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# The impact of prior asymptomatic COVID-19 infection on outcomes following coronary bypass surgery

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## Abstract

**Background** The optimal timing and expected postoperative course of coronary artery bypass grafting (CABG) after asymptomatic coronavirus disease 2019 (COVID-19) remain uncertain. Evidence guiding cardiac surgical practice has largely been extrapolated from mixed surgical cohorts or broader cardiac surgery series rather than from isolated CABG populations.

**Methods** This retrospective single-center cohort study included adults who underwent isolated CABG during 2021–2022. Patients with documented asymptomatic preoperative SARS-CoV-2 infection were compared with patients without documented prior COVID-19. Preoperative, intraoperative, and postoperative variables were extracted from institutional records. Outcomes included early clinical recovery, respiratory support, transfusion exposure, laboratory trajectories, and mortality. A timing subgroup analysis (< 4 weeks vs ≥ 4 weeks from infection to surgery) was prespecified as exploratory.

**Results** Seventy-six patients met eligibility criteria: 37 with prior asymptomatic COVID-19 and 39 without documented prior COVID-19. The cohort was predominantly male (81.6%), low risk by EuroSCORE II, and largely elective. Baseline demographics, major comorbidities, ventricular function, operative priority, number of grafted vessels, cardiopulmonary bypass time, cross-clamp time, extubation time, intensive care unit stay, hospital stay, oxygen requirement, and transfusion exposure were similar between groups. Postoperative complications were more frequent in the prior-COVID group (16.2% vs 0.0%; risk difference 16.2%, 95% CI 3.8–31.1%;  $P=0.011$ ), whereas mortality remained rare and not significantly different (2.7% vs 0.0%;  $P=0.487$ ). Longitudinal laboratory analyses showed expected perioperative inflammatory and hematologic changes within both groups, without consistent between-group separation. In the exploratory timing subgroup, no statistically significant differences were detected between earlier and later surgery, but this analysis was markedly underpowered.

**Conclusions** In this single-center exploratory cohort of predominantly elective, low-risk CABG patients, prior asymptomatic SARS-CoV-2 infection was not associated with a generalized worsening of early postoperative recovery, although postoperative complications were more frequent in the exposed group. These data are insufficient to inform CABG timing recommendations after asymptomatic infection and should not be extrapolated to unstable or higher-

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risk patients. Larger multicenter studies with better exposure characterization, vaccination data, and longer follow-up are required.

**Keywords** COVID-19, Asymptomatic infection, Coronary artery bypass grafting, Cardiac surgery outcomes, Postoperative complications

## Introduction

Coronary artery bypass grafting remains a durable revascularization strategy for complex coronary artery disease and a core component of contemporary cardiac surgical practice [1, 2]. Despite advances in perioperative care, CABG still triggers substantial inflammatory, hematologic, and pulmonary stress responses that can influence postoperative morbidity [3]. Contemporary coronary disease evaluation and treatment also increasingly integrate noninvasive imaging pathways and selected minimally invasive revascularization strategies in appropriate patients [4, 5]. Since the emergence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), perioperative decision-making has been complicated by uncertainty regarding the residual physiologic effects of prior infection [6, 7].

Early multicenter studies suggested that recent COVID-19 was associated with increased postoperative pulmonary complications and mortality, prompting recommendations to delay elective surgery for several weeks after infection [8–12]. However, most of those recommendations were derived from heterogeneous noncardiac populations, mixed cardiac surgical cohorts, or patients with symptomatic disease. Cardiac surgery warrants separate evaluation because cardiopulmonary bypass, ischemia–reperfusion injury, transfusion exposure, and postoperative ventilatory dependence can amplify systemic inflammation [3, 13–17].

Asymptomatic prior infection presents a particularly common and difficult scenario in contemporary practice. Heart teams must balance a theoretical postinfectious risk against the hazards of delaying indicated revascularization in patients with coronary artery disease. Yet data specific to isolated CABG after asymptomatic infection remain sparse, even though asymptomatic exposure became common during the later pandemic period and remains relevant in routine practice [11, 12, 18].

