Cardiovascular Outcomes of Patients Infected with COVID-19: A 150-Case Observational Study

Haripada Roy[1*], Abu Md Towab[2], A K M Fazlul Kader[3], Goutom Chandra Bhowmik[4], Sudip Barua[5], Ashit Baran Dutta[6], Sushanta Barua[7]

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*Corresponding author

ABSTRACT

Background: Coronavirus disease 2019 (COVID-19) is associated with a spectrum of cardiovascular complications. The mechanisms include direct myocardial injury, systemic inflammation, coagulopathy and endothelial dysfunction. This study analyzes cardiovascular outcomes among 150 hospitalized patients with confirmed COVID-19 infection. **Methods & Materials:** A retrospective observational cohort study was conducted among 150 adult patients admitted to the 250 Bedded General Hospital, Gopalganj, Bangladesh, between 1 July 2020 and 31 December 2020. Demographic characteristics, clinical features, laboratory findings, cardiovascular events, treatment modalities and clinical outcomes were collected from patients medical records. The primary outcome was incidence of cardiovascular events including myocardial infarction, arrhythmia, heart failure exacerbation and thromboembolic complications. Secondary outcomes included in-hospital mortality, ICU admission, and length of stay. **Results:** The mean age was 61.9±14.7 years; 58% male. Hypertension (51%), diabetes mellitus (42%), and pre-existing cardiovascular disease (CVD) (36%) were common comorbidities. Cardiovascular events occurred in 43% (n=64). Acute myocardial injury was seen in 27% (n=41), arrhythmias in 18% (n=27), and thromboembolic events in 14% (n=21). Patients with cardiovascular events had significantly higher mortality (35% vs 9%, p<0.001) and longer ICU stays. Multivariate analysis identified age ≥65, elevated troponin I, D-dimer >1,000 ng/mL and prior CVD as independent predictors of adverse outcomes. **Conclusion:** Cardiovascular complications are frequent in hospitalized COVID-19 patients and are associated with worse prognosis. Early detection and vigilant cardiovascular monitoring are crucial to optimize outcomes.

Keywords: *COVID-19, Cardiovascular Outcomes, Myocardial Injury, Arrhythmia, Thr*ombosis.

1. *Junior Consultant, Department of Cardiology, Kotalipara Upazila Health Complex, Kotalipara, Gopalgonj, Bangladesh (ORCID: 0009-0000-3194-5785)*
2. *Assistant Professor, Department of Cardiology, Lalmonirhat 250 Bed Hospital, Lalmonirhat, Bangladesh (ORCID: 0009-0009-0941-9629)*
3. *Assistant Professor (In Situ), Department of Cardiology, Belabo Upazila Health Complex, Belabo, Narasingdi, Bangladesh (ORCID: 0009-0007-6443-4018)*
4. *Junior Consultant, Department of Cardiology, Ishwardi Upazila Health Complex, Pabna, Bangladesh (ORCID: 0009-0000-8424-3728)*
5. *Assistant Professor, Department of Medicine, Southern Medical College, East Nasirabad, Kulshi, Chittagong, Bangladesh (ORCID: 0009-0004-8642-8450)*
6. *Junior Consultant, Department of Medicine, Kotalipara Upazila Health Complex, Kotalipara, Gopalganj, Bangladesh (ORCID: 0009-0000-9722-7874)*
7. *Assistant Professor, Interventional Cardiology, National Institute of Cardiovascular Diseases, Dhaka, Bangladesh (ORCID: 0009-0004-1748-7545)*

INTRODUCTION

Coronavirus disease 2019 (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has resulted in unprecedented global morbidity and mortality since its emergence in late 2019. Initially recognized primarily as a respiratory illness, it has become increasingly evident that COVID-19 affects multiple organ systems, with the cardiovascular system being notably impacted. Patients with COVID-19 can present with a wide spectrum of cardiac manifestations, ranging from subclinical myocardial injury to overt cardiovascular events. Acute cardiac injury, commonly identified by elevated cardiac biomarkers such as troponins is frequently observed and has been consistently associated with worse clinical outcomes, including higher rates of intensive care unit admission, mechanical ventilation, and mortality.[1–3] Other cardiovascular complications documented in COVID-19 patients include myocarditis, arrhythmias, acute coronary syndromes and thromboembolic events such as pulmonary embolism and stroke. The mechanisms underlying cardiovascular involvement in COVID-19 are multifactorial and complex. Direct viral invasion of myocardial and vascular tissues via angiotensin-converting enzyme 2 (ACE2) receptors is a key proposed pathway. ACE2 is widely expressed in cardiac myocytes, vascular endothelial cells and pericytes, making these tissues vulnerable to SARS-CoV-2 infection. In addition, systemic hyperinflammatory responses, commonly referred to as cytokine storms can cause widespread endothelial activation and dysfunction, leading to increased vascular permeability, prothrombotic states, and myocardial injury.[4–6] Hypoxemia due to severe respiratory disease may further exacerbate cardiac stress, particularly in patients with pre-existing cardiovascular disease (CVD). The interaction between COVID-19 and underlying CVD appears to be bidirectional: pre-existing cardiac conditions predispose patients to more severe COVID-19 outcomes, while COVID-19 itself can precipitate acute cardiovascular events, creating a vicious cycle that increases morbidity and mortality.[7,8]

