ORIGINAL RESEARCH

Surgical coronary revascularization in patients with COVID-19; complications and outcomes: A retrospective cohort study

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Abstract

Background and Aims: Coronary artery disease is high-risk comorbidity of
COVID-19 infection. Nonelective coronary artery revascularization in COVID-19
patients carries substantial risk. Therefore, it is essential to understand the risk
factors and outcomes fully. This study aims to evaluate the prognosis of coronary
artery bypass grafting (CABG) surgery in patients with COVID-19.

Methods: This retrospective cohort study assesses 171 patients who underwent
urgent and emergent CABG in Tehran Heart Center from March 2020 to September
2021. The patients were allocated to cases and controls based on COVID-19
infection status. Demographic and clinical features, alongside the complications and
outcomes, were compared between the two groups.

Results: According to diagnostic criteria, 62 patients were diagnosed with
COVID-19 (Case) and 109 patients had no COVID diagnosis (Control). Regarding
the demographics and risk factors, hypertension was more prevalent among patients
with COVID-19 (64.5% compared to 43.1% $p = 0.007$). Length of hospital stay,
ventilation time, and intensive care unit (ICU) stay time were significantly higher in
patients infected with COVID-19. Postoperative complications, including stroke,
atrial fibrillation, pleural effusion, blood transfusion, and Inotrope use, were
significantly higher in the case group. Mortality rates were also higher in
COVID-19 patients with an odds ratio of 1.53; however, this difference is not
statistically significant (p: 0.44, 95% CI = 0.50–4.01).

Conclusion: COVID-19 is associated with a significantly higher hospital stay,
ventilation time, and ICU stay. Mortality rates are also higher, albeit insignificantly.
Various postoperative complications are also higher with COVID-19.

KEYWORDS
coronary artery bypass grafting, coronavirus disease (COVID-19), severe acute respiratory
coronavirus-2 (SARS-CoV2)

1 | INTRODUCTION

Severe acute respiratory coronavirus-2 (SARS-COV-2), caused by a novel coronavirus first reported in Wuhan, China, was declared a pandemic on March 11, 2020, by World Health Organization.[1] A total of 466 million confirmed cases of COVID-19 and 6.07 million COVID-related mortalities have been reported by March of 2022.

Since 2020, hospitals have been challenged by an overbearing of patients due to the COVID-19 pandemic. Many hospitals were required to cancel or postpone elective surgeries.[2] However, despite the pandemic, performing surgeries was inevitable in high-risk patients with urgent conditions such as coronary artery disorders.[3,4]

Cardiovascular disorders have been a risk factor for severe COVID infection.[5,6] On the other hand, COVID infection has also been associated with new-onset cardiovascular injuries.[7–9] In a study conducted by He et al.[10] in 2020, myocardial injuries were associated with a poorer prognosis for COVID patients.[10] However, the exact interaction mechanism between COVID infection and cardiovascular disorders is yet to be understood. Several mechanisms have been hypothesized for SARS-CoV2-associated cardiovascular involvements, including coronary plaque destabilization, hypoxia, systemic inflammation, T cell cytokine response, myocardial fibrosis, and direct cardiomyocyte damage.[11]

Studies regarding the outcome of cardiac surgery in COVID-19 patients are limited. In 2020, Liu et al. studied 115 patients with myocardial infarction (MI) with 145 patients with similar presentations from 2019 and before the pandemic. They concluded that more critical situations accompany patients admitted during the pandemic due to the reduced patient referrals to hospitals.[12] Frasky et al. studied 13 coronary artery bypass grafting (CABG) candidates with simultaneous COVID-19 infection. They concluded that these patients have worse outcomes, especially if their surgery was postponed due to the disease.[13] In 2021 Casey et al. reported that cardiac surgeries are being performed with only 49% of the before-pandemic capacity.[14] Barkhordari et al. studied short-term respiratory outcomes of 25 COVID-19 patients who underwent cardiac surgeries. They concluded that COVID-19 patients have a worse prognosis in comparison to other patients.[15] In a cohort study of COVID-19 patients, TCIR (The Cardiothoracic Interdisciplinary Research Network and COVID Surg Collaborative) reported poorer outcomes for cardiac surgery in patients with concurrent COVID-19 infection. Mortality rates increased up to 24% were reported for COVID-19 patients who underwent cardiac surgeries.[16]

This study reports the outcomes of 62 cases of COVID-19 patients who underwent urgent CABG during the pandemic. The results were assessed and compared with a control group of patients who underwent urgent CABG without a COVID infection during the same period.

