

LETTER TO THE EDITOR

Open Access



# Cardiovascular complications and predictors of mortality in hospitalized patients with COVID-19: a cross-sectional study from the Indian subcontinent

Kanhai Lalani and M. Sudhakar Rao\*

**Keywords:** COVID-19, Coronavirus, Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), Cardiovascular complications, Myocarditis, Acute coronary syndrome, Neutrophil–lymphocyte ratio (NLR), Platelet–lymphocyte ratio (PLR)

## To the editor

We gratefully acknowledge Dr. Josef Finsterer's insightful comments on our study, "Cardiovascular complications and predictors of mortality in hospitalized patients with COVID-19: a cross-sectional study from the Indian subcontinent" [1]. We hope to address some of the concerns raised by J. Finster in this response.

Their first concern was the study's retrospective design. We acknowledge their concern and have addressed it in the limitations section of this study [1]. We have collected the data of COVID-19 patients admitted to our hospital during the first wave of COVID-19 in our country, before which no one had predicted such a pandemic [1]. We carefully observed certain hemocytometric parameters, electrocardiographic (ECG) changes, and cardiac complications among COVID-19 patients, and decided to publish a study on them after receiving ethics committee approval [1]. Hence, we conducted a retrospective study. However, all the blood investigations and ECGs were done by the same machine for all the patients

included at our hospital. The echocardiogram, on the other hand, was performed by the same machine but by different operators, which was a limitation for us. Ideally, we should conduct a prospective study to overcome all the shortcomings.

Their second concern was that the diagnosis of myocardial infarction was based solely on clinical and ECG criteria, rather than on coronary angiography (CAG) findings. 9 (64.3%) of 14 patients with anterior wall myocardial infarction (AWMI) underwent CAG and percutaneous coronary intervention (PCI) out of a total of 67 patients who presented with the acute coronary syndrome (ACS). 9 (75.0%) of 12 patients with inferior wall myocardial infarction (IWMI) or infero-posterior wall myocardial infarction (IPWMI) underwent CAG and PCI. 4 (9.8%) of 41 patients with non-ST-segment elevation myocardial infarction (NSTEMI) underwent CAG and PCI due to angina. The remaining patients were either thrombolysed or managed medically (Table 1). The treating physician or cardiologist determined which patients required invasive management.

Their third concern was that Takotsubo syndrome (TTS) was not considered as a complication of COVID-19. However, a coronary angiogram (CAG) is required to rule out significant coronary artery disease before diagnosing TTS [2]. During the beginning of the pandemic in our country, no standard government protocol was

This reply refers to the comment available online at <https://doi.org/10.1186/s41182-022-00474-9>.

\*Correspondence: [msudhakar88@gmail.com](mailto:msudhakar88@gmail.com)

Department of Cardiology, Kasturba Medical College, Manipal, Manipal Academy of Higher Education, Manipal, Karnataka 576104, India



© The Author(s) 2022. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

**Table 1** The number of COVID-19 patients who had ACS and underwent CAG and PCI

Complications	Total (n = 730)	CAG and PCI (n = 22)
ACS (n, %)	67 (9.2%)	
AWMI	14 (20.9%)	9 (64.3%)
IWMI	12 (17.9%)	9 (75.0%)
NSTEMI	41 (61.2%)	4 (9.8%)

published for the management of ST-segment elevation myocardial infarction (STEMI)/NSTEMI. According to local hospital policy, only a few ACS patients with COVID-19 underwent CAG and PCI with strict precautions, while the rest were kept on medical management to prevent virus spread. The treating physician or cardiologist determined which patients required invasive management. Patients who had ACS but did not have CAG and were treated medically were more likely to have stress cardiomyopathy or Takotsubo syndrome (TTS). All patients with elevated troponin could not undergo CAG due to multiple restrictions imposed by the government and local hospital policies to limit the spread and avoid unnecessary exposure to COVID-19. As a result, we did not mention TTS as a COVID-19 complication.

