Observations from the post-COVID-19 cardiovascular examination record

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ABSTRACT

Objective: To evaluate the prevalence and characteristics of "de novo" cardiovascular findings (DNCFs) among post-COVID-19 patients based on a basic cardiovascular diagnostic procedure. Moreover, to describe the patients' results obtained by means of different diagnostic methods, to determine the clinical variables associated with DNCFs during the examination and, finally, to find out the diagnostic value of different data from medical records (MRs).
Materials and methods: Patients aged > 18 years who had COVID-19 either at the hospital or at home were evaluated by clinical interviews, physical examination, electrocardiogram (EKG), echocardiogram, routine lab tests and cardiac biomarkers between 30 and 120 days after discharge. A total of 246 patients (age: 52 ± 13 years; women: 48 %; mild, moderate and severe COVID-19: 37 %, 39 % and 24 %, respectively) were included in the study. Twenty-four percent of the population were asymptomatic at the time of the evaluation. In those patients who developed symptoms, dyspnea was the most frequent one (28 %). Interviews were the method with the highest index of suspicion (45 %). Physical examination, EKG, echocardiogram and biomarkers showed normal values among 61 %, 60 %, 75 % and 96 % of the patients, respectively.
Results: DNCFs were found in 62 patients (25.2 %): heart rhythm disorders in 42 (17 %) and ventricular dysfunction in 20 (8 %). Five patients had coronary artery disease, six had myocarditis and two had valvular heart disease. In addition, post-COVID-19 pulmonary embolism (PE) was detected in 10 patients, six of whom (2.4 %) had to be rehospitalized. Furthermore, in a multivariate analysis, the independent predictive variables of DNCFs were prior history of chronic obstructive pulmonary disease (COPD), QTc > 440 msec, leukocytosis and intra-COVID-19 cardiovascular complication. MRs showed both low sensitivity and positive predictive value for DNCFs.
Conclusions: Although DNCFs were observed in 25 % of the population, only 2 % were significant. According to the data collected from this diagnostic procedure and in this time frame, special attention should be paid to patients with prior history of COPD and/or cardiovascular complications during the acute stage and/or prolonged QTc interval. Post-COVID-19 symptoms were of limited value for the diagnosis of arrhythmias or ventricular dysfunction.

Keywords: COVID-19; Post-Acute COVID-19 Syndrome; Prevalence (Source: MeSH NLM).

Observaciones a partir del registro de evaluación cardiológica pos-COVID-19

RESUMEN

Objetivo: Evaluar la prevalencia y características de los hallazgos cardiológicos "de Novo" (HCDN) en pacientes pos-COVID a partir de una secuencia diagnóstica cardiológica básica; asimismo, describir los resultados obtenidos en estos pacientes con los distintos métodos diagnósticos, detectar variables clínicas asociadas a la aparición de HCDN durante la evaluación y, por último, detectar el valor diagnóstico de distintos datos de la historia clínica (HC).
Materiales y métodos: Se evaluó a pacientes >18 años que padecieron la COVID-19, internados o en su domicilio, mediante interrogatorio, examen físico, electrocardiograma (ECG), ecocardiograma (ECO), rutina de laboratorio y biomarcadores cardíacos entre los 30 y 120 días después del alta. Se incluyeron 246 pacientes (edad: 52 ± 13 años; mujeres: 48 %; COVID-19 leve [37 %], moderado [39 %], grave [24 %]). El 24 % de la población no presentaba síntomas en el momento de la evaluación; en los sintomáticos, la disnea fue lo más frecuente (28 %). El interrogatorio fue el método que reveló mayor porcentaje de sospecha (45 %). El examen físico, el ECG, el ECO y los biomarcadores fueron normales en el 60 %, 55 %, 75 % y 96 % de los pacientes, respectivamente.
Resultados: Se detectaron HCDN en 62 pacientes (25,2 %): trastornos del ritmo en 42 (17 %) y disfunción ventricular en 20 (8 %). Cinco presentaron enfermedad coronaria; 6, miocarditis, y 2, valvulopatías. Además, se detectó tromboembolismo pulmonar (TEP) pos-COVID en 10 pacientes, de los cuales seis (2,4 %) debieron internarse nuevamente. Asimismo, en un análisis multivariado, las variables predictoras independientes de los HCDN fueron antecedentes de enfermedad pulmonar obstructiva crónica (EPOC), intervalo QTc > 440 ms, leucocitosis y complicación cardiológica intra-COVID (CCIC). La HC mostró baja sensibilidad y valor predictivo positivo para los HCDN.

