


Simultaneous Left Ventricular Aneurysm and Ventricular Septal Rupture Complicating Delayed STEMI Presentation: A Case-Based Review of Post-MI Mechanical Complications Amid the COVID-19 Pandemic

Muhammad Hassan Naeem Goraya, MD¹, Sidra Kalsoom, MD², Talal Almas, BS³, Muhammad Kashif Amin, MD⁴, Nadeem Hussain, MD⁵, Junaid Rasul Awan, MD⁶, Maryam Ehtesham, BS³, Muhammad Ali Niaz, BS³ , Hafeez UI Hassan Virk, MD⁷, and Steven J. Filby, MD⁷

Abstract

Amid the coronavirus disease 2019 (COVID-19) pandemic, there is an unprecedented increase in public avoidance of hospitals predominantly driven by fear of contracting the virus. Recent publications highlight a re-emergence of rare post-myocardial infarction complications. While mechanical complications are infrequent in the era of primary percutaneous coronary intervention, they are associated with high mortality rates. The concurrent occurrence of mechanical complications such as left ventricular aneurysm and ventricular septal rupture is an extremely rare entity. We hereby delineate a unique case of a 53-year-old Caucasian male who underwent successful concomitant closure of a ventricular septal rupture, left ventricular aneurysmectomy, and 3-vessel coronary artery bypass grafting. Due to a delayed initial presentation owing to the patient's fear of contracting COVID-19, the surgery was carried out 3 months after the myocardial infarction. His postoperative evaluation confirmed normal contractility of the left ventricle and complete closure of the ventricular septal rupture. Six months postoperatively, the patient continues to do well. We also present a literature review of the mechanical complications following delayed presentation of myocardial infarction amid the COVID-19 pandemic. This article illustrates that clinicians should remain cognizant of these extremely rare but potentially lethal collateral effects during the ongoing global public-health challenge. Furthermore, it highlights a significant concern regarding the delay in first medical contact due to the reluctance of patients to visit the hospital during the COVID-19 pandemic.

Keywords

coronavirus disease 2019, ST-segment elevation myocardial infarction, left ventricular aneurysm, ventricular septal rupture, delayed MI presentation, mechanical complications

Introduction

The coronavirus disease 2019 (COVID-19) pandemic has become a major global health challenge of this century with more than 183 million confirmed cases and over 3.97 million deaths to date. It has affected health care systems throughout the world even in the wake of recent advents such as the COVID-19 vaccine, thereby necessitating radical changes in therapeutic protocols. Consequently, the initial management of time-sensitive cardiovascular emergencies such as ST-elevation myocardial infarction (STEMI) has been limited to fibrinolytic therapy in some hospitals, often delaying

¹Services Institute of Medical Sciences, Lahore, Pakistan

²Conemaugh Memorial Medical Center, Johnstown, PA, USA

³Royal College of Surgeons in Ireland, Dublin, Ireland

⁴Texas Tech University Health Sciences Center, Amarillo, TX, USA

⁵Banner-University Medical Center, Tucson, AZ, USA

⁶University Hospital Limerick, Limerick, Ireland

⁷University Hospitals Cleveland Medical Center, Cleveland, OH, USA

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Corresponding Author:

Muhammad Hassan Naeem Goraya, MBBS, Services Institute of Medical Sciences, Jail Road, Shadman I Shadman, Lahore, Punjab 54000, Pakistan.
Email: hassangoraya2009@live.com



Table 1. Patient Laboratory Values on Admission and During Hospitalization.

Laboratory parameters, units	Normal value range	Day 1	Day 2	Day 3	Day 4	Day 5
Aspartate transaminase, U/L	3-40	429	255	192	139	98
Alanine aminotransferase, U/L	3-37	1329	1023	779	596	443
Lactate dehydrogenase, U/L	120-240	86	82	69	94	91
Alanine aminotransferase/lactate dehydrogenase ratio	>1.50	15.4	12.5	11.3	6.3	4.8
Total bilirubin, mg/dL	0.30-1.00	3	2.4	2.3	1.4	1.1
Creatine kinase, U/L	30-200	77	86	81	80	96
Troponin I, ng/L	0.0-34.2	0.17	0.16	0.17	0.14	0.10
White cell count, 10 ³ /μL	4.0-10.0	14.5	13.2	10.4	8.8	7.9
Hemoglobin, g/dL	13.0-17.0	13.8	14.1	12.6	13	12.6
Creatinine, mg/dL	0.73-1.18	1.14	0.95	0.86	0.89	0.77

the necessary percutaneous coronary intervention (PCI).¹ One study from the United States showed an estimated 38% decrease in STEMI activations during the early phase of the pandemic.² Similarly, a 40% decline was observed in STEMI interventions in Spain.³ Global lockdowns, social distancing guidelines, and awareness campaigns to limit the spread of COVID-19 have resulted in a decline in timely myocardial infarction (MI) presentations worldwide. Several studies posit that the public fear of acquiring COVID-19 in the hospital might indeed be responsible for this exorbitant decline.²⁻⁴

It is notable that the incidence of serious post-MI mechanical complications has decreased remarkably over the past few decades due to early reperfusion using primary PCI. In this context, the re-emergence of once-grave but now antiquated entities such as mechanical complications after MI during COVID-19 pandemic is perplexing.^{5,6} The resurgence of mechanical complications can be attributed, in part, to delayed MI presentations resulting in a delay in revascularization. We chronicle here the case of a STEMI patient who reportedly avoided making first medical contact for over 3 months owing to his fear of contracting COVID-19 in the hospital. After a significantly delayed presentation, his workup confirmed the simultaneous presence of a left ventricular aneurysm (LVA) and a Becker type III ventricular septal rupture (VSR) complicating his STEMI. In addition, we undertake a systematic literature review of mechanical complications associated with delayed MI presentation amid the COVID-19 pandemic. This article highlights the need for improved public awareness and education to seek early medical care for emergent cardiovascular conditions.

Illustrative Case

Presentation

A 53-year-old obese Caucasian man presented to our medical center with a 3-month history of worsening shortness of breath and lower extremity edema. The patient described

associated diaphoresis but denied any chest pain or dizziness. He did not seek medical attention early due to his apprehensions surrounding COVID-19. He denied alcohol intake or illicit drug dependence. He was not on therapy with any medications, denied recent hospitalization, and had not seen his primary care doctor in the last 10 years. At presentation, he was afebrile and hemodynamically stable.

