Clinical Profile and In-Hospital Outcome of COVID-19 Infection among Patients with Cardiovascular Disease: A Cross-Sectional Study

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ABSTRACT

Introduction

Coronary heart disease, hypertension, heart failure, diabetes, and other cardiovascular diseases (CVDs) increase the disease severity and in-hospital mortality among patients with COVID-19.

Methods

This is a hospital-based study assessing the effects of CVD on the in-hospital outcomes in patients admitted with COVID-19. Clinical characteristics and in-hospital outcomes were studied in patients with cardiovascular risk factors and underlying CVD.

Results

A total of 108 covid positive patients had an underlying cardiovascular disease/s in various forms with a mean age of 60.69±16.24 years and 55.6% were male. Hypertension and diabetes mellitus were the commonest cardiovascular risk factors. Among these patients, acute decompensated heart failure and cardiac arrhythmia commonly atrial fibrillation were the common cardiac complications. The in-hospital mortality rate was 16.67%. Those who died due to cardiac involvement was 18.2% in comparison to 14.3% of the patients who did not have cardiac involvement, although this could not reach statistical significance. The most common cause of death was multiorgan failure resulting in 44.5% of all cause of death followed by acute respiratory distress syndrome accounting 27.8% and refractory cardiogenic shock with 22.2% involvement. Among those who died vs those who survived length of hospital stay was significantly longer in death group (13.6 days vs 9.11 days, p=0.002)

Conclusion

In patients hospitalized with COVID-19, pre-existing established cardiovascular risk factors and CVD appear to be important contributors to mortality. The involvement of multiorgan predisposes COVID-19 patients to accentuated risk of mortality.

Keywords

Cardiovascular diseases, COVID-19, in-hospital mortality

INTRODUCTION

Coronavirus disease 2019 (COVID-19), officially known as severe acute respiratory syndrome-corona virus-2 (SARS-CoV-2), has spread worldwide since its identification in early December 2019. Although the majority of infections are mild and self-limiting, this pandemic has posed an unprecedented challenge to the global healthcare community.[1,2]

As underlying cardiovascular disease (CVD) is a common comorbidity in patients with SARS, Middle East respiratory syndrome (MERS) and COVID-19, pre-existing CVD and CV risk factors increase susceptibility to COVID-19.[3,4] Moreover, COVID-19 can actually exacerbate underlying cardiovascular disease and even cause de novo cardiac complications. This was supported by research findings suggesting that both vulnerability and outcome of COVID-19 are strongly associated with cardiovascular disease.[2,5,6] In fact, pre-existing cardiovascular disease has been shown to be associated with increased mortality in COVID-19 patients.[7-9]

The role of cardiovascular risk factors in the clinical course and outcome of patients infected with SARS-CoV-2 is well established. However, such clinical data in the context of the Nepalese population are lacking. Therefore, this study aims to determine clinical outcomes and in-hospital mortality in patients with SARS-CoV-2 and pre-existing cardiovascular disease. The impact of pre-existing CVD on clinical outcomes in these patients is also discussed.

METHODS

This is a single-center retrospective study of all the patients admitted with the diagnosis of COVID-19 with underlying CVD and cardiovascular risk factors. The study was conducted for a period of one year from January 2021 to December 2021. All patients aged 18 and older with laboratory-confirmed SARS-CoV-2 infection using real-time reverse transcription–polymerase chain reaction (PCR) assay of nasopharyngeal or oropharyngeal swab who required inpatient admission in the department of cardiology of Manmohan Cardio-thoracic Vascular and Transplant Center (MCVTC) were included.

The data were extracted retrospectively from the electronic health record system at our center. This included demographics, co-morbidities, underlying cardiovascular diseases, clinical characteristics, laboratory findings, complications, and in-hospital outcome data. Demographic details and laboratory parameters were obtained at the time of admission. These included inpatient number, age, sex, and residence address. History of tobacco use (smoking, smokeless tobacco) and past hypertension, diabetes, cardiovascular diseases, and other chronic diseases were also recorded. Cardiac manifestations of COVID-19 including myocardial infarction, myocarditis, arrhythmias, congestive heart failure, and cardiogenic shock were recorded and all the recruited patients were followed up to discharge or death and outcome events assessed.

