Managing Patients With ST-Elevation Myocardial Infarction at the Epicenter of the COVID-19 Pandemic

Lindsay Elbaum, MD, Eman Rashed, MD, PhD, and Mazullah Kamran, MD

Abstract: During the coronavirus disease 2019 (COVID-19) pandemic, strained acute care resources, the potential for rapid clinical decompensation, and concerns about staff safety has prompted a conservative management approach for acute coronary syndrome patients. We present our experience of COVID-19 patients at Elmhurst Hospital Center presenting with ST-Elevation Myocardial Infarction and compared outcomes of invasive vs conservative treatment strategies. (Curr Probl Cardiol 2021;46:100716.)

Introduction

As the severe acute respiratory syndrome coronavirus 2 causing coronavirus disease 2019 (COVID-19) has become more widespread, the clinical presentation has varied. In China, where the disease was first recognized in December 2019, a large proportion of patients were asymptomatic or had mild symptoms, <20% had severe respiratory symptoms, and about 5% became critically ill, of whom the estimated mortality was >50%. Critically ill patients and those developing acute respiratory distress syndrome were more often elderly with cardiac risk factors, co-morbidities, and elevated inflammatory markers than less symptomatic patients. Several forms of myocardial injury have been described in ≥8% of patients with COVID-19, and have been associated with a higher risk of mortality.[1,5]

Funding: None.
Conflicts of Interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.
Curr Probl Cardiol 2021;46:100716
0146-2806/$ – see front matter
https://doi.org/10.1016/j.cpcardiol.2020.100716

Across the globe, a decrease in ST-Elevation Myocardial Infarction (STEMI) case volume has been reported during the era of COVID-19. Elmhurst Hospital Center, a public hospital in Elmhurst, Queens, NY has been described as the "epicenter of the epicenter" of the COVID-19 pandemic in New York City, having been inundated with cases since early March 2020. At baseline, Elmhurst is a high volume STEMI center due to the high-risk, low-income, diverse immigrant population served. The cardiac catheterization laboratory provides primary percutaneous coronary interventions (PCI) without on-site cardiac surgery to over 100 patients annually presenting with STEMI. In 2019, 115 patients underwent primary PCI for STEMI.[4] A decreased number of patients presenting with acute coronary syndromes (ACS), including STEMI, reported from several U.S. hospitals during the COVID pandemic era has been attributed to a variety of reasons, such as patient fear in seeking medical attention due to concern of infectious risk, adaptation of healthier lifestyles with decreased stressors, and improvement in air pollution. One study reported an average 38% decrease at 9 high-volume centers across the country.[2] During the COVID-19 pandemic, strained acute care resources, the potential for rapid clinical decompensation, and concerns about staff safety has prompted a conservative management approach for ACS patients.[3]

Methods

At Elmhurst Hospital, however, 20 patients presented with STEMI between March 1 and April 30, 2020, compared with 18 during the corresponding period the previous year. Eight of the more recent patients that underwent coronary angiography tested negative for COVID-19 or were asymptomatic and presumed negative at follow-up. Of the 12 patients testing positive for COVID-19, 8 underwent cardiac catheterization and primary PCI. We performed a retrospective, observational case series of these COVID-19 patients presenting with STEMI and analyzed their demographics, clinical presentation, laboratory data, cardiac catheterization, and echocardiographic findings, and compared outcomes of those managed with an invasive strategy vs a more conservative approach.