Investigations

The patient underwent extensive diagnostic workup (Table 1). Electrocardiogram demonstrated ST-segment elevations in the inferior leads (Figure 1). He then underwent emergent coronary angiography, which divulged severe multi-vessel coronary artery disease, with complete occlusion of mid-right coronary artery (Figure 2; Supplementary Videos 1 and 2, available online). Left ventriculography revealed inferior wall hypokinesis of left ventricle with basilar inferior segment aneurysm and mural thrombus (Figure 3; Supplementary Video 3, available online). It also showed possible left-to-right shunt via an interventricular septum. The procedure was halted without PCI and the patient was admitted to coronary care unit for cardiothoracic surgery consultation. Transthoracic echocardiography showed mildly reduced biventricular function (left ventricular ejection fraction: 40% to 45%), with a basal inferior wall aneurysm and small VSR with left-to-right shunt (Supplementary Videos 4 and 5, available online). Cardiac magnetic resonance imaging was recommended by cardiothoracic surgery. It showed a wide-mouthed aneurysm in the base of the inferior wall, measuring 5.2 × 5.3 × 4.4 cm with an associated mural thrombus (Figure 4). There was a small-sized VSR in the inferior and basal aspect of interventricular septum, causing left-to-right shunt (Qp/Qs: 1.7; Table 2). Transmural delayed enhancement, involving mid and basal inferior septum, was suggestive of nonviable myocardium (Figure 5). No evidence of mitral regurgitation was present. Coronavirus testing via nasopharyngeal swab was negative.

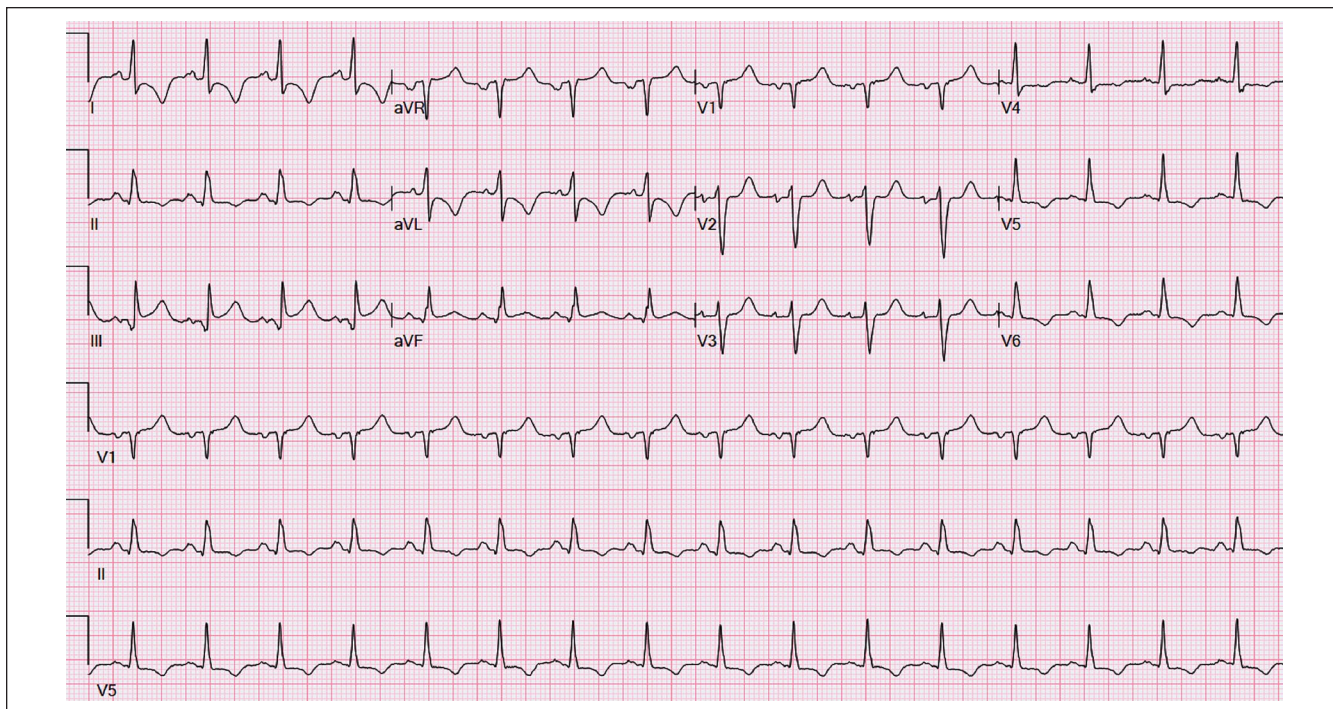


Figure 1. Twelve-lead electrocardiography at presentation. A 12-lead electrocardiogram shows ST elevation in inferior leads (II, III, AVF) with reciprocal ST depressions in lateral leads (I, AVL, V4-V6).



Figure 2. Angiography of right coronary artery (RCA) in left anterior oblique projection. It demonstrates complete occlusion of the mid vessel with the reconstitution of distal RCA from right to right collaterals.

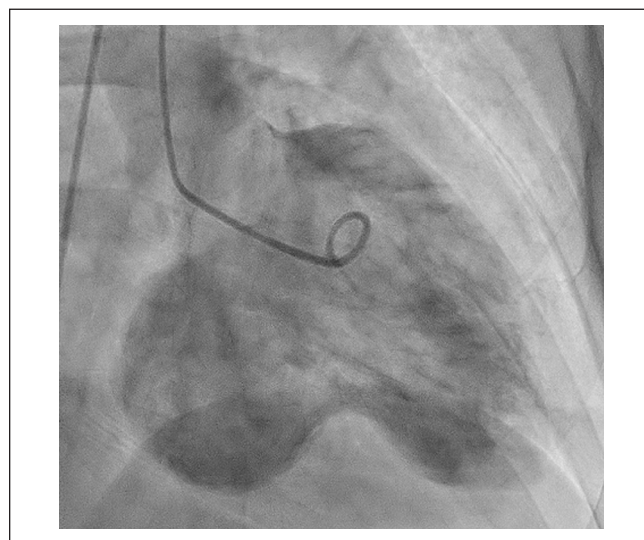


Figure 3. Left ventriculogram. Left ventriculogram in anterior oblique (RAO) projection demonstrating an inferobasal wall true aneurysm.

Management

After multidisciplinary team discussion, cardiothoracic surgery planned curative resection. The patient remained hemodynamically stable and was started on heparin infusion. He underwent an uneventful removal of mural

thrombus, aneurysmectomy, and VSR patch repair. The step-wise approach to the aneurysmectomy procedure is outlined in the flowchart (Figure 6). Furthermore, he also underwent 3-vessel coronary artery bypass grafting (CABG) for his multivessel disease. He tolerated the procedures well.