All data were transferred to a pre-specified electronic data sheet by two dedicated data collectors (RG and SS) and cross-checked. All the data were analyzed using IBM SPSS Statistics software version 25 (IBM Corp.). Baseline demographic data and clinical characteristics were described as numbers (n) and percentages (%) for categorical variables, or means and standard deviations for continuous variables with normal distribution. Analysis was done using Fischer exact test. The $p < 0.05$ was considered statistically significant.

This study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Committee (IRC) of the Institute of Medicine (IOM), Tribhuvan University prior to the start of the study.

RESULTS

A total of 108 Covid-positive patients had various forms of underlying cardiovascular disease during the study period. The average patient age was 60.69 ±16.24 years, and just over half of all patients, 55.6% (n=60), were male. On admission to the hospital, the main symptoms were breathlessness, chest pain, cough, fever, and loss of consciousness/ dizziness. Claudication and limb weakness were some of the other presenting symptoms. Hypertension and diabetes were the most common co-existing illness. Half of the patients (50%) had a history of cardiovascular events including coronary artery disease or a history of coronary intervention. More than half of the patients were smokers and 35.2% of the patients either consumed alcohol recently or had consumed it at some point in their life (Table 1).

Table 2 shows 66 (61.1%) patients had evidence of cardiac involvement. These were mainly acute decompensated heart failure, cardiac arrhythmia, and myocardial infarction. All these were more common among patients with pre-existing illnesses like diabetes, hypertension, and coronary artery disease. It was seen that 18.2% of the patients with cardiac involvement died in comparison to 14.3% of the patients who did not have cardiac involvement, although this could not reach statistical significance.

Of 18 patients (16.67%) who died, 12 patients had evidence of cardiovascular involvement in comparison to 6 without cardiovascular involvement. (66.7% vs 33.3%) (Table 2).

Table 1. Demographic characteristics of the patients

Characteristics	All Patients	Cardiovascular involvement		p-value
		No (42)	Yes (66)	
Age	60.69 ± 16.24	56.31 ± 15.27	63.48 ± 16.33	0.02*
Sex				
Female	48 (44.4%)	13 (27.1%)	35 (72.9%)	0.03*
Male	60 (55.6%)	29 (48.3%)	31 (51.7%)	
Co-morbidities				
Hypertension	47 (43.5%)	18 (38.3%)	29 (61.7%)	0.54
Diabetes	38 (35.2%)	17 (44.7%)	21 (55.3%)	0.41
CKD	11 (10.2%)	3 (27.3%)	8 (72.7%)	0.52
COPD	13 (12.0%)	2 (15.4%)	11 (84.6%)	0.08
Hypothyroidism	18 (16.7%)	6 (33.3%)	12 (66.7%)	0.79
Cardiovascular History	54 (50%)	18 (33.8%)	36 (66.7%)	0.16
Smoking	55 (50.9%)	20 (36.4%)	35 (63.6%)	0.69
Alcohol	38 (35.2%)	11 (28.9%)	27 (71.1%)	0.15
Presenting symptoms				
Breathlessness	72 (66.7%)	27 (37.5%)	45 (62.5%)	0.68
Chest Pain	49 (45.4%)	16 (32.7%)	33 (67.3%)	0.24
Cough	44 (40.7%)	15 (34.1%)	29 (65.9%)	0.43
LOC/Dizziness	15 (13.9%)	5 (33.3%)	10 (66.7%)	0.78
Fever	26 (24.1%)	14 (53.8%)	12 (46.2%)	0.11
Palpitation	2 (1.9%)	0 (0%)	2 (100%)	0.52
Claudication	11 (10.2%)	5 (45.5%)	6 (54.5%)	0.74
Weakness	2 (1.9%)	1 (50%)	1 (50%)	1

Table 2. Cardiac manifestations among patients with underlying cardiovascular diseases

