, $p=0.005$), with the rest of the lipid panel, no significant correlation was found in our study.

Thus, dyslipidemia was equally often observed in both groups of the postcovid period, being one of the components of MS and a risk factor for cardiovascular diseases. This is also confirmed by other researchers [13, 19].

Weight gain after infection was noted by many survey participants: 22.5% - from group 1, 17.5% - from group 2, there was no significant difference (OR 1.36 [95% CI 0.45-4.12] $p=0.576$). The reason for this was probably quarantine measures during the pandemic, which led to inactivity. Studies by foreign authors also noted an increase in body weight during the pandemic of a new coronavirus infection

Characteristics of patients according to the severity of the disease

CT picture	CT-0	CT-1	CT-2	CT-3	CT-4
	n (%)				
all	18 (22.5)	33 (41.3)	13 (16.3)	16 (20.0)	0
group I	9 (22.5)	12 (30.0)	7 (17.5)	12 (30.0)	0
group II	9 (22.5)	21 (52.5)	6 (15.0)	4 (10.0)	0
P _{I-II}	нд	0.044	нд	0.0282	



Gender characteristics of patients on CT lung * - p<0,05

[14]. The correlation analysis of BMI with the severity of the infection showed a statistically significant relationship between BMI and CT picture ($r=0.406$, $p=0.000$). According to BMI, 28 people (35%) were overweight, 29 people (36.3%) were obese. Our data are consistent with the International Registry of ACTIVE SARS-CoV-2, where 35.54% of 5808 patients were obese [5], and meta-analysis also showed that obese patients had a more severe course of SARS-CoV2 (OR = 2.31; 95% CI, 1.3-4.12) [8;16;22]. A comparative analysis of overweight and obesity in groups 1 and 2 showed that the incidence of overweight and obesity was higher in the group with a postcovid period of up to 6 months ($n=32$ or 80% of the total number in the group), when in group 2 there were 25 people or 62.5%, respectively (OR 2.40 [95% CI 0.87-6.55] $p=0.08$).

AO is the main component of MS, it affects, to a certain degree, the development of hypertension and type 2 diabetes mellitus. The frequency of occurrence of AO in the total sample was 65%. Higher

frequency of AO was observed in men (72.5%) rather than in women (57.5%), there were no statistically significant differences (OR 1.94 [95% CI 0.76-4.96] $p=0.241$). A strong correlation was found between WC and the degree of lung damage in COVID-19 ($r=0.452$, $p=0.000$), the greater the WC, the more severe the course of the disease.

The frequency of MS according to the criteria of the RSC in the general sample was more than half - 56.3%. In gender comparison, the incidence of this syndrome in men is slightly higher compared to women ($n=25$ or 62.5%; $n=20$ or 50%, respectively), the results did not differ significantly (OR 1.66 [95%CI 0.68-4.06] $p=0.260$). Higher incidence of AO and MS explains the relatively severe course of COVID-19 in men compared to women. There was also no significant difference when comparing between the groups for the postcovid period. Among COVID-19 patients receiving inpatient treatment, MS occurred in 42.3% of the total number of hospitalized, in contrast to outpatients, among whom MS was

registered in more than half (63.0%) ($p=0.08$). Higher incidence of MS in outpatient patients may be due to the high prevalence of the syndrome in the general urban population. We also did not obtain a significant correlation with MS from the degree of lung damage according to the CT picture ($r=0.109$, $p=0.334$). This is due to the fact that our pilot study included a small sample with an age limit of up to 69 years, among which there were no persons with extremely severe lung damage (CT-4). However, the results of numerous studies confirm the negative impact of MS on the severity of viral infection [7;9;10;17;20;23].

Conclusion. A survey of residents of Yakutsk who had a history of a new coronavirus infection in the first two waves of the pandemic showed a high prevalence of cardiometabolic disorders, in particular hypertension, obesity and metabolic syndrome. The most unfavorable course of COVID-19 was in the participants of the pilot study that got infected during the second wave of the pandemic. When comparing by gender, men were the most vulnerable to the disease - they had a more severe manifestation of the disease, both in the first and in the second wave of the pandemic. The relationship of blood pressure, body mass index, waist circumference and blood triglyceride levels with a more severe course of a new coronavirus infection in the anamnesis was presented.

It can be acknowledged that the pandemic has provoked a new wave of obesity and metabolic syndrome, as a consequence of stress, depression, deviant behavior and low physical activity during quarantine measures, which may soon cause a surge in the incidence of cardiovascular pathology and as a consequence of mortality from cardiovascular complications and diabetes mellitus. In the future, it is necessary to develop measures for broad medical examination, telehealth consultations, and make an emphasis on reducing modifiable risk factors for cardiovascular diseases in order to prevent premature deaths from diseases of the circulatory system.

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