Figure 4. Cardiac magnetic resonance (CMR) imaging. CMR imaging in sagittal view (2-chamber view) demonstrating left ventricular true aneurysm.

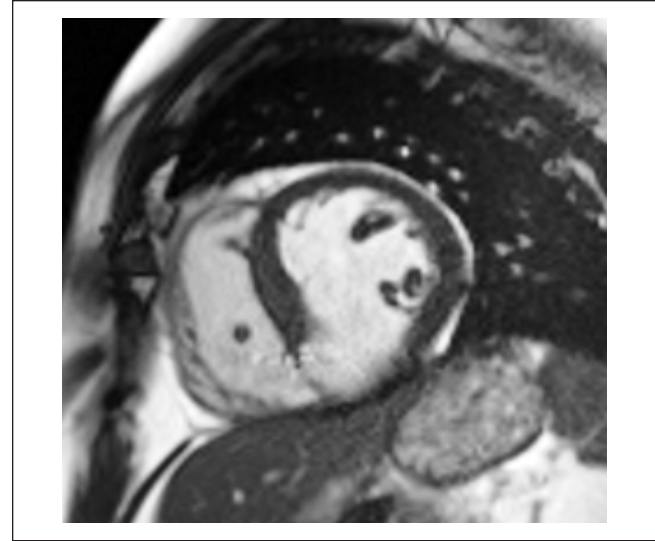


Figure 5. Cardiac magnetic resonance (CMR) imaging. Short-axis view of heart on CMR imaging showing ventricular septal rupture at inferobasal left ventricle.

Table 2. Right Heart Catheterization Measurements.

Hemodynamic parameters	Patient measurements
Aortic pressure, systolic/diastolic (mean), mm Hg	139/78
Right ventricle pressure, systolic/diastolic (mean), mm Hg	60/27
Pulmonary artery pressure, systolic/diastolic (mean), mm Hg	57/31
Right atrium pressure, mean, mm Hg	14
Pulmonary capillary wedge pressure, mean, mm Hg	18
Pulmonary blood flow, Qp, l/min	10
Systemic blood flow, Qs, l/min	5.9
Qp/Qs ratio	1.7

Clinical Outcome and Follow-up

His hospital course was uncomplicated. After 5 days of post-operative monitoring, he was discharged from the hospital in a stable condition. At the 6-month follow-up, he did not report any chest pain or shortness of breath, and his surgical wounds appeared well-healed. The patient continues to do well to date.

Methods

In order to study trends of mechanical complications following delayed presentation of acute MI amid COVID-19 pandemic, we conducted a systematic search of medical databases, including MEDLINE (PubMed and Ovid), Embase, Scopus, and Cochrane. Furthermore, we reviewed

conference papers from major cardiology scientific meetings. A comprehensive search strategy was constructed in order to identify relevant articles, using a combination of keywords. Search terminologies such as “mechanical complications,” “acute myocardial infarction,” “STEMI,” and “delayed presentation” were combined using the Boolean operators “AND” and “OR” with the terms “COVID-19,” “SARS-CoV-2,” “Coronavirus,” and “pandemic,” with all associated permutations. English-only articles were considered, without an application of a defined time filter. Two of the authors independently reviewed the titles and abstracts of the articles obtained from the initial search. For the eligibility of each study, full-text versions of potentially relevant articles were independently retrieved and reviewed by the other 2 authors. Concerns regarding the eligibility of individual studies were resolved after joint reassessment and consensus. The final inclusion of an article into quantitative analysis was based on a discussion headed by the senior author. The descriptive data are presented as mean \pm standard deviation, range, or percentage, as applicable.

Results

Initial database search yielded a total of 217 articles. A vast majority of articles were excluded as they were redundant ($n = 102$), duplicate ($n = 28$), reported pre-COVID-19 results ($n = 19$), did not describe individual patient data ($n = 16$), or the language was other than English ($n = 12$). A total of 40 studies were accessed in the full-version form in order to determine eligibility. It resulted in the further exclusion of irrelevant studies ($n = 19$). Finally, a total of 21 articles were identified to be pertinent with regard to the scope of this study and were included in the final quantitative analysis.