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Conclusiones: Aunque los HCDN se observaron en un cuarto de la población, solo fueron relevantes en el 2 %. De acuerdo con estos datos, mediante esta secuencia diagnóstica y en este lapso, el énfasis debería estar puesto en los pacientes con antecedentes de EPOC y/o complicaciones cardiológicas durante la etapa aguda y/o intervalo QTc prolongado. Los síntomas pos-COVID tuvieron un valor limitado para el diagnóstico de arritmias o disfunción ventricular.

Palabras clave: COVID-19; Síndrome Post Agudo de COVID-19; Prevalencia (Fuente: DeCS BIREME).

INTRODUCTION

From the beginning of the COVID-19 pandemic, the persistence of symptoms and damage to different organs after the acute stage of the disease caught our attention. Myocarditis, acute coronary syndrome, thromboembolic events, heart arrythmias and dysautonomia were described among the COVID-19-related cardiovascular disorders. At first, there was no guideline/consensus and/or recommendation for the adequate post-COVID-19 cardiovascular examination. The main emphasis was placed on finding out probable cardiovascular complications during the acute stage, particularly arrythmias and myocarditis. Special interest was paid to evaluate athletes in order to determine the proper time to resume physical activity [1,2].

Alarming findings and lack of knowledge led to suggest that the general population should undergo a cardiovascular examination after recovering from COVID-19. At the same time, when the first wave of the pandemic peaked in Buenos Aires (2020), Hospital Juan A. Fernández set up an outpatient consulting room for post-COVID-19 clinical examination of the cardiovascular system from 30 days after discharge.

MATERIALS AND METHODS

Study design and population

The study aimed to evaluate the prevalence and characteristics of "de novo" cardiovascular findings (DNCFs) among post-COVID-19 patients based on a basic cardiovascular diagnostic procedure. Moreover, to describe the patients' results obtained by means of different diagnostic methods, to determine the clinical variables associated with DNCFs during the examination and finally, to find out the diagnostic value of different data from medical records (MRs).

The research included patients over 18 years that recovered from the acute stage of COVID-19 (positive C-reactive protein [CRP] test) either in the hospital or at home.

Variables and measurements

A cardiovascular examination was performed between 30 and 120 days after discharge, and the record of the results was kept. The examination consisted of clinical interviews, physical examination, routine lab tests and CRP test, electrocardiogram (EKG), cardiac biomarkers and echocardiogram. Other complementary tests were requested depending on the preliminary results.

The test results were expressed as quantitative and qualitative data (a. normal, b. non-specific abnormal, or c. abnormal values with suspected association with prior COVID-19 infection).

Statistical analysis

Student's *t* or Mann-Whitney *U* tests were used according to the distribution of data as continuous variables. The chi-square test was used for the categorical variables; also, a multivariate predictive model with simple logistical regression was built. The variables were individually included in the multivariate model and their permanence was decided based on a Wald test ($p < 0.05$) and their confusing effect on other variables (more details about the multivariate statistical analysis are shown in the appendix). Sensitivity, specificity, predictive value and accuracy were determined for each variable obtained from MRs.

Ethical considerations

The retrospective cohort study was approved by the Ethics Committee of Hospital Juan A. Fernández.

