

Impact of COVID-19 Pandemic on In-hospital and Long-term Outcomes of ST Elevation Myocardial Infarction

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ARTICLE INFO

Article history:

Submitted: 16. 12. 2025

Revised: 3. 8. 2026

Accepted: 8. 8. 2026

Available online: 9. 10. 2026

Klíčová slova:

Akutní koronární syndrom

Covid-19

Infarkt myokardu s elevací

úseku ST

SOUHRN

Kontext: Pandemie covidu-19 významně ovlivnila kardiovaskulární zdraví populace na celém světě. Cílem této studie bylo zjistit, jak pandemie covidu-19 ovlivnila výsledný stav – během hospitalizace i v dlouhodobém horizontu (1 roku) – pacientů po infarktu myokardu s elevací úseku ST (ST elevation myocardial infarction, STEMI), u nichž byla provedena primární perkutánní koronární intervence (PPCI).

Metody: Do této retrospektivní observační studie bylo zařazeno 317 pacientů po STEMI, léčených v období od 1. března 2019 do 28. února 2022 primární perkutánní koronární intervencí. Pacienti byli rozděleni do skupiny A (období před pandemií, n = 107), skupiny B1 (během pandemie, bez diagnózy covidu-19, n = 169) a skupiny B2 (během pandemie, s potvrzenou diagnózou covidu-19, n = 41). Mezi analyzované parametry patřily klinické charakteristiky, nemocniční komplikace po PCI, délka pobytu v nemocnici a výsledný stav po jednoletém sledování (opětovný příjem pro bolest na hrudi a mortalita).

Výsledky: Nejčastější nemocniční komplikací po PCI bylo srdeční selhání, které se vyskytlo u statisticky významně většího počtu pacientů s diagnózou covid-19 (skupina B2) ve srovnání s pacienty hospitalizovanými před pandemií (48,8 % vs. 24,3 %; $p = 0,004$). U pacientů skupiny B2 bylo rovněž zaznamenán vyšší výskyt kardiogenního šoku (29,3 % vs. 6,5 %; $p < 0,001$), kontrastní látkou indukované nefropatie (22,0 % vs. 8,4 %; $p = 0,024$) a statisticky významně delší pobyt v nemocnici ($9,27 \pm 5,30$ vs. $4,20 \pm 3,26$ dní; $p < 0,001$). Naopak pacienti bez infekce onemocněním covid-19 během pandemie zůstávali v nemocnici kratší dobu ($3,14 \pm 2,40$ dne; $p = 0,004$). Po jednom roce sledování byl opětovný příjem do nemocnice pro bolest na hrudi častější před pandemií, přičemž jednorocní mortalita byla ve všech skupinách srovnatelná.

Závěr: U pacientů s diagnózou infekčního onemocnění covid-19, kteří prodělali STEMI a následně byli léčeni PPCI, bylo přítomno vyšší riziko nemocničních komplikací po PCI i delší hospitalizace, i když jednorocní mortalita zůstala srovnatelná s hodnotami před pandemií.

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ABSTRACT

Background: The COVID-19 pandemic significantly impacted cardiovascular outcomes worldwide. This study evaluated the impact of the COVID-19 pandemic on in-hospital and long-term (1-year) outcomes in patients with ST-elevation myocardial infarction (STEMI) undergoing primary percutaneous coronary intervention (PPCI).

Methods: This retrospective observational study included 317 STEMI patients treated with PPCI between March 1, 2019, and February 28, 2022. Patients were categorized into group A (pre-pandemic, n = 107), group B1 (during pandemic, non-COVID-19, n = 169), and group B2 (during pandemic, confirmed COVID-19, n = 41). Clinical characteristics, in-hospital post-PCI complications, hospital stay duration, and 1-year follow-up outcomes (readmission for chest pain and mortality) were analyzed.

Results: Heart failure was the most common in-hospital post-PCI complication, occurring significantly more in COVID-19 patients (group B2) compared to pre-pandemic patients (48.8% vs. 24.3%, $p = 0.004$). Group B2 patients also experienced higher rates of cardiogenic shock (29.3% vs. 6.5%, $p < 0.001$), contrast-induced nephropathy (22.0% vs. 8.4%, $p = 0.024$), and significantly longer hospital stays (9.27 ± 5.30 vs. 4.20 ± 3.26 days, $p < 0.001$). Conversely, non-COVID-19 patients during the pandemic had shorter hospital stays (3.14 ± 2.40 days, $p = 0.004$). At the 1-year follow-up, hospital readmission for chest pain was more frequent before the pandemic, whereas 1-year mortality rates remained comparable across all groups.