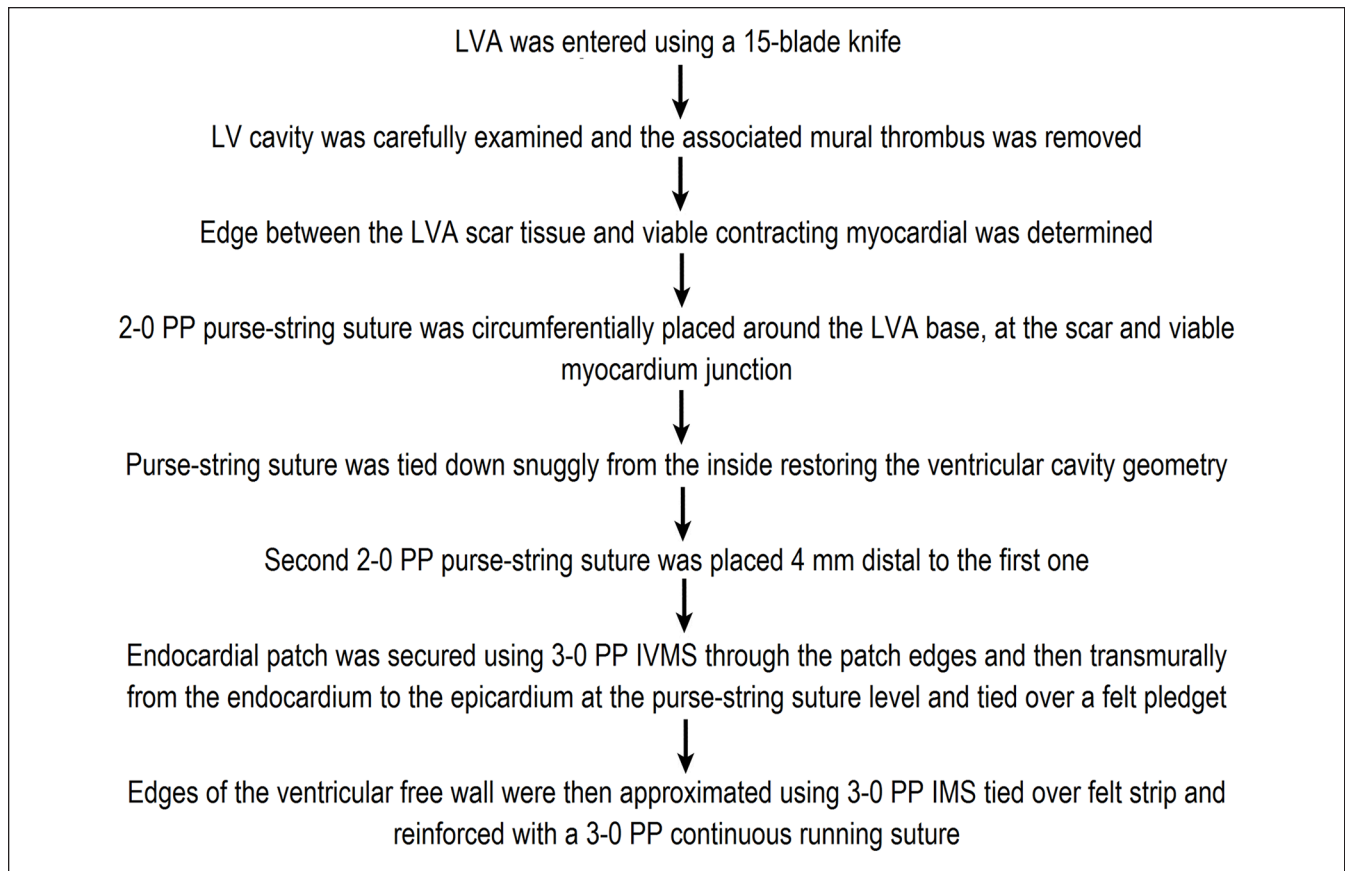


Figure 6. The step-wise approach to the aneurysmectomy procedure. LVA, left ventricular aneurysm; PP, polypropylene; IVMS, interrupted vertical mattress sutures; IMS, interrupted mattress sutures.

Mechanical complications following delayed MI presentations were described in a total of 26 case reports only (level of clinical evidence: IV) in 21 selected articles included in this study, dating from June 2020 to May 2021.⁷⁻²⁷ No gender predominance was noted as the male-to-female ratio was 1:1. The age of patients ranged from 37 to 87 years (mean \pm standard deviation = 64.12 ± 53.70 years). Notably, 24 (92%) of 26 patients were over 50 years of age. This observation may facilitate enhanced suspicion of mechanical complications in elderly patients (50 years and over) admitting with delayed MI presentations. In terms of the temporal relationship between the MI occurrence and onset of aforementioned complications, 20 (77%) of 26 patients developed symptoms within the first week after MI. Chest pain 18 (69%), dyspnea 13 (50%), and lightheadedness 4 (15%) were among the frequently encountered clinical presentations. On cardiac catheterization, a variety of underlying coronary artery lesions were identified. With regard to the detection of post-MI mechanical complications, transthoracic echocardiography was usually the first investigation employed to identify the type, location, and subsequent hemodynamic sequelae. These patients may require prompt hemodynamic stabilization, which may necessitate a combination of medical therapy and

mechanical circulatory support such as intra-aortic balloon pump 5 (19%), extracorporeal membrane oxygenation 2 (8%), and Impella 5.0 support 1 (4%). Surgery was performed in 17 (63%) patients. However, the optimal timing for surgical intervention remains to be determined in this setting. Notably, percutaneous therapeutic approaches were applied in 7 (27%) patients, denoting them as an emerging alternative treatment option for patients at prohibitive surgical risk. Of 26 patients for whom clinical outcomes were reported, a total of 8 (31%) patients died, whereas 2 (8%) patients remained under critical care. Notably, 16 (62%) patients recovered from these serious complications. The data regarding patient demographics, presenting symptoms, time from symptom onset to presentation, electrocardiographic features, anatomic findings, nature of mechanical complications, left ventricular ejection fraction, treatment, and clinical outcomes are summarized (Table 3).⁷⁻²⁷

Discussion

Acute STEMI is an established cause of significant mortality worldwide. Early detection followed by urgent management using PCI is effective in achieving optimal clinical

Table 3. Literature Review of Mechanical Complications After Delayed Presentations of Acute MI During COVID-19 Pandemic.

Authors	Publication time (month/year)	Age/sex (year)	Presenting symptoms	Time from symptom onset to presentation to ER	Electrocardiographic features	Anatomic findings	Complications	LVEF	Treatment	Clinical outcome
Gaballa et al ⁷	June 2020	87/Female	Nonexertional, epigastric, nonradiating, sharp chest pain	Several days	Normal sinus rhythm with T-wave inversions in the anterolateral leads	Significant stenosis of the LAD s/p placement of a DES	VSR	35% to 40%	Family decided to change goals of care measures	Died
Masroor et al ⁸	June 2020	48/Male	Persistent chest pain	2 days	Inferolateral STEMI	Occlusion of the dominant RCA	VSR with Qp/Qs was 3	25%	PCI + IABP + surgical repair	Recovered
Atreya et al ⁹	August 2020	52/Male	Dyspnea, chest pressure, and altered mental status		Sinus rhythm with ST-segment depression in the precordial leads	Thrombotic occlusion of the middle left circumflex artery	Severe MR with ruptured papillary muscle	Normal	Venoarterial ECMO + IABP + surgical mitral valve replacement	Recovered
Albiero et al ¹⁰	August 2020	72/Male	Severe chest pain	5 days	Extensive anterolateral STEMI	Coronary angiography showed proximal LAD artery occlusion	Subacute LV free wall rupture with mural thrombus	25%	PCI + surgical repair	Recovered
Shah et al ¹¹	August 2020	75/Female	Progressive chest pain	7 days	Inferolateral STE inferior Q waves Broad R waves V1-V2	Tortuous 100% mid-RCA occlusion with TIMI flow grade 0 80% distal left main 80% proximal LAD	VSR Basal inferolateral wall pseudoaneurysm IABP	50% to 55%	PCI with an IABP	The patient was sent for urgent CABG
Ahmed et al ¹²	August 2020	82/Female	Worsening shortness of breath and leg swelling	2 days	ST-segment elevations in leads V2-V6 with Q waves in leads I, aVL, V5-V6	LHC revealed acute total occlusion of the proximal LAD, diffuse 40% stenosis in the LCx, 70% stenosis of ramus intermedius, and 40% stenosis of mid-RCA	VSR with Qp/Qs was 1.56	30%	Percutaneous closure of VSR	Recovered
Ahmed et al ¹³	August 2020	65/Male	Shortness of breath	3 days	ST-segment elevation in leads II, III, and aVF with small Q waves	LHC revealed a completely occluded RCA at the mid-segment	VSR with Qp/Qs was 4.6	40%	CABG + patch repair of VSR	Recovered
Joshi et al ¹⁴	August 2020	72/Female	Substernal chest heaviness radiating to the back and bilateral upper limbs, and lightheadedness	14 hours	ST-segment elevation in the inferior leads with associated Q waves and reciprocal ST-segment depressions in high lateral leads	Coronary angiography demonstrated acute thrombotic occlusion of the mid RCA stent and no obstructive CAD in the left main, LAD, and left circumflex arteries	VSR with Qp/Qs was 2.2	Not reported	PCI of the mid RCA with I DES + comfort measures only as per patient's wishes	Died
Alsidawi et al ¹⁵	August 2020	67/Female	Chest pain, shortness of breath, and hypotension	5 days	Inferior ST-segment elevation with Q waves	Dominant RCA was totally occluded	VSR with Qp/Qs was 1.6	50%	Complex ventricular septal repair + a right ventricular assist device	Remained critically ill in the ICU
Qureshi et al ¹⁶	August 2020	68/Female	Lightheadedness, pre-syncope, and shoulder pain	7 days	Posterior MI	100% occlusion of an inferior distal branch of a large second obtuse marginal	Ventricular free wall rupture	35% to 40%	IABP + blood evacuation from pericardium	Recovered

