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Original article

Cardiovascular manifestations of post-COVID-19 syndrome. A cross-sectional analytical study

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ABSTRACT

Introduction: Exercise intolerance, palpitations, and arterial hypertension are prominent among the cardiovascular manifestations of post-COVID-19 syndrome.

Objective: To describe the cardiovascular manifestations in patients with post-COVID-19 syndrome.

Methods: An observational, analytical, cross-sectional study was conducted in patients seen at the multidisciplinary post-COVID-19 clinic of the Carlos Manuel de Céspedes Provincial General Hospital in Bayamo, Granma province, from January 2, 2024, to December 31, 2025. Patients of either sex, over 18 years of age, recovered from

confirmed COVID-19, according to World Health Organization definitions, were included.

Results: The incidence rate of cardiovascular manifestations was 54.9 (95% CI: 45.20 to 66.17; p: 0.000). Females predominated at 63.4%. Among the manifestations, the following stood out: exercise intolerance (34.2%), palpitations (23.3%), and newly diagnosed arterial hypertension (19.8%). The average time from infection onset to medical care was significantly longer in patients with cardiovascular manifestations (p=0.019). The shorter immunization time before falling ill was significantly less in the patients (p=0.001).

Conclusions: The incidence of cardiovascular manifestations was high. The mean age was the most affected. Exercise intolerance, palpitations, and newly diagnosed arterial hypertension stand out among the main manifestations. The need for early immunization and prompt and adequate medical care is evident.

Keywords: Post-COVID-19 syndrome; Cardiovascular manifestations; Immunization; Disease severity.

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Introduction

Some patients infected with the SARS-CoV-2 virus present clinical manifestations several weeks or months after apparent recovery from the disease. (1)

This condition is called post-COVID-19 syndrome and occurs in individuals with a history of probable or confirmed SARS-CoV-2 infection, generally three months after the onset of COVID-19. It is characterized by symptoms that last at least two months and cannot be explained by an alternative diagnosis. (1-3)

The most common symptoms are fatigue, shortness of breath, and cognitive dysfunction, but other symptoms that interfere with the patient's daily functioning may also appear. Symptoms may be new, appearing after the initial recovery from an

acute episode of COVID-19, or they may persist from the onset of the disease. Some fluctuate or appear during relapses. (3,4) Within this spectrum of clinical manifestations, cardiovascular symptoms and signs stand out. (3-6)

In Cuba, although research on COVID-19 has been disseminated, further research on post-COVID-19 syndrome is needed. Therefore, this research aims to describe the cardiovascular manifestations in patients with post-COVID-19 syndrome.

Methods

General characteristics of the research

A cross-sectional analytical observational study was conducted on patients with post-COVID-19 syndrome, treated at the multidisciplinary post-COVID-19 consultation of the Carlos Manuel de Céspedes provincial general hospital, in Bayamo, Granma province, in the period from January 2, 2024 to December 31, 2025.

Inclusion criteria

p were includedPatients without distinction of sex, over 18 years of age, recovered from COVID-19 with a confirmed diagnosis, according to the definitions of the World Health Organization (WHO).

Post-COVID-19 syndrome was defined as the syndrome that occurs in individuals with a history of probable or confirmed SARS-CoV-2 infection, generally three months after the onset of COVID-19, with symptoms lasting at least two months and not attributable to an alternative diagnosis. Symptoms may be of new onset, following initial recovery from an acute episode of COVID-19, or may have persisted since the onset of the illness. (1,2)

Exclusion criteria

The g were excludedshelves, and patients who left the consultation without completing data collection. Also, individuals with a history of cardiovascular disease or with studies demonstrating the presence of long-standing cardiovascular disease

manifestations, as the objective was to identify possible secondary effects of the virus in individuals in a post-COVID-19 state.

Bias control

A protocol for the multidisciplinary consultation was prepared, discussed and approved by the Scientific Council of the institution and the Research Ethics Committee, in which the diagnosis, treatment, follow-up and inclusion and exclusion criteria were clearly established.