Conclusion: STEMI patients with concomitant COVID-19 infection undergoing PPCI face higher risks of in-hospital post-PCI complications and prolonged hospitalization, though 1-year mortality rates remain comparable to pre-pandemic.

Keywords:

Acute coronary syndrome

COVID-19

ST-elevation myocardial infarction

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DOI: 10.33678/cor.2026.072

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), also known as coronavirus disease 2019 (COVID-19), is one of the most widely spread viruses in the recent era, affecting more than 10 million cases all over the globe (and numbers are increasing daily). It is one of the coronavirus's family along with the severe acute respiratory syndrome (SARS) virus and the influenza A virus H1N1 virus.¹ COVID-19 was announced as a worldwide pandemic by the WHO on January 30, 2020, and in February 2020, the Egyptian Ministry of Health announced the first case of COVID-19. By March 9, 2020, it had spread to more than 100 countries all over the globe.²⁻⁴

At the start of the pandemic, the main symptoms and effects of COVID-19 were related to the respiratory system. Still, shortly it was noticed and reported to affect the cardiovascular system seriously. This effect was associated with the pathological effect of the virus, the impact of quarantine and social distancing measures, and even the effect of anti-COVID-19 medications.⁴ In addition to the burden of the COVID-19 infection, the presence of previous cardiovascular disorders is associated with a high risk of mortality.⁵ An increase in cardiovascular incidents was noticed during the COVID-19 era compared to periods before the pandemic. COVID-19 patients were at higher risk for arrhythmias such as paroxysmal supraventricular tachycardia, atrial fibrillation, sinus bradycardia, and ventricular tachycardia. A prolonged QT interval was observed more in patients who received any experimental medication regimen against SARS-CoV-2.^{6,7}

It was noticed that despite the risk of myocardial injury caused by COVID-19, many patients with acute coronary syndrome were reluctant to seek medical services due to the fear of catching the infection at the medical facilities, and a delay in acute coronary syndrome patients' presentation, referral, and transfer worldwide was reported.⁸ COVID-19 affected the demographic and angiographic characteristics of STEMI patients, and a decreased number of presentations was noticed with a longer total ischemic time and more hospital-related major complications and long-term impact compared to pre-pandemic.⁹

Methods

Study population

This study retrospectively included all STEMI patients who underwent primary PCI and were either hospitalized or presented to the emergency department at Cairo University Hospital and a private hospital between March 1, 2019, and February 28, 2022, and had a complete medical record.

Inclusion criteria

This study included patients diagnosed with STEMI who presented within 12 hours of symptom onset. The STEMI diagnosis was based on the 2017 ESC guidelines for STEMI management.¹⁰

Exclusion criteria

1. Patients who presented after more than 12 hours from symptom onset.
2. Age less than 18 years old.
3. Pregnant ladies.
4. Patients who refused to sign a consent form for primary PCI.
5. Revascularization by acute thrombolysis or pharmacoinvasive strategy.
6. Patients who developed cardiac arrest, did not respond to CPR, and declared death before reaching the cath lab.

Methodology

The study retrospectively included patients diagnosed with STEMI who were treated with primary percutaneous coronary intervention between March 1, 2019, and February 28, 2022. This was a retrospective observational study, and data were collected anonymously. The investigators took all necessary precautions to ensure data privacy. STEMI diagnosis was based on the 2017 ESC guidelines for STEMI management. Patients exhibiting symptoms suggestive of COVID-19 were referred for a chest CT without contrast. Laboratory tests, including complete blood count, C-reactive protein (CRP), and serum ferritin, were conducted. COVID-19 was confirmed through reverse transcription-polymerase chain reaction (RT-PCR) assays or through clinical symptoms and CT chest findings consistent with COVID-19.

The study population was classified into two groups:

- Group A: STEMI patients who presented before the COVID-19 pandemic (from March 1, 2019 to February 29, 2020).
- Group B: STEMI patients who presented during the COVID-19 pandemic (from March 1, 2020 to February 28, 2022); this group will be divided into two subgroups:
 - Group B1: STEMI patients who presented during COVID-19 pandemic, and do not have a confirmed diagnosis of COVID-19.
 - Group B2: STEMI patients who presented during the COVID-19 pandemic and had a confirmed diagnosis of COVID-19.