The present study therefore examined whether a documented history of asymptomatic SARS-CoV-2 infection affected early outcomes after isolated CABG. We focused on clinical recovery, respiratory support, perioperative laboratory trajectories, and an exploratory subgroup comparison according to the interval between infection and surgery.

## Methods

### Study design and setting

This was a retrospective single-center cohort study performed at the Department of Cardiovascular Surgery, Ankara City Hospital, University of Health Sciences, Ankara, Türkiye, during the 2021–2022 study period. Adults aged 18 to 80 years undergoing isolated CABG were eligible. The upper age limit was selected to reduce age-related heterogeneity in this relatively small cohort and to focus on a more comparable adult CABG population. The exposure group comprised patients with documented preoperative SARS-CoV-2 positivity who remained asymptomatic throughout the infectious episode. Asymptomatic status was verified retrospectively from institutional/public health records and follow-up patient contact focused on predefined COVID-19-related symptoms. Because symptom ascertainment was retrospective and not based on a standardized contemporaneous questionnaire, misclassification of minimally symptomatic cases remained possible. The comparison group consisted of patients with no documented prior COVID-19; however, undetected prior infection could not be excluded. Patients with symptomatic COVID-19, redo sternotomy, active preoperative infection or fever, and concomitant cardiac procedures were excluded. History of COVID-19 was identified through the national public health information system. During the study period, surgical timing was determined according to institutional practice based on urgency of revascularization, absence of ongoing COVID-19-related symptoms, routine surgical and anesthetic assessment, and multidisciplinary discussion when required. No dedicated institutional protocol mandating a fixed waiting interval after asymptomatic infection was used beyond standard preoperative screening and routine perioperative evaluation.

Preoperative variables included age, sex, comorbidities, medication use, imaging findings, ejection fraction, aortic dimensions, operative priority, EuroSCORE II, arterial blood gas parameters, and laboratory markers. In addition to group status, the interval from documented infection to surgery was recorded in the exposed cohort. Intraoperative variables included procedure duration, cardiopulmonary bypass time, cross-clamp time, operative approach, and number of distal anastomoses. Postoperative variables included extubation time, reintubation, noninvasive ventilation requirement, ward oxygen requirement, length of intensive care and hospital stay, drainage volume, lactate, transfusion exposure,

complications, rehospitalization, and mortality. Postoperative complications were collected from routine clinical records and included re-exploration for bleeding, pericardial effusion requiring clinical evaluation or treatment, wound complications, sternal dehiscence, and postoperative COVID-19 diagnosis. Rehospitalization referred to unplanned readmission during the early postoperative period captured by the institutional record. Serial laboratory analyses were evaluated preoperatively, in the early postoperative period, and before discharge. Vaccination status, serologic data, viral variant assignment, and formal pulmonary function testing were not systematically available for all patients and were therefore not included in the primary analysis.

### Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were reported as frequency, percentage, mean  $\pm$  standard deviation, or median (minimum–maximum/interquartile range [IQR]), as appropriate. Categorical variables were compared using the chi-square test or Fisher exact test, as appropriate. Normality of continuous variables was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk tests, as well as skewness–kurtosis measures and graphical methods including histograms, Q–Q plots, stem-and-leaf plots, and boxplots. For normally distributed continuous variables, between-group comparisons were performed using the independent-samples t test, and within-group comparisons were performed using repeated-measures analysis of variance (ANOVA). For non-normally distributed continuous variables, between-group comparisons were performed using the Mann–Whitney U test, and within-group comparisons were performed using the Friedman test. Bonferroni correction was applied only to post hoc pairwise comparisons within repeated-measures analyses; reported between-group p values for the main clinical outcomes are otherwise unadjusted and should be interpreted cautiously given the exploratory nature of the serial biomarker analyses. For key binary outcomes, absolute risk differences with 95% confidence intervals were calculated to convey effect size and uncertainty. A two-sided p value of  $<0.05$  was considered statistically significant. Sample size calculation was performed using G\*Power version 3.1.9.7 (Franz Faul, Universität Kiel, Germany). Assuming 90% power, an effect size of  $d=0.8$ , and an alpha level of 0.05, a minimum total sample size of 68 patients ( $n_1=34$ ,  $n_2=34$ ) was determined to be sufficient. Because the number of postoperative complication events was small, multivariable logistic regression was not pursued to avoid unstable estimates.