(continued)

Table 3. (continued)

Authors	Publication time (month/year)	Age/sex (year)	Time from symptom onset to presentation to ER	Presenting symptoms	Electrocardiographic features	Anatomic findings	Complications	LVEF	Treatment	Clinical outcome
Qureshi et al ⁶	August 2020	72/Female	4 days	Weakness, shortness of breath followed by a mechanical fail	Remote inferior infarct and anterolateral ST segment elevations	Serial 70% and 99% stenoses of the mid LAD	VSR	30%	Percutaneous closure of VSR but care was withdrawn by family	Died
Qureshi et al ⁶	August 2020	53/Male	5 days	Worsening chest pain, shortness of breath, and diaphoresis	Sinus tachycardia, with ST segment elevations in the inferior leads and reciprocal depressions in the lateral leads	A 100% proximal RCA occlusion with left to right collaterals	VSR	35%	Surgical repair of VSR	Died
Qureshi et al ⁶	August 2020	72/Female	7 days	Shortness of breath and chest pain	A pulseless electrical activity arrest requiring several rounds of CPR before achieving return of spontaneous circulation	A severely stenotic LAD artery with evidence of thrombus	VSR	35% to 40%	Stenting, percutaneous closure of the VSR	Died
Rimac et al ¹⁷	August 2020	64/Female	30 days	Dyspnea and recurrent pleuritic chest pain	Inferior T-wave inversion	A huge mass adjacent to the left ventricle, a severe culprit lesion within the RCA	A ruptured posterolateral myocardial wall with a giant pseudoaneurysm (90 × 80 mm) communicating through a 35-mm neck	—	Pseudoaneurysm + repair of the posterolateral myocardial wall with a patch + CABG	Recovered
Shah et al ¹¹	August 2020	75/Female	7 days	Chest discomfort	Inferolateral STE Inferior Q waves Broad R waves V1-V2	Tortuous 100% mid-RCA occlusion with TIMI flow grade 0 80% distal left main 80% proximal LAD	Post-MI VSD Basal inferolateral wall pseudoaneurysm IABP	50% to 55%	PCI with an IABP	The patient was sent for urgent CABG
Parikh et al ¹⁸	October 2020	67/Male	5 days	Epigastric pressure and dyspnea	Inferior Q waves	An occluded RCA	VSR	—	Venoarterial ECMO	Died
Parikh et al ¹⁸	October 2020	60/Female	7-14 days	Dyspnea, chest pain, and vomiting	Anterior Q waves	LAD occlusion	VSR	—	Percutaneous VSR closure followed by surgical repair of apical extension	Recovered
Khanal et al ¹⁹	November 2020	61/Male	30 days	Symptoms of CHF	Sinus tachycardia, right axis deviation, ST elevation in lead III, T inversion in lead II, III, aVF, and V1 to V4	A proximal 80% occlusion of the LCA and mid 90% occlusion of the RCA	LVA + VSR	40%	CABG + left ventriculoplasty + VSR repair	Recovered
Pilato et al ²⁰	November 2020	58/Female	365 days	Cardiac surgery	ST-elevated ACS	Sudden occlusion of the LAD	Subacute LV free wall rupture	—	Surgical repair	Recovered

(continued)

Table 3. (continued)

Authors	Publication time (month/year)	Age/sex (year)	Presenting symptoms	Time from symptom onset to presentation to ER	Electrocardiographic features	Anatomic findings	Complications	LVEF	Treatment	Clinical outcome
Tan et al ²¹	December 2020	65/Male	Exertional angina	60 days	ST-elevation in the inferolateral leads	100% occlusion of the mid LCx	LV wall rupture, LVP, and cardiac tamponade	40%	Surgical repair	Recovered
Evans et al ²²	February 2021	37/Male	Worsening dyspnea	7 days	Normal sinus rhythm with poor R-wave progression seen in the precordial leads	A completely occluded LAD just beyond a large diagonal branch and RCA with moderate proximal disease	Transmural infarct + pseudoaneurysm in the LAD + muscular VSD with was Qp:Qs 2:1	21%	Transcatheter VSD closure	Recovered
Fermades et al ²³	August 2020	55/Female	Worsening heart failure symptoms and recurrent pleuritic chest pain	2 days	Anterior wall MI	The middle segment occlusion of the LAD	Apical aneurysm with organized thrombus, and a small circumferential pericardial effusion	25%	Aneurysmectomy	Recovered
Bakhshi et al ²⁴	March 2021	56/Male	Exertional angina and shortness of breath	5 days	Anterolateral STEMI	LHC showed culprit 100% occlusion of the proximal LAD and chronic total occlusion of RCA	VSR with Qp/Qs was 1.3 + LV apical thrombus	32%	Orthotopic heart transplantation	Recovered
Bakhshi et al ²⁴	March 2021	53/Male	Progressive exertional chest pain	7 days	Anterolateral STEMI	LHC revealed 95% stenosis of the mid-LAD and first diagonal artery	A large apical VSR	45%	Orthotopic heart transplantation	Recovered
Briani et al ²⁵	March 2021	70/Male	Dyspnea, fatigue, and ongoing hypotension	42 days	Acute anterior MI	Absence of restenosis after prior PCI on proximal LAD	Apical aneurysm and MR	30%	IABP + Impella 5.0 support + cardiac surgery	Recovered
Nasr et al ²⁶	April 2021	67/Male	Chest pain, collapsed	Several days	Inferior STEMI	RCA was opacified in the proximal segment with significant acute thrombosis	LV free wall rupture	Depressed	Cardiac surgery	Died
Briosa et al ²⁷	May 2021	69/Female	Crushing chest pain	Several days	Sinus tachycardia with inferior ST-segment elevation	An occluded proximal LCx	A flail posterior mitral valve leaflet due to chordae tendineae rupture with associated severe MR	—	PCI + IABP	Died

