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RESEARCH LETTER

ST-Elevation Myocardial Infarction in Patients With COVID-19

Clinical and Angiographic Outcomes

Giulio G. Stefanini, MD, PhD, MSc
Alaide Chieffo, MD

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), is causing a dramatic pandemic.[1] Lombardy, in northern Italy, is one of the most affected regions worldwide.[2] Cardiovascular complications occur frequently in patients with COVID-19,[3] with challenges in acute management. We aimed to evaluate incidence, clinical presentation, angiographic findings, and clinical outcomes of ST-elevation myocardial infarction (STEMI) in patients with COVID-19.

All hospitals with catherization laboratories in Lombardy were contacted to collect cases of patients with confirmed COVID-19 who underwent an urgent coronary angiogram because of STEMI between February 20, 2020 (date of first COVID-19 case in Lombardy) and March 30, 2020.[2] Data were collected retrospectively, in anonymized fashion without any sensitive data, therefore not requiring institutional review board approval. COVID-19 was confirmed with reverse transcription–polymerase chain reaction assays. STEMI was defined based on the presence of typical symptoms associated with ST-segment elevation or new left bundle-branch block.[4] A stenosis was considered as the culprit lesion in case of angiographic evidence of thrombotic occlusion/subocclusion. Obstructive coronary artery disease was defined based on the angiographic evidence of a stenosis >50% on visual estimation.

A total of 28 patients with COVID-19 with STEMI were included. All patients met the guideline definition of STEMI[4] with localized ST-elevation (25 patients, 89.3%) or new left bundle-branch block (3 patients, 10.7%), and all were treated in the setting of emergent activation.

The Table displays a detailed overview of each included patient. The mean age was 68±11 years, 8 patients (28.6%) were women, 20 (71.4%) had arterial hypertension, 9 (32.1%) had diabetes mellitus, 8 (28.6%) had chronic kidney disease, and 3 (10.7%) had a previous myocardial infarction.

For 24 patients (85.7%), the STEMI represented the first clinical manifestation of COVID-19, and they did not have a COVID-19 test result at the time of coronary angiography. The remaining 4 patients had STEMI during hospitalization for COVID-19. Twenty-two patients (78.6%) presented with typical chest pain associated with or not associated with dyspnea, and 6 patients (21.4%) had dyspnea without chest pain.

On echocardiography, 23 patients (82.1%) had localized wall motion abnormalities, 3 (10.7%) had diffuse hypokinesia, and 2 (7.1%) did not have abnormalities. The left ventricular ejection fraction was <50% in 17 patients (60.7%).

All patients underwent urgent coronary angiography, and none was treated with fibrinolysis. Out of 28 patients, 17 patients (60.7%) had evidence of a culprit lesion requiring revascularization, and 11 patients (39.3%) did not have obstructive coronary artery disease.

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Key Words: coronavirus ■ ST elevation myocardial infarction

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Table. Overview of Included Patients

No.	Age, y	Sex	BMI, kg/m²	Cardiovascular Risk Factors					Medical History		
				HTN	Dyslipidemia	Diabetes Mellitus	Chronic Kidney Disease	Active Smoker	Prior PCI	Prior CABG	Prior MI
Patients without a culprit lesion											
1	79	F	30.2	Y	N	N	N	N	Y	N	N
2	66	F	22.7	Y	N	N	N	N	N	N	N
3	64	F	24.4	Y	N	N	N	N	N	N	N
4	77	M	24.6	Y	N	Y	Y	N	N	N	N
5	89	M	27.4	Y	N	N	Y	N	N	N	N
6	53	F	19.9	N	N	N	Y	N	N	N	N
7	69	M	24.5	Y	Y	N	Y	N	N	N	N
8	54	F	23.4	N	N	N	N	N	N	N	N
9	71	M	22.2	Y	Y	N	N	N	N	N	N
10	65	M	27.6	Y	N	N	N	Y	N	N	Y
11	75	M	23.7	Y	Y	N	Y	N	N	N	N
Patients with a culprit lesion											
12	79	M	24.2	N	N	N	Y	N	N	N	N
13	74	M	24.8	Y	Y	Y	N	N	Y	N	Y
14	66	M	22.9	N	N	Y	N	N	N	N	N
15	59	M	27.7	Y	Y	Y	Y	N	N	N	N
16	45	F	27.5	N	N	N	N	N	N	N	N
17	83	M	30.0	Y	Y	N	N	N	N	N	N
18	63	M	22.6	Y	N	Y	N	N	N	N	N
19	49	M	23.5	N	N	N	N	Y	N	N	N
20	70	F	26.6	Y	Y	N	N	N	N	N	N
21	57	M	26.4	Y	Y	N	N	Y	N	N	N
22	67	M	24.2	N	N	N	N	N	N	N	N
23	58	M	34.5	Y	Y	Y	N	N	N	N	N
24	74	M	27.3	Y	Y	Y	...	N	Y	N	N
25	83	M	25.4	Y	Y	Y	Y	N	Y	N	Y
26	61	M	21.7	Y	Y	Y	N	Y	N	Y	N
27	72	M	21.6	N	N	N	N	N	N	N	N
28	74	F	22.5	Y	N	N	N	N	N	N	N

(*Continued*)

As of March 31, 2020 (median follow-up, 13 days; interquartile range, 2–20 days), 11 patients (39.3%) had died, 1 (3.6%) was still hospitalized in an intensive care unit, and 16 (57.1%) had been discharged.

