Family Medicine and Primary Care: Open Access
Muja E, et al. J Family Med Prim Care Open Acc 6: 208.
www.doi.org/10.29011/2688-7460.100208
www.gavinpublishers.com

Research Article

Covid 19 and Cardiovascular Complications

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Citation: Muja E, Laçi I, Doko Xh, Marko S, Akshija I (2022) Covid 19 and Cardiovascular Complications. J Family Med Prim Care Open Acc 6: 208. DOI: 10.29011/2688-7460.100208

Received Date: 23 November, 2022; **Accepted Date:** 29 November, 2022; **Published Date:** 05 December, 2022

Abstract

Background: Coronavirus disease 2019 (COVID-19) rapidly spread around the world becoming a global public health emergency. It is caused by a novel enveloped, positively stranded RNA beta coronavirus named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1]. COVID-19 has been found to interact and influence the cardiovascular system leading to myocardial damage and cardiac and endothelial dysfunction mainly through the angiotensin 2 converting enzyme receptor (ACE-2). On the one hand, respiratory symptoms are worse in COVID-19 patients with pre-existing heart disorders; on the other hand, new-onset cardiac dysfunction is common in this subgroup. Indeed, heart damage was noted even without the clinical features of respiratory disease. **Methods:** We included 219 patients in the study who met our admission criteria. Patients were divided into 2 categories according to the severity of the disease covid -19: Moderate - severe (According to the classification, this group includes all patients who do not need intensive care at the time of admission and require low amounts of oxygen supplementation <5L) and Severe (All unstable patients requiring high-liter oxygenation >5 L and intensive care). **Results:** Our data show that 65.1% of patients presenting with arterial hypertension develop critical covid 19 and 56.4% of those without arterial hypertension have moderate to severe covid 19. 81.0% of patients diagnosed with diabetes mellitus 2, manifest critical covid -19, 19.0% of cases instead manifest moderate-severe covid-19. Ischemic heart disease as one of the complications visualized during covid 19 was observed in 31 patients, from which 22 patients experience critical covid 19, constituting a total of 71.0% of cases and 9 patients experience a moderate-severe form of covid 19 (29.0%). The results of mortality show that from 42 patients with diabetes mellitus, 57.1% (24 patients) face death and from 177 patients without diabetes mellitus, only 25.4% (45 patients) has this result. From 31 patients with ischemic heart disease during Covid 19 disease, 11 patients or 35.5% go to death. We can also see that from 188 clinical cases that do not have ischemic heart disease as a complication from covid 19, only 58 patients go to death, therefore 30.9%. **Conclusion:** This original study confirms that Covid 19, being an infectious disease capable of causing an important systemic inflammation, can compromise the cardiovascular system by predisposing to some complications such as the onset of ischemic heart disease and arrhythmias. Arterial hypertension, Diabetes mellitus and Ischemic heart disease are significant factors for the development of a severe Covid disease and Diabetes mellitus is a statistically significant factor for mortality.

Keywords: Arterial hypertension; COVID-19; Diabetes; Mortality; Severity

Introduction

Coronavirus disease 2019 (COVID-19) rapidly spread around the world becoming a global public health emergency. It is caused by a novel enveloped, positively stranded RNA beta coronavirus named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1]. Although COVID-19 was initially considered a respiratory disease, it has rapidly become clear that a multiorgan involvement was common. In particular, the heart often represents a target organ and patients may develop Heart Failure (HF). COVID-19 has been found to interact and influence the cardiovascular system leading to myocardial damage and cardiac and endothelial dysfunction mainly through the Angiotensin 2 Converting Enzyme receptor (ACE-2) [2]. On the one hand, respiratory symptoms are worse in COVID-19 patients with pre-existing heart disorders; on the other hand, new-onset cardiac dysfunction is common in this subgroup. Indeed, heart damage was noted even without the clinical features of respiratory disease [3].

Some patients who contract COVID-19 are asymptomatic, others have mild to moderate disease, and approximately 5-8% of infected patients develop hypoxia, bilateral pulmonary infiltrates, impaired pulmonary compliance, resulting in acute respiratory failure requiring Non-Invasive Ventilation (NIV) or mechanical ventilatory support, septic shock, and multiple organ failure. It is estimated that 17.9% to 33.3% of infected patients will remain asymptomatic [4].