RESULTS

A total of 246 post-COVID-19 patients were examined between August 2020 and December 2021. The results are shown in the tables of the supplementary material.

As to demographics and history, the average age was 52 ± 13 years, and 48 % were females. Seventy-six percent of the population had an increased body mass index, and 38 patients (15 %) reported a previously known heart disease. Eighty percent did not have symptoms before getting infected, and 92 % of the patients had fallen into functional class (FC) I before.

Concerning the acute stage of COVID-19, 78 % of the patients were hospitalized and in 24 % the disease became severe. Out of the total of the hospitalized patients, 18 % had any of the intra-COVID-19 cardiovascular complications (ICCCs), elevated enzymes being the most frequent one. Admission to the intensive care unit (ICU) was required by 17.6 % and mechanical ventilation (MV) by 8 %.

Regarding the post-COVID-19 cardiovascular examination,

50 % of the population was evaluated between 30 and 60 days after discharge. The prevalence of symptoms was not related to the time elapsed between discharge and the post-COVID-19 examination. Twenty-four percent of the patients had not developed symptoms at the time of the examination, and 29 % fell into FC II or higher. Among the possible cardiovascular symptoms, dyspnea was the most frequent one (28 %), and palpitations and precordialgia were each reported by 10 % of the population. On the other hand, 55 % took some kind of medication at the time of the examination, among which angiotensin-converting enzyme (ACE) inhibitors/angiotensin II receptor blockers (ARBs), hyperglycemic agents and anticoagulants were the most frequent. The physical examination revealed hypertension in 45 % and sinus tachycardia in 23 % of the patients. In addition, orthostatic hypotension was observed in 5 %, exaggerated chronotropic response to standing in 7 % and diagnostic criteria for postural tachycardia in 1 %. Signs of right- and left-sided heart failure were found in 5 % and 4 % of the population, respectively.

According to the EKG, sinus rhythm was observed in almost the entire population. Out of the 32 patients that showed conduction disorders, 19 were "de novo" events (16 in patients with no cardiovascular history and 3 in patients with a cardiovascular history). A prolonged QTc was determined in 8 % of the population; no patient had a QTc interval over 500 ms or a QTc interval dispersion over 80 ms. Moreover, sinus tachycardia and ventricular extrasystoly were the most frequent arrythmias.

As to the lab tests, the routine ones were normal in 134 patients (55 %), hyperglycemia being the most common disorder in 61 (27 %). Also, the CRP was high in 22 %, and both pro-BNP and troponin in 4 % of the population.

The echocardiogram revealed dilated left ventricle in 42 patients (17 %). Moderate or severe depressed left ventricular function was detected in 4 patients and segmental wall motion abnormalities in 5. Dilated right ventricle was observed in 42 patients (17 %) and dysfunction in 9 (4 %). All of these were "de novo" findings.

In the qualitative assessment of the results obtained by the diagnostic methods (Table 1), clinical interviews showed the highest index of suspicion (45 %). The physical examination, EKG and echocardiogram were normal in 60 %, 55 % and 75 %, respectively. Biomarkers were normal in 96 % of the cases.

Table 1. Qualitative summary of the diagnostic methods

	Normal *n* (%)	Non-specific abnormal *n* (%)	Suspicious abnormal *n* (%)
Clinical interview	58 (23.5)	76 (31)	112 (45.5)
Physical examination	148 (60)	71 (29)	27 (11)
EKG	136 (55)	78 (32)	32 (13)
Echocardiogram	184 (75)	47 (19)	15 (6)
	Normal	Abnormal	
Pro-BNP test	236 (96)	10 (4)	
Troponin test	235 (96)	11 (4)	

*Pro-BNP: Pro B-type natriuretic peptide.

In patients with DNCFs, the first diagnostic method whose abnormal result led to the final diagnosis was clinical interview in 33 patients, followed by physical examination in 12, EKG in 14, echocardiogram in 2 and troponin test in 1.