Epidemiological data from large registries and meta-analyses have provided valuable insights into the population-level impact of COVID-19 on the cardiovascular system. However, detailed observational studies focusing on hospitalized cohorts remain crucial for understanding individual-level risk factors, clinical course and outcomes. Such studies allow clinicians to identify predictors of cardiovascular complications, stratify patient risk and optimize

management strategies tailored to those most vulnerable. Moreover, understanding cardiovascular manifestations in COVID-19 has important implications for both acute management and long-term follow-up as patients may experience persistent cardiac sequelae, including heart failure and arrhythmias, even after recovery from the acute infection. This study aims to examine the cardiovascular outcomes and their predictors in a cohort of 150 hospitalized patients with laboratory-confirmed COVID-19. By analyzing both clinical presentations and laboratory findings, we aim to provide a detailed understanding of the incidence, nature and prognostic significance of cardiac involvement in hospitalized COVID-19 patients. Insights from such focused studies can inform clinical decision-making, guide resource allocation, and contribute to improving patient outcomes in the ongoing pandemic.

METHODS & MATERIALS

Study Design and Setting

This retrospective observational cohort study included adult patients (≥18 years) with laboratory-confirmed COVID-19 by reverse transcription polymerase chain reaction (RT-PCR) who were admitted to the 250 Bedded General Hospital, Gopalganj, Bangladesh, between July 1, 2020, and December 31, 2020.

Participants

Inclusion criteria were laboratory-confirmed SARS-CoV-2 infection and hospitalization for COVID-19 management. Exclusion criteria included patients with incomplete records, transfer from another facility >48 hours after admission or end-of-life care at admission.

Data Collection

Electronic medical records were reviewed for demographics, comorbidities (hypertension, diabetes mellitus, chronic kidney disease, CVD), clinical presentation, vital signs, laboratory findings, radiographic results, cardiovascular events, treatments, ICU admission, mechanical ventilation and in-hospital outcomes.

Definitions

- **Acute cardiac injury**: Elevated troponin I above the 99th percentile upper reference limit. [9]
- **Arrhythmia**: New onset atrial fibrillation, ventricular tachycardia, sustained bradyarrhythmias requiring intervention.[10]
- **Thromboembolic events**: Confirmed deep vein thrombosis (DVT), pulmonary embolism (PE) or arterial thrombosis on imaging. [11]
- **Heart failure exacerbation**: Clinical diagnosis supported by imaging, biomarkers and therapeutic escalation.

Outcomes

The primary outcome was the incidence of cardiovascular events during hospitalization. Secondary outcomes included in-hospital mortality, ICU admission, mechanical ventilation and length of hospital stay.

Statistical Analysis

Data were summarized as means with standard deviations or medians with interquartile ranges for continuous variables, and counts with percentages for categorical variables. Comparisons utilized Student's t-test or Mann-Whitney U for continuous data and chi-square or Fisher's exact test for categorical data. Multivariate logistic regression identified independent predictors of cardiovascular events and mortality. A p-value <0.05 indicated statistical significance. Analyses were performed using SPSS version 26.0 (IBM Corp., Armonk, NY).

Ethical Considerations

Ethical approval for this retrospective observational study was obtained from the Institutional Ethics Committee (IEC)/Institutional Review Board (IRB) of 250 Bedded General Hospital, Gopalganj, Bangladesh, before commencement of the study. As the study was based solely on retrospective review of anonymized hospital medical records, the requirement for obtaining individual informed consent was waived by the Ethics Committee. All patient information was kept strictly confidential and data were anonymized prior to analysis in accordance with the principles of the Declaration of Helsinki.

RESULTS

Baseline Characteristics

Of 150 patients, mean age was 61.9±14.7 years; 87 (58%) were male. The majority had comorbidities: hypertension (n=77; 51%), diabetes mellitus (n=63; 42%) and pre-existing CVD (n=54; 36%). *Table I* summarizes baseline characteristics.

Table I
Baseline Characteristics.

