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Dynamics of cardiological parameters in athletes after COVID-19 infection

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Abstract

The aim of the study was to investigate the impact of coronavirus infection (COVID-19) on the cardiovascular system (CVS) of athletes and the dynamics of relevant parameters during physical activity after the recovery.

Methods. A total of 62 marathon runners (training duration: 3 to 7 years; mean age: 43.8 ± 3.5 years) were examined. The participants were divided into two groups: Group 1 (n=34) included athletes who had recovered from a mild form of COVID-19; Group 2 (n=28) included athletes without a history of COVID-19. All participants underwent electrocardiography (ECG), 24-hour Holter ECG monitoring, echocardiography (EchoCG), and Doppler echocardiography using the ALOKA ProSound 6-Premier system (Japan) at rest and after physical exertion. Cardiovascular response types and recovery dynamics were assessed.

Results. EchoCG revealed no significant differences in chamber or wall sizes, except for the right atrium ($p<0.05$). In Group 1, 47.1% of participants had pericardial effusion >5.0 mm (mean 5.70±0.27 mm) ($p<0.05$), peaking at 7.0 mm by the 2nd–3rd month post-recovery and persisting up to six months. Physical exertion revealed increased grades of mitral regurgitation ($p<0.05$, Fisher's exact test), with no increase in aortic regurgitation

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(p=1.000). Holter monitoring showed supraventricular extrasystoles 46.8 times more frequently and ventricular extrasystoles 6.4 times more frequently (RYAN grade I) in Group 1. Episodes of paroxysmal supraventricular tachycardia were recorded in 23.5% of athletes and ventricular tachycardia in 5.8%. Asymptomatic ST-segment depression (downsloping and horizontal types) was observed in 17.5%. A hypertensive response to exertion (p<0.01) and delayed blood pressure recovery (up to 3 months) were also recorded.

Conclusion. Despite the mild clinical course of COVID-19, cardiovascular changes during physical activity peaked at 2–3 months post-recovery and persisted for at least six months. These findings should be considered when determining fitness to return to training and competition.

Keywords: COVID-19, athletes, cardiovascular system, dynamics, physical activity, electrocardiography.

Conflict of interest: none declared.

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Introduction

At the end of 2019, an outbreak of a novel infection occurred in the People's Republic of China. In 2020, the World Health Organization (WHO) officially designated the disease as COVID-19 ("Coronavirus disease 2019"). The International Committee on Taxonomy of Viruses named the pathogen SARS-CoV-2. Subsequently, the Delta and Omicron variants significantly increased viral transmissibility[1]. Among all SARS-CoV-2 variants, Omicron, characterized by multiple mutations in the spike (S) protein, demonstrated the highest level of contagiousness [1]. As of May 8, 2024, there have been 704,753,890 confirmed cases of COVID-19 in 231 countries, with over 7.0 million deaths worldwide; the case fatality rate stands at 0.99%[2].

Contemporary literature typically focuses on patients who experienced severe forms of the disease [2–4]. Among physically active individuals, COVID-19 often manifests with minimal clinical symptoms. Despite this, their training regimens are usually suspended or reduced for a short period. After recovery, many athletes, motivated by concerns about losing physical conditioning and competitive performance, return to full training too quickly, placing themselves at increased risk for complications [5, 6].

The aim of the study is to evaluate the impact of COVID-19 on the cardiovascular system (CVS) in athletes and assess the dynamics of cardiovascular indicators during the recovery period.

Methods

A total of 62 athletes (mean age 43.8 ± 3.5 years) were examined, of whom 34 (54.8%) had a history of mild COVID-19 and 28 (45.2%) had not been infected. All participants underwent assessments before and after physical exertion testing (ET).

Following a clinical examination, all athletes underwent electrocardiography (ECG), 24-hour Holter monitoring (HMECG), echocardiography (EchoCG), and Doppler echocardiography (Doppler EchoCG) using the ALOKA ProSound 6-Premier system (Japan), both at rest and after a combined stress test consisting of a 3-minute jog followed by a 15-second sprint at maximum intensity. The type of cardiovascular response and recovery parameters were recorded.

Statistical Analysis

Statistical analysis was performed using StatTech v 2.1.0. Differences were considered statistically significant at $p < 0.05$. If the data did not follow a normal distribution, results were presented as the median (Me) and interquartile range (Q1–Q3). The Mann–Whitney U test was used to assess differences in independent variables. Categorical data were described using absolute values and percentages. Comparison of proportions in 2×2 contingency tables was carried out using Fisher's exact test.

