

## Specific characteristics of STEMI in COVID-19 patients and their practical implications: a systematic review

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**Introduction:** STEMI is one of the cardiac emergencies whose management has been mostly challenged by the COVID-19 pandemic. Patients presenting with the "lethal combo" of STEMI and concomitant SARS-CoV-2 infection have faced dramatic issues related to need for self-isolation, systemic inflammation with multi-organ disease, and difficulties to obtain timely diagnosis and treatment.

**Methods:** We performed a systematic search of three electronic databases from February 1st 2020 to January 31st 2022. We included all studies reporting crude rates of in-hospital outcomes of STEMI patients with concomitant COVID-19.

**Results:** A total of 9 observational studies were identified, mainly conducted during the first wave of the pandemic. STEMI patients with COVID-19 were more likely Afro-American and displayed higher rates of hypertension and diabetes with lower smoking prevalence. Associated comorbidities, including coronary artery disease, prior stroke and chronic kidney disease were also more common in those with SARS-CoV-2 infection. At coronary angiography, a higher thrombus burden in COVID-19 positive

STEMI patients was highlighted, with up to 10-fold higher rates of stent thrombosis and greater need for glycoprotein IIb/IIIa inhibitors and aspiration thrombectomy; this was not always associated with prolonged times from symptom onset to hospital admission and door-to-balloon. COVID-19 positive STEMI patients were less likely to receive coronary angiography and primary PCI, and more likely to be treated with fibrinolytics only. At the same time, patients with Covid-19 were more prone to present MINOCA. In-hospital mortality ranged from 15% to 40%, with consistent variability across different studies and subjects who tested positive for SARS-CoV-2 did also present higher rates of cardiogenic shock, cardiac arrest, prolonged ICU stay, mechanical ventilation, major bleeding, and stroke.

**Conclusion:** The coexistence of STEMI and COVID-19 was associated with increased in-hospital mortality and poor short-term prognosis. This was not entirely attributable to logistic issues determining delayed coronary revascularization, since patients' specific clinical and angiographic characteristics, including higher burden of cardiovascular risk factors and greater coronary thrombogenicity might have substantially contributed to this trend.

	Choudry et al., JACC 2020 [1]	Rodriguez-Leor et al., Eurointervention 2021 [2]	Cone et al., Am J Cardiol 2021 [3]	Kite et al., JACC 2021 [4]	NACMI registry, JACC 2021 [5]	Saad et al., JAMA 2021 [6]
Study period	March 2020 – May 2020	March 2020– April 2020	March 2020 – June 2020	March 2020 – July 2020*	January 2020 – December 2020	January 2019 – December 2020
Country	UK	Spain	US	Global	US and Canada	US
Enrolment strategy	Consecutive patients	Consecutive patients	Consecutive patients	Patients whose data were uploaded on a web-based system	Prospective, investigator-initiated registry	Consecutive patients
Type of MI	STEMI	STEMI	STEMI and NSTEMI	STEMI	STEMI	STEMI (Out-of-hospital)
Prevalence of COVID-19 (n [%])	39 (34)	91 (9)	86 (6)	Not assessed (n=144)	Not assessed (n=230)	565 (0.7)
Age (years) (mean±SD)	61.7±11.0 vs. 61.7±12.6, p=0.63	64.8±11.8 vs. 62.5±13.1, p=0.95	70.8±14.7 vs. 66.5±14.6, p=0.008	63.1±12.6 vs. 65.6±13.4, p=0.018	p<0.05 for comparison between age groups	p=0.05 for comparison between age groups
Male gender (%)	84.6 vs. 75, p=0.34	84.4 vs. 78.4, p=0.18	55.8 vs. 55.1, p=0.904	77.8 vs. 72.2, p=0.14	71 vs. 68, p=0.38	69.9 vs. 70.3, p=0.85
Afroamerican race (%)	56.4 vs. 44.7, p=0.25	-	64 vs. 48.2, p=0.005	-	Not assessed in control group (24% in Covid+ STEMI)	16.8 vs. 11.4, p<0.001
Obesity	BMI (kg/m <sup>2</sup> ): 26.7 (24.8–30.7) vs. 26.87 (22.6–29.4), p=0.64	-	Weight (kg): 80.5±22.7 vs. 86.1±38.2, p=0.075	BMI (kg/m <sup>2</sup> ): 27.3±4.5 vs. 27.8±5.5, p=0.18	BMI (kg/m <sup>2</sup> ): 29.3±7.6 vs. 29.5±6.4, p=0.7	25.5 vs. 21.5, SMD=0.09
Hypertension (%)	71.8 vs. 42.1, p=0.003	51.7 vs. 53.3, p=0.28	47.7 vs. 57.8, p=0.07	64.8 vs. 44.8, p<0.001	73 vs. 69, p=0.16	79.1 vs. 74.8, SMD=0.1
Dyslipidemia (%)	61.6 vs. 36.8, p=0.02	48.4 vs. 46.9, p=0.27	58.1 vs. 59.3, p=0.83	46 vs. 28.9, p<0.001	46 vs. 60, p<0.001	66 vs. 67.2, SMD=0.02
Diabetes mellitus (%)	46.2 vs. 26.3, p=0.04	23.1 vs. 20.9, p=0.06	57 vs. 39.7, p=0.002	34 vs. 20.9, p<0.001	46 vs. 28, p<0.001	48 vs. 33.9, SMD=0.29
Smoking (%)	61.6 vs. 46.1, p=0.17	18.7 vs. 45.5, p<0.001	-	31.7 vs. 33.7, p=0.77	44 vs. 59, p<0.001	15.9 vs. 31.6, SMD=0.38
Chronic kidney disease (%)	-	-	44.2 vs. 26.1, p<0.001	9.9 vs. 3.6, p<0.001	-	20.7 vs. 15.7, SMD=0.13
Lung disease (%)	-	-	Asthma: 3.5 vs. 5.3, p=0.47	11.8 vs. 13.4, p=0.78	-	COPD: 11.7 vs. 14.9, SMD=0.09
Prior stroke (%)	-	-	16.3 vs. 8.6, p=0.02	7.6 vs. 5.7, p=0.11	10 vs. 9, p=0.8	6.7 vs. 6.1, SMD=0.02
History of CAD (%)	Previous PCI: 23.1 vs. 6.6, p=0.02	15.6 vs. 13, p=0.04	51.2 vs. 65.7, p=0.006	Previous PCI: 13.9 vs. 10.2, p=0.03	24 vs. 31, p=0.05	85.8 vs. 88.8, SMD=0.09
History of heart failure (%)	-	-	44.2 vs. 34.9, p=0.08	19 vs. 2.8, p<0.001	16 vs. 9, p=0.01	17.5 vs. 19.7, SMD=0.06
Troponin T (ng/L) (%)	1,221 (179–4,143) vs. 369 (78.9–1,109), p<0.003	-	22.9±52.8 vs. 22.1±43.7, p=0.91	2224.0 (58.0–7,449.5) vs. 899.0 (100.0–3,745.0), p=0.15	-	-