Characteristics	All Patients	In Hospital Death		p-value
		Yes	No	
Cardiac involvement				
No	42 (38.9%)	6 (14.3%)	36 (85.7%)	0.79
Yes	66 (61.1%)	12 (18.2%)	54 (81.1%)	
Cardiac involvement				
ADHF	15 (13.9%)	3 (20%)	12 (80%)	0.71
AF	13 (12%)	1 (7.7%)	12 (92.3%)	0.69
NSTEMI	11 (10.2%)	3 (27.3%)	8 (72.7%)	0.39
STEMI	13 (12%)	5 (38.5%)	8 (61.5%)	0.04*
Unstable Angina	2 (1.9%)	0 (0%)	2 (100%)	1
CHB	5 (4.6%)	0 (0%)	5 (100%)	0.59
Thrombosis/Aneurysm	6 (5.6%)	0 (0%)	6 (100%)	0.59
LVSD				
HF with REF	19 (17.6%)	5 (26.3%)	14 (73.7%)	0.02*
HF with MREF	32 (29.6%)	9 (28.1%)	23 (71.3%)	
HF with PEF	57 (52.8%)	4 (7.0%)	53 (93.0%)	
LVDD				
Normal	25 (23.1%)	0 (0%)	25 (100%)	0.006*
Grade I LVDD	51 (47.2%)	7 (13.7%)	44 (86.3%)	
Grade II LVDD	29 (26.9%)	10 (34.5%)	19 (65.5%)	
Grade III LVDD	3 (2.8%)	1 (33.3%)	2 (66.7%)	
Duration of illness (Days)	7.47 ± 12.69	5.78 ± 4.87	7.83 ± 13.81	0.54
Hospital stay (Days)	9.86 ± 5.76	13.61 ± 6.33	9.11 ± 5.37	0.002*

Table 4. Laboratory parameters among patients with/without cardiovascular involvement

Characteristics	All Patients	Cardiovascular involvement		p-value
		No (42)	Yes (66)	
WBC > 10000	39 (36.1%)	15 (38.5%)	24 (61.5%)	1
Ferritin > 264	46 (42.6%)	17 (37.0%)	29 (63.0%)	0.84
LDH > 246 IU/L	79 (73.1%)	28 (35.4%)	51 (64.6%)	0.27
d-Dimer >500	48 (44.4%)	20 (41.7%)	28 (58.3%)	0.69
HBA1c > 6.5	48 (44.4%)	20 (41.7%)	28 (58.3%)	0.69
Troponin I > 0.120	27 (25.0%)	2 (7.4%)	25 (92.6%)	<0.001*
CPKMB > 25	83 (76.9%)	34 (41.0%)	49 (59.0%)	0.49

Table 5: Cause of death among deceased patients

Cause	Number (%)
Multiorgan failure	8 (44.5)
Acute respiratory distress syndrome	5 (27.8)
Refractory cardiogenic shock	4 (22.2)
Ventricular fibrillation	1 (5.6)
Total	18

Table 3 shows the laboratory parameters of these patients at the time of admission. Although all these parameters are on the higher side among the patients with cardiovascular involvement, troponin I levels were significantly higher (92.6% vs 7.4%, p<0.001).

However, coronary events including ST segment elevation myocardial infarction (STEMI), left ventricular systolic and diastolic dysfunction were significant among those who died. The most common cause of death was attributed by Multiorgan dysfunction syndrome (MODS) with total patients being eight (44.5%), followed by acute respiratory distress syndrome, 5 patients (27.8 %) and refractory cardiogenic shock, 4 patients (22.2 %). There was a single case of ventricular fibrillation leading to sudden cardiac death, accounting 5.6 % of total number of patient who died (Table 4).

Also, the duration of hospital stay was significantly higher among these patients (13.6 Vs 9.11 days, p=0.002) (Table 2).