[1] Temporary guidelines: prevention, diagnosis and treatment of a coronavirus disease 2019 (COVID-19) of the Ministry of Health of the Russian Federation (version 16 of 18/08/2022)/ Russian

[2] World health organization /https://data.who.int/ dashboards|covid19|cases (date of access 08.05.2024). Russian

Results

According to EchoCG data, there were no significant differences in the sizes of the chambers and walls of the heart in the two groups, except for the the right atrium (p<0.05) (Table 1).

Table 1. **Echocardiographic parameters in the studied groups of athletes**

Parameters	Group 1 (M±m)	Group 2 (M±m)	p
Age, years	44.29±1.69	42.6±3.62	0.674 n/s
Aortic diameter (annulus), mm	27.68±0.54	26.00±1.06	0.165 n/s
Aortic diameter (sinus of Valsvalva), mm	36.69±0.84	35.27±1.23	0.345 n/s
Left atrium cavity, mm	40.78±0.62	39.37±1.05	0.254 n/s
Left ventricle cavity, mm	51.21±0.90	48.67±1.32	0.119 n/s
Interventricular septum thickness, mm	10.30±0.19	9.99±0.37	0.459 n/s
Left ventricle posterior wall thickness, mm	9.25±0.20	8.90±0.33	0.369 n/s
Right ventricle cavity, mm	38.79±0.50	37.47±1.12	0.287 n/s
Right atrium cavity, mm	43.40±0.76	40.23±1.19	⩽0.05
Ejection fraction, %	70.14±1.04	68.43±1.21	0.289 n/s

Note. Significant parameters are highlighted at p < 0.05.

Among individuals who had recovered from COVID-19, pericardial effusion greater than 4.0 mm was observed more frequently. Two subgroups were identified: athletes with pericardial fluid less than 5.0 mm and those with more than 5.0 mm. Individuals with effusion related to trauma, thyroid disease, rheumatologic or oncologic conditions, a history of myocardial infarction, or prior cardiac surgery were excluded from the analysis.

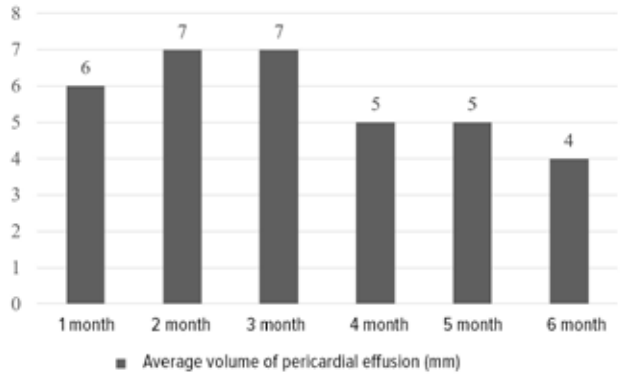

Fig. 1. Dynamics of pericardial effusion in the convalescent period (mm)

A pericardial effusion exceeding 5.0 mm was detected in 47.1% of the participants (mean: 5.70 ± 0.27 mm, p < 0.05) who had previously contracted COVID-19. During the first month, 6% of athletes in group 1 had an average effusion of 6.0 mm. In the second and third months, 31% of individuals presented with effusions reaching up to 7.0 mm. In the fourth and fifth months, 13% showed effusions up to 5.0 mm, and by the sixth month, the volume had decreased to 4.0 mm (Figure 1).

When assessing the degree of mitral and aortic regurgitation using Doppler EchoCG data (at rest and after ET), the following data were obtained (Tables 2-4).

Table 2. **Mitral and aortic regurgitation before and after exercise testing**

Studied groups	Paravalvular mitral regurgitation, %	Grade I mitral regurgitation, %	Paravalvular aortic regurgitation, %	Grade I aortic regurgitation, %
Group 1 before ET	5.9	-	5.9	-
Group 1 after ET	-	20.6	14.7	8.8
Group 2 before ET	7.1	-	-	-
Group 2 after ET	10.7	-	3.6	-

Table 3. **Analysis of the mitral regurgitation parameter after physical exercise**

Parameter	Categories	COVID-19		p
		no history of COVID-19	history of COVID-19	
Mitral regurgitation after ET	Paravalvular mitral regurgitation	3	0	0.008*
	Grade I mitral regurgitation, %	0	7	

Note. * – differences in parameters are statistically significant (p < 0.05).