### Results

A total of 76 patients were included: 39 in the no-COVID group and 37 in the prior asymptomatic COVID-19 group. Overall mean age was  $63.4 \pm 8.5$  years, and 62 patients (81.6%) were male. The cohort was predominantly elective and low risk, with very similar operative urgency distributions and low median EuroSCORE II values in both groups. Hypertension and diabetes were common in both cohorts, whereas CT evidence of prior pulmonary involvement was limited to 5 patients in the prior-COVID group. Baseline ventricular function was comparable. Exertional angina was more frequent in the no-COVID group (87.2% vs 62.2%;  $P=0.016$ ), but this difference was not accompanied by higher objective operative risk in either cohort. The cohort structure and subgroup allocation are shown in Fig. 1.

Operative characteristics were also similar. Most patients in both groups underwent 3- or 4-vessel grafting, and the distribution of distal anastomoses did not differ significantly. A small number of procedures were performed off-pump, without meaningful between-group imbalance. Procedure duration, cardiopulmonary bypass time, and cross-clamp time were likewise comparable, suggesting that prior asymptomatic infection was not associated with greater operative complexity in this cohort.

Respiratory support requirements showed no significant between-group difference. Reintubation occurred only in the prior-COVID group (2 patients), but this difference was not statistically significant. Noninvasive ventilation use, ward oxygen requirement, extubation time, intensive care stay, and hospital stay were similar between groups. Rehospitalization was numerically more frequent in the prior-COVID cohort (16.2% vs 5.1%; risk difference 11.1%, 95% CI  $-3.5$  to  $26.5$ ;  $P=0.148$ ), with wound-related concerns representing the most common reason for readmission. Serial PaO<sub>2</sub> and PaCO<sub>2</sub> values changed significantly within each group over the perioperative course, but between-group comparisons at matched time points were not significant. Selected early postoperative event rates are summarized in Fig. 2.

Most laboratory markers behaved as expected after cardiac surgery. Albumin fell postoperatively and partially recovered by discharge, whereas white blood cell count, neutrophils, C-reactive protein, procalcitonin, platelet-to-lymphocyte ratio, neutrophil-to-lymphocyte ratio, monocyte-to-lymphocyte ratio, and systemic immune-inflammation index rose in the postoperative period and trended toward recovery by discharge. These within-group patterns were observed in both cohorts, whereas between-group differences were generally absent. Serial peri-extubation oxygenation values are illustrated in Fig. 3.