Results

The patients with COVID-19 and STEMI had diverse ethnic backgrounds, reflecting the demographics of the surrounding community. The mean age was 60.6 years; 75% were male, 50% had a history of hypertension, 33% diabetes mellitus, 59% hyperlipidemia, 25% tobacco smoking, and one patient had previously established coronary artery disease with

history of remote coronary artery bypass grafting surgery. The average glycosylated hemoglobin A_1C level was 6%, and LDL-cholesterol 110 mg/dL (Table 1). All patients had localizing ST-elevations on electrocardiogram, 50% in the inferior leads, 42% anterior and 8% lateral. The 8 patients who underwent coronary angiography were presumed positive for COVID-19 while test results were pending, and staff took appropriate precautions with personal protective equipment. Six of eight patients underwent cardiac catheterization via the right radial artery approach. All patients had obstructive coronary disease with the culprit lesion characterized by occlusive thrombosis (Table 2). Each patient received a loading dose of a P_2Y_{12} inhibitor antiplatelet medication, aspirin, intravenous heparin and eptifibatide, and interventions involved aspiration thrombectomy and deployment of drug-eluting stents. The patient with prior coronary artery bypass grafting was treated successfully with aspiration thrombectomy and angioplasty alone. Grade 3 TIMI flow was achieved in 75% of patients (Table 2).

The 4 patients treated conservatively either presented >24 hours after the onset of symptoms or recognition of ACS was delayed after hospital admission. All had signs of acute respiratory distress syndrome and required endotracheal intubation on the day of STEMI diagnosis (Table 1). These patients received dual antiplatelet therapy and systemic anticoagulation. In each case, thrombolysis was considered but deferred because of hemodynamic stability, delayed presentation, and need for other acute management measures that could increase the risk of bleeding.

Among the 12 patients with COVID-19 and STEMI, the overall mortality was 42%, with 25% in those undergoing primary PCI, and 75% in those managed without PCI. Nonsurvivors were older, had higher inflammatory markers and peak troponin levels and more often had bilateral pulmonary infiltrates than survivors. Six patients in the PCI group were discharged from the hospital without procedural complications, and one of the patients in the medically managed group remained in the intensive care unit at the end of the observation period (Table 1).

Discussion

This case series highlights that in the public hospital system serving the community most impacted by the COVID-19 pandemic in the U.S. to date, the monthly STEMI volume was similar to that during the comparable period a year earlier, likely a result of socioeconomic factors and patient demographics of the Queens population, in contrast to reports of diminished volumes in other healthcare systems, including corporate

Table 1. Characteristics of 12 STEMI COVID-19 positive patients

	Total N = 12	Primary PCI N = 8	Conservative Management N = 4	Survivors N = 7	Nonsurvivors N = 5
Mean age (range)	60.6 (22-78)	60.4 (22-78)	61 (37-76)	54 (22-74)	69.8 (64-78)
Male sex – no (%)	9 (75)	6 (75)	3 (75)	6 (86)	3 (60)
BMI- no (range)	28.6 (21-43)	30 (21-43)	26 (21-29)	31 (21-43)	26 (20-29)
Race/ethnicity – no (%)					
White (Eastern European)	3 (25)	3 (37.5)	0	2 (29)	1 (20)
Black	1 (8)	1 (12.5)	0	1 (14)	0
Hispanic	5 (42)	3 (37.5)	2 (50)	3 (43)	2 (40)
East Asian	2 (17)	0	2 (50)	0	2 (40)
Bengali	1 (8)	1 (12.5)	0	1 (14)	0
Risk factor – no (%)					
Hypertension	6 (50)	5 (63)	1 (25)	4 (57)	2 (40)
Diabetes	4 (33)	3 (38)	1 (25)	2 (29)	2 (40)
Mean A1c %	6	6	6.1	6.1	6
Hyperlipidemia	7 (59)	5 (63)	2 (50)	3 (43)	4 (80)
Mean LDL mg/dL (range)	110 (50-166)	111 (50-166)	107 (58-141)	113 (79-166)	105 (50-141)
Tobacco use (current or former)	3 (25)	3 (38)	0	3 (43)	0
History of lung disease	1 (8)	0	1 (25)	0	1 (20)
Chronic kidney disease	0				
Established coronary artery disease (CAD)*	1 (8)	1 (12.5)	0	1 (14)	0
Symptoms at time of STEMI					
Chest pain	12 (100)	8 (100)	4 (100)	7 (100)	5 (100)
Shortness of breath	6 (50)	1 (12.5)	4 (100)	2 (29)	4 (80)
Cough	3 (25)	0	3 (75)	1 (14)	2 (40)
Fever/myalgia	5 (42)	2 (25)	3 (75)	3 (43)	2 (40)
Cardiac arrest/shock	0				