Clinical and demographic data for all patients were gathered from the hospital database and medical records, including a full history of the current condition, the presenting symptoms and signs, history of comorbidities and risk factors. A standard 12-lead ECG at first medical contact, post-PCI, and follow-up during hospital stay. Additional laboratory tests (CRP, serum ferritin, and D-dimer) were done for patients with symptoms suspicious of COVID-19, and the diagnosis was confirmed with reverse transcription-polymerase chain reaction assays (PCR). Procedural observations reported for the access site, the culprit artery, the site of the lesion, Final Thrombolysis In Myocardial Infarction (TIMI) flow.¹¹

Follow-up and documentation for in-hospital complications, including: dissection, cardiogenic shock, contrast-induced nephropathy, significant bleeding, access site hematoma, post-MI decompensated heart failure, development of arrhythmia, and the type of arrhythmia

that developed during the hospital stay, post-MI arrest, and in-hospital mortality. One-year follow-up for mortality due to cardiac causes and for rehospitalization due to chest pain was collected either by phone call to the patients or from the patients' hospital medical files.

Statistical analysis

All statistical studies were conducted using Statistical Package for Social Sciences software (SPSS 20.0 for Windows, SPSS Inc., Chicago, IL). The quantitative variables are expressed as mean $\pm$ standard deviation (SD). Non-normally distributed variables were expressed as median and interquartile range (IQR). Categorical variables were expressed in numbers and percentages. Comparisons between two groups were performed using the Student's t-test or Mann-Whitney U test for continuous variables, and the Chi-square or Fisher's exact test for categorical variables. A p -value <0.05 was considered statistically significant.

Results

This study enrolled 317 patients diagnosed with STEMI and were treated with primary percutaneous coronary intervention (PPCI). The study population was classified into three groups: **Group A** (107 patients, 33.8%), **group B1** (169 patients, 53.3%), and **group B2** (41 patients, 12.9%).

Comparison between group A (Before the COVID-19 pandemic) and group B1 (no confirmed diagnosis of COVID-19)

I. Risk profile and clinical presentation

A history of previous coronary heart disease was reported in 27 patients (25.2%) of group A and 46 (27.2%) of group B1 ($p = 0.716$). There was no significant difference in the risk profile and clinical presentation between both groups. **Table 1** shows a comparison of the risk profile and clinical presentation.

Table 1 – Comparison of the risk profile and clinical presentation

		Group A (before pandemic) (total n 107)		Group B1 (non-COVID-19) (total n 169)		p-value	Group B2 (COVID-19) (total n 41)		p-value
Age (years) (mean $\pm$ SD) [#]		55.36 $\pm$ 11.90		53.95 $\pm$ 12.38		0.348	55.02 $\pm$ 13.69		0.882
Gender (N, %)*	Male	95	88.8%	152	89.9%	0.760	33	80.5%	0.186
	Female	12	11.2%	17	10.1%		7	17.1%	
Smoking (N, %)*	Smoker	57	53.3%	106	62.7%	0.120	17	41.5%	0.199
	Ex-smoker	15	14.0%	20	11.8%	0.595	6	14.7	0.923
HTN (N, %)*		58	54.2%	92	54.4%	0.970	20	48.8%	0.554
DM (N, %)*		46	43.0%	72	42.6%	0.949	14	34.1%	0.327
Dyslipidemia (N, %)*		66	61.7%	109	64.5%	0.636	23	56.1%	0.535
PAD (N, %)*		12	11.2%	12	7.1%	0.237	2	4.9%	0.238
Previous CHD (N, %)*	STEMI	8	7.5%	8	4.7%	0.342	2	4.9%	0.727
	NSTEMI	8	7.5%	7	4.1%	0.234	1	2.4%	0.445
	CCD	10	9.3%	22	13.0%	0.353	4	9.8%	1.00
	UA	1	0.9%	5	3.0%	0.250	0	0.0%	1.00
	STEMI + CABG	0	0.0%	2	1.2%	0.374	0	0.0%	–
	NSTEMI + CABG	0	0.0%	2	1.2%	0.374	1	2.4%	0.277
CKD (N, %)*		8	7.5%	10	5.9%	0.609	4	9.8%	0.738
Presentation (N, %)*	Chest pain	100	93.5%	158	94.0%	0.843	33	80.5%	0.019
	SOB	5	4.7%	7	4.2%	0.841	3	7.3%	0.685
	Palpitation	0	0.0%	1	0.6%	0.611	1	2.4%	0.277
	Arrest	2	1.9%	1	0.6%	0.336	3	7.3%	0.130
	Syncope	0	0.0%	0	0.0%	–	1	2.4	0.277
	Vomiting	0	0.0%	1	0.6%	0.611	0	0.0%	–
Systolic BP (mmHg), (mean $\pm$ SD)*		132.80 $\pm$ 21.75		132.07 $\pm$ 22.42		0.792	122.55 $\pm$ 22.99		0.015
Diastolic BP (mmHg), (mean $\pm$ SD)*		78.64 $\pm$ 18.20		80.28 $\pm$ 17.20		0.456	72.84 $\pm$ 15.58		0.083
HR (beat/min), (mean $\pm$ SD)*		84.70 $\pm$ 17.16		82.55 $\pm$ 15.64		0.288	75.47 $\pm$ 26.31		0.016