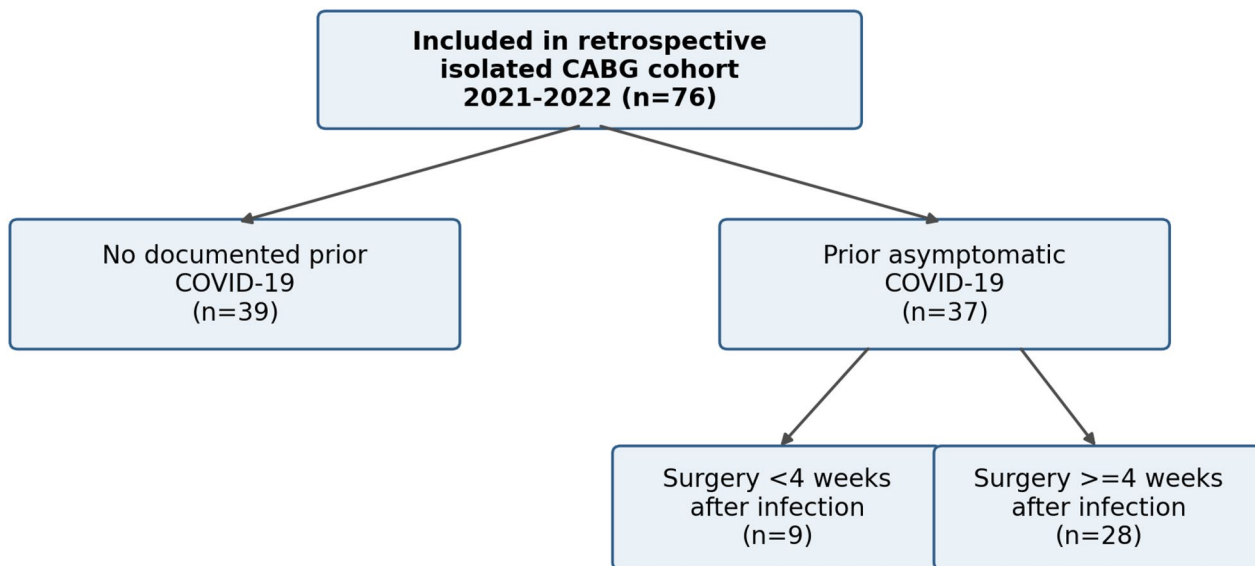


**Fig. 1** Study flow and timing subgroup