EDITORIAL

Myocardial Infarction During the COVID-19 Pandemic

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Early during the COVID-19 pandemic, it was recognized that infection with SARS-CoV-2 was associated with an increased risk of both arterial and venous thrombotic complications. This association is strongest for venous thromboembolic disease, but the risk of myocardial infarction (MI) is approximately doubled in the 7 days after COVID-19 diagnosis.[1] Multiple studies have suggested worse outcomes in patients with COVID-19 and MI,[2,3] with direct effects of the virus on endothelial cells, increased propensity for vascular thrombosis, and deficient care delivery all mechanistically implicated.[4]

Related article

The study by Saad et al[5] in this issue of *JAMA* reexamines these findings in the largest cohort yet described. Using the Vizient Clinical Database, an administrative database of more than 700 US academic hospitals and affiliates, the authors described in-hospital outcomes for patients with COVID-19 and ST-segment elevation MI (STEMI). Propensity score matching was used to compare patients with COVID-19 and STEMI with 2 separate control groups: patients without COVID-19 hospitalized with STEMI in 2020 and patients hospitalized with STEMI in 2019 before the onset of the pandemic. By comparing patients who were cared for under the same system constraints, the first comparison attempted to isolate the association between concomitant COVID-19 and STEMI outcomes, whereas the second comparison evaluated the association of both COVID-19 infection and care delivery before and after the COVID-19 pandemic with STEMI outcomes.

The authors found that among 36 309 patients with out-of-hospital STEMI admitted to more than 500 primary percutaneous coronary intervention (PCI)–capable hospitals in 2020, a total of 565 had concomitant COVID-19; 359 of 1937 patients with in-hospital STEMI had concomitant COVID-19. After adjusting for patient and hospital factors in the propensity score–matched analysis, 15% of patients with COVID-19 and out-of-hospital STEMI died compared with 11% of patients without COVID-19 with STEMI (odds ratio, 1.43 [95% CI, 1.10-1.86]); 77% of patients with COVID-19 and in-hospital STEMI died compared with 44% of patients without COVID-19 with STEMI (odds ratio, 4.11 [95% CI, 2.97-5.69]). These results were similar when comparing patients with COVID-19 and STEMI vs patients without COVID-19 and STEMI from 2020 or patients with STEMI from 2019 in the pre–COVID-19 era.

The study by Saad et al[5] represents an important effort to better describe MI outcomes during the pandemic, although several limitations challenge the interpretation of these data. First, the administrative database used in this study lacks granular clinical information. Although the authors adjusted for age, cardiogenic shock, and cardiac arrest on presentation, they were unable to adjust for other key factors associated with post-STEMI outcomes, including admission vital signs, serum creatinine level, frailty, and the presence of heart failure on admission. The influence of limited clinical data may be magnified when comparing outcomes between patients with COVID-19 and patients without COVID-19 with in-hospital STEMI, for whom severity of illness at the time of STEMI diagnosis cannot be deduced from administrative data.

Second, the propensity model created by the authors to compare patients with STEMI with COVID-19 vs patients with STEMI without COVID-19 attempted to estimate the likelihood of having COVID-19 at the time of STEMI diagnosis. The authors included several demographic and clinical variables in this model, although the model is not comprehensive; for example, data were lacking on patients' occupation, number of weekly personal contacts (ie, inability to socially distance), or other behavioral features that affect exposure to the SARS-CoV-2 virus. This lack of information could bias the results unpredictably; patients with more weekly personal contacts are likely to be less frail and more active, but may have lower levels of education and socioeconomic status.

Third, it is assumed with administrative data that conditions not coded are not present, but this may or may not be the case with the effects of missing data also influencing the analyses unpredictably. Fourth, and relatedly, administrative data are not audited and may contain errors. In the present study, 86% of patients without COVID-19 with out-of-hospital STEMI underwent coronary angiography, compared with 96% of patients with STEMI in the American College of Cardiology's Chest Pain–MI Registry, a disease-specific clinical database that manually collects and audits data on consecutive MI patients at nearly 800 US hospitals.[6] Similarly, in the study by Saad et al, 30.4% of patients without COVID-19 with STEMI developed acute heart failure during hospitalization and 17.3% developed cardiogenic shock,[5] both of which are considerably higher than the rates observed in contemporary, audited, multicenter US registries.[7,8] Fundamentally, administrative coding schema designed primarily for billing cannot be guaranteed to provide an accurate portrait of a clinical entity, either at the individual or population level.