Delimitation and operationalization of variables

Dependent variableCardiovascular manifestations; present or absent.

Independent variables:

Age, sex, substance use, and comorbidity were considered as socio-demographic indicators. The quick COVID-19/Severity Index (qCSI) score ≥ 4 points was used to define disease severity.

Phenotypes were classified according to the National Action Protocol for COVID-19 version 1.6. (7) The time elapsed from symptoms to health care and the time from immunity to acquisition of infection were also considered.

The drugs to be taken into account were: interferon, nimotuzumab, prophylactic heparin, aspirin, and steroids.

The tests were performed in the institution's laboratory on the Mondays following the multidisciplinary consultation for patients with post-COVID-19 syndrome, after guidance from the pre-analytical phase.

Statistical analysis

Statistical analysis employed descriptive statistics (absolute and relative frequencies). Quantitative variables were analyzed by calculating their arithmetic mean and standard deviation; 95% confidence intervals (95% CI) were estimated for the mean. To compare means in patients with and without cardiovascular manifestations, a Student's t-test was used to compare means. In cases of non-normal distribution, the

Mann-Whitney U test was applied. Qualitative variables were assessed using their frequency distribution.

The incidence rate of cardiovascular manifestations was determined with its 95% confidence interval.

To compare the results of the qualitative variables, the difference of proportions test for independent groups was performed. The data were then used to create a database in the Statistical Package for the Social Sciences (SPSS) version 27.0.

Ethical regulations

In carrying out this study, the ethical principles recommended in the Declaration of Helsinki for conducting clinical-epidemiological research were taken into consideration.

Result

The incidence rate of cardiovascular manifestations was 54.9 (95% CI: 45.2-66.2; p=0.000).

Table 1 shows the sociodemographic factors and severity of COVID-19 during hospitalization. Females predominated (63.4%). Substance abuse was not common. Only 4.5% of patients had a Quick COVID-19 Severity Index (qCSI) ≥ 4 points, while 37.1% were classified as phenotype 5.

Table 1. Sociodemographic indicators and severity of COVID-19 during admission

Indicators		**No.**	**%**
Sex	Female	128	63.4
	Male	74	36.6
Smoking	Yeah	17	8.4
	No	185	91.6
Alcoholism	Yeah	15	7.4
	No	187	92.6
Obesity	Yeah	70	34.7
	No	132	65.3
	Yeah	9	4.5

Quick COVID-19/Severity Index (qCSI) scale ≥ 4 points	No	193	95.5
Phenotype 5	Yeah	75	37.1
	No	127	62.9

As can be seen in Table 2, the cardiovascular manifestations of post-COVID-19 syndrome that stand out according to frequency are exercise intolerance (34.2%), palpitations (23.3%), and newly diagnosed hypertension (19.8%).

Table 2. Cardiovascular manifestations of post-COVID-19 syndrome

Cardiovascular manifestations	No.	%
Exercise intolerance	69	34.2
Palpitations	47	23.3
Newly diagnosed high blood pressure	40	19.8
Heart failure	31	15.3
Orthostatic hypotension	29	14.4
ischemic precordial pain	27	13.3
Pericarditis	17	8.4

The mean age of patients with cardiovascular manifestations did not differ significantly from that of patients without cardiovascular manifestations (p=0.168). The mean number of days from the onset of infection to medical attention was significantly longer in patients with cardiovascular manifestations (p=0.019). The time since immunization before becoming ill was significantly shorter in these patients (p=0.001). (Table 3)

Table 3 Differences in the average values of quantitative variables

Variables	ECV*	n	Average	95% confidence interval		p
				Lower	Superior	
Age	Yeah	111	56.87	54.31	58.26	0.168
	No	91	55.56			
Days from infection to medical care	Yeah	111	4.60	3.43	4.79	0.019
	No	91	3.51			
Days of immunization before getting sick	Yeah	109	107.28	1.59	1.72	0.001
	No	91	154.21			

*CVD: cardiovascular disease

Table 4 shows that the most used drugs were interferon in 61.4% of patients and steroids in 47.5% (dexamethasone and prednisone).