structure

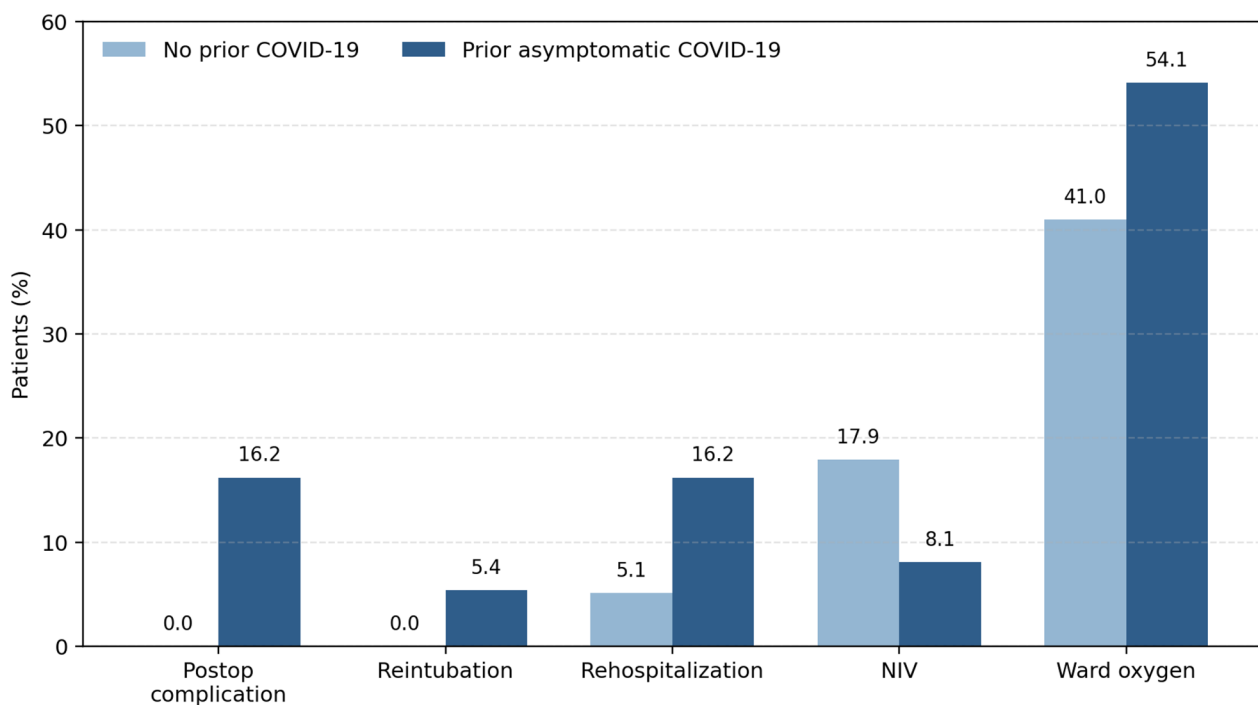
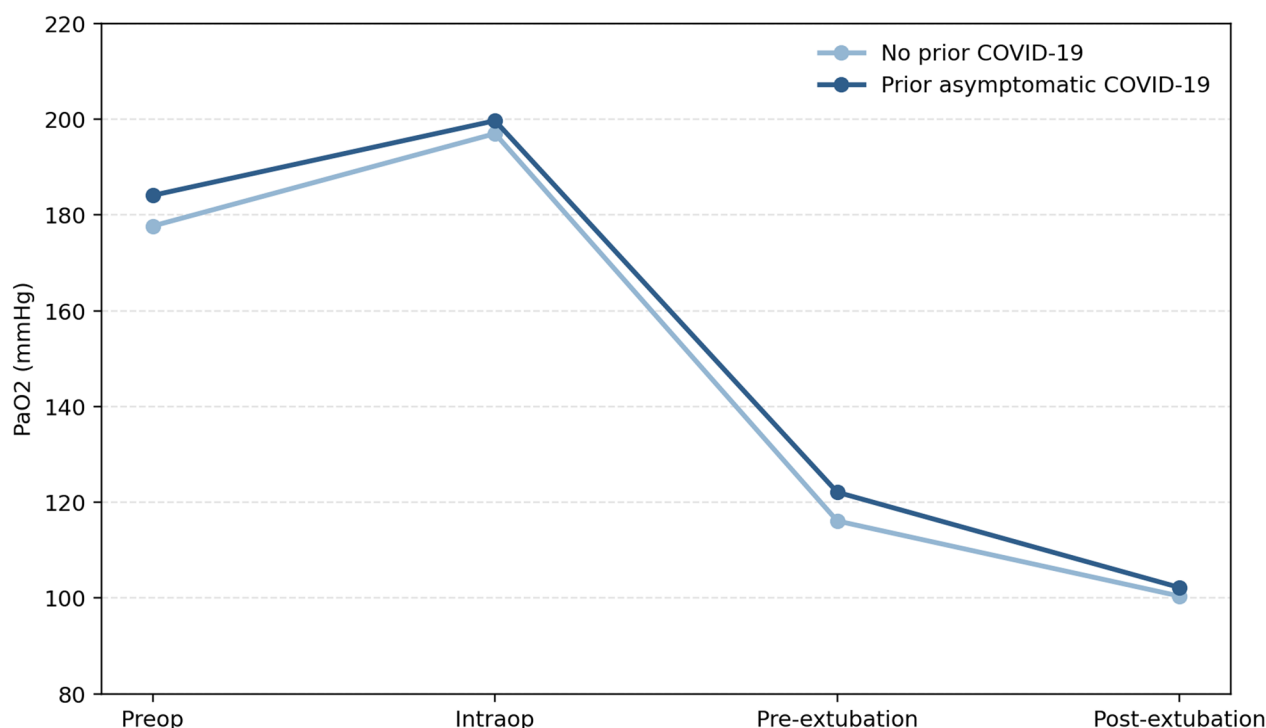