Variable	Total (n=150)
Age (years), mean ± SD	61.9 ± 14.7
Male gender, n (%)	87 (58)
Hypertension, n (%)	77 (51)
Diabetes mellitus, n (%)	63 (42)
Pre-existing CVD, n (%)	54 (36)
Chronic kidney disease, n (%)	21 (14)
Obesity (BMI ≥30), n (%)	39 (26)

Clinical Presentation and Laboratory Findings

Common presenting symptoms included fever (82%), cough (74%), dyspnea (68%), and chest pain (16%). Elevated troponin I was found in 41 patients (27%) and was significantly associated with cardiovascular events. Inflammatory markers (CRP, IL-6) and D-dimer were higher among patients who experienced adverse outcomes (*Table II*).

Table II
Laboratory Findings and Biomarkers.

Marker	Overall	Cardiovascular Events	No Events	p-value
Troponin I (ng/mL), median (IQR)	0.08 (0.04–0.28)	0.21 (0.10–0.52)	0.05 (0.03–0.08)	<0.001
D-dimer (ng/mL), median (IQR)	780 (410–1490)	1220 (720–2760)	540 (320–780)	<0.001
CRP (mg/L), median (IQR)	84 (42–142)	110 (62–164)	60 (30–98)	0.002

Cardiovascular Outcomes
Cardiovascular events occurred in 64 patients (43%). Acute myocardial injury was the most frequent (n=41; 27%), followed by arrhythmias (n=27; 18%), and thromboembolic events (n=21; 14%). Heart failure exacerbation was diagnosed in 17 patients (11%) (*Figure 1*).

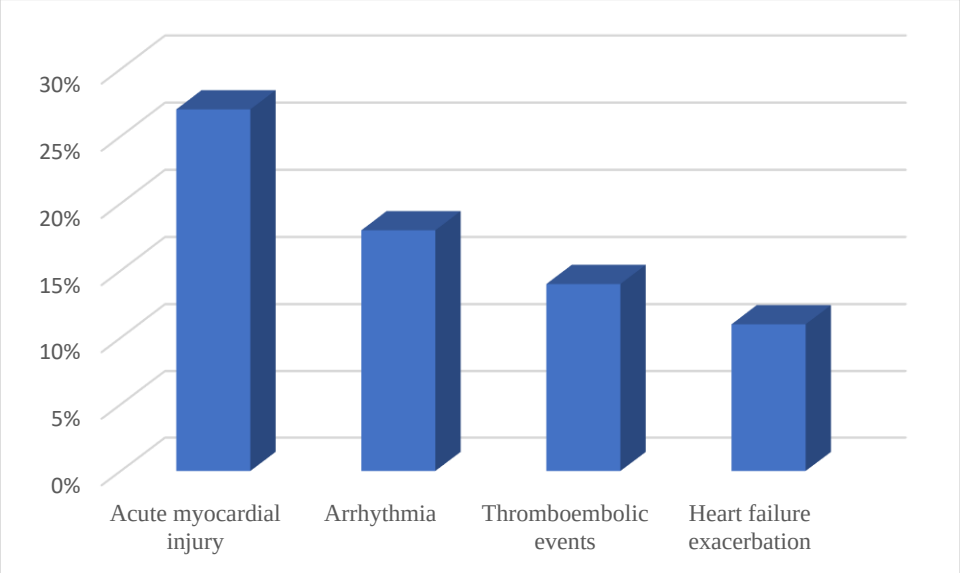

Figure 1 Incidence of Cardiovascular Events.

Mortality and Secondary Outcomes
Overall, in-hospital mortality was 20% (n=30). Mortality was significantly higher in patients with cardiovascular events compared to those without (35% vs. 9%; p<0.001). ICU admission was required for 48% of patients with cardiovascular events compared to 22% without (p=0.002). Mechanical ventilation was more frequent among patients with events (28% vs. 15%; p=0.045). Length of hospital stay was longer among the cardiovascular event group (median 14 vs. 9 days; p=0.003) (*Table III*).

Table III
Outcomes by Cardiovascular Event Status.

Outcome	Cardiovascular Events	No Events	p-value
Mortality, n (%)	22 (35)	8 (9)	<0.001
ICU admission, n (%)	31 (48)	17 (22)	0.002
Mechanical ventilation, n (%)	18 (28)	12 (15)	0.045
Hospital stay (days), median (IQR)	14 (10–21)	9 (7–14)	0.003