Table 1

Study	Country	N. of Covid+ STEMI	N. of Covid- STEMI	Mortality	ICU admission	Stroke	Major bleeding	CGS	Mechanical ventilation
Stefanini et al. [7]	Italy	28	-	39.3%	-	-	-	-	-
Choudry et al. [1]	UK	39	76	17.9% vs. 6.5%, p=0.10	28% vs. 5%, p=0.003*	-	-	Cardiac arrest: 28.2% vs. 9.2%, p=0.01	-
Rodriguez-Leor et al. [2]	Spain	91	919	Overall: 23.1% vs. 5.7%, p<0.001 CV mortality: 13.2 vs. 5.1%, p=0.002 Non-CV mortality: 9.9% vs. 0.5%, p<0.001	-	-	3.3% vs. 1.5%, p=0.21	9.9% vs. 3.8%, p=0.007	4.4% vs. 1.6%, p=0.06
Case et al. [3]	US	86	1,447	27.9% vs. 3.7%, p<0.001	64%	-	-	-	33.7%
Hamadeh et al. [8]	Lithuania, Italy, Spain, Iraq	78	-	-	-	Ischemic: 4% hemorrhagic: 6%	-	17%	18%
Popovic et al. [9]	France	11	72	27.3% vs. 5.6%, p=0.02	-	-	-	36.4% vs. 4.2%, p=0.03	-
Kite et al. [4]	Global	144	24,961	22.9% vs. 5.7%, p<0.001	33.9%	2.1% vs. 0.14%, p=0.002	2.8% vs. 0.26%, p<0.001	20.1% vs. 8.7%, p<0.001	11.6% vs. 0.4%, p<0.001
NACMI [5]	US and Canada	230	460	33% vs. 4%, p<0.001	Length of stay (days): 3 (1.0–10.0)	3% vs. 0%, p=0.017	-	18% vs. 10%, p=0.002	-
Saad et al. [6]	US	565	75,869	15.4% vs. 9%, p<0.001	Length of stay (days): 1.0 (0.0, 3.0) vs. 1.0 (0.0–2.0), p=0.06	Death + stroke: 18.2% vs. 10.5%, p<0.001	9.7% vs. 6.9%, p=0.007	18.2% vs. 16.8%, p=0.38	21.2% vs. 13.9%, p<0.001

Table 2