

Fear of COVID-19 leading to late presenting myocardial infarction complicated by cardiogenic shock due to ventricular septal rupture

Kazim Aykent,¹ Gergis Kirolos,² Mahin Khan,¹ Ankush Moza¹

¹Michigan State University/ McLaren Flint, Department of Cardiovascular Medicine, McLaren Health Care Corp, Flint, Michigan, USA

²Michigan State University/ McLaren Flint, Department of Internal Medicine, McLaren Health Care Corp, Flint, Michigan, USA

Correspondence to

Dr Kazim Aykent;
kazimaykent@yahoo.com

Accepted 10 March 2022

SUMMARY

Post myocardial ventricular septal rupture (VSR) is one of the most fatal complications of acute myocardial infarction (AMI) in spite of percutaneous and surgical closure. With the advancement of percutaneous coronary interventions in a timely manner, incidence of post MI VSR has declined remarkably. However, the COVID-19 pandemic-related late hospital presentations with AMI increases the possibilities of a potential upward shift in the incidence of post MI VSR. This case report aimed to increase awareness of negative contributions of the current pandemic to AMI and its fatal complications.

BACKGROUND

Since the emergence of the COVID-19 pandemic, there have been about 275 million confirmed cases and more than 5.3 million deaths globally according to the WHO.¹ While the virus causes severe and life threatening hypoxaemic respiratory failure, there have been ample reports of extrapulmonary manifestations including venous and arterial thromboembolism, myocardial dysfunction and arrhythmia, acute kidney injury, dermatological and neurological complications.² Not only have there been reports of medical adverse events, COVID-19 has resulted in significant psychosocial stress and delay in patients seeking medical care for emergencies like acute myocardial infarction (AMI).³ Recent data indicates almost 40% decline in catheterisation for ST-elevation myocardial infarction (STEMI) during the early phase of the pandemic in the USA which will likely continue to contribute to morbidity and mortality.⁴ This case report aimed to increase awareness about negative contributions of the current pandemic to the leading cause of death in the globe and its fatal complications.

CASE PRESENTATION

A man in his 60s, a lifetime non-smoker with a medical history notable for hyperlipidaemia and severe peripheral vascular disease who presented to the emergency department with reports of progressive dyspnoea and generalised weakness for a week. On further questioning, he reported that he had several episodes of self-limiting chest discomfort 2 weeks prior to the presentation day. During these episodes, the patient did not seek any medical attention due to fear of contracting COVID-19. On presentation, the patient was hypotensive with a blood pressure of 60/40 mm Hg, tachycardic with a heart rate of 140 beats per minute and hypoxic

with an oxygen saturation of 85%. Other vitals were within normal limits. Physical examination was remarkable for jugular vein distension, a holosystolic murmur on the left sternal border, bilateral crackles at lung bases, cold and clammy extremities. ECG in the field was consistent with acute inferior STEMI and ventricular tachycardia (figure 1). Blood work on presentation was as follow: Blood urea nitrogen 49 mg/dL, creatinine 1.89 mg/dL, aspartate aminotransferase 239 U/L, alanine transaminase 135 U/L, venous lactic acid 11.4 mM/L, troponins 13.4 ng/mL and B-type natriuretic peptide 173 pg/mL. Presenting ECG and rhythm in the field are shown in figures 1 and 2. Left ventriculogram (LVG) showed findings suggestive of ventricular septal rupture (VSR) (videos 1 and 2). Coronary angiogram showed a total occlusion of the right coronary artery (RCA) at the mid portion. The other coronary arteries had non-obstructive stenosis (figures 3–5). Transthoracic echocardiogram (TTE) revealed a large VSR with regional wall motion abnormalities and moderately reduced left ventricular systolic functions (figures 6 and 7).

Differential diagnosis includes acute coronary syndrome, acute aortic syndrome, stress-induced cardiomyopathy and acute myocarditis. In the presence of STE in the inferior leads on 12-lead ECG and ventricular tachycardia in a pre-elderly man, inferior myocardial infarction is the most likely diagnosis. Additionally, haemodynamic instability and abnormal examination findings indicating reduced tissue perfusion are suggestive of acute cardiogenic shock. Moreover, pansystolic murmur in the left sternal border on auscultation raises suspicion for AMI-related complications such as post MI VSR or papillary muscle rupture. Therefore, LVGs in the right anterior oblique and left anterior oblique projections were immediately performed that showed the basal, mid and distal inferior wall hypokinesis with evidence of shunt from the left ventricle to the right ventricle at systole. TTE confirmed the defect in the mid portion of the interventricular septum (IVS). Bilateral selective coronary angiogram revealed a total occlusion of the RCA at the mid-level that was the culprit lesion for AMI.