DNCFs were detected in 62 patients (25.2 %), out of whom 48 did not have a previously known heart disease.

Heart rhythm disorders were found in 42 patients (17 %): sinus tachycardia in 25 (20 as the only finding), sinus bradycardia in 3, ventricular arrhythmia in 18 and frequent supraventricular arrhythmia/atrial fibrillation in 6. Also, the following "de novo" conduction disorders were observed: complete right bundle branch block in 5, fascicular block in 1 and first-degree atrioventricular (AV) block in 2.

Ventricular dysfunction was detected in 20 patients (8 %). The etiology was ischemia-necrosis in 4, myocarditis in 5 and unexplained in 11. The final diagnosis was coronary artery disease, myocarditis and valvular heart disease in 5, 6 and 2 patients, respectively. Furthermore, post-COVID-19 pulmonary embolism (PE) was found in 10 patients.

The percentage of DNCFs was similar in the period from August 2020 to March 2021 ($n = 110$ patients, with prevalence of the Alpha and Beta variants) and in the period from April

to November 2021 (*n* = 136, with prevalence of the Delta variant).

Six patients (2.4 % out of all the evaluated population and 10 % of the patients with DNCFs) required rehospitalization because of heart failure.

In the variables of MRs associated with DNCFs (Table 2), patients with DNCFs were older and had higher prevalence of history of hypertension, diabetes and chronic obstructive pulmonary disease (COPD) than patients with no DNCF. The severity of COVID-19 did not differ in those two groups, but the emergence of cardiovascular complications in the acute stage and the presence of at least 2 risk factors for severe COVID-19 evidenced differences. The group of patients with DNCFs showed a more prolonged QTc interval; a lower hematocrit level; and higher leukocyte, urea and creatinine levels. Though the prevalence of CRP levels dichotomized as normal/abnormal were not different in both groups, higher continuous levels were found in the group of patients with DNCFs.

Table 2. Univariate analysis
A. Dichotomized variables (chi-square test)

Variable (prevalence %)	DNCFs YES *n* (%)	DNCFs NO *n* (%)	*p*
Male sex (52)	36 (58)	92 (50)	0.3
Caucasian ethnic group (61)	39 (63)	111 (60)	0.76
History (71)	49 (79)	126 (68)	0.14
Prior heart disease (15)	14 (23)	24 (13)	0.1
Hypertension (26)	27 (43.5)	36 (20)	0.0004
Diabetes (16)	18 (29)	21 (11)	0.002
Overweight (76)	45 (73)	143 (78)	0.48
COPD (8.5)	10 (16)	11 (6)	0.01
> 2 risk factors for COVID-19 (15)	18 (29)	19 (10)	0.0008
Prior medication (47)	35 (56)	81 (44)	0.1
ACE inhibitors/ARBs (21.5)	24 (39)	29 (16)	0.0003
Presence of prior symptoms (19)	13 (21)	34 (18)	0.7
Acute stage of COVID-19			
Mild (37)	23 (37)	68 (37)	1.0
Moderate (39)	22 (35.5)	74 (40)	0.5
Severe (24)	17 (27)	42 (23)	0.49
ICCC (18)	21 (34)	24 (13)	0.0005
Intra-COVID-19 PE (7)	7 (11)	11 (6)	0.16
Post-COVID-19 examination			
Post-COVID-19 symptoms (76)	52 (84)	136 (74)	0.12
Potentially cardiovascular symptoms (44)	32 (52)	76 (41)	0.18
Vital signs			
Hypotension (3)	1 (2)	7 (4)	0.68
Normotension (52)	25 (40)	102 (55)	0.04
Mild hypertension (32)	20 (32)	58 (31)	1
Hypertension > 160 (12)	12 (21)	16 (9)	0.018
Sinus bradycardia (3)	3 (5)	4 (2)	0.37
Elevated CRP level (21)	15 (28)	36 (21)	0.35

*ACE inhibitors/ARBs: angiotensin-converting enzyme inhibitors / angiotensin II receptor blockers.