**Fig. 2** Early postoperative event rates by exposure group

The main between-group signal favoring the control cohort was postoperative complication burden. No postoperative complication was recorded in the no-COVID cohort, whereas 6 events (16.2%) occurred in the prior-COVID cohort (risk difference 16.2%, 95% CI 3.8–31.1%;  $P=0.011$ ). The events were heterogeneous and included bleeding revision ( $n=2$ ), pericardial effusion ( $n=1$ ), saphenous wound infection ( $n=1$ ), sternal dehiscence ( $n=1$ ), and 1 postoperative COVID-19 diagnosis ( $n=1$ ).

Mortality was rare overall and did not differ significantly between groups (0% vs 2.7%; risk difference 2.7%, 95% CI –6.5 to 13.8%;  $P=0.487$ ). Transfusion requirements were common but similar across cohorts.

Within the prior-COVID cohort, 9 patients underwent surgery within 4 weeks of infection and 28 underwent surgery at least 4 weeks after infection. No statistically significant difference was found between these subgroups for extubation time, intensive care stay, hospital

**Fig. 3** Serial PaO<sub>2</sub> trajectory in patients with and without prior asymptomatic COVID-19**Table 1** Baseline, triage, and operative characteristics

| Variable                                          | No prior COVID-19 (n = 39)          | Prior asymptomatic COVID-19 (n = 37) | P value |
|---------------------------------------------------|-------------------------------------|--------------------------------------|---------|
| Age, y                                            | 63.4 ± 8.3                          | 63.3 ± 8.7                           | 0.965   |
| Male sex, n (%)                                   | 32 (82.1%)                          | 30 (81.1%)                           | 1.000   |
| Hypertension, n (%)                               | 22 (56.4%)                          | 24 (64.9%)                           | 0.604   |
| Diabetes mellitus, n (%)                          | 17 (43.6%)                          | 24 (64.9%)                           | 0.103   |
| Chronic obstructive pulmonary disease, n (%)      | 3 (7.7%)                            | 6 (16.2%)                            | 0.303   |
| Exertional angina, n (%)                          | 34 (87.2%)                          | 23 (62.2%)                           | 0.016   |
| Ejection fraction, %                              | 51.8 ± 8.3                          | 51.9 ± 8.5                           | 0.927   |
| EuroSCORE II, %                                   | 0.91 (0.69–1.15)                    | 0.88 (0.68–1.06)                     | 0.700   |
| Operative priority, n (%)                         | 32/7/0<br>elective/urgent/emergency | 30/6/1<br>elective/urgent/emergency  | 0.580   |
| CT evidence of prior pulmonary involvement, n (%) | 0 (0.0%)                            | 5 (13.5%)                            | 0.024   |
| Off-pump CABG, n (%)                              | 3 (7.7%)                            | 2 (5.4%)                             | 1.000   |
| Cardiopulmonary bypass time, min                  | 118.7 ± 34.2                        | 105.1 ± 23.3                         | 0.056   |
| Cross-clamp time, min                             | 69.5 ± 20.0                         | 70.3 ± 20.1                          | 0.870   |
| Operation time, min                               | 324.7 ± 78.3                        | 309.6 ± 58.8                         | 0.345   |
| Distal anastomoses / grafted vessels              | Predominantly 3–4 grafts            | Predominantly 3–4 grafts             | 0.978   |

Values are presented as mean ± standard deviation, median (interquartile range), or n (%), according to the source dataset.

stay, oxygen requirement, reintubation, rehospitalization, bypass time, cross-clamp time, blood gas parameters, or postoperative complications. However, this subgroup analysis was exploratory and markedly underpowered, and the absence of significant differences should not be interpreted as evidence of safety equivalence (Tables 1, 2 and 3).

## Discussion

This single-center study evaluated a relatively stable, predominantly elective, and low-risk isolated CABG cohort. Prior asymptomatic SARS-CoV-2 infection was not associated with broad worsening of early postoperative recovery metrics, including operative times, respiratory support, intensive care unit stay, hospital stay, transfusion exposure, or mortality. The only statistically significant between-group difference was a higher

**Table 2** Directional behavior of major perioperative laboratory markers (selected numeric comparisons are provided in Supplementary Table S1)

| Marker            | Early postoperative pattern                        | Interpretive note                                                      |
|-------------------|----------------------------------------------------|------------------------------------------------------------------------|
| Albumin           | Decreases, then partially recovers by discharge    | Typical dilutional and inflammatory response after CABG                |
| WBC / neutrophils | Increase early, then trend downward                | Consistent with postoperative stress and inflammatory activation       |
| Lymphocytes       | Transient postoperative decrease                   | Expected early postoperative lymphopenia in both cohorts               |
| CRP               | Marked postoperative rise with slow decline        | Reflects surgery-related systemic inflammation                         |
| LDH               | Rises early, then partially improves               | Compatible with tissue injury and perioperative stress                 |
| NLR / PLR / MLR   | Peak postoperatively, then decline                 | Composite inflammatory indices followed similar trajectories           |
| Platelets         | Lowest early, highest by discharge                 | Recovery pattern consistent with postoperative consumption and rebound |
| SII               | Substantial postoperative increase with later fall | No clear between-group separation despite within-group changes         |

Selected quantitative comparisons are provided in Supplementary Table S1. For example, median postoperative CRP was 0.070 (0.038–0.174) g/L in the no-COVID group and 0.073 (0.050–0.168) g/L in the prior-COVID group ( $P=0.582$ ); postoperative neutrophil-to-lymphocyte ratio was 15.2 (12.2–21.8) versus 13.1 (10.7–17.7) ( $P=0.057$ ), and postoperative systemic immune-inflammation index was  $4233.2 \pm 2233.9$  versus  $3390.3 \pm 1789.1$  ( $P=0.077$ ).