Overall, the patient's presentation was consistent with cardiogenic shock due to complicated AMI. Given ventricular tachycardia leading to haemodynamic compromise, a successful cardioversion was performed. In addition to intravenous vasopressors, intra-aortic balloon pump (IABP) was inserted



© BMJ Publishing Group Limited 2022. No commercial re-use. See rights and permissions. Published by BMJ.

To cite: Aykent K, Kirolos G, Khan M, et al. *BMJ Case Rep* 2022;**15**:e248592. doi:10.1136/bcr-2021-248592



Figure 1 Presenting ECG showing widened QRS tachycardia with a heart rate of 156 beats per minute and ST segment elevation in the inferior leads representing acute inferior ST segment elevation myocardial infarction and ventricular tachycardia.

for the purpose of percutaneous mechanical circulatory support (PMCS) due to cardiogenic shock. The case was discussed with the cardiothoracic surgery team and emergent repair of VSR was declined due to high-risk features. Therefore, the decision was made to proceed with percutaneous coronary intervention (PCI) for the culprit lesion. After pre-dilatation of the index lesion, two drug-eluting stents were inserted to the mid RCA with no complications.

On the first day post cardiac catheterisation, he remained in cardiogenic shock and pulmonary oedema despite intravenous vasopressors, IABP counter-pulsation therapy and mechanical ventilation. Given severe upper and lower peripheral vascular disease, percutaneous mechanical circulatory support with axial or centrifugal flow was not feasible at our institution. The patient was eventually transferred to a larger centre for advanced PMCS and surgical closure of the VSR. He was placed on veno-arterial extracorporeal membrane oxygenation (VA ECMO) on arrival at the accepting centre and underwent surgical closure on VA ECMO 4 days after the transfer. Over the next several days, VA ECMO was successfully decannulated. However, the patient continued to require increasing pressure support and oxygen requirements that eventually progressed to persistent hypotension on maximum pressure support. The patient eventually had a cardiac arrest and expired within 10 days of surgery.

GLOBAL HEALTH PROBLEM LIST

The incidence of the COVID-19 has been up trending globally with increasing morbidity and mortality since the outbreak was officially confirmed in 2019.

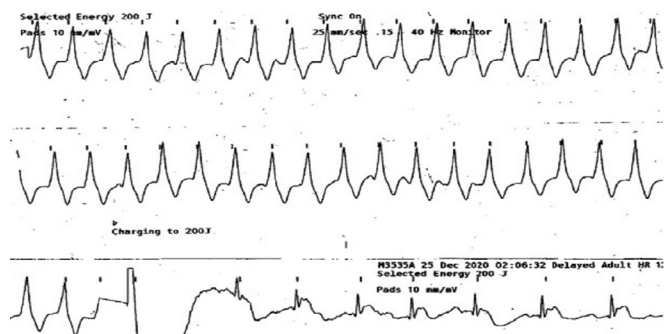
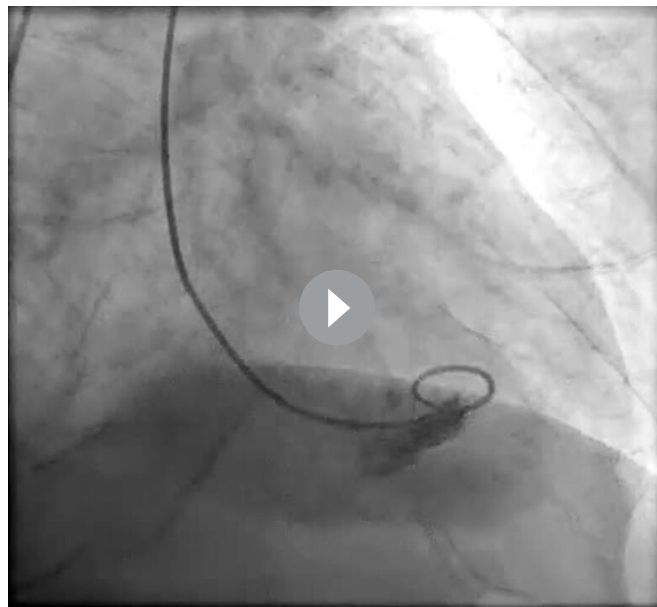


Figure 2 An ECG strip during cardioversion in synchronised mode with a 200 joule that converted the ventricular tachycardia to sinus rhythm.