2 | METHODS

2.1 | Study design

We performed a retrospective cohort study on patients who underwent an urgent or emergent CABG surgery in 2020 and or 2021 at Tehran Heart Center. This procedure involves taking a blood vessel from another part of the body (usually the chest, leg, or arm) and attaching it to the coronary artery above and below the narrowed area or blockage. This new blood vessel is known as a graft. This study was approved by the Tehran Heart Center (THC) review board and Ethical Committee of Tehran University of Medical Sciences on September 23, 2021 (Ethics code: IR.TUMS.THC.REC.1400.070).

2.2 | Setting

Tehran Heart Center, Affiliated with the Tehran University of Medical Sciences, is a major tertiary center providing services to patients with cardiovascular disorders from all Iran and Regional countries since 2002.

2.3 | Participants

Adult Patients undergoing urgent or emergent CABG procedures between March 1, 2020 and July 1, 2021 were included in the study. All patients were candidates for an urgent or emergent CABG surgery due to one of the following reasons[17,18]: left-main coronary stenosis or 3-vessel disease (3VD), unaccesable anatomy for percutaneous coronary intervention (PCI), or failed PCI, ongoing ischemia without a response to noninvasive treatments, unstable hemodynamics for PCI, angiographic incidents.

One hundred and seventy-one patients were included in the study, and their records were reviewed. Patients were divided into two groups based on confirmed COVID-19 infection in the last 14 days leading to the surgery. Diagnosis of COVID infection was based on a positive COVID-19 real-time polymerase chain reaction (RT-PCR) test or a computed tomography—scan (CT-Scan) results in favor of COVID infection alongside with patient's symptoms. CT scans were reported by two expert radiologists and confirmed by an infectious disease specialist based on the latest World Health Organization (WHO) guidelines on COVID diagnosis.[19]

Sixty-two of these patients were diagnosed with COVID-19 infection before the surgery. Due to the COVID infection diagnosis, all patients in the COVID group were isolated during their surgery. All of the COVID patients were asymptomatic before the surgery. The control group consisted of the other 109 patients without a COVID diagnosis.

2.4 | Variables and measurements

The patients' demographic and risk factor profiles were gathered and compared between the two groups. These factors included Age, Sex, Body mass index (BMI), Hypertension, Diabetes, Dyslipidemia, CHF (congestive heart failure), COPD (chronic obstructive pulmonary disease), Addiction, and Family history. Clinical characteristics of the

patients were also assessed. These characteristics consisted of recent MI status, EF (ejection fraction), Angiography results, NYHA (New York Heart Association) Classification status, and Lab results. Surgical features including the type of surgery, CPB (cardiopulmonary bypass) utilization, Perfusion time, Number of anastomoses, and IABP (intra-aortic balloon pump) insertion were evaluated for both groups.

Primary outcomes included 30-day mortality, length of stay (LOS), intensive care unit (ICU) stay time, and ventilation time. Postoperative complications including stroke, atrial fibrillation, pericardial and pleural effusion, blood transfusion, renal failure (RF), sepsis, and cerebrovascular accident (CVA) were also evaluated. Primary outcomes and postoperative complications were compared between the Case (COVID+) and Control (COVID−) groups. Data were collected from the THC surgical data bank and reviewed patient records based on the study checklist.

2.4.1 | Ethical approval

Based on the local ethical regulations at THC, informed consent was obtained from all patients at the time of admission for a possible anonymous report of the medical data. In addition, the proposal for this project was approved by the Ethical Committee of Tehran University of Medical Sciences (Ethics code: IR.TUMS.THC.REC.1400.070).