Based on disease severity, clinical symptoms and laboratory, radiographic abnormalities, hemodynamics and organ function, the National Institutes of Health of New York (NIH) has published guidelines that classify COVID-19 into five distinct types. clinically; Mild disease which includes all those individuals who have symptoms of COVID-19 such as fever, cough, sore throat, malaise, headache, body aches, nausea, vomiting, diarrhoea, anosmia or dysgeusia but without wheezing or imaging of the abnormal chest. Moderate disease, which includes all those individuals who have clinical symptoms or radiological evidence of lower respiratory tract disease and who have an oxygen saturation (SpO_2) ≥ 94% in the ambient air. Serious disease in which all those individuals who have (SpO_2) ≤ 94% in the ambient air belong; a ratio between the partial pressure of arterial oxygen and the fraction of inspired oxygen, (PaO_2 / FiO_2) <300 with marked tachypnea with respiratory rate> 30 breaths / min or pulmonary infiltrates> 50%. Critical illness, which includes all those individuals who have acute respiratory failure, septic shock or multi-organ dysfunction. Patients with severe COVID-19 disease can develop Acute Respiratory Distress Syndrome (ARDS), which tends to occur approximately one week after the onset of symptoms. ARDS is a new onset of severe respiratory failure or is due to a worsening of an already identified respiratory picture. Instead, extra pulmonary manifestations include; Renal manifestations in which hospitalized patients with severe COVID-19 may experience acute kidney injury, other clinical and laboratory manifestations include proteinuria, haematuria, electrolyte abnormalities such as hyperkalaemia, hyponatremia, acid-base disturbances such as metabolic acidosis [5].

Cardiac manifestations include myocardial damage manifested as Myocardial Ischemia or Infarction (MI) and myocarditis, acute coronary syndromes, arrhythmias, cardiomyopathy, and cardiogenic shock [6,7].

The leading cause of death in COVID-19 is Acute Respiratory Distress (ARDS); however, there is no shortage of cases in which death is due to involvement of the cardiovascular system and shock [2]. The presence of chronic heart disease or cardiac involvement leads to a higher mortality rate than in patients without cardiovascular disease [8].

The presence of chronic heart disease or cardiac involvement leads to a higher mortality rate than in patients without cardiovascular disease [8]. In a report of 44,672 confirmed cases of COVID-19 from the Chinese Center for Disease Control and Prevention, the overall mortality rate was 2.3% for the entire cohort but significantly higher for patients with hypertension (6%), diabetes (7%) or cardiovascular disease (11%) [9]. Some patients with COVID-19 have shown ST-segment elevation on ECG [10]. The pathophysiology of ACS in COVID-19 is unclear, but it may be related to SARS-CoV-2 direct endothelial damage, micro thrombi formation or systemic inflammation and cytokine storm resulting in plaque rupture or coronary spasm [11]. A retrospective study of 416 hospitalized COVID-19 patients found that 20% had an underlying myocardial lesion; these patients had a much higher mortality rate (51%) than patients without heart damage (5%) [12]. Most early studies did not report echocardiographic or cardiac Magnetic Resonance Imaging (MRI) findings. Subsequent studies identified patients with myocardial damage resulting in abnormal cardiac imaging and cardiac contractile dysfunction [13]. The histopathological evidence of COVID-19 affecting the myocardium is limited. In one case report, a patient with COVID-19 developed ARDS, hypotension, and cardiogenic shock. Endomyocardial biopsy showed low-grade myocardial inflammation with coronavirus particles observed in the myocardial interstitium [14].

The Aim of the Study

1. Highlight which are the cardiovascular complications among patients hospitalized with Covid -19.
2. Evaluate how cardiovascular diseases affect Covid -19.
3. Study of the mortality based on covid -19 severity and how the cardiovascular diseases affect this result.

Materials and Methods

In this retrospective analysis, the clinical data of about 400 patients with a positive history of covid -19, treated in the covid ward of two hospital centers, in the period 1 March 2021 -31 December 2021, were verified, from which were excluded the

patients who did not have adequate clinical data for the study. We included 219 patients in the study who met the inclusion criteria.

The inclusion criteria are:

1. Patient with covid -19 diagnosed with positive RT PCR, admitted to a specialized ward for covid 19.
2. Patient with interstitial pneumonia and with moderate to severe or critical disease.
3. Patients who have undergone cardiological evaluation (ECG, cardiac enzymes, echocardiogram)
4. Patients were divided into 2 categories according to the severity of the disease covid -19;

- Moderate - severe (According to the classification, this group includes all patients who do not need intensive care at the time of admission and require low amounts of oxygen supplementation < 5 L)
- Severe (All unstable patients requiring high-liter oxygenation and intensive care > 5 L)

The exclusion criteria are:

- Age less than 18 years
- Patients with an unknown diagnosis of Covid 19, i.e. without a positive RT PCR analyses
- Patients without a full cardiac evaluation

In this retrospective study, the medical records of patients with a previous history of cardiovascular disease and a positive history of covid -19 were studied. All complications of hospitalized patients were considered and we analyzed ECG, Echocardiogram and laboratory tests of all patients. We analyzed a total of 219 patients including 92 females and 127 males. We reported patient data in tables in excel, based on sex, age, severity of covid - 19, pre-existing heart disease and heart disease that appeared during hospitalization for covid -19, from which we then came to the statistical analysis.