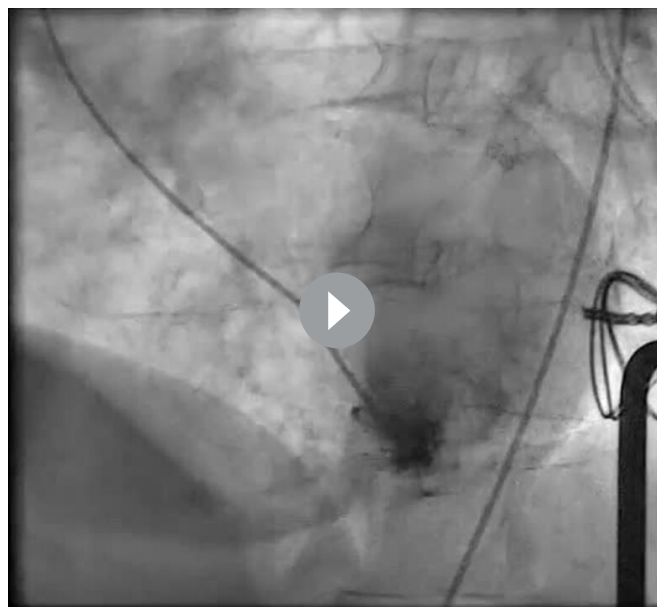


Video 1 Left ventriculogram in right anterior oblique projection.

The overall mortality rate has risen worldwide, especially in the USA which was 20% higher between March and August 2020 in comparison with all-cause mortality from previous years since 2014.

Since public health measures have been announced globally to mitigate the spread of the COVID-19, late presenting cases from cardiac and non-cardiac conditions became more prevalent due to the inability to reach designated healthcare centres on time for multitude of reasons including the contagious nature of the virus, stay home orders, strict hospital policies for preventing the spread of COVID-19 pandemic as well as overburdened healthcare systems.

This global pandemic has a likely positive correlation with the increased proportion of late presenting fatal cardiac emergencies especially mechanical complications post AMI.



Video 2 Left ventriculogram in left anterior oblique projection.

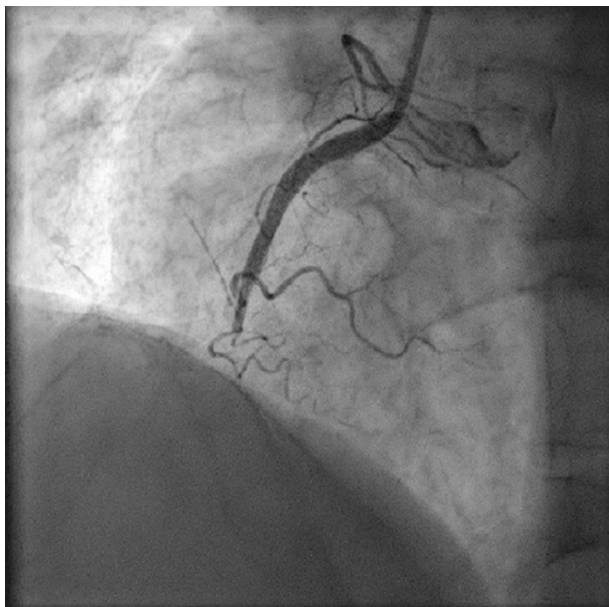


Figure 3 Selective right coronary angiogram in left anterior oblique projection showing a total occlusion of the right coronary artery at its mid-level.

GLOBAL HEALTH PROBLEM ANALYSIS

Post MI VSR results from a complete occlusion of a coronary artery supplying blood to a territory of the IVS.⁵ Latham first recognised VSR as a complication of AMI in an autopsy report in 1847.⁶ Although, the incidence reported is somewhere between 1% and 3% historically, the current data has shown a marked decrease in incidence by about 10-fold primarily due to the advancement of early reperfusion strategies for the last few decades.⁷ Despite the advent of percutaneous and surgical techniques in the closure of post MI VSR, it still remains a devastating complication with grim prognosis. In the published series, the mortality rate varies at 18.4% with the delay of surgery up to 7 days, 58.4% with emergent repair and 94% if left untreated by day 30 post presentation.^{8,9} Therefore, high index of suspicion is required for early recognition and treatment optimisation in a timely manner.