**Table 3** Early postoperative outcomes

| Outcome                                        | No prior COVID-19 | Prior asymptomatic COVID-19 | P value |
|------------------------------------------------|-------------------|-----------------------------|---------|
| Extubation time, min                           | 450 (360–540)     | 450 (395–532.5)             | 0.884   |
| ICU stay, d                                    | 2.0 (1.0–3.0)     | 1.0 (1.0–2.0)               | 0.307   |
| Total hospital stay, d                         | 14.0 $\pm$ 4.9    | 13.0 $\pm$ 4.7              | 0.379   |
| Postoperative hospital stay, d                 | 6.9 $\pm$ 2.3     | 6.7 $\pm$ 2.0               | 0.231   |
| Reintubation                                   | 0                 | 2 (5.4%)                    | 0.234   |
| Noninvasive ventilation                        | 7 (17.9%)         | 3 (8.1%)                    | 0.311   |
| Ward oxygen requirement                        | 16 (41.0%)        | 20 (54.1%)                  | 0.364   |
| Rehospitalization                              | 2 (5.1%)          | 6 (16.2%)                   | 0.148   |
| Any postoperative complication                 | 0                 | 6 (16.2%)                   | 0.011   |
| Mortality                                      | 0                 | 1 (2.7%)                    | 0.487   |
| Bleeding revision, n (%)                       | 0 (0.0%)          | 2 (5.4%)                    | 0.234   |
| Pericardial effusion, n (%)                    | 0 (0.0%)          | 1 (2.7%)                    | 0.487   |
| Wound complication / sternal dehiscence, n (%) | 0 (0.0%)          | 2 (5.4%)                    | 0.234   |
| Postoperative COVID-19 diagnosis, n (%)        | 0 (0.0%)          | 1 (2.7%)                    | 0.487   |

Early postoperative outcomes were broadly comparable between the two groups. No statistically significant between-group differences were observed in extubation time, intensive care unit stay, total hospital stay, postoperative hospital stay, reintubation, rehospitalization, noninvasive ventilation requirement, ward oxygen requirement, transfusion requirement, or mortality (all  $P>0.05$ ). However, postoperative complications occurred more frequently in patients with prior asymptomatic COVID-19 infection, corresponding to an absolute risk difference of 16.2% (95% CI 3.8–31.1%), and represented the only outcome that differed significantly between groups.

composite postoperative complication rate in the prior-COVID cohort.

These findings should be interpreted within the broader evolution of perioperative COVID-19 evidence. Early multinational studies suggested increased postoperative risk soon after infection, particularly among symptomatic patients and those with systemic illness, leading to conservative delay recommendations [8–12]. More recent analyses have emphasized that infection severity and persistent symptoms may modify postoperative risk more strongly than a calendar interval alone [11, 12]. Our data are broadly consistent with that framework in the limited

sense that the exposed patients were asymptomatic, generally low risk, and mostly operated outside the earliest post-infectious window. However, this study cannot be used to challenge existing timing recommendations.

The exploratory subgroup analysis comparing surgery within 4 weeks versus at least 4 weeks after infection requires particular caution. Only 9 patients underwent surgery within 4 weeks, and the analysis was underpowered for clinically meaningful differences in recovery, complications, or mortality. Accordingly, the absence of statistically significant subgroup differences does not demonstrate safety equivalence and should be regarded as hypothesis-generating only.

The laboratory findings further support a cautious interpretation. Albumin decreased after surgery and partially recovered by discharge, whereas leukocyte count, neutrophils, CRP, procalcitonin, and composite inflammatory indices increased postoperatively in both cohorts. The similarity of these trajectories suggests that CABG-related physiology remained the dominant driver of perioperative laboratory behavior, with no clear between-group separation for most routinely monitored markers. These perioperative patterns are also broadly consistent with prior work highlighting the prognostic relevance of neutrophil-to-lymphocyte ratio, systemic immune-inflammation index, platelet-based indices, dynamic inflammatory markers, and coagulation abnormalities in surgical and COVID-19 populations [19–25].