B. Continuous variables (Student's t or Mann-Whitney U tests)

Variable (prevalence)	DNCFs YES	DNCFs NO	*p*
Age (years)	56.9 ± 13.6	50.4 ± 12.4	0.0002
EKG			
PR (ms)	156 ± 21	154 ± 21	0.67
P (ms)	96 ± 16	97 ± 17	0.7
P/PR	0.58 ± 0.1	0.62 ± 0.12	0.12
QT (ms)	357 ± 34	365 ± 24	0.08
QTc (ms)	424 ± 31	406 ± 23	0.0001
QTd (ms)	38.4 ± 15	38.5 ± 16	0.98
Lab tests			
Hematocrit (%)	39.9 ± 5,1	41.4 ± 3.8	0.01
Leukocytes (mm³)	8,449 ± 2,300	7,058 ± 1,699	0.0001
Glycemia (mg/dl)	111.2 ± 25.9	104.5 ± 26.7	0.1
Urea (mg/dl)	37.4 ± 15.2	30.1 ± 10.8	0.0001
Na+ (mmol/l)	140 ± 2.5	140.5 ± 2.6	0.61
K+ (mmol/l)	4.2 ± 0.5	4.6 ± 3.2 (4,3)	0.39
Creatinine (mg/dl)	0.91 ± 0.47	0.70 ± 0.2	0.003
CRP (mg/dl) (median)	0.78 ± 1.3 (0.35)	0.74 ± 2.4 (0.24)	0.02
Troponin (ng/l) (median)	13 ± 24 (3.9)	5 ± 19 (3)	0.0001
Pro-BNP (pg/ml) (median)	179 ± 465 (18)	15.5 ± 13 (9)	0.0001

The multivariate analysis (Table 3) shows variables with significant Wald test *p* value: post-COVID-19 cardiovascular complications (PCCCs), history of COPD, QTc ≥ 440 ms and leukocytosis (WBC ≥ 10,000/mm³), out of which QTc was the most significant. A trend toward to statistical significance was observed in patients ≥ 65 years old with creatinine ≥ 1 mg/dl.

Table 3. Multivariate model

DNCFs	Odds ratio	Std err	*z*	*p/z*	95 % CI
ICCC	2.86	1.2	*2.4*	*0.013*	*1.24-6.54*
Age > 65 years	2.32	1.0	*1.9*	*0.058*	*0.97-5.54*
COPD	3.20	1.8	*2*	*0.045*	*1.02-9.99*
QTc > 440 ms	5.10	2.5	*3.3*	*0.001*	*1.91-13.63*
Leukocytosis (WBC > 10,000/mm³)	4.16	2.3	*2.5*	*0.011*	*1.37-12.5*
Creatinine > 1 mg/dl	2.33	1	*1.87*	*0.61*	*0.96-5.69*

Table 4 shows sensitivity, specificity and predictive value of different data from MRs. None of the data selected from MRs reaches a high positive predictive value. Thus, "dyspnea" has a low positive predictive value for ventricular dysfunction, and the same occurs with "palpitations" for arrhythmia.

Table 4. Sensitivity, specificity and predictive value for DNCFs from different clinical data