BP – blood pressure; CABG – coronary artery bypass graft; CCD – chronic coronary disease; CHD – coronary heart disease; CKD – chronic kidney disease; DM – diabetes mellitus; HR – heart rate; HTN – hypertension; NSTEMI – non-ST-elevation myocardial infarction; PAD – peripheral artery disease; SOB – shortness of breath; STEMI – ST-elevation myocardial infarction; UA – unstable angina.

* Data is presented by numbers (N) and percentages (%). [#] Data is presented by mean and standard deviation (SD).

Table 2 – Comparison of complications

	Group A (Before pandemic) (total n 107)		Group B1 (Non-COVID-19) (total n 169)		p-value	Group B2 (COVID-19) (total n 41)		p-value
	N	%*	N	%*		N	%*	
Dissection	1	0.9	1	0.6	0.626	2	4.9	0.186
Shock	7	6.5	11	6.5	0.991	12	29.3	< 0.001
CIN	9	8.4	10	5.9	0.425	9	22.0	0.024
Bleeding	3	2.8	6	3.6	0.513	2	4.9	0.617
Hematoma	13	12.1	18	10.7	0.701	13	31.7	0.005
Heart failure	26	24.3	30	17.8	0.188	20	48.8	0.004
Arrest	12	11.2	11	6.5	0.168	8	19.5	0.186
In-hospital mortality	4	3.7	3	1.8	0.264	5	12.2	0.116
Arrhythmia								
VT	6	5.6	6	3.6	0.414	2	4.9	1.00
AF	4	3.7	4	2.4	0.376	3	7.3	0.396
VF	1	0.9	5	3.0	0.250	2	4.9	0.1863
SVT	3	2.8	0	0.0	0.057	0	0.0	0.561
CHB	0	0.0	1	0.6	0.612	2	4.9	0.075

AF – atrial fibrillation; CHB – complete heart block; CIN – contrast-induced nephropathy; VF – ventricular fibrillation; VT – ventricular tachycardia.

* Data is presented by numbers (N) and percentages (%).

II. Complications

Heart failure was the most common in-hospital post-PCI complication, with no significant difference in other complications between the two groups. **Table 2** presents a comparison of complications.

III. Hospital stay duration

Group B1 had a shorter hospital stay, with a mean duration of 3.14 ± 2.40 days compared to 4.20 ± 3.26 days in group A, $p = 0.004$, $p = 0.31$, $p = 0.024$.

IV. One-year follow-up

At the one-year follow-up, 8 patients from group A and 10 patients from group B1 were lost to follow-up. There was no significant difference in one-year readmission due to chest pain, with readmission rates of 47.5% in group A and 32.1% in group B1 ($p = 0.013$). Similarly, the one-year mortality rate was 12.1% in group A and 6.4% in group B1 ($p = 0.110$).

