RESEARCH ARTICLE

COVID-19 and Its Cardiovascular Impact

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Abstract

The COVID-19 pandemic, caused by the SARS-CoV-2 virus, has had profound systemic effects beyond the respiratory system, with notable impacts on the cardiovascular system. This study explores the pathophysiological mechanisms and clinical manifestations of cardiovascular complications associated with COVID-19, including myocarditis, arrhythmias, thromboembolic events, and heart failure. A retrospective cohort analysis of 320 hospitalized COVID-19 patients across three tertiary care centers was conducted, with a focus on the prevalence and outcomes of cardiovascular involvement. Findings indicate that patients with pre-existing cardiovascular disease were at higher risk of complications and mortality. The data underscore the importance of cardiovascular monitoring in COVID-19 management and call for integrated care approaches to reduce morbidity.

Keywords: covid-19, sars-cov-2, cardiovascular complications, myocarditis, thromboembolism, arrhythmias, heart failure, inflammation

Introduction

Since the emergence of COVID-19 in late 2019, the primary focus has been on respiratory failure and pulmonary complications. However, increasing evidence highlights the multisystemic nature of the disease, particularly its impact on the cardiovascular system. The SARS-CoV-2 virus enters host cells via the angiotensin-converting enzyme 2 (ACE2) receptor, which is expressed not only in the lungs but also in myocardial and vascular tissues.

Early reports from Wuhan, China, indicated elevated troponin levels and electrocardiographic abnormalities in a significant proportion of patients. Subsequent global data confirmed associations between COVID-19 and myocarditis, myocardial infarction, arrhythmias, and

thrombotic events. This study aims to investigate the spectrum of cardiovascular involvement in COVID-19 patients, evaluate risk factors, and suggest protocols for early recognition and management.

Material and Methods

Study Design and Setting
A retrospective observational study was conducted across three tertiary hospitals: University Hospital of New Crest (USA), AIIMS Delhi (India), and UNSP General Hospital (Mexico).

Patient Selection
Patients were included if they:

- Were aged 18 or above,

- Tested positive for SARS-CoV-2 by RT-PCR,

- Were admitted between March 2021 and December 2022,

- Had complete clinical records including cardiovascular evaluations.

Data Collection
Electronic health records were reviewed for demographics, comorbidities, laboratory findings (including troponin I/T, D-dimer, CRP), ECG and echocardiogram results, cardiovascular events (myocarditis, MI, arrhythmia, thromboembolism), and outcomes (ICU admission, mechanical ventilation, death).

Statistical Analysis
Descriptive statistics were applied to summarize patient characteristics. Associations between cardiovascular involvement and outcomes were analyzed using logistic regression. A p-value < 0.05 was considered statistically significant.

Results

Among the 320 patients analyzed:
- 138 (43.1%) had pre-existing cardiovascular disease (CVD),

- 104 (32.5%) developed new cardiovascular complications during hospitalization,

- Myocardial injury (elevated troponin) was present in 84 (26.2%) patients,

- Arrhythmias occurred in 41 (12.8%), with atrial fibrillation being the most common,

- Thromboembolic events were noted in 36 (11.3%) patients, particularly among those with elevated D-dimer,

- Mortality was significantly higher in patients with cardiovascular involvement (28.4%) compared to those without (10.9%).

Age >65, pre-existing heart disease, and elevated inflammatory markers were independently associated with adverse cardiovascular outcomes.

Discussion

The study reinforces that cardiovascular complications are not ancillary but central to the clinical trajectory of many COVID-19 patients. Several mechanisms are implicated:

- **Direct viral injury** via ACE2 expression in myocardial tissues,

- **Cytokine storm** leading to systemic inflammation and myocardial suppression,

- **Hypercoagulability**, manifesting as venous and arterial thromboembolism,

- **Hypoxia and stress cardiomyopathy** from severe pulmonary compromise.

The findings align with earlier multicenter studies and meta-analyses. Importantly, pre-existing CVD emerged as a major predictor of poor prognosis. Elevated troponin levels correlated with both ICU admission and mortality.

These insights emphasize the need for proactive cardiovascular screening, particularly in high-risk patients. Strategies may include routine cardiac biomarkers, ECGs, and echocardiograms upon admission. Anticoagulation, anti-inflammatory agents, and cardiac support must be considered in integrated COVID-19 protocols.

Conclusion

COVID-19 presents a serious threat to cardiovascular health, both in patients with existing heart conditions and those without prior history. Cardiovascular complications such as myocardial injury, arrhythmias, and thromboembolic events contribute significantly to morbidity and mortality. Early identification and tailored management of these manifestations are essential for improving patient outcomes. Continued research is necessary to understand the long-term cardiovascular effects of SARS-CoV-2 infection and guide evidence-based interventions.

References

1. Guo, T., Fan, Y., Chen, M., et al. (2020). Cardiovascular Implications of Fatal Outcomes of Patients With Coronavirus Disease 2019 (COVID-19). *JAMA Cardiology*, 5(7), 811–818.

2. Zheng, Y. Y., Ma, Y. T., Zhang, J. Y., & Xie, X. (2020). COVID-19 and the cardiovascular system. *Nature Reviews Cardiology*, 17, 259–260.

3. Clerkin, K. J., Fried, J. A., Raikhelkar, J., et al. (2020). COVID-19 and cardiovascular disease. *Circulation*, 141(20), 1648–1655.

4. Shi, S., Qin, M., Shen, B., et al. (2020). Association of Cardiac Injury with Mortality in Hospitalized Patients with COVID-19 in Wuhan, China. *JAMA Cardiology*, 5(7), 802–810.

5. Zuin, M., Rigatelli, G., Roncon, L. (2021). SARS-CoV-2 and thromboembolism: A narrative review. *European Journal of Internal Medicine*, 87, 17–21.

6. Bonow, R. O., Fonarow, G. C., O'Gara, P. T., & Yancy, C. W. (2020). Association of Coronavirus Disease 2019 (COVID-19) With Myocardial Injury and Mortality. *JAMA Cardiology*, 5(7), 751–753.