Universal risk factors of this fatal complication are advanced age, female gender, history of stroke, ST-segment elevation on ECG, elevated cardiac markers, higher heart rate, lower blood pressure, higher Killip classification and delayed or lack of



Figure 4 Selective left coronary angiogram in right caudal projection showing the left coronary system with non-obstructive coronary artery disease.

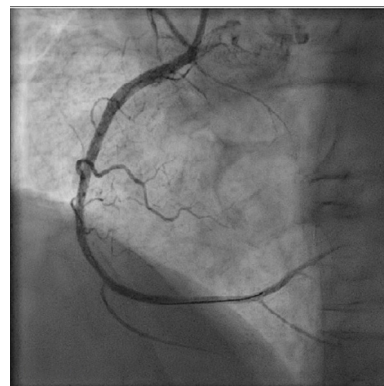


Figure 5 Post stenting image showing a complete resolution of the culprit lesion in the mid portion of the right coronary artery with no complications.

reperfusion. The data also shed light into a negative correlation between the presence of atherosclerotic risk factors and post MI VSR.⁵ Our case was classical for the late presentation of acute inferolateral MI complicated by VSR. Traditional cardiovascular risk factors were relatively less present which was consistent with the current data.

The anterior IVS is supplied by the left anterior descending (LAD) artery as opposed to a dominant RCA generally provides a blood supply to the inferior IVS. As a result, apical VSRs are seen in the presence of total occlusions of the LAD whereas infarcted dominant RCAs usually result in basal VSRs. Moreover, RCA-related VSRs are more likely to be large and associated with intra-myocardial dissection and involvement of the free wall.^{8,10} In our case, the defect interestingly was located in the mid portion of the IVS. This may be explained by the RCA being dominant and supplying such a large territory in the IVS from the base to the mid portion.

When it comes to timing of surgery, the mortality rates have been reported lower in patients with delay of the closure than those who underwent early repair within 1 week or treated conservatively.^{5,10} Despite medical treatment, PMCS and a successful PCI of the infarct-related artery with an optimal door-to-balloon time, cardiogenic shock remained persistent. Our patient remained on ECMO for 10 days and underwent a surgical closure of the VSR on day 10. He transiently recovered from shock but unfortunately developed cardiac arrest and expired in the same hospitalisation.

Since the global health organisations announced the COVID-19 pandemic in 2019, the whole world has started

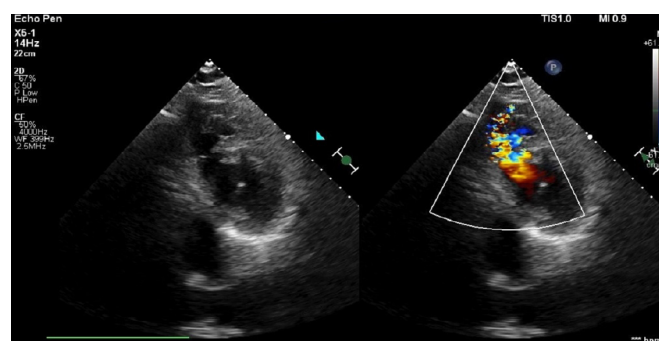


Figure 6 Transthoracic echocardiogram (short axis view) shows a large drop out of the interventricular septum with turbulent flow on colour Doppler representing the ventricular septal rupture (white arrow).

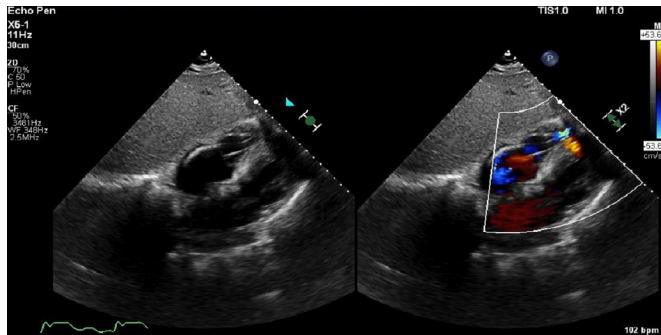


Figure 7 Transthoracic echocardiogram shows the ventricular septal rupture (white arrow) in subcostal view.