Table 4. **Analysis of the aortic regurgitation parameter after physical exercise**

Parameter	Categories	Covid-19		p
		No history of COVID-19	History of COVID-19	
Aortic regurgitation* after ET	Paravalvular aortic regurgitation	1 (100.0)	5 (62.5)	1.000
	Grade I aortic regurgitation	0 (0,0)	(37,5)	

Note. * When comparing the aortic regurgitation parameter, we were unable to identify significant differences

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Table 5. **Holter ECG monitoring data in the study groups**

Groups	AV block, %	SA block, %	Supraventricular extrasystoles, count	Ventricular extrasystoles, count	Episodes of paroxysmal tachycardia, %	Early ventricular repolarization syndrome, %	ST-segment depression of downsloping and horizontal type, %	Bundle branch block, %	QT prolongation, %
Group 1	11.7	8.9	41514 (avg.1221) 50.9 /hour	10508 (avg 309.1) 12.9 /hour	supraventricular-23.5 ventricular-5.8	14.7	17.5	11.8	8.9
Group 2	10.7	3.6	732 (avg. 26.1)-1 / hour	1354 (avg 48.3) -2 / hour	supraventricular -3.6	14.3	-	3.6	-

According to the presented table, statistically significant differences were identified based on the variable "COVID-19" (p = 0.008) using Fisher's exact test.

The odds of mitral regurgitation grade I were higher in the group of individuals who had recovered from COVID-19 compared to those who had not contracted the infection; however, the difference in odds did not reach statistical significance.

ECG analysis revealed that after the functional load test (at 1–2 minutes of the recovery period), the right atrial overload was reliably observed in 59% of cases in group 1 and persisted in 26.5% of athletes during the five-month convalescent period. Sinus arrhythmia was more frequently detected during the first four months post-COVID-19 (20.6%), while ventricular extrasystoles were most commonly observed in the second month (8.8%).

No statistically significant differences were found in repolarization disorders (T-wave flattening or inversion) between the two groups (50% in group 1 vs. 55.5% in group 2), with the highest incidence observed in month 6 (11.8%).

HMECG demonstrated statistically significant differences in group 1: the frequency of supraventricular extrasystoles was 46.8 times higher, and ventricular extrasystoles were 6.4 times more common (Ryan Grade I). Paroxysmal supraventricular tachycardia during physical exertion was identified in 23.5% of subjects, while ventricular tachycardia occurred in 5.8%. Asymptomatic ST segment depression (descending and horizontal types) was observed in 17.5% of athletes in group 1; such changes were not recorded in the control group (Table 5)

When analyzing the types of response to physical exercise, an atypical (hypertensive) response was recorded significantly more often (p<0.01) (Table 6).

Table 6. **Types of cardiovascular system responses to physical exercise in the studied groups**

Categories	Type of response		Mann–Whitney U Test, p
	Normotonic response, %	Hypertensive response, %	
Group 1	64.7%	35.3	0.003*
Group 2	96.4%	3.6%	

Note. * The differences in the parameters were statistically significant (p < 0.01).

56% of athletes in the first group exhibited delayed blood pressure recovery (p < 0.01). No statistically significant differences were found in heart rate recovery between the groups (Figure 2).

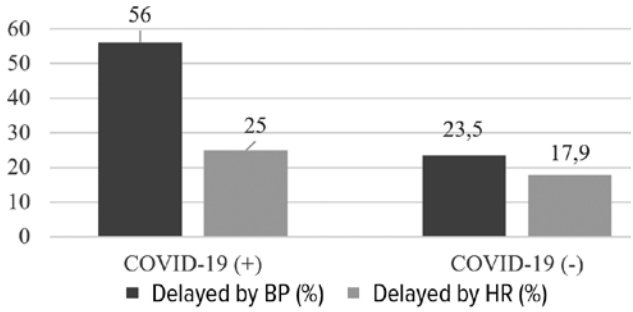

Fig. 2. Recovery time in the studied groups, (%)

The hypertensive type of response and delayed blood pressure recovery persisted during the 2nd and 3rd months of the convalescent period. Delayed heart rate recovery was observed up to 4 months (Fig. 3).

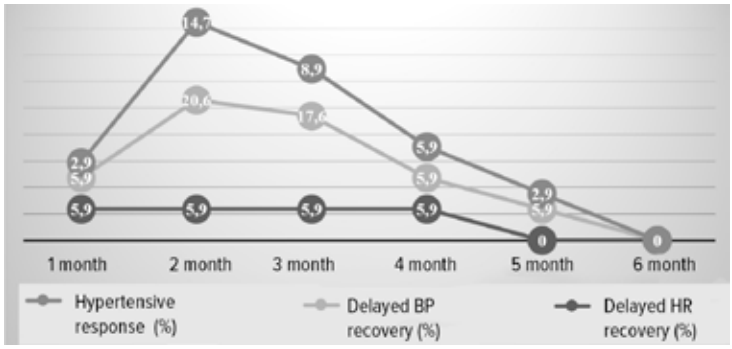

Fig. 3. Recovery dynamics after COVID-19

Discussion

In modern literature, most studies report findings among patients who experienced severe forms of COVID-19 [2] and focus on the role of comorbidities in disease severity [3]. Long-term alterations such as ECG and echocardiographic abnormalities and an increased incidence of pericardial effusion have been documented 6–12 months after hospital discharge [4,7,8]. Our study focused on cardiovascular changes in athletes who had recovered from mild COVID-19 and resumed marathon training. It was found that, post-clinical recovery, pericardial effusion exceeding 5.0 mm was observed in 47.1% of individuals ($p<0.05$), with the greatest effusion (up to 7.0 mm) seen within the first three months, persisting for up to six months.