2.5 | Statistical analysis

Frequencies and percentages were reported for categorical variables. Normally distributed continuous variables were described using mean and SD and were compared between COVID-19 and non-COVID-19 groups using a Student's t-test. Non-normally distributed variables were expressed as median with 25th and 75th percentiles and were compared between the two aforementioned groups applying the Mann–Whitney U test. Categorical variables were described as absolute frequencies with percentages and were compared between COVID-19 and non-COVID-19 groups using χ^2 or Fisher's exact test, as appropriate.

Stabilized inverse probability weights (sIPW) were calculated using propensity scores extracted from the logistic regression of Age, Sex, Hypertension, Dyslipidemia, EF, GFR (glomerular filtration rate), and diabetes on COVID-19.

The unadjusted and adjusted effects of COVID-19 on binary outcomes were evaluated by applying a logistic regression model. The effects were reported through an odds ratio with a 95% confidence interval (CI). Linear regression models were used to assess the effect of COVID-19 on the logarithm of LOS, ICU stay, and ventilation time. Regression coefficients with corresponding 95% CI were reported.

All tests were performed two-sided and p values of less than 0.05% and 95% CI that did not include zero were considered statistically significant. Statistical analyses were conducted using IBM SPSS Statistics for Windows, version 23.0 (IBM Corp.) and Stata Statistical Software, release 15.2 (Stata Corp LLC.)

3 | RESULTS

3.1 | Participants

A total of 171 patients were included in the study, from 37 to 91 years old, with a mean age of 62.39 (±9.67). There were 128 (74.9%) male patients in the study group. Sixty-two patients were diagnosed with COVID-19 before the surgery based on PCR or chest CT results. A positive COVID-19 PCR diagnosed 14 cases, and CT scan results diagnosed 53 cases. Diagnosis of COVID-19 was confirmed by radiology and infectious diseases specialists. Out of these patients, 39 received antiviral drugs, including Remdesivir, Atazanavir, Lopinavir, β-interferons, and hydroxychloroquine. The antiviral treatment guidelines were limited and based on emerging evidence (2020). All 62 patients diagnosed with COVID-19 infection were stable and asymptomatic before the surgery, with an SPO2 of more than 93%. Other than antiviral treatments for COVID patients, similar routine pre- and post-CABG medical treatments were conducted for both groups.

3.1.1 | Descriptive data

Clinical and para-clinical patient characteristics in the two groups are reported subsequently. Recent MI (in the last 21 days) was reported in 41% of the patients (17% NSTEMI and 24% STEMI). Recent MI prevalence was 43.5% in patients with COVID-19 and 39.4% in the control group. In all, 84.8% of the patients had an NYHA classification of II or higher. This percentage was 80.6% and 87.1% for COVID and non-COVID patients. Angiographic results demonstrated a 75.4%, 7.0%, and 17.5% prevalence rate for single vessel disease (SVD), 2VD, and 3VD diagnosis, respectively. These results were 77.4% and 74.3% for SVD, 6.5% and 7.3% for 2VD, 16.1% and 18.1% for 3VD in cases and controls, respectively. The mean EF was 39.17% (±10.76) according to echocardiography results. Mean EF was reported at 37.26% (±10.72) and 40.25% (±10.68) for COVID and non-COVID patients, respectively. Surgical features are described in Tables 1 and 2.

All patients underwent urgent or emergent surgical revascularization due to left-main artery involvement, ongoing ischemia, PCI accidents, and hemodynamic instability. In all, 89% of the patients had an isolated CABG surgery, while 11% had a combined valvular and CABG surgery. Only five patients (2.9%) underwent off-pump surgery and 97.1% of the surgeries were on-pump. The average perfusion time was 104.2 ± 42.13 in COVID patients and 88.33 ± 59.47 in non-COVID patients. The average number of arterial and venous anastomoses was 3.26 in all patients. IABP was utilized in 25.8% of the COVID patients and 14.7% of the controls. Blood products were required for 22.8% of the patients

TABLE 1 Demographic, risk factor profiles, clinical characteristics, and lab results compared between two groups