Definitions

All definitions that we used, are taken from ESC (European Society of Cardiology) Guidelines.

Arterial hypertension: All patients with a positive history of arterial hypertension with or without ongoing therapy.

Newly onset arterial hypertension: Sustained high values of blood pressure; High normal 130-139 and/or 85-89 , 1 grade hypertension 140-159 and/or 90-99 , Grade 2 hypertension 160-179 and/or 100-109 Grade 3 hypertension ≥180 and/or ≥110 Isolated systolic hypertension.

Ventricular arrhythmia subtypes: Premature Ventricular Complex (PVC): Premature occurrence of an abnormal QRS complex (duration typically ≥120 ms, corresponding T-wave typically broad and in the opposite direction of the major QRS deflection, no preceding P-wave).

Unifocal or monomorphic PVCs: PVCs with a single QRS morphology.

Multifocal, multiform, or polymorphic PVCs: PVCs with different QRS morphologies.

Short-coupled PVC: A PVC that interrupts the T-wave of the preceding conducted beat.

Ventricular Tachycardia (VT): ≥3 consecutive beats with a rate >100 b.p.m. originating from the ventricles, independent from atrial and atrioventricular (AV) nodal conduction.

Non-sustained Ventricular Tachycardia (NSVT): Run of consecutive ventricular beats persisting for 3 beats to 30 s.

Monomorphic Ventricular Tachycardia (MVT): Same QRS morphology from beat to beat.

Polymorphic Ventricular Tachycardia (PVT): Continually changing QRS morphology.

Sustained Monomorphic/Polymorphic Ventricular Tachycardia (SMVT/SPVT): Continuous VT for at least 30 s, or which requires an intervention for termination.

Bidirectional Ventricular Tachycardia: Beat to beat alternation of the frontal QRS axis (e.g. in Catecholaminergic Polymorphic Ventricular Tachycardia [CPVT], Andersen–Tawil, digoxin toxicity, acute myocarditis).

Torsades de pointes ventricular tachycardia (TdP): Subtype of a polymorphic VT in the context of QT prolongation with continually changing QRS complexes that appear to spiral around the baseline of the electrocardiogram (ECG) lead in a sinusoidal pattern.

Ventricular Fibrillation (VF): A chaotic rhythm with undulations that are irregular in timing and morphology, without discrete QRS complexes on the surface ECG.

Electrical storm: VA that occurs 3 or more times within 24 h (separated by at least 5 min), each requiring termination by an intervention.

Incessant VT: Continuous sustained VT that recurs promptly despite repeated intervention for termination over several hours.

Diabetes mellitus: Patients with positive anamnesis for diabetes with or without ongoing treatment; fasting glucose <110 mg/dl, 2 hours after eating glucose >180 mg/dl.

Ischemic cardiopathy: Includes the acute coronary syndromes such as unstable angina, NSTEMI and STEMI.

Unstable angina: Defined as myocardial ischaemia at rest or on minimal exertion in the absence of acute cardiomyocyte injury/ necrosis.

Acute Myocardial Infarction (AMI): defines cardiomyocyte necrosis in a clinical setting consistent with acute myocardial

ischaemia. A combination of criteria is required to meet the diagnosis of AMI:

1. Symptoms of myocardial ischaemia.
2. New ischaemic ECG changes.
3. Development of pathological Q waves on ECG.
4. Imaging evidence of loss of viable myocardium or new regional wall motion abnormality in a pattern consistent with an ischaemic aetiology.
5. Intracoronary thrombus detected on angiography or autopsy.

NSTEMI: Non ST Elevation Myocardial Infarction; STEMI: ST Elevation Myocardial Infarction; AF: Atrial Fibrillation. A supraventricular tachyarrhythmia with uncoordinated atrial electrical activation and consequently ineffective atrial contraction.

AF Classification

- **First diagnosed**: AF not diagnosed before, irrespective of its duration or the presence/severity of AF-related symptoms.
- **Paroxysmal**: AF that terminates spontaneously or with intervention within 7 days of onset.
- **Persistent**: AF that is continuously sustained beyond 7 days, including episodes terminated by cardioversion (drugs or electrical cardioversion) after ≥7 days
- **Long-standing persistent:** Continuous AF of >12 months' duration when decided to adopt a rhythm control strategy.
- **Permanent:** AF that is accepted by the patient and physician, and no further attempts to restore/maintain sinus rhythm will be undertaken. Permanent AF represents a therapeutic attitude of the patient and physician rather than an inherent pathophysiological attribute of AF, and the term should not be used in the context of a rhythm control strategy with antiarrhythmic drug therapy or AF ablation. Should a rhythm control strategy be adopted, the arrhythmia would be re-classified as 'long-standing persistent AF'.