Their fourth concern was that endocarditis was not mentioned as a cardiac complication of COVID-19, which had recently been reported in a few case reports [3–5]. However, patients with preexisting cardiac conditions, including prosthetic valves and implanted devices, were already excluded from our study [1]. We enrolled patients in our study at the beginning of the pandemic in our country, so they were exposed to COVID-19 for the first time with no prior exposure [1]. The case report published by Miri et al. [3] has clearly mentioned that the patient had COVID-19 1 month prior and recent RT-PCR was negative during the second admission with infective endocarditis. The second case reported by Romeo et al. [4] had a history of prior cardiac surgery, and he was treated with corticosteroids, long broad-spectrum antibiotics, and immunosuppressors during his prolonged ICU stay with COVID-19 illness; he was later readmitted with a fungal infection. Vivo et al. [5] reported a third case with preexisting cardiac disease and an implanted device in situ. He had COVID-19 pneumonia as well as *Staphylococcus epidermidis*-positive infective endocarditis at the same time. However, no conclusive evidence linking COVID-19 and endocarditis has been reported. Patients with a preexisting cardiac condition or a history of COVID-19 illness were excluded from our study. As a result, no patients with prosthetic valves or implanted devices were included in the study.

Their fifth concern was whether myocarditis should be diagnosed using cardiac magnetic resonance imaging (MRI) or endo-myocardial biopsy. We all agree that a cardiac MRI or biopsy should be used to confirm a diagnosis of myocarditis. However, due to local hospital policy and limited resources in developing countries, cardiac MRI or biopsy was not possible in our study populations. During the pandemic, only life-saving procedures were permitted in order to limit the spread of COVID-19. Due to limited resources, a large (1791) number of patients were unable to obtain an echocardiogram and were thus excluded from the study [1]. As a result, myocarditis was diagnosed solely on the basis of echocardiographic findings, which may have underestimated many subclinical cases, which was a major limitation in our study and was mentioned in the limitations.

Overall, this interesting article has several limitations which challenge our results and interpretation. We hope that our clarifications to your responses have been adequately addressed, and that the disease under study requires a larger prospective study in the future to overcome these limitations. We want to thank our colleagues once more for their interest in our research.

#### Acknowledgements

Not applicable.

#### Author contributions

Writing—review and editing: KL, MSR. All authors read and approved the final manuscript.

#### Funding

Not applicable.

#### Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

#### Declarations

#### Ethics approval and consent to participate

Informed consent was taken. The study protocol was approved by the Kasturba Medical College and Kasturba Hospital Institutional Ethics Committee (Reg. No. IEC 124/2021).

#### Consent for publication

Not applicable.

#### Competing interests

The authors declare that they have no competing interests.

Published online: 19 December 2022

#### References

1. Lalani K, Seshadri S, Samanth J, et al. Cardiovascular complications and predictors of mortality in hospitalized patients with COVID-19: a cross-sectional study from the Indian subcontinent. *Trop Med Health*. 2022;50(1):55. <https://doi.org/10.1186/s41182-022-00449-w>.

2. Ghadri JR, Wittstein IS, Prasad A, et al. International Expert Consensus Document on Takotsubo Syndrome (Part I): clinical characteristics, diagnostic criteria, and pathophysiology. *Eur Heart J*. 2018;39(22):2032–46. <https://doi.org/10.1093/eurheartj/ehy076>.
3. Miri C, Brem FL, Rasras H, et al. COVID-19 complicated by infective endocarditis or concomitant infection? A case report. *Pan Afr Med J*. 2022;31(41):263. <https://doi.org/10.11604/pamj.2022.41.263.29438>.
4. Romeo MG, Comentale G, Cirillo V, et al. Sars-Cov-2 infection as a possible risk factor for prosthesis endocarditis: a challenging redo-Bentall for sub-valvular abscess. *J Card Surg*. 2022;37(9):2845–8. <https://doi.org/10.1111/jocs.16729>.
5. De Vivo S, Barberio M, Corrado C, et al. CRT implantation after transvenous lead/device extraction (TLE) in a patient with COVID-19: Endocarditis triggered by syndrome coronavirus 2 (SARS-COV-2) infection? A case report pacing. *Clin Electrophysiol*. 2022;45(6):807–10. <https://doi.org/10.1111/pace.14218>.

### Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Ready to submit your research? Choose BMC and benefit from:

- fast, convenient online submission
- thorough peer review by experienced researchers in your field
- rapid publication on acceptance
- support for research data, including large and complex data types
- gold Open Access which fosters wider collaboration and increased citations
- maximum visibility for your research: over 100M website views per year

At BMC, research is always in progress.

Learn more [biomedcentral.com/submissions](https://biomedcentral.com/submissions)