Table 4. Drugs used

Drugs	No.	%
Interferon	124	61.4
Steroids (dexamethasone and prednisone)	96	47.5
Aspirin	81	40.1
Prophylactic heparin	56	27.7
Nimotuzumab	9	4.5

Discussion

Cardiovascular manifestations in patients with post-COVID-19 syndrome vary in nature, severity, and duration. Preliminary studies indicate that up to 30% of patients may continue to experience symptoms for up to nine months after the acute infection. (1-3)

Given this uncertainty, research is needed to objectively define the incidence and prevalence of cardiovascular manifestations, as well as specific predictive factors, duration, degree of involvement, and the possible effects of various treatments.

Similar to the present investigation, other authors cite a predominance in women and a less frequent occurrence in smokers and obese individuals. (5) Regarding the results found, the findings could be explained by the fact that the study population was predominantly female, with fewer risk factors than men.

Among COVID-19 survivors, 5% to 29% complain of chest pain, shortness of breath, or palpitations after recovery, which can last six months or more after the acute infection. (8)

Recent reports, based on the use of cardiac magnetic resonance imaging, indicate that subacute myocarditis occurs in patients convalescing from COVID-19. (9-11) It is the authors' opinion that these common and frequent symptoms could be the result of cardiac injury during the disease.

Elevated troponin levels and inflammatory markers such as C-reactive protein, white blood cell count, and procalcitonin were also found, corroborating the importance of inflammation in the development of myocardial injury. (10-13) This also explains the heart failure observed in a group of patients, (11-14) which is consistent with the results of this research.

Both disease severity and classification in phenotype 5 were frequent in patients with cardiovascular manifestations in the present series.

The higher incidence of cardiovascular manifestations in the most severely ill patients originates from the disease itself. The virus causes pericardial and myocardial inflammation through direct or immune-mediated cytotoxic mechanisms, with the consequent development of pericarditis, pericardial effusion, and in some cases, tamponade. Furthermore, in the cardiovascular system, elevated levels of angiotensin-converting enzyme 2 allow for direct viral invasion. (15,16)

Furthermore, the immune response and cytokines cause inflammation of the heart muscle, interfering with the conduction system and the heart's pumping capacity, which will persist for weeks or months, and even permanently in a group of patients who survive the acute infection. (15-17)

Similar to the present study, new-onset hypertension in post-COVID-19 syndrome is a frequent complication. Among the recognized biopathogenic mechanisms are dysregulation of the angiotensin-converting enzyme 2 pathway and inflammation. (18-20)

Also, consistent with the results found, postural orthostatic tachycardia syndrome is observed in recovered patients who still experience significant disability even 6-8 months after the acute infection. (21)

Postural orthostatic tachycardia syndrome is due to possible underlying mechanisms, although they are not mutually exclusive and include hypovolemia, neurotropism, inflammation, and autoimmunity. (22-24)

The average age ranges from 55 to 60 years, according to several studies, which coincides with the present series. (25-27)

There is an inverse relationship between the timing of immunization and the development of post-COVID-19 syndrome; this is consistent with the present series. (28-30) Based on the authors' experience, early vaccination was able to reduce the prevalence of persistent COVID-19 and, consequently, should be considered in public health policies in the face of any viral epidemic or pandemic.

Delays in medical care following COVID-19 can lead to the development of post-COVID-19 syndrome. Lack of appropriate care can result in significant disability and increased demand for healthcare services due to post-COVID-19 syndrome, as found in this study.

Finally, the most frequently used medications coincide with those prescribed in the different versions of the national protocols.

Conclusions

This research found a high incidence of cardiovascular manifestations in patients with post-COVID-19 syndrome, with middle-aged individuals being the most affected. Among the manifestations, exercise intolerance, palpitations, and newly diagnosed hypertension stand out. The study also highlights the need for early immunizations, healthcare worker training, and public education to provide timely and appropriate medical care.

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Conflict of interest

The authors declare no conflicts of interest.

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