Abbreviations: CABG, coronary artery bypass grafting; CAD, coronary artery disease; CHF, chronic heart failure; COVID-19, coronavirus disease 2019; CPR, cardiopulmonary resuscitation; DES, drug-eluting stent; ECMO, extracorporeal membrane oxygenation; ER, emergency room; IABP, intra-aortic balloon pump; ICU, intensive care unit; LAD, left anterior descending; LCA, left coronary artery; LCx, left circumflex; LHC, left heart catheterization; LV, left ventricular; LVA, left ventricular aneurysm; LVEF, left ventricular ejection fraction; MI, myocardial infarction; MR, mitral regurgitation; PCI, percutaneous coronary intervention; RCA, right coronary artery; STEMI, ST-elevation myocardial infarction; TIMI, thrombolysis in myocardial infarction; VSD, ventricular septal defect; VSR, ventricular septal rupture.

outcomes.²⁸ In recent times, the COVID-19 pandemic has overwhelmed health care systems categorically, often masking the presence of other serious medical emergencies, including cardiac pathologies.²⁹ As per the data from several European nations, 25% to 40% decreased STEMI admissions were noted amid the pandemic.^{3,30,31} A similar trend has also been noted in the United States.³²⁻³⁴ An international study performed by the European Society of Cardiology demonstrated a significant reduction of >40% in the gross number of STEMI admissions.³⁵ Furthermore, a study from Hong Kong revealed an increase in the total time elapsed before the presentation of STEMI from 82.5 to 318 minutes due to excessive wariness surrounding the pandemic.³⁶ Imperatively, a dilatory presentation of MI may result in grave mechanical complications that were once considered extremely rare.³⁷ The present patient had no other deterrents to seeking medical attention, except for his fear of contracting COVID-19 from the hospital.

LVA is an established complication in patients with massive MI who have a delayed presentation. Currently, the incidence of this complication has been significantly decreased. As per the analysis of the National Inpatient Sample from 2000 to 2017, LVA complicated 0.2% of 11 622 528 admissions for acute MI.³⁸ It may pose a diagnostic challenge, particularly in its differentiation from a pseudoaneurysm.³⁹ Multimodality cardiac imaging is frequently required for accurate detection, which also helps in selection of the appropriate treatment.³⁸ After a significantly delayed presentation due to COVID-19, this patient's workup also included cardiac magnetic resonance imaging that not only confirmed the LVA but also helped in the assessment of the myocardial viability. In patients with small-to-moderate size asymptomatic LVAs, medical therapy can be considered with an estimated 5-year survival of up to 90%.⁴⁰ The medical therapy should target afterload reduction using an angiotensin-converting enzyme inhibitor and anticoagulation in cases with a thrombus within the aneurysmal sac or left ventricle or if there is a remarkable left ventricular dysfunction. Surgical intervention such as aneurysmectomy in conjunction with CABG, as in this case, can be performed in LVA patients with ventricular arrhythmic and/or pump function failure refractory to medical and minimally invasive treatments.⁴¹

VSR is also a serious post-MI complication, with a mortality rate bordering 50%. It has become exceedingly rare in the current era of PCI, with an incidence ranging from 0.17% to 0.31% following STEMI.^{42,43} This patient had a Becker type III VSR, which is predominantly caused by late presentation of acute MI and is not commonly attributed to reperfusion damage. This type of VSR lesions frequently occurs in the subacute phase, 3 to 5 days following acute MI.⁴³ In this patient, the exact timing of the VSR lesion could not be ascertained due to his significantly delayed initial presentation. Most of these lesions, as evidenced by the present case, occur after RCA infarction. VSRs are an established cause of left-to-right shunting, leading to pressure and volume overload in the right ventricle. Transthoracic echocardiography

plays a vital role in detection, measurement of dimensions, and impact of the VSR as well as exclusion of probable etiologies. Furthermore, left ventriculography can aid in confirming the presence of VSR in cases with unexplained hemodynamic instability while undergoing primary PCI. On pulmonary artery catheterization, the Qp/Qs can be calculated using right ventricular step-up oxygen saturation.⁴³ In terms of management, surgical patch repair is the treatment of choice.⁴³ This patient showed excellent recovery after surgical intervention.

The present case is rare and unique in multiple ways. It has several pertinent clinical implications. First, aneurysms in the inferoposterior wall are uncommon. Second, VSR after MI rarely occurs in the inferior and basal portion of the interventricular septum. Third, the concurrent presence of a true LVA and VSR is an extremely rare clinicopathologic entity that can be particularly serious. Fourth, our patient presented a rare case of post-MI mechanical complications with chronic heart failure symptoms such as worsening shortness of breath and lower extremity edema. Fifth, this case demonstrates the clinical effectiveness of CABG, removal of mural thrombus, aneurysmectomy, and VSR patch repair for a favorable outcome despite late presentation. Sixth, it highlights the fear of patients to contract COVID-19 from hospitals that has led to reduction in hospitalization rates due to MI, resulting in re-emergence of life-threatening mechanical complications.

As indicated by the results of the literature review, severe post-MI mechanical complications are being reported across the globe now. With regard to the public awareness of these mechanical complications, several international organizations, such as the American Heart Association, the European Society of Cardiology, and a number of independent clinicians, have written opinion pieces in print media.⁴⁴⁻⁴⁷ Similarly, individual patient experiences regarding contracting severe mechanical complications after acute MI continue to be broadcasted.^{48,49} Due to the ongoing situation, it is exceedingly important to start mass information campaigns.⁵⁰⁻⁵³ All possible barriers in making first medical contact in MI patients need to be eradicated with comprehensive and urgent programs. The use of telemedicine has now proved to be effective in order to improve the MI prognosis and clinical outcomes during the ongoing COVID-19 pandemic.⁴² Telemedicine should also be further studied in relation to the re-emergence of severe mechanical complications of MI that are missed due to delayed initial presentation. Eventually, innovative programs should be immediately launched for prompt detection of MI and to possibly circumvent serious mechanical complications amid the commotion elicited by the COVID-19 pandemic.