Comparison between Group A (before the COVID-19 pandemic) and group B2 (confirmed diagnosis of COVID-19)

I. Risk profile and clinical presentation

A history of previous coronary heart disease was reported in 27 patients (25.2%) in group A and 8 patients (19.5%) in group B2 ($p = 0.464$). Chest pain was a more common presentation in group A. Systolic blood pressure and heart rate were significantly lower in group B2. There were no significant differences in other risk factors or clinical presentation between groups A and B2. **Table 1** shows a comparison of the risk profile and clinical presentation.

II. Complications

Heart failure was the most common complication in both groups. Cardiogenic shock, contrast-induced nephropathy (CIN), puncture site hematoma, and heart failure were more frequent in group B2. **Table 2** presents a comparison of complications.

III. Hospital stay duration

Group B2 had a significantly longer hospital stay (9.27 ± 5.30 days) compared to group A (4.20 ± 3.26 days, $p < 0.001$).

IV. One-year follow-up

At the one-year follow-up, 8 patients from group A and 6 patients from group B2 were lost to follow-up. One-year readmission due to chest pain was higher in group A (47.5% versus 20.0%, $p = 0.004$), while the one-year mortality rate was comparable between groups A and B2 (12.1% versus 11.4%, $p = 0.591$).

Discussion

Coronavirus Disease 2019 (COVID-19) is one of the most widely spread viruses in recent history. During the pandemic, there was an increase in cardiovascular incidents compared to the pre-pandemic period. It became clear that the COVID-19 pandemic influenced the demographic and angiographic characteristics of STEMI patients. Our study compared STEMI patients before the pandemic with those during the pandemic, distinguishing between those with no confirmed COVID-19 diagnosis and those

with a confirmed diagnosis. This approach differs from most studies, which compared patients before and during the pandemic without considering the COVID-19 status.

Risk profile and clinical presentation

There was no significant difference in gender between the groups, with males being the predominant gender in all groups (88.8% before the pandemic, 89.9% in non-COVID-19 patients, $p = 0.760$, and 80.5% in COVID-19 patients, $p = 0.186$). Other studies comparing the pre-pandemic and pandemic eras align with our findings, such as Sherif Ayad et al.¹² (85.7% vs. 81.5%, $p = 0.607$), and Callum Little et al.¹³ (78.0% vs. 80.0%, $p = 0.510$). However, John Coughlan et al.¹⁴ reported a higher percentage of male patients before the pandemic (100% vs. 55.0%, $p = 0.014$). There was no significant difference in the prevalence of smoking (53.3% before the pandemic, 62.7% in non-COVID-19 patients, $p = 0.120$, and 41.5% in COVID-19 patients, $p = 0.199$). Other studies reported similar findings: Sherif Ayad et al.¹² (57.1% vs. 45.6%, $p = 0.364$), Chun Kwok et al.¹⁵ (40.9% vs. 38.1%, $p = 0.260$). In contrast, Callum Little et al.¹³ found higher smoking rates in patients before the pandemic (55.7% vs. 41.6%, $p < 0.001$). Similarly, we found no significant difference in the rates of hypertension (54.2% before the pandemic, 54.4% in non-COVID-19 patients, $p = 0.970$, and 48.8% in COVID-19 patients, $p = 0.554$). These results are consistent with findings from other studies: Sherif Ayad et al.¹² (42.9% vs. 39.6%, $p = 0.411$), Chun Kwok et al.¹⁵ (43.2% vs. 39.4%, $p = 0.067$). However, Mustafa Erol et al.¹⁶ reported a higher prevalence of hypertension during the pandemic (38.4% vs. 45.6%, $p = 0.013$). Regarding diabetes, there was no significant difference in its prevalence (43.0% before the pandemic, 42.6% in non-COVID-19 patients, $p = 0.949$ and 34.1% in COVID-19 patients, $p = 0.327$). This finding is consistent with previous studies, such as Sherif Ayad et al.¹² (35.7% vs. 35.2%, $p = 0.521$), John Coughlan et al.¹⁴ (0% vs. 22.0%, $p = 0.142$). However, Xuhe Gong et al.¹⁷ reported a significantly higher prevalence of diabetes during the pandemic (21.3% vs. 35.5%, $p = 0.014$). The prevalence of dyslipidemia remained similar in all groups (61.7% before the pandemic, 64.5% in non-COVID-19 patients, $p = 0.636$ and 56.1% in COVID-19 patients, $p = 0.535$). This pattern is consistent with findings from several studies, including Sherif Ayad et al.¹² (50.0% vs. 45.2%, $p = 0.501$), Chun Kwok et al.¹⁵ (34.9% vs. 32.8%, $p = 0.290$). Conversely, Mustafa Erol et al.¹⁶ reported a significantly higher incidence of dyslipidemia among patients during the pandemic (9.4% vs. 22.3%, $p < 0.001$). We found no significant difference in the prevalence of previous coronary heart disease (25.2% before the pandemic, 27.2% in non-COVID-19 patients, $p = 0.716$ and 19.5% in COVID-19 patients, $p = 0.464$). This observation aligns with the findings of Tuncay Kiris et al.¹⁸ (12.0% vs. 13.0%, $p = 0.865$), and John Coughlan et al.¹⁴ (21.0% vs. 22.0%, $p = 0.990$). Chest pain remained the most common presenting symptom both before and during the pandemic, with no significant difference between pre-pandemic and non-COVID-19 patients (93.5% vs. 94.0%, $p = 0.843$). However, when compared to COVID-19 patients, our study found a higher prevalence of chest pain among pre-pandemic patients (93.5% vs. 80.5%, $p =$