Variable (prevalence)	Sensitivity	Specificity	Predictive value (+)	Predictive value (-)	Accuracy
Male sex (52)	0.58	0.50	0.28	0.78	0.52
Caucasian ethnic group (61)	0.63	0.40	0.26	0.76	0.46
History (71)	0.79	0.32	0.28	0.82	0.43
Prior heart disease (15)	0.23	0.87	0.37	0.77	0.71
Hypertension (26)	0.44	0.80	0.43	0.81	0.71
Diabetes (16)	0.29	0.89	0.46	0.79	0.74
Overweight (76)	0.73	0.22	0.24	0.71	0.35
COPD (8.5)	0.16	0.94	0.48	0.77	0.74
2 to 4 risk factors for COVID-19 (15)	0.29	0.90	0.49	0.79	0.74
Prior medication (47)	0.56	0.56	0.30	0.79	0.56
ACE inhibitors/ARBs (21.5)	0.39	0.84	0.45	0.80	0.73
Presence of prior symptoms (19)	0.21	0.82	0.28	0.75	0.66
Acute stage of COVID-19					
Mild (37)	0.37	0.63	0.25	0.75	0.6
Moderate (39)	0.35	0.60	0.23	0.73	0.5
Severe (24)	0.27	0.77	0.29	0.76	0.65
ICCC (18)	0.34	0.87	0.47	0.80	0.74
Intra-COVID-19 PE (7)	0.11	0.94	0.39	0.76	0.73
Post-COVID-19 examination					
Post-COVID-19 symptoms (76)	0.84	0.26	0.28	0.83	0.41
Potentially cardiovascular symptoms (44)	0.52	0.59	0.30	0.78	0.57
Vital signs					
Systolic pressure < 100 (3)	0.02	0.96	0.13	0.76	0.73
Normotension (52)	0.40	0.45	0.20	0.69	0.43
Hypertension > 160 mmHg (12)	0.21	0.91	0.43	0.78	0.74
Sinus bradycardia (3)	0.05	0.98	0.43	0.75	0.74
Left ventricle dysfunction					
Dyspnea (28)	0.61	0.75	0.16	0.96	0.74
Arrhythmias					
Palpitations (10)	0.17	0.92	0.29	0.85	0.79

The history of COPD and the presence of more than one risk factor for severe COVID-19 were the data with the highest specificity but with low sensitivity.

DISCUSSION

This study shows the results of post-COVID-19 outpatient cardiovascular examination in an unselected population between 30 and 120 days after discharge from the acute stage. The population included patients of both sexes with different severity of COVID-19 in the acute stage. The Amerindian ethnic group accounted for at least one-third of the population. Furthermore, it should be noted that a high rate of patients was overweight.

Based on a comprehensive review of post-COVID-19 cardiovascular sequelae, Raman et al. [3] proposed a cardiovascular diagnostic procedure adapted to the patient's risk, which included 3 high-risk groups: patients who had any of the PCCCs, those who had "de novo" symptoms or signs and athletes. They proposed a first diagnostic stage comprising MRs, EKG, echocardiogram and lab tests. Subsequent studies would be requested according to the prior suspicion.

In this research the population was not selected as per the aforementioned risk criteria. Instead, the observations were related to a "real" population that visited a consultation room for post-COVID-19 cardiovascular examination. Besides the history of COVID-19 infection, only cardiac biomarkers and echocardiogram with no clinical suspicion were systematically required.

As in other studies, a high percentage of patients with persistent symptoms were found. Any of the potentially cardiovascular symptoms occurred in 42 % of the patients. Other studies have pointed out percentages of up to 86 % [4] and 89 % [5], even 7 months after the acute stage. However, the positive predictive value of symptoms to detect ventricular dysfunction or arrythmias was low. Dyspnea as well as palpitations may be explained by other reasons during the recovery from an infectious respiratory illness under pandemic conditions.

In this study population, 25 % of the patients had DNCFs, out of which only 2.4 % had high clinical significance. The most frequent ones were heart rhythm disorders, followed by ventricular dysfunction. This study did not have the design required to clarify the actual prevalence of DNCFs since the diagnostic procedure was the usual one in clinical practice. A possible approach to the "actual" prevalence of post-COVID-19 findings/sequelae was suggested by retrospective large-scale population-based cohort studies conducted by health agencies in which they were analyzed in a general way. The information agreed regarding the higher risk for sequelae in the post-COVID-19 population than in different control groups [6,7]. It was found that almost one-third of the population were rehospitalized due to major cardiovascular events, among other reasons [8]. Heart arrythmias were the disorder with higher risk gradient compared with the control population [9]. It was highlighted that increased—though lower—risk persisted, even in young patients that had mild COVID-19. Tazare et al. agreed upon the increased risk of post-COVID-19 cardiovascular sequelae, but pointed out that it was not higher than that observed in hospitalized patients with other lower respiratory tract infections in 2019 [10].