Variable	Total (171 = n)	COVID infection Yes (62 = n)	No (109 = n)	p value
Demographic characteristics				
Age	62.4 (±9.7)	63.7 (±10.1)	61.7 (±8.9)	0.27[a]
Male gender	128 (74.9%)	44 (71.0%)	84 (77.1%)	0.38[b]
Risk factor profiles				
BMI	27.6 (±4.4)	26.9 (±4.7)	27.99 (±4.3)	0.12[a]
Diabetes	84 (49.1%)	31 (50.0%)	53 (48.6%)	0.88[b]
Hypertension	87 (50.9%)	40 (64.5%)	47 (43.1%)	0.007[b]
Dyslipidemia	64 (37.4%)	17 (27.4%)	47 (33.1%)	0.04[b]
Positive family history	50 (29.2%)	19 (30.6%)	31 (28.4%)	0.91[b]
Smoking	59 (34.5%)	21 (33.9%)	38 (34.9%)	0.48[c]
Opium addiction	38 (21.8%)	11 (16.4%)	27 (24.8%)	0.25[c]
Clinical characteristics				
Recent MI				
No recent MI	101 (59.1%)	35 (56.5%)	66 (60.6%)	0.88[b]
NSTEMI	29 (17.0%)	11 (17.7%)	18 (16.5%)	
STEMI	41 (24.0%)	16 (25.8%)	25 (22.9%)	
NYHA classification				
None	19 (11.1%)	10 (16.1%)	9 (8.3%)	0.56[c]
I	7 (4.1%)	2 (3.2%)	5 (4.6%)	
II	99 (57.9%)	34 (54.8%)	65 (59.6%)	
III	45 (26.3%)	16 (25.8%)	29 (26.6%)	
IV	1 (0.6%)	0 (0.0%)	1 (0.9%)	
Angiography result				
SVD	129 (75.4%)	48 (77.4%)	81 (74.3%)	0.71[b]
2VD	12 (7.0%)	4 (6.5%)	8 (7.3%)	
3VD	30 (17.5%)	10 (16.1%)	20 (18.3%)	
Eco results (EF)	39.1 (±10.8)	37.2 (±10.7)	40.2 (±10.7)	0.08[a]
Lab results				
GFR	72 (55–89)	68 (54–85)	76 (57–93)	0.11[d]
Creatinine	1.1 (0.9–1.3)	1.1 (0.9–1.2)	1.1 (0.9–1.3)	0.93[d]
Hb	13.9 (±1.9)	13.5 (±2.2)	14.1 (±1.8)	0.07[a]
WBC/10^3	8.6 (7.4–10.3)	8.9 (7.5–11)	8.4 (7.2–9.7)	0.11[d]
K	4.25 (±0.41)	4.20 (±0.41)	0.41 (±4.28)	0.43[a]
TG	128 (98–171)	129 (89–203)	128 (101–169)	0.89[d]
LDL	83 (63–108)	83 (61–110)	85 (65–108)	0.98[d]
HDL	37.8 (±9.5)	38.0 (±8.0)	37.7 (±10.2)	0.83[a]
TC	146. 7 (±42.6)	146.6 (±44.0)	146.8 (±41.9)	0.98[a]
PT	12.24 (±2.7)	12.25 (±2.8)	12.23 (±2.6)	0.94[a]
INR	1.14 (±0.30)	1.15 (±0.32)	1.14 (±0.29)	0.81[a]

TABLE 1 (Continued)

Variable	Total (171 = n)	COVID infection		p value
		Yes (62 = n)	No (109 = n)	
Surgical characteristics				
Surgery type				
Isolated CABG	152 (88.9%)	55 (88.7%)	97 (89.0%)	0.99[b]
Nonisolated CABG	19 (11.1%)	7 (11.3%)	12 (11.0%)	
On pump surgery	166 (97.1%)	59 (95.2%)	107 (98.2%)	0.35[c]
Perfusion time	85 (60–105)	92 (78–130)	75 (50–100)	0.001[d]
Number of anastomosis	3.26 (±1.12)	3.41 (±1.00)	3.18 (±1.18)	0.07[a]
IABP emplacement	32 (18.7%)	16 (25.8%)	16 (14.7%)	0.07[b]
Usage of blood products	39 (22.8%)	14 (22.6%)	25 (22.9%)	0.96[b]