Statistical Analyses

Data processing was performed in the SPSS platform. We processed data on the number of cardiovascular complications in total and the number of special complications according to the pathologies. The elaboration of these data to extract the different statistical meanings was elaborated in the SPSS program.

We also used logistic regression analysis, using two variables which are age and sex, as they are characteristics common to the two diseases, cardiovascular diseases and Covid 19 disease. The data are entered in separate tables and in the summary table, together with the multivariate logistic analysis as well as in different graphs.

Results

In this study, 219 patients were presented to the hospital with a positive history for covid-19, concluding the admission criteria, of which 92 were females and 127 were males.

Severity of Covid 19: From 92 females affected by covid -19, 44 of them had a moderate-severe disease (47.8%) and 48 females a critical covid 19 disease (52.2%).

From the data we can see that from 86 patients with positive anamnesis for arterial hypertension, 56 patients had a critical disease and 30 patients a moderate -severe form of the infection. From the patients who did not have hypertension, 75 had a moderate - severe disease and 58 patients had critical covid 19. In the majority of cases, clinical data show that 65.1% of patients presenting with pre-existing hypertension have critical covid 19 and 56.4% of those without pre-existing arterial hypertension have moderate-to-severe covid 19. Thus, arterial hypertension is significant in the severity of covid 19 (p 0.002).

Arterial hypertension also is one of the main complications observed in 69 patients with covid -19 from which, 36 patients manifest a critical form of covid 19, (52.2%). From a total of 150 patients who do not experience arterial hypertension during covid -19, 72 manifest a moderate-severe disease, and 78 patients manifest a critical form.

The 81.0% of patients diagnosed with diabetes mellitus 2, manifest critical covid -19 disease, 19.0% of cases instead manifest moderate-severe covid-19. These clinical data indicate that type 2 diabetes mellitus has a very high statistical significance in the severity of covid -19 (p 0.0001).

Ischemic heart disease observed during covid 19 in 31 patients, from which 22 patients manifest critical covid 19, (71.0%) and 9 patients experienced moderate-to-severe covid 19 (29.0%). Although the number of patients who complicate during covid 19 ischemic heart disease is lower than in patients who do not show ischemic c during infection, clinical data show that ischemic heart disease has a statistical significance in the severity of covid 19 (P 0.002). From 11 patients presenting with atrial fibrillation, 90.9% show a critical form of disease and only 9.1% a moderate-severe degree of the disease (P 0.007).

Mortality

From 92 females, 30 (32.6%) face death, while 62 (67.4%) recover. On the other hand, from 127 males, 39 (30.7%) go to death while 88 (69.3%) recover. Mortality is slightly higher among women because of the older age but this result is not statistically significant (P 0.7).

From 42 patients with diabetes mellitus, 57.1% (24 patients) face death, thus constituting the majority of cases. On the other hand, from 177 clinical cases without diabetes mellitus, only 25.4% (45 patients) go to death (P 0.0001).

In this statistical analysis adjusted for age and sex (therefore the influence of age and sex was removed) we analysed the severity and mortality of patients with covid 19, and how different factors taken in the study influence the severity and mortality (Tables 1 and 2) (Figures 1-4).

	Severity				
Variable	**Moderate-severe**	**Critical**	**P-value**	**P adjusted (sex and age)**	**Total**
Sex (m)	61 (58.1%)	66 (57.9%)	0.976		127 (58.0)
Age	62.77 ± 12.12	67.96 ± 10.92	**0.001**		65.47 ± 11.77
Preexisting hypertension	30 (28.6%)	56 (49.1%)	**0.002**	**0.021**	86 (39.3%)
Hypertension during Covid	33 (31.4%)	36 (31.6%)	0.981	0.946	69 (31.5%)
Diabetes mellitus type 2	8 (7.6%)	34 (29.8%)	**0.000**	**0.000**	42 (19.2%)
Anamnestic ischemic cardiopathy	1 (1.0%)	6 (5.3%)	0.074	0.187	7 (3.2%)
Ishemic cardiopathy during covid	9 (8.6%)	22 (19.3%)	**0.023**	**0.057**	31 (14.2%)
Atrial fibrillation	1 (1.0%)	10 (8.8%)	**0.007**	0.061	11 (5.0%)
Ventricular arrhythmia	1 (1.0%)	6 (5.3%)	0.074	0.178	7 (3.2%)
BAV	2 (1.9%)	10 (8.8%)	**0.024**	0.057	12 (5.5%)
Pericarditis	1 (1.0%)	1 (0.9%)	0.730		2 (0.9%)
Myocarditis	0 (0.0%)	1 (0.9%)	0.521		1 (0.5%)
PTE	1 (1.0%)	2 (1.8%)	0.531		3 (1.4%)
VTE	0 (0.0%)	1 (0.9%)	0.521		1 (0.5%)
Stroke	0 (0.0%)	1 (0.9%)	0.521		1 (0.5%)
Mortality	**3 (2.9%)**	**66 (57.9%)**	**0.000**	**0.000**	**69 (31.5%)**
Hypertension	**63 (60.0%)**	**92 (80.7%)**	**0.001**	**0.013**	**155 (70.8%)**
Ischemic cardiopathy	**10 (9.5%)**	**28 (24.6%)**	**0.003**	**0.016**	**38 (17.4%)**
All Complications 2					
0	36 (34.3%)	12 (10.5%)			48 (21.9%)
1	52 (49.5%)	41 (36.0%)			93 (42.5%)
2	16 (15.2%)	41 (36.0%)			57 (26.0%)
3	1 (1.0%)	17 (14.9%)			18 (8.2%)
4	0 (0.0%)	3 (2.6%)			3 (1.4%)
Total	105 (47.9%)	114 (52.1%)	0.000	0.000	219 (100%)