DISCUSSION

Cardiovascular diseases and risk factors such as hypertension, diabetes, heart failure (HF), and ischemic cardiomyopathy are more common in patients hospitalized with severe COVID-19 infection.[10,11] The presence of these risk factors can have adverse consequences, leading to admission to intensive care units and increased severity of illness.[12,13] The presence of hypertension, diabetes and cardiovascular disease has also been reported to be associated with a two-fold increased risk of death from COVID-19.[13]

CVD risk factors such as hypertension (43.5%) and diabetes (35.2%) were more common than established CVD in a cohort of hospitalized patients, similar to other UK studies and another study conducted in Nepal.[14,15] Acute congestive heart failure was the most common cardiac complication. This is explained by the fact that in patients with pre-existing cardiovascular comorbidities and in the elderly, heart failure is likely to be exacerbated in these settings, including in cases of unknown or subclinical cardiac dysfunction. In addition, tachycardia, fever, renal dysfunction, and hyperhydration can lead to heart failure with preserved ejection fraction in elderly patients with left ventricular dysfunction during the course of COVID-19.[16] In our study, among various laboratory parameters, only troponin I was significantly higher in patients with cardiovascular lesions. None of the other laboratory parameters reached statistical significance. In the study by Zhang et al, among the patients with severe COVID-19, the incidences of acute myocardial injury, acute kidney injury, arrhythmia, and sudden death were significantly higher in the CVD group than in the non-CVD group (all p<0.05),[17] This might account for the scenario in our study.

The high incidence of cardiac arrhythmias, primarily atrial fibrillation, observed in this study may have multiple triggers, including: myocardial ischemia, increased sympathetic tone, inflammation (both systemic and myocardial) and electrolyte imbalance. Our findings of a low incidence of myocarditis are consistent with several other reports and a recent review of autopsy cases.[18,19] Similar to our study, hospitalized COVID-19 patients who developed STEMI were found to have higher in-hospital mortality.[20]

In a study by Sherpa et al., they showed that the mortality rate in this study period in cardiovascular patients was high and the mortality rate was 11.1%.[15] despite being influenced by a high degree of heterogeneity between studies.[21] The findings

of our study are consistent with these studies. The study suggests that older age and diabetes are associated with higher risk of in-hospital mortality in patients infected by SARS-CoV-2 which is supported by our study as well.[21] In a meta-analysis of 51 studies and 48,317 patients, mainly from high- and upper-middle-income countries, younger and older patients reported a relative risk of developing severe disease or dying. mortality in patients with hypertension (RR 2.50, 95% CI 2.15–2.90), diabetes (RR 2.25, 95% CI 1.89–2.69) and cardiovascular disease (RR 3.11, 95% CI 2.55–3.79).[22] It has been found that Asia and Africa, as low-middle- and low-income countries, have the highest death rates from COVID-19. This may be due to the high prevalence of cardiovascular risk factors in these countries. Neighboring India has more cardiovascular risk factors, a higher number of COVID-19 infections and deaths.[23] To add, heart failure had adverse prognosis in patients with COVID-19 infection which was shown by capacity covid consortium.[24] Similarly, many of the admitted patients developed heart failure during their course of hospital stay.

Among patients infected with COVID-19 with underlying cardiovascular risk factors, septic shock and multiple organ failure were the most common causes of immediate death, which was also true of our study.[25,26] In addition, respiratory failure and sudden cardiac death are also thought to be other common causes of immediate death.[27,28] We encountered refractory cardiogenic shock as a common cause of death in our patients. This may be due to the presence of a serious underlying heart disease that may be decompensated by many other comorbidities.

Our study has several limitations. First, This is a single-center retrospective study with very small sample size. Secondly, The cause of worsening of clinical condition and cause of mortality was very difficult to ascertain due to occurrence of COVID-19 infection and cardiovascular disease in the same patient.

CONCLUSION

Among patients hospitalized for COVID-19, pre-existing cardiovascular disease appears to be a larger cause of in-hospital mortality. Patients with cardiovascular disease should be considered high-risk patients due to their burden of common risk factors for severe COVID-19 outcomes such as hypertension, diabetes, obesity, and smoking.

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CONFLICT OF INTEREST

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