Sinus arrhythmia was more frequently recorded within the first four months post-COVID-19, while ventricular extrasystoles were most prevalent during the second month of training. Following exercise stress testing, dynamic right atrial overload was identified and persisted for up to five months, affecting right atrial size, as confirmed by echocardiographic data.

No significant differences were found in repolarization disturbances, though such changes persisted and reached a peak by month six, likely due to ongoing training stress in both groups. HMECG monitoring revealed a significantly higher incidence of supraventricular and ventricular extrasystoles (Ryan Grade I) in post-COVID athletes. Exercise-induced paroxysmal supraventricular and ventricular tachycardia episodes were also recorded, along with asymptomatic ST-segment depression.

In the non-COVID group, these changes were not observed. Following exercise testing, a significant increase in mitral regurgitation grade was noted, persisting for up to five months of the convalescent period. Additionally, a hypertensive response to physical load ($p<0.01$) and delayed post-exercise blood pressure recovery were more frequently observed in the post-COVID group, lasting up to three months.

Conclusion

Among marathon athletes who had recovered from mild COVID-19, supraventricular and ventricular extrasystoles were recorded several times more frequently compared to those who had not contracted the virus. In this group, asymptomatic, exercise-induced episodes of paroxysmal tachycardia were also identified. Painless ST-segment depression of upsloping and horizontal type was observed in 17.5% of individuals with a history of mild COVID-19. Additionally, pericardial effusion exceeding 5.0 mm was detected more than three times as often in these individuals compared to non-infected athletes, with persistence for up to six months post-infection.

Thus, the findings indicate that even after a mild clinical course of COVID-19, and in the absence of overt symptoms or residual clinical signs, cardiovascular involvement may persist for at least six months in physically active individuals. These observations should be carefully considered when making decisions about resuming training or participation in competitive sports.

Conflict of interests: none declared.

References

1. Bazdyrev ED Coronavirus disease an urgent problem of the XXI century». Complex problems of cardiovascular diseases. 2020. 9(2): 6–16. Russian.
2. Gluckman TJ, Bhave NM, Allen LA, et al. 2022 ACC Expert Consensus Decision Pathway on Cardiovascular Sequelae of COVID-19 in Adults: Myocarditis and Other Myocardial Involvement, Post-Acute Sequelae of SARS-CoV-2 Infection, and Return to Play: A Report of the American College of Cardiology Solution Set Oversight Committee. J Am Coll Cardiol. 2022 May 3;79(17):1717-1756. DOI: 10.1016/j.jacc.2022.02.003
3. Øvrebotten T, Myhre P, Grimsmo J et al. Changes in cardiac structure and function from 3 to 12 months after hospitalization for COVID-19. Clin Cardiol. 2022 Aug 3. DOI: 10.1002/clc.23891
4. Yaroslavskaya EI, Krinochkin DV, Shirokov NE et al. Comparison of clinical and echocardiographic parameters of patients with COVID-19 pneumonia three months and one year after discharge. Cardiology. 2022;62(1):13-23. Russian. DOI: 10.18087/cardio.2022.1.n1859
5. Badtieva VF,Sharykin AS, Zelenkova IE Sports medicine and the sports community in the conditions of the coronavirus epidemic. Consilium Medicum. 22. 5 (2020): 8-34. Russian.
6. National manual "Sports Medicine", edited by B.A. Polyaev, G.A. Makarova, S.A Parastaeva, 2nd ed., revised. and additional. M. : GEOTAR-Media, 2022. 880 p. Russian.

7. Kanorskiy SG, Panchenko DI, Bystrov AO et al. Echocardiographic changes in COVID-19 survivors 6 and 12 months after hospital discharge. International Journal of Heart and Vascular Diseases. 2023. 11(37): 17-24. Russian. DOI: 10.24412/2311-1623-2023-37-17-24
8. Arutyunov GP, Tarlovskaya EI, Arutyunov AG on behalf of co-authors. Clinical features of post-COVID-19 period. Results of the international register «Dynamic analysis of comorbidities in SARS-CoV-2 survivors (AKTIV SARS-CoV-2)». Data from 6-month follow-up. Russian Journal of Cardiology. 2021;26(10):4708. Russian. DOI:10.15829/1560-4071-2021-4708