(*continued on next page*)

Table 1. (*continued*)

	Total N = 12	Primary PCI N = 8	Conservative Management N = 4	Survivors N = 7	Nonsurvivors N = 5
Electrocardiographic location of ST segment elevation					
Anterior	5 (42)	4 (50)	1 (25)	3 (43)	2 (40)
Lateral	1 (8)	1 (12.5)	0	0	1 (20)
Inferior	6 (50)	3 (37.5)	3 (75)	4 (57)	2 (40)
Time of STEMI EKG from symptom onset					
<4 hours	5 (42)	5 (62.5)	0	3 (43)	2 (40)
4-12 hours	1 (8)	1 (12.5)	0	1 (14)	0
12-24 hours	1 (8)	1 (12.5)	0	1 (14)	0
>24 hours	5 (42)	1 (12.5)	4 (100)	2 (29)	3 (60)
CXR at time of STEMI					
Bilateral infiltrates	6 (50)	2 (16)	4 (100)	2 (60)	4 (80)
Unilateral infiltrates	0				
Clear	6 (50)	6 (75)	0	5 (71)	1 (20)
Laboratory data[†]					
Initial troponin T ng/dL	0.7 (0-2.7)	0.5 (0-2.7)	1 (0-2)	0.6 (0-2.7)	0.8 (0-2)
Peak troponin T	8.8 (1.3-22.5)	10.3 (1.3-22.5)	5.8 (2.7-10.23)	7.7 (1.3-18.1)	10.4 (4.4-22.5)
Peak CRP mg/L	173.7 (3.2-300)	111.3 (3.2-225.2)	298.5 (294-300)	114.2 (3.2-300)	257.1 (190.5-300)
Peak D-dimer ng/mL	7031 (150-48,648)	1264 (150-3190)	18,566 (2272-48,648)	1967 (150-6202)	14,121 (376- 48,648)
White blood cell count x 10^3/mcL	14.5 (9-26)	13.8 (9-26)	16 (11-23)	12.7 (9-22)	17.1 (11-26)
Absolute lymphocyte count x 10^3/mcL	1.5 (0.7-3.4)	1.8 (0.7-3.4)			
	0.8 (0.6-0.9)	1.9 (0.7-3.4)	0.8 (0.6-0.9)		
Echo findings					
Regional wall motion abnormalities	12 (100)				
Ejection fraction ≤40%	7 (58)	5 (62.5)	2 (50)	5 (71)	2 (40)
Ejection fraction >40%	5 (42)	3 (37.5)	2 (50)	2 (29)	3 (60)

(*continued on next page*)

Table 1. (*continued*)

	Total N = 12	Primary PCI N = 8	Conservative Management N = 4	Survivors N = 7	Nonsurvivors N = 5
Therapies					
Antiplatelet Agent	12 (100)				
Anticoagulation	12 (100)				
Statin	11 (92)	8 (100)	3 (75)	7 (100)	4 (80)
Azithromycin	5 (42)	2 (25)	3 (75)	1 (14)	4 (80)
Plaquenil	5 (42)	2 (25)	3 (75)	1 (14)	4 (80)
Outcomes					
Mechanical ventilation	5 (42)	1 (12.5)	4 (100)	1 (14)	4 (80)
Renal replacement therapy	2 (17)	1 (12.5)	1 (25)	1 (14)	1 (20)
Hospital Discharge	6 (50)	6 (75)			
In-hospital death	5 (42)	2 (25)	3 (75)		
CCU length of stay (days)	8.3 (3-22)	6.6 (3-17)	11.5 (4-22)	7 (3-9)	11 (2-22)

*Patient with history of CAD and prior 4v CABG 5 years prior to current ACS presentation.