Abbreviations: BMI, body mass index; CABG, coronary artery bypass grafting; GFR, glomerular filtration rate; HDL, high-density lipoprotein; INR, international normalized ratio; LDL, low-density lipoprotein; MI, myocardial infarction; NSTEMI, non-ST-elevation myocardial infarction; NYHA, New York Heart Association; PT, prothrombin time; STEMI, ST-elevation myocardial infarction; SVD, single vessel disease; TC, total cholesterol.

[a]T-test analysis was used for continuous variables.

[b]Pearson χ^2 test was used for categorical variables.

[c]Fisher's exact test was used for variables that performing the χ^2 test was not possible.

[d]In variables without normal distribution, median values alongside 25th and 75th percentiles were reported. Mann–Whitney analysis was used for these variables.

TABLE 2 Descriptive comparison of outcomes between groups

Variable	COVID-19 Infection		Total (171)
	No (109)	Yes (62)	
Length of stay (days)	9 (7–13)[a]	14 (9–19)	11 (8–15)
Ventilation time (h)	16 (12–20)	18.5 (15–46)	16 (12–23)
ICU stay (h)	70 (26–124)	144 (89–233)	93 (45–161)

[a]In variables without normal distribution, median values alongside 25th and 75th percentiles were reported.

during the surgery (22.6 and 22.9 for COVID and non-COVID patients, respectively).

3.1.2 | Outcome data

During the 30-day follow-up, there were 16 mortalities in both groups. The main cause of mortality was heart failure in 14 patients, acute respiratory distress syndrome (non-COVID related) in one, and septic shock in one patient. Mortality rates for COVID and non-COVID were 11.3% and 8.3%, respectively, with an OR of 1.52 in the adjusted model; however, this difference is not statistically significant. Meanwhile, stroke was significantly higher in COVID patients and was reported in 12.9% and 5.5% of COVID and non-COVID patients. The comparison of atrial fibrillation, which occurred in 25.8% of the infected patients, and 9.2% of the control group, shows a significant difference. While pleural and pericardial effusion was reported in 40% and 8.1% of the COVID patients, 24.8% and 2.8% of

non-COVID patients. However, this difference was only significant for pleural effusion. Severe complications including sepsis, renal failure, and CVA occurred in 12.9% and 3.7% of COVID and non-COVID patients, respectively. Although the differences for severe complications were statistically significant in unadjusted models, these differences lost significance after adjustment (Figure 1).

The average patient LOS was 13.22 days. This duration was 16.97 days for COVID patients and 11.09 days for controls. The mean ICU stay was 145.5 h in total, while COVID patients stayed 234.55 h in the ICU. The mean ICU stay for non-COVID patients was 94.33 h. Similarly, the average mechanical ventilation time was 37.72 h, and COVID and non-COVID patients were ventilated at 53.32 and 28.85 h. All the data mentioned above showed strong significance.

3.1.3 | Main results

IPW propensity match was performed based on seven variables. These variables were chosen based on data inconsistency between the two groups. The discrepancy of matched variables, including Age, Sex, BMI, EF, HTN, Diabetes mellitus, and GFR before and after IPW propensity weighting, is demonstrated in the Supporting Information: Figure 1S.