In 2020, Puntmann et al. found a very high prevalence (60 %) of myocardial inflammation by using magnetic resonance imaging (MRI) in post-COVID-19 patients, even those who had mild symptoms.[11]. Since then, the results of other studies have been different. For example, Daniels et al. [12] reported a prevalence of clinical and subclinical myocarditis of 2.3 % in a population of 1,597 athletes, while Eiros et al. [13] pointed out 7.9 % of myopericarditis and 17.3 % of isolated myocarditis in 139 healthcare workers. In our setting, a study conducted in 24 professional soccer players who suffered from mild or asymptomatic COVID-19 did not find physical, electrocardiographic, echocardiographic or MRI alterations [14].

In our study and others [15-17], sinus tachycardia was the most frequent heart rhythm disorder. This condition is not exclusive of COVID-19 since it was described as a sequela of other infectious diseases [18,19]. Though a possible high prevalence of postural tachycardia related to dysautonomia or inflammatory events has been stated, only 3 patients in our study complied with the criteria for such entity [20,21].

Age over 65 years was associated with DNCFs in a univariate analysis, although it only shows a trend in the multivariate model. The QTc duration was the variable with the highest statistical weight. The reason was probably the persistence of an inflammatory state since, despite the percentage of patients with abnormal polymerase chain reaction (PCR) was similar with or without DNCFs, absolute values were higher in the first group. The association of a prolonged QTc interval with an inflammatory state has been previously described [22,23]. A strong association between the QTc interval and IL-6 levels was observed in autoimmune diseases [24]. Likewise, the treatment with IL-6 inhibitors normalized the QTc interval in patients with rheumatoid arthritis [25].

The differences mentioned in this report between the first and second wave probably reflect a) demographic differences between the population treated during the first and the second wave and b) changes to the guidelines concerning hospitalization criteria. Variables that were potentially related to the pathogenicity of any of the strains did not show differences between the two periods.

The limitations found in the study included the following: out of the 2,103 hospitalized patients during this record period, 246 (12 %) were evaluated, which could have involved a multifactorial bias.

The record was created using the information from patients who visited a cardiology outpatient consultation room. The prevalence of DNCFs in patients who may have been admitted directly to the emergency room or hospitalized cannot be inferred from such record.

The term "de novo" means the progression of a known heart disease or the emergence of a previously unknown—but not necessarily absent—cardiovascular finding. Nevertheless, most of the population reported being asymptomatic and previously falling into FC I.

The study evaluated patients in a wide time frame between 30 and 120 days. However, the time between the discharge and post-COVID-19 examination was not related to the detection of DNCFs.

The evaluation reflected the condition in a specific time during the recovery period. Later complications can be responded only with a longitudinal follow-up.

In conclusion, the prevalence of DNCFs based on a cardiovascular examination in an outpatient consultation room in an unselected population that suffered COVID-19 reached 25 %. Nevertheless, only approximately 2 % of the patients had a higher clinical significance.

As to the diagnostic methods, interviews were the first to determine a clinical suspicion, followed by EKG. The echocardiogram and cardiac biomarkers detected very few previously unsuspected cases.

Some clinical data, lab tests and QTc interval duration were independently associated with DNCFs. It is important to rate the risk of cardiovascular sequelae due to the dimension of the pandemic. Observations based on this record suggest that, at least in the analyzed time frame, the emphasis should be placed on those patients who suffered from cardiovascular complications in the acute stage or had a history of COPD or a more prolonged QTc interval.

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