During the COVID-19 outbreak, the regional STEMI network was reorganized,[2] and we have observed a reduction in the number of patients presenting with STEMI. Both factors might have contributed to the relatively low number of cases observed during the study period. However, considering the cardiovascular risk profile of patients with COVID-19, many of these are expected to have STEMI in the coming months. Evidence-based strategies are mandatory to guide their clinical management. Our findings provide relevant evidence showing that, although all patients had a typical STEMI presentation, angiography demonstrated the absence of a culprit lesion in 39.3% of cases, therefore excluding a type 1 myocardial infarction.

A recent document from the American College of Cardiology's Interventional Council and the Society of Cardiovascular Angiography and Intervention discusses how to guarantee state-of-the-art treatment as well as the safety of healthcare providers involved in management of STEMI in the context of a COVID-19 outbreak.[3] The document recommends weighing carefully the balance between healthcare provider exposure and

Table. Continued

Clinical Presentation						EKG Changes	LVEF, %	WMA	Culprit Vessel	Stenosis	Clinical Status*
Symptoms			Hemodynamic Parameters								
Chest Pain	Dyspnea	NYHA Class	SBP, mm Hg	HR, bpm	O_2 Sat, %						
N	Y	II	145	90	95	ST-elevation, inferior	58	13,14,15,16, 17	…	…	Discharge
Y	Y	III	165	90	97	ST-elevation, inferior	39	4,9,10,14,15,17	…	…	Discharge
Y	N	I	160	114	92	ST-elevation, anterolateral	35	13,14,15,16, 17	…	…	Discharge
Y	Y	III	145	66	96	ST-elevation, lateral	60	None	…	…	Death
Y	N	II	140	92	89	ST-elevation, anterolateral	35	7,13,17	…	…	Death
N	Y	III	110	98	92	ST-elevation, inferolateral	26	Diffuse	…	…	Discharge
N	Y	IV	70	110	90	New LBBB	30	1,7,13	…	…	Death
Y	Y	IV	110	60	96	New LBBB	60	None	…	…	Discharge
Y	Y	II	130	80	96	ST-elevation, inferior	35	3,4,5,10,11	…	…	Discharge
N	Y	IV	70	118	88	ST-elevation, inferior	55	4,10	…	…	Death
Y	Y	II	140	90	90	ST-elevation, inferolateral	40	Diffuse	…	…	Death
Y	Y	IV	80	95	96	ST-elevation, anterolateral	10	6,12,16,17	LM	100%, thrombotic	Death
Y	Y	III	150	115	90	ST-elevation, anterior	25	1,7,13	Ostial LAD	100%, thrombotic	Death
Y	Y	IV	90	99	91	ST-elevation, anterolateral	26	7,8	Prox LAD	100%, thrombotic	Discharge
Y	Y	IV	120	105	88	ST-elevation, anterior	35	8,12	Prox LAD	90%, thrombotic	Death
Y	Y	II	120	115	98	ST-elevation, anterior	50	7,8,13,14	Mid LAD	100%, thrombotic	Discharge
N	Y	III	160	65	95	New LBBB	48	2,8,14,17	Mid LAD	90%, thrombotic	Discharge
Y	N	I	150	82	98	ST-elevation, anterior	51	13,14,17	Mid LAD	99%, thrombotic	Discharge
Y	N	II	113	66	98	ST-elevation, inferior	55	3,4,5,10,11	Prox LCX	99%, thrombotic	Discharge
Y	N	I	150	85	92	ST-elevation, inferolateral	55	4,5,10,11,15	Prox LCX	100%, thrombotic	Discharge
Y	N	I	110	62	98	ST-elevation, inferior	57	4,10,15	Prox LCX	100%, thrombotic	Discharge
Y	N	I	140	80	98	ST-elevation, inferior	55	4,10,15	Prox RCA	100%, thrombotic	Discharge
Y	Y	IV	140	95	97	ST-elevation, inferior	45	4,10,15	Prox RCA	100%, thrombotic	ICU
Y	N	IV	80	98	86	ST-elevation, inferolateral	30	4,10,15	Mid RCA	99%, thrombotic	Death
Y	Y	I	130	75	99	ST-elevation, inferolateral	38	4,10,15	Mid RCA	100%, thrombotic	Discharge
Y	N	I	160	68	97	ST-elevation, inferior	54	4,5	Mid RCA	100%, thrombotic	Discharge
Y	Y	IV	60	42	90	ST-elevation, inferior	20	Diffuse	Mid RCA	100%, thrombotic	Death
N	Y	IV	100	66	98	ST-elevation, inferior	35	3,4,5,9,10,11	PDA	100%, thrombotic	Death