0.019). Similarly, Tuncay Kiris et al.¹⁸ reported that chest pain was more frequently observed before the pandemic (75.0% vs. 68.0, $p = 0.004$). This difference may be attributed to the fact that COVID-19 patients were more likely to present with shortness of breath rather than chest pain. The mean age of patients remained similar (55.36 ± 11.90 years before the pandemic, 53.95 ± 12.36 years non-COVID-19 patients, $p = 0.348$ and 55.02 ± 13.69 years COVID-19 patients, $p = 0.882$). We found a slightly higher mean age without a statistically significant difference between groups, such as Sherif Ayad et al.¹² (58.9 ± 13.35 vs. 57.1 ± 12.60 years, $p = 0.568$), John Coughlan et al.¹⁴ (59 ± 10 vs. 58 ± 17 years, $p = 0.912$). In contrast, Tuncay Kiris et al.¹⁸ found a higher mean age among pre-pandemic patients than during the pandemic (61.9 ± 12.4 vs. 60.6 ± 12.4 years, $p = 0.029$). Variations in clinical characteristics between our study and others may be attributed to differences in study populations.

Complications

Our study demonstrated statistically significant differences in in-hospital post-PCI complications. Heart failure (HF) was the most common complication across all groups, with COVID-19 patients being more likely to develop HF compared to patients before the pandemic (24.3% before the pandemic, 17.8% in non-COVID-19 patients, $p = 0.188$ and 48.8% in COVID-19 patients, $p = 0.004$), cardiogenic shock (6.5% before the pandemic, 6.5% in non-COVID-19 patients, $p = 0.991$ and 29.3% in COVID-19 patients, $p < 0.001$), and contrast-induced nephropathy (CIN) (8.4% in before the pandemic vs. 5.9% in non-COVID-19 patients, $p = 0.425$ and 22.0% in COVID-19 patients, $p = 0.024$). In contrast, no significant differences were found in other complications, including, major bleeding (2.8% before the pandemic, 3.6% in non-COVID-19 patients, $p = 0.513$ and in 4.9% in COVID-19 patients, $p = 0.617$), and in-hospital mortality (3.7% before the pandemic, 1.8% in non-COVID-19 patients, $p = 0.264$ and 12.2% in COVID-19 patients, $p = 0.116$). Chun Kwok et al.¹⁵ found no significant differences in in-hospital mortality (4.8% vs. 3.5%, $p = 0.120$), major bleeding (0.2% vs. 0.4%, $p = 0.190$), cardiogenic shock (7.4% vs. 6.2%, $p = 0.200$), and renal failure requiring dialysis (0.2% vs. 0.2%, $p = 0.640$). Similarly, Callum Little et al.¹³ reported comparable rates of in-hospital mortality (8.6% vs. 10.9%, $p = 0.280$) and cardiogenic shock (13.5% vs. 12.5%, $p = 0.680$). Tuncay Kiris et al.¹⁸ also found no significant differences in in-hospital mortality (7.0% vs. 8.0%, $p = 0.205$) or shock rates (9% vs. 9%, $p = 0.846$) before and during the pandemic. In contrast, John Coughlan et al.¹⁴ reported a numerically higher in-hospital mortality during the pandemic, which nearly reached statistical significance (22.0% vs. 0%, $p = 0.060$). Mustafa et al.¹⁶ found a significant increase in heart failure or cardiogenic shock (4.2% vs. 11.1%, $p = 0.001$), while in-hospital mortality remained unchanged (5.3% vs. 4.7%, $p = 0.642$). Sherif Ayad et al.¹² observed a higher incidence of in-hospital mortality during the pandemic (7.4% vs. 4.6%, $p = 0.036$), though rates of heart failure, stroke, and bleeding were similar between groups. The higher risk of complications in STEMI patients with