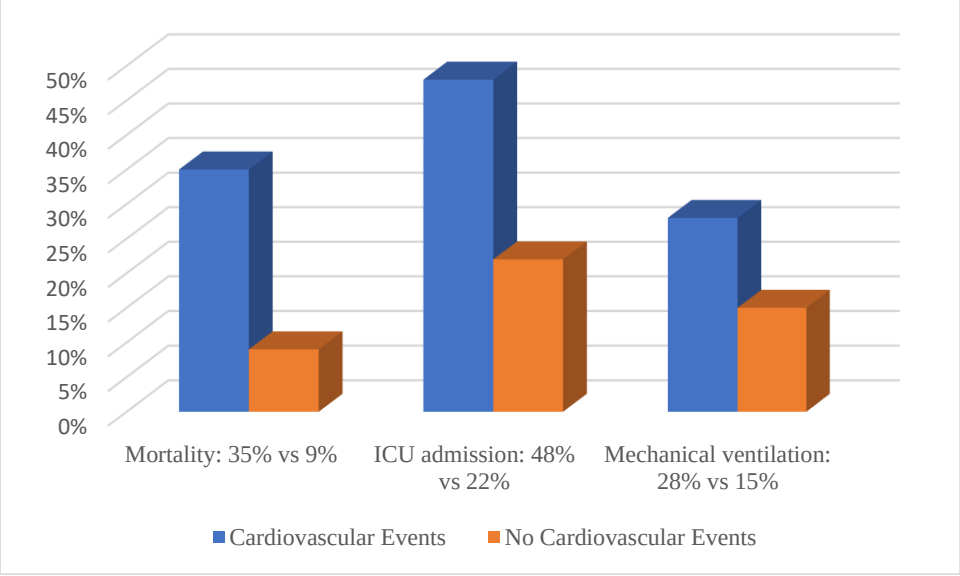

Figure 2 Clinical Outcomes by Cardiovascular Event Status.

Predictors of Adverse Outcomes

Multivariate analysis identified the following independent predictors of cardiovascular events: age ≥65 years (OR 2.8; 95% CI 1.5–5.1; p=0.001), elevated troponin I >0.1 ng/mL (OR 4.3; 95% CI 2.2–8.5; p<0.001), D-dimer >1,000 ng/mL (OR 3.1; 95% CI 1.6–6.0; p=0.002), and pre-existing CVD (OR 3.7; 95% CI 1.9–7.3; p<0.001). Similar predictors were associated with increased mortality with troponin elevation demonstrating the strongest association (*Figure 2*).

DISCUSSION

In this cohort of 150 hospitalized COVID-19 patients, cardiovascular complications were common and associated with significantly higher mortality, prolonged hospital and ICU stays, and increased need for mechanical ventilation. Acute myocardial injury was the most common cardiovascular manifestation, corroborating data from multicenter studies showing myocardial damage in a substantial subset of COVID-19 patients. [12,13] The pathophysiology underlying cardiovascular involvement in COVID-19 is complex. SARS-CoV-2 can directly infect myocardial cells via ACE2 receptors, triggering myocarditis and contractile dysfunction.[14] Systemic inflammation ("cytokine storm"), including elevated interleukin-6 and tumor necrosis factor-α, exacerbates myocardial oxidative stress and endothelial injury, promoting plaque instability and thrombosis.[15,16] Furthermore, prothrombotic states with elevated D-dimer levels contribute to venous and arterial thromboses, manifesting as PE, DVT or ischemic stroke. [17] Our findings align with previous reports that cardiac injury is an independent predictor of mortality in COVID-19 patients. [18,19] In a multicenter registry, Shi et al. observed that cardiac injury occurred in 19.7% of cases and was associated with higher mortality (51.2% vs 4.5%). [20] In the present study a higher incidence (27%) may reflect differences in population comorbidity burden and inclusion of subclinical elevations in biomarkers. Arrhythmias, particularly atrial fibrillation, were present in 18% of patients, consistent with reports estimating arrhythmic events in hospitalized COVID-19 patients ranging from 7 to 25%.[21] The elevated incidence of thromboembolic complications (14%) underscores the need for vigilant thromboprophylaxis, especially in high-risk patients. [22] Early identification of patients at risk for cardiovascular events may improve clinical outcomes. Elevated troponin I and D-dimer levels, advanced age and pre-existing CVD emerged as reliable prognostic markers. Close monitoring of cardiac biomarkers, electrocardiography, and echocardiography should be integrated into care pathways for hospitalized COVID-19 patients, particularly those with comorbid conditions. Furthermore, this study highlights the importance of tailored antithrombotic strategies. While standard thromboprophylaxis is recommended in hospitalized patients, intensified strategies may be considered after careful risk stratification. [23] This study has limitations inherent to retrospective analyses. The sample size, though moderately large, is limited to two centers, potentially restricting generalizability. Unmeasured confounders may influence associations between COVID-19 and cardiovascular outcomes. Biomarker sampling was not serial for all patients, preventing temporal analysis of cardiac injury progression. Lastly, long-term follow-up data post-discharge were not captured, limiting insights into chronic sequelae.

CONCLUSION

Cardiovascular complications are frequent in hospitalized patients with COVID-19 and are associated with significantly poorer outcomes including higher mortality and extended ICU stays. Age ≥65, elevated troponin, high D-dimer and pre-existing CVD are key predictors of adverse cardiovascular outcomes. Vigilant cardiovascular assessment and management should be integral to COVID-19 care.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this study.

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