operating interventions to mitigate the spread of the virus using public health measures including self-isolation, social distancing and wearing facial masks. Despite this global effort, symptomatic patients from COVID-19 have surged to the hospitals and COVID-19 positive admission rates reached to historical high numbers in 2020. However, the fear of contagion made some patients with angina or equivalents to present to the facilities either very late or did not present at all. Furthermore, universal efforts to inhibit the spread of the virus have resulted in unwanted deviations in the STEMI guidelines. The donning and doffing process of the protective personal equipment (PPE) and the absence of negative pressure systems in the most cardiac catheter laboratories have required additional steps and tests prior to initiating emergent percutaneous coronary interventions. Therefore, large delays have been seen in symptom onset to hospital time as well as door-to-balloon time due to contemporary hospital disinfection protocols.²

Conversely, the total number of non-COVID-19 hospitalisations in 2020 declined remarkably in comparison with the hospitalisations in 2019.^{11 12} A retrospective analysis from Italy showed that COVID-19 negative STEMIs experienced approximately two times longer door-to-balloon time in 2020 as compared with the door-to-balloon time in the pre-COVID years. Also, the major adverse cardiac events were more likely to be seen in the study group.¹³ At the beginning of the outbreak, there was a significant reduction in acute cardiac admissions and length of stay concerning about disruption in acute care of cardiovascular conditions during the COVID-19 pandemic.¹¹

In terms of non-COVID-19 non-cardiac emergencies, delayed care seeking due to disruption in the healthcare utilisation has resulted in increased morbidity and mortality. An observational prospective study enrolling a total of 185 patients has shown that 50% of the acute surgical cases who tested negative for the COVID-19 experienced service delay in healthcare and presented late with stage IV cancer as underlying aetiology.¹⁴

According to a nationwide, web-based 1-week survey between June 24 and June 30 2020, 41% of the US adults were found to have avoidance of medical care during the pandemic due to concerns about COVID-19. Medical care delay was more prevalent in non-Hispanic black population, young adults, aged 18–24 years, disabled persons and those with chronic conditions. The percentage of individuals who denied seeking emergent/urgent care was about 12% based on the survey. Approximately one-third of the survey population reported delay in routine care in regards to a degree of fear and worry in the general population.¹⁵

Despite the outbreak-related delays in acute cardiac care, primary PCI still remains the cornerstone treatment strategy for patients who had a STEMI at PCI-capable hospitals when

it could be provided in a timely manner, with an expert team outfitted with PPE in a dedicated cardiac catheterisation laboratory (CCL). In order to prevent late door-to-balloon time in STEMIs, several actions have been recommended by cardiac societies across high-impact regions in the USA. These actions include a quick screening for COVID-19, the use of ultra-rapid COVID-19 testing if available, rapid classification of patients with STEMI into COVID-19 positive/probable or COVID-19 possible groups and transferring COVID-19 positive or probable STEMIs to dedicated CCLs.¹⁶

The impact of the COVID-19 pandemic to AMI and its complications is largely unknown since the data are lacking. Additionally, large delays from diagnosis to treatment in this context have become ordinary during the pandemic and it is unclear the amount of impact on morbidity and mortality rates due to increased risk of developing post-MI complications. Moreover, patients who had an AMI who chose not to seek medical attention could probably have been affected the most.

Our case signals a potential shift in the characteristics of patients who had an AMI with regards to the pandemic. It also highlights the importance of educating our patients and the population in general about the devastating complications from acute medical emergencies and the essence of timely presentation to the hospital to avoid such complications.

Learning points

- ▶ Late presenting myocardial infarction (MI) cases increase due to COVID-19 outbreak.
- ▶ High index of suspicion for MI-related complications especially post MI ventricular septal rupture (VSR).
- ▶ Physical examination is the crucial step to suspect post MI VSR.
- ▶ Use of percutaneous mechanic circulatory support to bridge surgery if feasible.
- ▶ The importance of optimal timing of surgery in the management of post MI VSR.

Contributors KA, MK and GK contributed equally in the writing and editing of the manuscript. AM supervised the project and made significant changes to the final manuscript. All authors agreed upon the finalised manuscript to be published. All authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Consent obtained from next of kin.

Provenance and peer review Not commissioned; externally peer reviewed.

Case reports provide a valuable learning resource for the scientific community and can indicate areas of interest for future research. They should not be used in isolation to guide treatment choices or public health policy.