BMI indicates body mass index; bpm, beats per minute; CABG, coronary artery bypass grafting; EKG, electrocardiographic; F, female; HR, heart rate; HTN, arterial hypertension; ICU, intensive care unit; LAD, left anterior descending; LBBB, left bundle-branch block; LCX, left circumflex artery; LM, left main; LVEF, left ventricular ejection fraction; M, male; MI, myocardial infarction; N, no; NYHA, New York Heath Association; O_2 Sat, oxygen saturation; PCI, percutaneous coronary intervention; PDA, posterior descending artery; Prox, proximal; RCA, right coronary artery; SBP, systolic blood pressure; WMA, wall motion abnormalities assessed by echocardiography, segments based on the cardiac segmentation model of the American Heart Association; and Y, yes.

*As of March 31, 2020 (median follow-up, 13 days; interquartile range, 2–20 days).

patient benefit. Our findings underscore that all efforts should be made to differentiate between type 2 myocardial infarctions and myocarditis versus type 1 myocardial infarctions.

Our findings also show that a strategy relying on systematic fibrinolysis[5] is not justified because reperfusion appears not to be required in a significant proportion of patients with COVID-19 with STEMI.

We acknowledge that this is an early report on a relatively small number of patients. However, we wish to underscore that we systematically collected data on patients with COVID-19 with STEMI in Lombardy during the first 6 weeks of the outbreak.

In patients in whom a culprit lesion was excluded by coronary angiography, we were unable to determine whether the clinical presentation was caused by a type

2 myocardial infarction, a myocarditis subsequent to SARS-CoV-2 infection, SARS-CoV-2–related endothelial dysfunction, or a cytokine storm. Further investigations are needed to fully elucidate the pathophysiology of myocardial injury in patients with COVID-19.

In conclusion, our findings show that STEMI may represent the first clinical manifestation of COVID-19. In approximately 40% of patients with COVID-19 with STEMI, a culprit lesion is not identifiable by coronary angiography. A dedicated diagnostic pathway should be delineated for patients with COVID-19 with STEMI, aimed at minimizing patients' procedural risks and healthcare providers' risk of infection.

ARTICLE INFORMATION

The data that support the findings of this study are available from the corresponding author upon reasonable request by email.

Authors

Giulio G. Stefanini, MD, PhD; Matteo Montorfano, MD; Daniela Trabattoni, MD; Daniele Andreini, MD; Giuseppe Ferrante, MD, PhD; Marco Ancona, MD; Marco Metra, MD; Salvatore Curello, MD; Diego Maffeo, MD; Gaetano Pero, MD; Michele Cacucci, MD; Emilio Assanelli, MD; Barbara Bellini, MD; Filippo Russo, MD; Alfonso Ielasi, MD; Maurizio Tespili, MD; Gian Battista Danzi, MD; Pietro Vandoni, MD; Mario Bollati, MD; Lucia Barbieri, MD; Jacopo Oreglia, MD; Corrado Lettieri, MD; Alberto Cremonesi, MD; Stefano Carugo, MD; Bernhard Reimers, MD; Gianluigi Condorelli, MD, PhD; Alaide Chieffo, MD

Correspondence

Giulio G. Stefanini, MD, PhD, MSc, Cardio Center, Humanitas Clinical and Research Hospital IRCCS, Via Manzoni 56, 20089 Rozzano-Milan, Italy. Email giulio.stefanini@gmail.com

Affiliations

Cardio Center, Humanitas Clinical and Research Hospital IRCCS, Rozzano, Milan, Italy (G.G.S., G.F., B.R., G.C.). IRCCS San Raffaele Hospital, Milan, Italy (M. Montorfano, M.A., B.B., F.R., A.C.). Centro Cardiologico Monzino IRCCS, Milan, Italy (D.T., D.A., E.A.). Department of Clinical Sciences and Community Health, University of Milan, Italy (D.A.). Cardiology Unit, ASST Spedali Civili, Brescia, Italy (M. Metra, S. Curello). Fondazione Poliambulanza, Brescia, Italy (D.M., G.P.). Ospedale Maggiore di Crema, Italy (M.C.). Istituto Clinico Sant'Ambrogio, Milan, Italy (A.I., M.T.). Ospedale di Cremona, Italy (G.B.D.). Ospedale San Gerardo, Monza, Italy (P.V.). Ospedale Maggiore di Lodi, Italy (M.B.). Ospedale San Paolo, Milan, Italy (L.B., S. Carugo). Grande Ospedale Metropolitano Niguarda, Milan, Italy (J.O.). Ospedale di Mantova, Italy (C.L.). Humanitas Gavazzeni, Bergamo, Italy (A. Cremonesi).

Disclosures

None.

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