Table 1: Severity of Covid 19 and Cardiovascular complications. Logistic regression analyses.

	Mortality				
Variable	**no**	**yes**	**P-value**	**P adjusted (sex and age)**	**Total**
Sex (m)	88 (58.7%)	39 (56.5%)	0.765		127 (58.0)
Age	64.81 ± 11.89	66.90 ± 11.47	0.219		65.47 ± 11.77
Preexisting Hypertension	55 (36.7%)	31 (44.9%)	0.245	0.405	86 (39.3%)
Hypertension during covid	48 (32.0%)	21 (30.4%)	0.817	0.772	69 (31.5%)
Diabetes mellitus 2	18 (12.0%)	24 (34.8%)	**0.000**	**0.000**	42 (19.2%)
Anamnestic ischemic cardiopathy	3 (2.0%)	4 (5.8%)	0.143	0.206	7 (3.2%)
During covid cardiopathy	20 (13.3%)	11 (15.9%)	0.607	0.724	31 (14.2%)
Atrial fibrillation	5 (3.3%)	6 (8.7%)	0.091	0.152	11 (5.0%)
Ventricular arrhythmia	**2 (1.3%)**	**5 (7.2%)**	**0.033**	**0.050**	**7 (3.2%)**
BAV	7 (4.7%)	5 (7.2%)	0.314	0.474	12 (5.5%)

Pericarditis	2 (1.3%)	0 (0.0%)	0.730		2 (0.9%)
Myocarditis	0 (0.0%)	1 (1.4%)	0.315		1 (0.5%)
PTE	3 (2.0%)	0 (0.0%)	0.319		3 (1.4%)
VTE	1 (0.7%)	0 (0.0%)	0.685		1 (0.5%)
STROKE	0 (0.0%)	1 (1.4%)	0.315		1 (0.5%)
Mortality					
Hypertension	103 (68.7%)	5 (75.4%)	0.311	0.538	155 (70.8%)
Ischemic Cardiopathy	23 (15.3%)	15 (21.7%)	0.245	0.344	38 (17.4%)
All complications 2					
0	38 (25.3%)	10 (14.5%)			48 (21.9%)
1	69 (46.0%)	24 (34.8%)			93 (42.5%)
2	34 (22.7%)	23 (33.3%)			57 (26.0%)
3	9 (6.0%)	9 (13.0%)			18 (8.2%)
4	0 (0.0%)	3 (4.3%)			3 (1.4%)
Total	150 (68.5%)	69 (31.5%)	0.000	0.001	219 (100%)

Table 2: Mortality of the Covid 19 patients according to the presence of cardiovascular complications.

The variables that most influence and condition the severity of COVID-19 are:

- Pre-existing arterial hypertension diagnosed during Covid -19 (P 0.010)
- Diabetes mellitus (P 0.0001)
- Ischemic heart disease diagnosed previously and during Covid 19 (P 0,05)

The variables that most influence mortality from a statistical point of view:

- Diabetes mellitus 2 (P 0.0001)
- Ventricular arrhythmia (P 0,050)