REFERENCES

- 1 Who.int. Data at who, 2021. Available: <https://covid19.who.int/> [Accessed 2 Nov 2021].
- 2 Joshi S, Kazmi FN, Sadiq I, *et al.* Post-Mi ventricular septal defect during the COVID-19 pandemic. *JACC Case Rep* 2020;2:1628–32.
- 3 Tam C-CF, Cheung K-S, Lam S, *et al.* Impact of coronavirus disease 2019 (COVID-19) outbreak on ST-segment-elevation myocardial infarction care in Hong Kong, China. *Circ Cardiovasc Qual Outcomes* 2020;13:e006631.
- 4 García S, Albaghdadi MS, Meraj PM, *et al.* Reduction in ST-segment elevation cardiac catheterisation laboratory activations in the United States during COVID-19 pandemic. *J Am Coll Cardiol* 2020;75:2871–2.

- 5 Crenshaw BS, Granger CB, Birnbaum Y, *et al*. Risk factors, angiographic patterns, and outcomes in patients with ventricular septal defect complicating acute myocardial infarction. GUSTO-I (global utilization of streptokinase and TPA for Occluded coronary arteries) trial Investigators. *Circulation* 2000;101:27–32.
- 6 Peter ML. Lectures on subjects connected with clinical medicine, comprising diseases of the heart. *Br Foreign Med Rev* 1847;23:169–84.
- 7 Moreyra AE, Huang MS, Wilson AC, *et al*. Trends in incidence and mortality rates of ventricular septal rupture during acute myocardial infarction. *Am J Cardiol* 2010;106:1095–100.
- 8 Jones BM, Kapadia SR, Smedira NG, *et al*. Ventricular septal rupture complicating acute myocardial infarction: a contemporary review. *Eur Heart J* 2014;35:2060–8.
- 9 Arnaoutakis GJ, Zhao Y, George TJ, *et al*. Surgical repair of ventricular septal defect after myocardial infarction: outcomes from the Society of thoracic surgeons national database. *Ann Thorac Surg* 2012;94:436–44. discussion 443-4.
- 10 Goyal A. Contemporary management of post-MI ventricular septal rupture. *American College of Cardiology*, 2018. Available: www.acc.org/latest-in-cardiology/articles/2018/07/30/06/58/contemporary-management-of-post-mi-ventricular-septal-rupture.htm [Accessed 3 Nov 2021].
- 11 Bhatt AS, Moscone A, McElrath EE, *et al*. Fewer hospitalizations for acute cardiovascular conditions during the COVID-19 pandemic. *J Am Coll Cardiol* 2020;76:280–8.
- 12 Nguyen JL, Benigno M, Malhotra D, *et al*. Pandemic-related declines in hospitalization for non-COVID-19-related illness in the United States from January through July 2020. *PLoS One* 2022;17:e0262347.
- 13 D'Amario D, Rodolico D, Cappannoli L, *et al*. Are we missing something in the management of acute coronary syndromes in COVID-19-Negative patients? *J Am Coll Cardiol* 2020;76:2573–4.
- 14 Khan R, Zaidi N, Chituku T, *et al*. Non- COVID fatalities in the COVID era: a paradigm shift in the face of a pandemic- lessons learnt (or not). *Ann Med Surg* 2021;70:102617.
- 15 Kathleen PH, Aaron KP, Jourdan D. Impact of the COVID-19 pandemic on emergency department Visits- United States. *MMWR Morb Mortal Wkly Rep* 2020;69:699–704.
- 16 Mahmud E, Dauerman HL, Welt FGP, Ehtisham M, Harold LD, Frederick GPW, *et al*. Management of acute myocardial infarction during the COVID-19 pandemic: a position statement from the Society for cardiovascular angiography and interventions (ScAI), the American College of cardiology (ACC), and the American College of emergency physicians (ACEP). *J Am Coll Cardiol* 2020;76:1375–84.

Copyright 2022 BMJ Publishing Group. All rights reserved. For permission to reuse any of this content visit <https://www.bmj.com/company/products-services/rights-and-licensing/permissions/>
 BMJ Case Report Fellows may re-use this article for personal use and teaching without any further permission.

Become a Fellow of BMJ Case Reports today and you can:

- ▶ Submit as many cases as you like
- ▶ Enjoy fast sympathetic peer review and rapid publication of accepted articles
- ▶ Access all the published articles
- ▶ Re-use any of the published material for personal use and teaching without further permission

Customer Service

If you have any further queries about your subscription, please contact our customer services team on +44 (0) 207111 1105 or via email at support@bmj.com.

Visit casereports.bmj.com for more articles like this and to become a Fellow