Despite these concerns, the primary findings of the study by Saad et al[5] are consistent with results observed in several registries that have collected detailed clinical data about patients presenting with STEMI in the COVID-19 era, including the North American COVID-19 Myocardial Infarction (NACMI) Registry.[2,3,9] MI in patients with COVID-19 disproportionally affects Hispanic and Black patients. Patients with COVID-19 and

STEMI have an increased prevalence of adverse cardiovascular risk factors, particularly diabetes, which was present in nearly half of these patients in the NACMI Registry and the study by Saad et al. Moreover, high-risk pre-PCI conditions, such as cardiac arrest (11% in both data sets) and cardiogenic shock (18% in the NACMI Registry), are common among patients with STEMI and COVID-19. Yet, despite this high-risk clinical profile, patients with STEMI and COVID-19 were less likely to undergo invasive angiography and primary PCI, received less mechanical circulatory support, and were more likely to receive fibrinolytic therapy than contemporary and historical control patients. In addition, in-hospital mortality was significantly higher in patients with STEMI and COVID-19 (15% for out-of-hospital STEMI and 78% for in-hospital STEMI in the Vizient database and 33% overall in the NACMI Registry). These findings require explanations for the excess mortality associated with COVID-19 in patients with MI.

Possible mediators of this excess mortality include delayed presentation, higher incidence of cardiogenic shock and cardiac arrest, different pathophysiological mechanisms (eg, more thrombogenic lesions and microthrombi), and deviations from standard treatment protocols.[2,9-11] Although more basic mechanistic research is needed to clarify the unique pathophysiology of STEMI in patients with COVID-19, substantial information is available related to the systems of care delivery for these patients. For example, the study by Saad et al highlights the frequency at which STEMI occurs while patients with COVID-19 are hospitalized and the extent to which this is associated with the observed higher mortality in this population. In the study by Saad et al,[5] one-third of STEMIs among patients with COVID-19 occurred in patients hospitalized for other reasons, most frequently for COVID-19. By contrast, just 5% of STEMIs in patients without COVID-19 were among those hospitalized for other reasons. Patients with in-hospital STEMI have higher mortality than those with out-of-hospital STEMI for reasons related both to comorbidities and systems of care,[12] and outcomes in patients with COVID-19 who develop STEMI while hospitalized are dismal (78% mortality rate in the study by Saad et al[5]).

Current evidence also underscores the potential harms associated with deviations from evidence-based STEMI protocols that occurred during the early phases of the pandemic. Multiple studies documented treatment delays and reduced access to primary PCI for patients with STEMI and COVID-19, with these changes in care patterns associated with increased risks of mortality and heart failure.[2,4,9,10] The current study by Saad et al,[5] as well as previous analyses, support current recommendations from the Society of Cardiovascular Angiography and Interventions and the American College of Cardiology demonstrating that primary PCI is feasible in patients with COVID-19 with STEMI and should remain the primary reperfusion modality in the absence of futility markers.[13]

Negative alterations in care delivery for STEMI during the pandemic extended beyond deviations from previous in-hospital protocols. Early reports that demonstrated reduced cardiac catheterization laboratory activations for STEMI and increased cardiac arrests at home raised concerns that many patients with acute MI were not seeking medical care during the pandemic, potentially unraveling 3 decades of scientific progress.[14,15] Lockdowns instituted during the first wave of the pandemic may have failed to properly emphasize to the public the differences between hospitals (essential service) and nonessential services, such as bars, restaurants, and gyms. Also, recommendations to "self-quarantine" for 2 weeks when symptoms of COVID-19 were present, some of which may be indistinguishable from symptoms of heart disease, such as dyspnea and cough, may have contributed to many patients delaying or forgoing necessary medical care. As the pandemic continues and in potential future public health emergencies, it is imperative to emphasize the importance of timely care for patients with acute MI.

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Published Online: October 29, 2021. doi:10.1001/jama.2021.19608

Conflict of Interest Disclosures: Dr Fanaroff reported receiving grants from the American Heart Association and the National Institutes of Health and personal fees from Intercept Pharmaceuticals outside the submitted work. Dr Garcia reported receiving grants from Medtronic, Abbott Vascular, and Edwards Lifesciences and a research grant from the Society for Cardiovascular Angiography and Interventions to study myocardial infarction in COVID-19 during the conduct of the study. Dr Giri reported receiving grants to his institution and personal fees from Boston Scientific and Inari Medical and personal fees from AstraZeneca outside the submitted work.

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