Outcome comparison analysis before and after the IPW match is demonstrated in Table 3. Mortality rates were higher in the COVID group, with an OR of 1.52 in the adjusted model. However, this difference was not considered statistically significant. LOS, Ventilation, and ICU times were significantly higher in COVID patients for
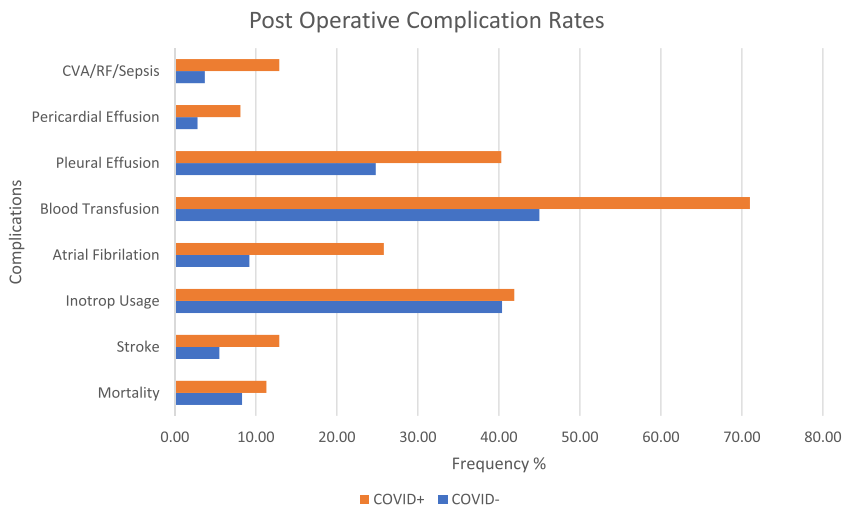
Post Operative Complication Rates

FIGURE 1 Comparison of the effect of COVID infection on the postoperative complications of CABG surgery. CABG, coronary artery bypass grafting; CVA, cerebrovascular accident; RF, renal failure.

TABLE 3 Analysis comparison of outcomes between two groups (adjusted and unadjusted models)

Outcomes/complications	Unadjusted			Adjusted (IPW)		
	$β^a$	95% CI	p value	$β^a$	95% CI	p value
Length of stay (days)	0.32	0.15–0.49	<0.001	0.275	0.09–0.46	0.004
ICU stay (hours)	0.869	0.58–1.16	<0.001	0.833	0.53–1.14	<0.001
Ventilation time (hours)	0.391	0.11–0.67	0.01	0.41	0.09–0.73	0.01
	OR^b	95% CI	p value	OR^b	95% CI	p value
Mortality	1.414	0.50–4.01	0.514	1.524	0.52–4.50	0.44
Stroke	2.543	0.84–7.71	0.099	3.496	1.08–11.28	0.04
Blood products administration	2.993	1.54–5.82	0.001	3.031	1.48–6.19	0.002
Atrial fibrillation	3.443	1.45–8.17	0.005	3.991	1.58–10.07	0.003
Pleural effusion	2.052	1.05–4.00	0.035	2.248	1.10–4.59	0.03
Pericardial effusion	3.099	0.72–13.44	0.131	3.751	0.81–17.30	0.09
CVA/RF/Sepsis	3.889	1.12–13.50	0.032	3.308	0.88–12.38	0.08

Abbreviations: CI, confidence interval; CVA, cerebrovascular accident; ICU, intensive care unit; IPW, inverse probability weights; OR, odds ratio; RF, renal failure.

aAnalysis was performed on the logarithmic values of continuous variables, and a coefficient (β) was reported.

bOdds ratio was reported for categorical variables.

both models. Blood product transfusion was significantly higher in patients with COVID-19 in both models. Atrial fibrillation, pleural effusion, and stroke were significantly higher in COVID patients (OR of 3.99, 2.25, and 3.49, respectively, in the adjusted model). Pericardial effusion and severe complications (RF, sepsis, and CVA) were higher in COVID patients (OR of 3.75 and 3.30 respectively in the adjusted model). Though, this difference was not regarded as statistically significant.

It is worth mentioning that isolation protocols were applied for suspected or confirmed COVID patients on admission. All healthcare providers had adequate personal protective equipment (PPE) provided for them. COVID patients were operated on in a separate operating room, and all of the staff had full PPE during the procedure.