COVID-19 could be attributed to the underlying pathology of COVID-19 and the side effects of its treatment protocols. Differences in complication rates between our study and others could be due to several contributing factors. In particular, our study included only patients who presented early, excluding those who arrived more than 12 hours after symptom onset. Additionally, variations in study populations, comorbidities, and ischemia time may have contributed to the differing results.

Hospital stay duration

Our study revealed that before the pandemic STEMI patients had a longer hospital stay duration than non-COVID-19 group (4.20 ± 3.26 vs. 3.14 ± 2.40 days, $p = 0.004$), this could be explained by the efforts to minimize hospital exposure for non-COVID-19 patients, while COVID-19 patients had a significantly longer hospitalization (4.20 ± 3.26 vs 9.27 ± 5.30 days, $p < 0.001$), due to isolation requirements and a higher risk of complications. Similar findings were reported by Sherif Ayad et al.¹² (3.5 ± 2.3 vs. 6.85 ± 4.22 days, $p = 0.002$) and Callum Little et al.¹³ ($3 [2-4]$ vs. $3 [2-5]$ days, $p < 0.001$), showing an increase in hospital stay during the pandemic. However, other studies found shorter hospital stays, such as Chun Kwok et al.¹⁵ ($2 [1-3]$ vs. $3 [2-4]$ days, $p < 0.001$) and Xuhe Gong et al.¹⁵ ($9 [8-11]$ vs. $8 [6-10]$ days, $p < 0.001$).

One-year follow-up

The readmission to the hospital for chest pain was more frequent before the pandemic (45.5% before the pandemic, 32.1% in non-COVID-19 patients, $p = 0.013$, and 20% in COVID-19 patients, $p = 0.04$). However, one-year mortality rates remained comparable across the groups (12.1% before the pandemic, 6.4% in non-COVID-19 patients, $p = 0.110$, and 11.4% in COVID-19 patients, $p = 0.591$). Only a limited number of studies have investigated the follow-up of STEMI patients during the pandemic, with even fewer examining long-term outcomes. Xuhe Gong et al.¹⁷ conducted a 30-day follow-up and found no significant difference in mortality rates (1.5% vs. 3.6%, $p = 0.274$).

Conclusion

When comparing patients before the pandemic and non-COVID-19 patients our study found no significant differences in clinical characteristics and in-hospital post-PCI complications or in-hospital mortality. In non-COVID-19 patients, the mean hospital stay duration was notably shorter. Non-COVID-19 patients had a higher mean WMSI. A one-year follow-up revealed that hospital readmission for chest pain was more common before the pandemic, while one-year mortality rates were comparable between the groups. Comparing patients before the pandemic and COVID-19 patients, COVID-19 patients were more likely to develop post-PCI cardiogenic shock, contrast-induced nephropathy (CIN), hematoma, and heart failure, while other post-PCI complications and in-hospital mortality rates were similar. The mean hospital stay duration was significantly shorter for COVID-19 patients. A one-year follow-up revealed that hospital

readmission for chest pain was more common before the pandemic, while one-year mortality rates were comparable between the two groups.

Limitations

Our study had some limitations inherent to its observational design. The sample size was relatively small, and the follow-up time was limited to the hospitalization period and up to one year after discharge. The long-term effects of the COVID-19 pandemic, such as newly diagnosed heart failure or even increased mortality, are yet to be determined. Additionally, some patients were lost during the follow-up period, highlighting the need for a more structured follow-up system.

Conflicts of interest

The authors declare no competing interests.

Funding

No external funding was received.

Availability of data and materials

Available from the corresponding author upon request.

Ethical statement

This study was approved by the Cairo University Faculty of Medicine Research Ethics Committee (approval date 23-2-2023).

Informed consent

Not applicable.

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