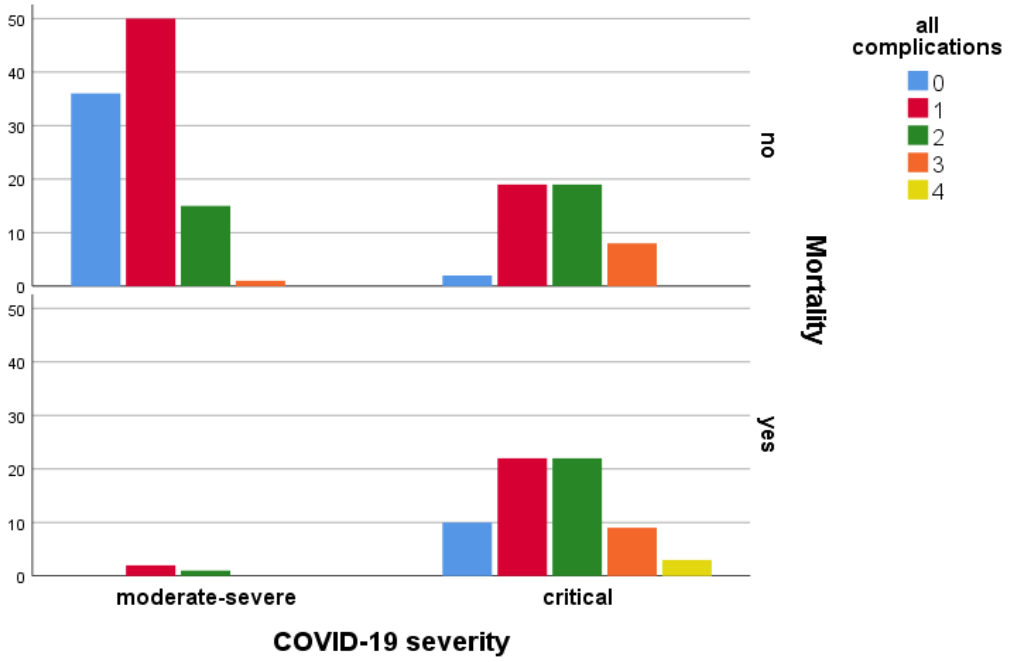

Figure 1: Mortality of the Covid 19 patients according to the severity of the disease and the number of cardiovascular complications.

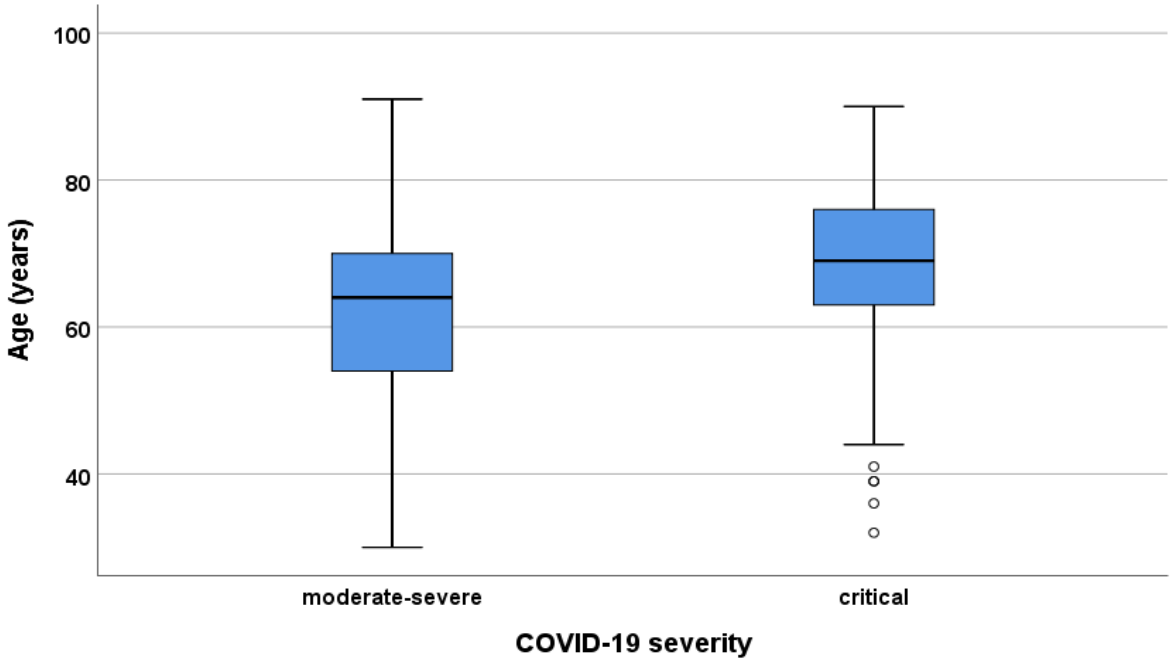

Figure 2: Age and Covid 19 severity.