4 | DISCUSSION

The current literature regarding CABG in COVID-19-infected patients and their outcomes is limited. This retrospective cohort survey studied 171 patients who underwent urgent or emergent CABG surgery during the COVID pandemic. Baseline characteristics, postoperative complications, and outcomes were compared between patients based on COVID infections before surgery. Demographic characteristics were similar in both groups. The prevalence of hypertension and dyslipidemia was significantly higher in patients with COVID-19 infection. In contrast, other differences between the two groups' baseline characteristics were not statistically significant. Demographic and risk factor profiles were consistent with international and regional studies on CABG

patients.[20,21] Regarding COVID vaccination status, none of the included patients were fully vaccinated during the study timeline (March 2020–July 2021) as it was only the first phase of public vaccination in Iran, primarily including the HCW. Thus, future studies are required to assess the effect of COVID vaccination on the outcomes of CABG surgeries.

Clinical and paraclinical characteristics, including the prevalence of recent MI, NYHA classification, Angiography results, EF, and lab results, had no significant difference between the two patient groups. Mean EF was reported at a much lower than normal value (39.1 ± 10.8) for all patients, which is explained by most patients' high-grade coronary artery involvement and ongoing ischemia. Other studies on urgent CABG patients demonstrated similar EF rates and angiography results.[20,22,23] Similar to previous studies, the majority of surgeries were isolated on-pump CABG procedures.[15] Between surgical characteristics, perfusion time, the number of anastomoses, and IABP usage were higher in COVID patients; other than the difference in perfusion time, this difference was not statistically significant, possibly, due to the limited sample size.

Mortality rates in COVID patients (11.3%) were higher than in other patients, with an odds ratio of 1.53. However, this difference was not statistically significant. We assume that this insignificance is due to the limited sample size. Studies on COVID patients who underwent general surgeries also reported an increase in mortality rates.[24,25] The primary outcomes, including ICU stay, ventilation hours, and total LOS, were significantly higher in the COVID group both before and after the propensity match. Previous studies on patients undergoing general surgeries during COVID infection also reported a similar increase in ICU stay.[15,26] Various complications, including stroke, atrial fibrillation, pleural effusion, inotrope, and blood product administration, were significantly higher in COVID patients.

These results can confirm the adverse effects of COVID infection on the CABG procedure. All COVID patients were stable and asymptomatic before the surgery. However, the lung damage and inflammation caused by CPB and the open-heart surgery[27,28] could have been amplified by the underlying pathologies caused by the COVID infection. Underlying COVID pathologies accounting for the evident increase in intraoperative and postoperative complications can include inflammatory response, cardiovascular and respiratory dysregulations, and coagulation abnormalities.[29–31] Further studies can help us better understand the interaction mechanism between COVID infection and cardiac surgery outcomes.

The detected increase in inpatient complications and mortalities demands a careful risk assessment strategy before the surgery. Associated risks of delaying an urgent CABG surgery or performing the surgery during a COVID infection should be delicately compared by a multidisciplinary team before any decision-making. The results of this study and future similar studies can be essential in providing evidence for the best treatment selection in COVID patients requiring urgent CABG surgery.

4.1 | Study limitations

Although the number of cases in our study was higher than in previous studies, the major limitation of our study was yet our sample size. Urgent and emergent CABG procedures were limited in all hospitals, especially during the COVID pandemic. The number of patients who underwent the procedure despite a confirmed COVID infection was also restricted. Therefore, the low sample size may have affected our statistical analysis. Several confounder variables were detected in the study, and we tried to limit their effects on the results by performing an IPW propensity score match. Further studies are still required better to understand the effects of COVID-19 on CABG outcomes.

5 | CONCLUSION

Considering the increase in COVID-19 infections worldwide and the uncertainty regarding the end of this pandemic, especially with the emerging highly infectious variants, understanding this disease and its complications, particularly in the cardiovascular system, is essential. This study compared urgent and emergent CABG surgery outcomes between patients with and without COVID infection during the pandemic. Our results suggested that COVID infection before the surgery is associated with significantly higher LOS, mechanical ventilation, and ICU stay time. Various postoperative complications were higher in patients infected with COVID-19. Additional studies can help us improve our understanding of COVID infection's effects on cardiac surgeries, particularly CABG surgery.

from the study as planned (and, if relevant, registered) have been explained.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.