Learning Objectives

- While acute MI presentations have considerably decreased during COVID-19 pandemic, delayed PCI presents a therapeutic dilemma after re-emergence

of anachronistic post-MI complications. Clinicians should remain cognizant of rare mechanical complications, including simultaneous LVA and VSR in patients with delayed presentation of acute MI in order to institute prompt and appropriate treatment.

- The COVID-19 pandemic and patients avoiding hospitals are causing detrimental effects in late presentation of acute MI, and leading to the resurging of catastrophic mechanical complications.
- It is imperative to start educating the community about the formidable clinical value of making the first contact early in individuals with any concerning symptoms and signs despite the fear of acquiring COVID-19.

Author Contributions

All authors contributed equally to the conception and design of the work; the acquisition, analysis, and interpretation of data for the work; and drafting the work or revising it critically for important intellectual content. All authors read and approved the final manuscript.

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Ethics Approval

Our institution does not require ethical approval for reporting individual cases or case series.

Informed Consent

Verbal informed consent was obtained from the patient for their anonymized information to be published in this article.

ORCID iD

Muhammad Ali Niaz  <https://orcid.org/0000-0002-9795-2707>

Supplemental Material

Supplemental material for this article is available online.

References

- Daniels MJ, Cohen MG, Bavry AA, Kumbhani DJ. Reperfusion of STEMI in the COVID-19 era—business as usual? *Circulation*. 2020;141:1948-1950.
- Garcia S, Albaghdadi MS, Meraj PM, et al. Reduction in ST-segment elevation cardiac catheterization laboratory activations in the United States during COVID-19 pandemic. *J Am Coll Cardiol*. 2020;75:2871-2872.
- Rodríguez-Leor O, Alvarez-Álvarez B, Ojeda S, et al. Impacto de la pandemia de COVID-19 sobre la actividad asistencial en cardiología intervencionista en España [in Spanish]. *REC Interv Cardiol*. 2020;2:82-89.
- De Filippo O, D'Ascenzo F, Angelini F, et al. Reduced rate of hospital admissions for ACS during covid-19 outbreak in Northern Italy. *N Engl J Med*. 2020;383:88-89.
- Lin TW, Tsai MT, Wu HY, Roan JN, Luo CY. Mechanical complications of acute myocardial infarction during the COVID-19 pandemic. *Acta Cardiol Sin*. 2021;37:114-116.
- Bryndza MA, Litwinowicz R, Bartus S, et al. Incidence of mechanical complications following myocardial infarction during the first two months of the COVID-19 pandemic in the Southern Poland region: a multicenter study. *Kardiol Pol*. 2021;79:66-68.
- Gaballa S, AlJaf A, Patel K, Lindsay J, Hlaing KM. COVID-19 fears may be worse than the virus: a case of cardiogenic shock secondary to post-myocardial infarction ventricular septum rupture. *Cureus*. 2020;12:e8809.
- Masroor S. Collateral damage of COVID-19 pandemic: delayed medical care. *J Card Surg*. 2020;35:1345-1347.
- Atreya AR, Kawamoto K, Yelavarthy P, et al. Acute myocardial infarction and papillary muscle rupture in the COVID-19 era. *JACC Case Rep*. 2020;2:1637-1641.
- Albiero R, Seresini G. Subacute left ventricular free wall rupture after delayed STEMI presentation during the COVID-19 pandemic. *JACC Case Rep*. 2020;2:1603-1609.
- Shah K, Tang D, Ibrahim F, et al. Surge in delayed myocardial infarction presentations: an inadvertent consequence of social distancing during the COVID-19 pandemic. *JACC Case Rep*. 2020;2:1642-1647.
- Ahmed T, Lodhi SH, Kapadia S, Shah GV. Community and healthcare system-related factors feeding the phenomenon of evading medical attention for time-dependent emergencies during COVID-19 crisis. *BMJ Case Rep*. 2020;13:e237817.
- Ahmed T, Nautiyal A, Kapadia S, Nissen SE. Delayed presentation of STEMI complicated by ventricular septal rupture in the era of COVID-19 pandemic. *JACC Case Rep*. 2020;2:1599-1602.
- Joshi S, Kazmi FN, Sadiq I, Azemi T. Post-MI ventricular septal defect during the COVID-19 pandemic. *JACC Case Rep*. 2020;2:1628-1632.
- Alsidawi S, Campbell A, Tamene A, Garcia S. Ventricular septal rupture complicating delayed acute myocardial infarction presentation during the COVID-19 pandemic. *JACC Case Rep*. 2020;2:1595-1598.
- Qureshi WT, Al-Drugh S, Ogunsua A, et al. Post myocardial infarction complications during the COVID-19 pandemic—a case series. *Cardiovasc Revasc Med*. Published online August 10, 2020. doi:10.1016/j.carrev.2020.08.005
- Rimac G, Marzouk M, Dumont É, Paradis JM. When a delayed cardiology consultation leads to a massive left ventricle pseudoaneurysm: collateral effects of the COVID-19 pandemic. *Eur Heart J*. 2020;41:3102.
- Parikh M, Busman M, Dickinson M, Wohns D, Maddar RD. Ventricular septal rupture in 2 patients presenting late after myocardial infarction during the COVID-19 pandemic. *JACC Case Rep*. 2020;2:2013-2015.