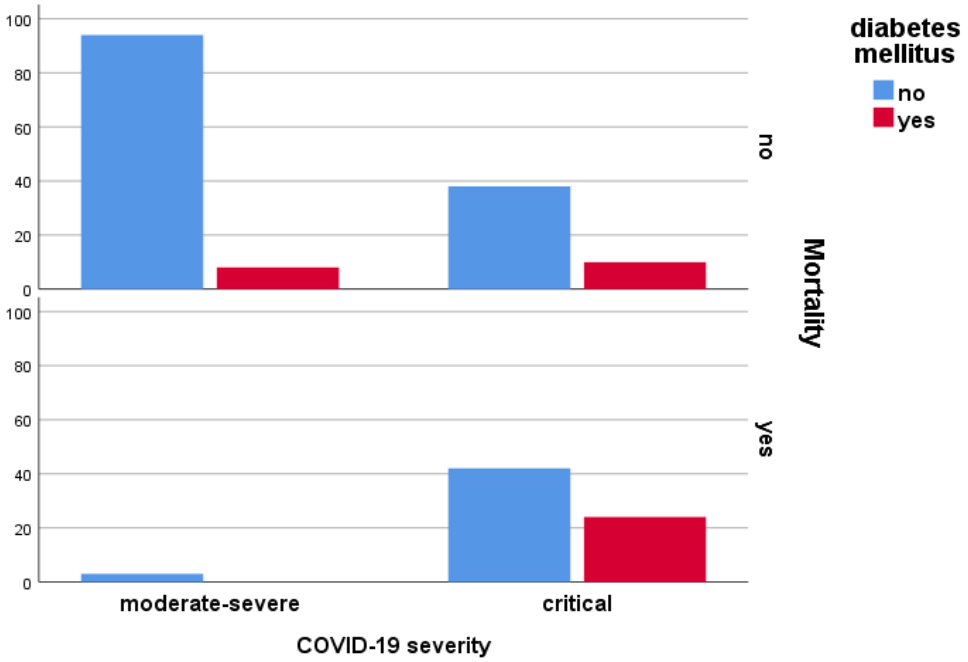

Figure 3: Mortality according Covid 19 severity and the presence of diabetes mellitus type 2.

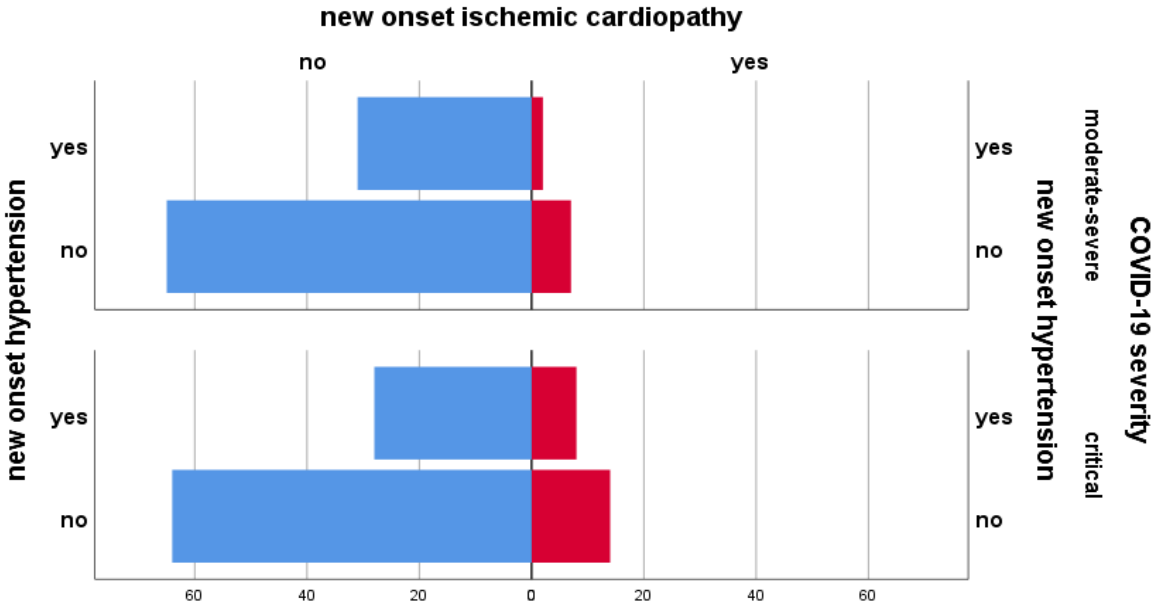

Figure 4: Covid 19 severity according to the new onset arterial hypertension and new onset ischemic cardiopathy.

Discussion

Our study shows that patients with severe SARS Cov 2 or Covid 19 are more likely to develop major cardiovascular complications such as ischemic heart disease. This could be attributed to the significant inflammation that characterizes a large number of cases with this

infectious disease. In these cases we may also have an increased likelihood for other complications which are related to both the impairment of the patient's general situation and ischemic heart disease. Clinically relevant complications include arrhythmias such as atrial fibrillation with other ventricular response and ventricular arrhythmias such as ventricular tachycardia or ventricular fibrillation. These rhythm disturbances significantly affect the patient's condition and indicate a poor prognosis.