†The reference value for a negative troponin T is defined as <0.010 ng/dL. The reference value for CRP <5 mg/L. The reference value for D-dimer was 0-243 ng/mL. The reference range for ferritin was 30-400 ng/mL. The reference value for WBC was 4.80-10.80 $\times$ 10^3/mcL. The reference value for absolute lymphocyte count was 1.00-4.90 $\times$ 10^3/mcL.

Table 2. Cardiac catheterization data

	Total N = 8	Survivors N = 6	Nonsurvivors N = 2
Conclusions – no (%)*			
3 vessel CAD	3 (37.5)	2 (33)	1 (50)
2 vessel CAD	2 (25)	1 (17)	1 (50)
1 vessel CAD	3 (37.5)	3 (50)	0
Culprit vessel – no (%)			
Left anterior descending artery	3 (37.5)	2 (33)	1 (50)
Left circumflex artery	3 (37.5)	2 (33)	1 (50)
Right coronary artery	1 (12.5)	1 (17)	0
Left internal mammary artery†	1 (12.5)	1 (17)	0
Arterial access – no (%)			
Radial artery	6 (75)	5 (83)	1 (50)
Femoral artery	2 (25)	1 (17)	1 (50)
Post procedural TIMI flow			
Grade 3	6 (75)	4 (67)	2 (100)
Grade 2	2 (25)	2 (33)	0

*All patients had obstructive coronary disease with an occlusive thrombosis in the culprit artery.
†Patient with history of prior 4v CABG, culprit lesion was thrombosis of internal mammary artery.

hospitals in New York City. A variety of manifestations of myocardial injury have been described in patients with COVID-19, including myocarditis and intramyocardial microvascular thrombosis. The majority of the patients we describe had clinical characteristics typical of patients with ACS encountered under nonpandemic circumstances, including localizing ST-elevations on the electrocardiogram, troponin elevation proportionate to the extent of myocardial injury, and corresponding regional wall motion abnormalities detected by echocardiography, although patients managed without PCI did not undergo coronary angiography. While consensus-based recommendations for management of patients with STEMI during the COVID-19 pandemic have been issued by several professional societies, patients whose respiratory status requires mechanical ventilation face high mortality rates independent of cardiovascular factors. Patients in whom cardiac symptoms predominate, with or without other manifestations of COVID-19 illness (eg, fever or myalgia), who presented early and were managed with an invasive strategy, with appropriate precautions, enjoyed more favorable outcomes. Accordingly, our experience supports an individualized clinical assessment rather than a uniform approach in this challenging era.

REFERENCES

1. The European Society for Cardiology. ESC Guidance for the Diagnosis and Management of CV Disease during the COVID-19 Pandemic. https://www.escardio.org/Education/COVID-19-and-Cardiology/ESCCOVID-19-Guidance. (Last update: 10 June 2020)
2. Garcia Santiago, et al. Reduction in ST-segment elevation cardiac catheterization laboratory activations in the United States during COVID-19 Pandemic. *J Am Coll Cardiol* 2020;75:2871–2.
3. Jing ZC, et al. Recommendations from the Peking union medical college hospital for the management of acute myocardial infarction during the COVID-19 outbreak. *Eur Heart J* 2020;14:1791–4.
4. Aversano T, et al. Thrombolytic therapy vs primary percutaneous coronary intervention for myocardial infarction in patients presenting to hospitals without on-site cardiac surgery: a randomized controlled trial. *JAMA* 2002;287:1943–51.
5. Clerkin KJ, et al. Coronavirus Disease 2019 (COVID-19) and cardiovascular disease. *Circulation* 2020;141:1648–55.