The complication signal nevertheless deserves careful interpretation. Complications in the prior-COVID cohort were heterogeneous and included bleeding revision, pericardial effusion, wound complications, sternal dehiscence, and one postoperative COVID-19 diagnosis. Because these events do not suggest a single unifying mechanism, the finding may represent either a true residual vulnerability not captured by routine perioperative measures or a chance observation related to small numbers. Rehospitalization was also numerically higher in the prior-COVID cohort, with wound-related concerns

accounting for the most common reason for readmission, but this difference was not statistically significant.

Strengths of this study include the focus on isolated CABG rather than mixed cardiac surgery, broadly matched baseline risk and operative characteristics, and the combined assessment of clinical, respiratory, and laboratory data. These features improve internal consistency but do not overcome the study's exploratory nature.

Taken together, the present findings suggest that prior asymptomatic SARS-CoV-2 infection may not broadly worsen early in-hospital recovery after isolated CABG in stable, low-risk patients. Nevertheless, the complication signal and substantial methodological limitations mean that these data should be viewed as exploratory and hypothesis-generating. Scheduling decisions after prior asymptomatic infection should continue to rely on individualized multidisciplinary assessment rather than any inference of safety from this small cohort.

This question remains relevant in health systems where waiting-list pressure and recurrent admissions remain common. Excessively rigid postponement can produce its own harms in coronary disease, including persistent angina, repeat hospital utilization, and interim ischemic events while awaiting CABG [26–29]. More broadly, perioperative COVID-19 literature has evolved from initial cautionary timing studies toward more stratified analyses that account for infection severity, persistence of symptoms, and procedure-specific context [8, 9]. Cardiac surgery remains comparatively underrepresented in this conversation, and prior reports have often combined coronary procedures with valve, aortic, or other open-heart operations rather than isolated CABG [30, 31].

### Limitations and future directions

Several limitations should be acknowledged explicitly. The study was retrospective, single-center, and relatively small, with low event counts for several clinically important outcomes. Non-significant findings therefore should not be interpreted as equivalence, because clinically relevant type II error remains possible. Asymptomatic status was ascertained retrospectively, which introduces recall bias, and the control group may have included undetected prior infections during a period when asymptomatic SARS-CoV-2 exposure was common; both issues could bias effect estimates toward the null. Vaccination status, serologic data, viral variant information, and systematic pulmonary function testing were not available. Operations were performed by different surgeons, complications were collected from routine records rather than independent adjudication, and the composite complication endpoint grouped events with potentially different etiologies. Follow-up was limited to the early postoperative period, so this study cannot address

medium-term outcomes or graft patency, particularly of saphenous vein grafts.

Future studies should be multicenter, adequately powered, and designed around severity-stratified post-COVID surgical phenotypes. For CABG specifically, contemporary registries should capture vaccination exposure, interval from infection, symptom burden, radiologic recovery, and standardized 30-day and 90-day outcomes, as well as longer-term graft patency and readmission data.

### Conclusions

Among predominantly elective, low-risk patients undergoing isolated CABG, prior asymptomatic SARS-CoV-2 infection was not associated with a generalized worsening of early postoperative recovery, although composite postoperative complications were more frequent in the exposed group. These data are insufficient to inform CABG timing recommendations after asymptomatic infection and should not be extrapolated to unstable or higher-risk patients. Larger multicenter studies with better exposure characterization, vaccination data, and longer follow-up are required before CABG-specific recommendations can be refined.

### Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s13019-026-04489-9>.

Additional file 1.

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None

### Author contribution

E.K. designed the study, collected the data, performed the analysis, and wrote the main manuscript. M.Y. and E.Ş. contributed to data interpretation and manuscript revision. E.K. supervised the study and critically revised the manuscript. All authors reviewed and approved the final manuscript.

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### Data availability

The datasets generated and/or analyzed during the current study are not publicly available due to patient confidentiality and institutional restrictions but are available from the corresponding author on reasonable request and with appropriate institutional approval.

### Declarations

#### Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Review Board of Ankara Bilkent City Hospital (Approval No: E1-22–2555).

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**Informed consent**

Written informed consent was obtained from all patients included in the study.

**Trial registration**

This study was not registered as it does not meet the criteria for a clinical trial registration.

**Competing interests**

The authors declare no competing interests.

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