Other important findings of our study are the patient's pre-existing conditions or comorbidities. Among the most important conditions are arterial hypertension and type 2 diabetes mellitus. We understand that patients with a history of arterial hypertension and diabetes mellitus have much more chance of having severe Covid disease. We must underline that among patients with Diabetes mellitus mortality is higher and this result continues as such even after the regression analysis. In our analysis it appears that diabetes mellitus increases the mortality rate 3.8 times among patients hospitalized with Covid. In this case we can say with certainty that Diabetes mellitus is an important factor for the severity of the Covid disease and for the patient's prognosis.

Regarding ischemic heart disease, we have two categories of patients, those with anamnestic, i.e. pre-existing ischemic heart disease and those diagnosed with ischemic heart disease during hospitalization for Covid. Overall we have seen that the presence of this pathology predisposes to a more severe degree of Covid and contributes to a poorer prognosis. Exactly, ischemic heart disease increases the likelihood of having a higher grade pathology 2.6 times.

Regarding atrial fibrillation, our results demonstrate a more severe course in patients diagnosed with this arrhythmia. It is well known that atrial fibrillation is the most frequent arrhythmia and is closely linked to the presence of diseases such as arterial hypertension, ischemic heart disease and habits such as smoking and alcohol. This arrhythmia mostly predisposes to an onset of thrombo-embolic complications such as stroke and myocardial infarction. In our study population, in patients hospitalized with Covid, we have seen a predisposition to an increased severity of Covid in patients with atrial fibrillation.

Here the pathophysiological mechanisms of atrial fibrillation also come into play, which can predispose to both thrombo-embolic complications and a worsening of heart function causing acute heart failure. The presence of other types of arrhythmias in the course of Covid, such as atrioventricular block of various degrees, demonstrates a picture of not only cardio-vascular decompensation, but also hydro electrolytic, renal insufficiency and glucose decompensation. All this is often present in patients hospitalized with Covid and especially those in more serious conditions.

To reinforce our results, we performed a logistic regression analysis using two variables such as age and sex, being 2 common characteristics of both cardiovascular diseases and Covid. In this analysis we built 2 models including in the first model the anamnestic conditions that is pre-existing and in the second model the recent conditions that is diagnosed during hospitalization.

In the first model it appears that age and arterial hypertension are significant for the course of Covid. In the second model it appears that age, diabetes and ischemic heart disease during Covid are significant. In this model we note that newly diagnosed arterial hypertension or arising during hospitalization is not a significant factor for the severity of Covid, this probably because in-hospital therapy is more targeted and optimal and in any case Hypertension creates more damage if chronic and long-lasting.

Mortality remains high in patients with a severe picture of the infection, unlike those with a moderate-severe picture in which mortality is much lower. These results demonstrate how important an early diagnosis of these cardiological conditions is, and of course, optimal treatment as well.

In the Clevelend Center Tianyan Fu study published in Elsevier, they saw a complication of Covid 19 with Acute Myocardial Infarction [15]. In another review conducted by Sana Niazi, on Covid 19 and cardiac manifestations, they concluded that the known cardiovascular complications in these patients are essentially Angina pectoris, Arrhythmias, Myocardial infarction, Heart failure and sudden cardiac death [16].

Another original article by Mario Gramegna of the San Raffaelle Institute in Milan focuses on another important topic during the pandemic, that of the presentation of cases with STEMI. There has been a later hospital presentation of these types of patients during the Covid 19 pandemic. This will certainly have a major impact on prognosis [17].

In a review by Bishnu P. Dhakal, cardiac manifestations during Covid 19 fluctuate from elevated troponin and BNP, to life-threatening arrhythmias, fulminant myocarditis, and refractory cardiogenic shock [7]. In a study conducted by Ying Ying Zheng, it was found that the pathophysiological mechanisms of cardio vascular damage through ACE 2 but also causing direct inflammatory damage to myocytes [18].

The study by Leonardo Italia of the University of Brescia focuses on the prevalence of heart failure during the Covid pandemic. The results of this study demonstrate a strong link of the onset of heart failure during Covid and also its worsening. Other findings concern myocarditis with a significant reduction in ejection fraction or even diastolic dysfunction [19].

The picture is now clear, Covid 19 predisposes to the onset of cardiovascular complications and when these exist, they contribute to a more poor prognosis.

Limitations

The limitation of this study is that we could have had more patients, but we excluded most of them because they did not have the correct cardiac evaluation.

Conclusions

This original study confirms that Covid 19, being an infectious disease capable of triggering an important systemic

inflammation, can compromise the cardiovascular system by predisposing to some complications such as the onset of ischemic heart disease and arrhythmias.

High blood pressure, Diabetes mellitus and Ischemic heart disease are significant factors for the development of a severe Covid disease. Diabetes mellitus is a statistically significant factor in mortality.

These conclusions lead us to think that we can benefit from an earlier diagnosis of Covid, and from a more timely treatment of severe and critical cases. An emphasis also goes on the diagnosis and treatment of cardiovascular diseases, being the first cause of global motility and in the case of Covid, a very important factor for prognosis.

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