19. Khanal S, Ghosh S, Mishra AK. A case report of a double catastrophe: true left ventricular aneurysm and ventricular septal rupture complicating acute myocardial infarction and presenting as chronic heart failure. *Cureus*. 2020;12:e11292.
20. Pilato E, Pinna GB, Parisi V, Manzo R, Comentale G. Mechanical complications of myocardial infarction during COVID-19 pandemic: an Italian single-centre experience. *Heart Lung*. 2020;49:779-782.
21. Tan JH, Tong J, Ho HH. Delayed presentation of acute coronary syndrome with mechanical complication during COVID-19 pandemic: a case report. *Eur Heart J Case Rep*. 2020;5:ytaa506.
22. Evans MC, Steinberg DH, Rhodes JF, et al. Ventricular septal defect complicating delayed presentation of acute myocardial infarction during COVID-19 lockdown: a case report. *Eur Heart J Case Rep*. 2021;5:ytab027.
23. Fernandes RM, Mota T, Azevedo P, et al. Giant left ventricular (pseudo?) aneurysm complicating anterior myocardial infarction. *J Am Col Cardiol Case Rep*. 2021;2:334-338.
24. Bakhshi H, Gattani R, Ekanem E, et al. Ventricular septal rupture and cardiogenic shock complicating STEMI during COVID-19 pandemic: an old foe re-emerges. *Heart Lung*. 2020;50:292-295.
25. Briani M, Torracca L, Crescenzi G, Barbone A. Impella 5.0 support before, during, and after surgical ventriculoplasty following acute myocardial infarction in the COVID-19 era: a case report. *Eur Heart J Case Rep*. 2021;5:ytab037.
26. Nasr GH, Glovaci D, Mikhail A, et al. Left ventricular free wall rupture as a result of delayed presentation of an inferior ST-elevation myocardial infarction due to fear of COVID-19: case report. *J Cardiothorac Surg*. 2021;16:106.
27. Briosa E, Gala A, Hinton J, Sirohi R. Cardiogenic shock due to acute severe ischemic mitral regurgitation. *Am J Emerg Med*. 2021;43:292.
28. Ibanez B, James S, Agewall S, et al. 2017 ESC guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: the task force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). *Eur Heart J*. 2018;39:119-177.
29. Rodriguez-Leor O, Cid-Alvarez B. ST-segment elevation myocardial infarction care during COVID-19: losing sight of the forest for the trees. *JACC Case Rep*. 2020;2:1625-1627.
30. Rangé G, Hakim R, Motreff P. Where have the STEMIs gone during COVID-19 lockdown? *Eur Heart J Qual Care Clin Outcomes*. 2020;6:223-224.
31. Metzler B, Siostrzonek P, Binder RK, Bauer A, Reinstadler SJ. Decline of acute coronary syndrome admissions in Austria since the outbreak of COVID-19: the pandemic response causes cardiac collateral damage. *Eur Heart J*. 2020;41:1852-1853.
32. Braiteh N, Rehman WU, Alom M, et al. Decrease in acute coronary syndrome presentations during the COVID-19 pandemic in upstate New York. *Am Heart J*. 2020;226:147-151.
33. Zitelny E, Newman N, Zhao D. STEMI during the COVID-19 pandemic—an evaluation of incidence. *Cardiovasc Pathol*. 2020;48:107232.
34. Khot UN, Reimer AP, Brown A, et al. Impact of COVID-19 pandemic on critical care transfers for ST-segment-elevation myocardial infarction, stroke, and aortic emergencies. *Circ Cardiovasc Qual Outcomes*. 2020;13:e006938.
35. Pessoa-Amorim G, Camm CF, Gajendragadkar P, et al. Admission of patients with STEMI since the outbreak of the COVID-19 pandemic: a survey by the European Society of cardiology. *Eur Heart J Qual Care Clin Outcomes*. 2020;6: 210-216.
36. Tam CF, Cheung KS, 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.
37. Trabattoni D, Montorsi P, Merlino L. Late STEMI and NSTEMI patients' emergency calling in COVID-19 outbreak. *Can J Cardiol*. 2020;36:1161.
38. Vallabhajosyula S, Kanwar S, Aung H, et al. Temporal trends and outcomes of left ventricular aneurysm after acute myocardial infarction. *Am J Cardiol*. 2020;133:32-38.
39. Inayat F, Ghani AR, Riaz I, et al. Left ventricular pseudoaneurysm: an overview of diagnosis and management. *J Investig Med High Impact Case Rep*. 2018;6:2324709618792025.
40. Mourdjinis A, Olsen E, Raphael MJ, Mounsey JP. Clinical diagnosis and prognosis of ventricular aneurysm. *Br Heart J*. 1968;30:497-513.
41. Levine GN, Bates ER, Bittl JA, et al. ACCF/AHA guideline for the management of ST-elevation myocardial infarction. *Circulation*. 2016;134:e123-e155. doi:10.1161/CIR.000000000000404
42. Swain E. Telehealth strategy improves STEMI care in Latin America, 2020. Accessed June 25, 2021. <https://www.healio.com/news/cardiology/20200518/telehealth-strategy-improves-stemi-care-in-latin-america>
43. Jones BM, Kapadia SR, Smedira NG, et al. Ventricular septal rupture complicating acute myocardial infarction: a contemporary review. *Eur Heart J*. 2014;35:2060-2068.
44. European Society of Cardiology. Fear of COVID-19 keeping more than half of heart attack patients away from hospitals, 2020. Accessed June 25, 2021. <https://www.escardio.org/The-ESC/Press-Office/Press-releases/Fear-of-COVID-19-keeping-more-than-half-of-heart-attack-patients-away-from-hospitals>
45. CardioSmart. Coronavirus and your heart: don't ignore heart symptoms. Accessed June 25, 2021. <https://www.cardiosmart.org/assets/infographic/covid-19-don't-ignore-heart-symptoms#:~:text=If%20you%20think%20you%20are,Getting%20care%20quickly%20is%20critical>
46. Kolata G. Amid the coronavirus crisis, heart and stroke patients go missing, 2020. Accessed June 25, 2021. <https://www.nytimes.com/2020/04/25/health/coronavirus-heart-stroke.html>
47. American Heart Association. Knocking down fears, myths and misinformation about calling 911 in the pandemic. Accessed June 25, 2021. <https://www.heart.org/en/coronavirus/coronavirus-covid-19-resources/knocking-down-fears-myths-and-misinformation-about-calling-911-in-the-pandemic>
48. Wood S. Dire, unusual STEMI complications blamed on COVID-19 hospital avoidance. Accessed June 25, 2021. <https://www.tctmd.com/news/dire-unusual-stemi-complications-blamed-covid-19-hospital-avoidance>
49. Galante A. After man, 38, dies of heart attack, wife shares urgent message: "Go to the ER." Accessed June 25, 2021.

- <https://www.today.com/health/heart-attack-covid-19-why-young-father-didn-t-go-t184278>
50. Chieffo A, Stefanini GG, Price S, et al. EAPCI position statement on invasive management of acute coronary syndromes during the COVID-19 pandemic. *Eur Heart J.* 2020;41:1839-1851.
 51. Ashraf S, Ilyas S, Alraies MC. Acute coronary syndrome in the time of the COVID-19 pandemic. *Eur Heart J.* 2020;41:2089-2091.
 52. Cleveland Clinic. Seek care for heart emergencies during COVID-19, 2020. Accessed June 25, 2021. <https://newsroom.clevelandclinic.org/2020/04/23/seek-care-for-heart-emergencies-during-covid-19/>
 53. Roffi M, Guagliumi G, Ibanez B. The obstacle course of reperfusion for ST-segment-elevation myocardial infarction in the COVID-19 pandemic. *Circulation.* 2020;141:1951-1953.