




# Retrospective record review on timing of COVID-19 vaccination and cardiac surgery

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## Abstract

**Background:** Novel clinical challenges are faced by cardiac surgeons under the coronavirus disease 2019 (COVID-19) pandemic. Amidst the uncertainties faced due to the socioeconomic and public health impact, there is little evidence surrounding COVID-19 vaccination in patients undergoing cardiac surgery. Timing of vaccination and postvaccination adverse effects are required parameters to discuss with cardiac surgical patients.

**Methods:** This is a single-center, retrospective observational study. All patients who underwent adult cardiac surgery at the Prince of Wales Hospital, Hong Kong from January 2021 to December 2021 were included. Postoperative clinical outcomes, COVID-19 vaccination status, and vaccination-related adverse effects were collected.

**Results:** A total of 426 patients; 117 (27%) underwent isolated coronary artery bypass grafting, 111 (26%) underwent valvular surgery, and 97 (23%) underwent aortic surgery. Patients received either Sinovac CoronaVac or Pfizer BNT162b2 vaccine. Overall vaccination rate with at least 1 dose was 52% ( $n = 212$ ), 15% ( $n = 63$ ) received the first dose before surgery, 36% ( $n = 149$ ) received the first dose vaccination after surgery. Rate of completion with second and third doses of vaccination were 22% ( $n = 89$ ) and 4.9% ( $n = 20$ ), respectively. The mean timing of first dose of vaccine after surgery was  $216 \pm 84$  days from operation. Three (1.4%) patients recorded vaccination-related complications.

**Conclusions:** COVID-19 vaccination is safe in patients who received major cardiac surgery, with low adverse effects recorded and no vaccine-related mortality observed. A time frame of 3–6 months after cardiac surgery receiving COVID-19 vaccination is reasonable and could serve as a guidance for future COVID-19 vaccination booster programs.

## KEYWORDS

adult cardiac surgery, COVID-19, SARS-CoV-2, vaccination

## 1 | INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) has led to an unprecedented global socio-economical and healthcare crisis, with a death toll in the millions. Vaccination for COVID-19 was approved by the government and started in February–March 2021, in Hong Kong Special Administrative Region (HKSAR), with the options of Sinovac CoronaVac and Pfizer BNT162b2 vaccines.<sup>1,2</sup> The fifth wave of COVID-19 hit HKSAR in March 2022,<sup>3</sup> when the completion rate of two doses of COVID-19 vaccination was at 78.6%, as of March 8, 2022.<sup>2</sup>

The COVID-19 vaccines help reducing the chance of infection and severity of disease in the infected individuals, the timing of COVID-19 vaccination in patients who have received cardiac surgery was poorly studied. There is a lack of evidence to guide the best timing of postoperative COVID-19 vaccination in cardiac surgery, balancing the risks of COVID-19 infection and risks related to vaccination. Furthermore, cardiovascular risks associated with COVID-19 vaccination have caused vaccine hesitancy<sup>4,5</sup>; the guidance notes from the Department of Health of HKSAR recommends a general advice to defer vaccination for 3–6 months in patients with recent acute myocardial infarction or stroke, to attain a good recovery and stable control before COVID-19 vaccination.<sup>6</sup>

The Society of Thoracic Surgeons guidance document published in November 2021,<sup>7</sup> recommending shared decision-making for COVID-19 vaccination after cardiothoracic surgery, without suggesting a specific time frame. Noncardiac surgical guidelines recommend a time frame for vaccination as minimal as 1–2-weeks post breast surgery,<sup>8</sup> while in transplant surgery, a time frame up to 3 months postoperation.<sup>9</sup> In the field of cardiac surgery, the consideration of deferring vaccination is to allow adequate postoperative recovery to mount a robust immune response for the best vaccination effect, and to minimize uncertainties in the management of postcardiac surgery complications or vaccine-related reactogenicity complications.<sup>7</sup> There is no specific local or regional guideline on the timing of COVID-19 vaccination postcardiac surgery. Early in the pandemic, the local consensus of Hong Kong cardiothoracic surgeons, was to defer COVID-19 vaccination for at least 3–6 months from the time of cardiac surgery.

The aim of this study is to find out the impact of postoperative COVID-19 vaccination on patients received cardiac surgery and to identify an acceptable time frame for those to receive COVID-19 vaccination.

## 2 | METHODS

This is a retrospective record review observational study with the waiving of consent from the institute ethics committee (NTEC-CREC Number: 2022.114, 28/4/2022).

## 2.1 | Patients

Between January 2021 and December 2021, all patients who have received adult cardiac surgery from the Prince of Wales Hospital, HKSAR, were included. The COVID-19 vaccination program was initiated in HKSAR on February 26, 2021. The cutoff date for data collection of our current study is March 8, 2022.

Retrospective chart review on the postoperative clinical outcomes, COVID-19 vaccination status, and infection were collected via the electronic clinical management system (CMS) of the Hospital Authority, HKSAR.

Primary outcomes are the rate and type of vaccination, timing of vaccination from date of surgery. Secondary outcomes are (i) complications from COVID-19 vaccinations requiring hospital admission or attendance at designated out-patient clinics as recorded on the CMS and (ii) any postcardiac surgery COVID-19 infection and its related complications. COVID-19 infection was defined as real-time RT-PCR (RT-rtPCR) detection or rapid antigen point-of-care tests (RAT) detection that was documented on the CMS.

## 2.2 | Data analysis

Data were retrieved and collected via the institutional cardiac surgery database and the CMS. Categorical data was listed with percentages and continuous variables with normal distribution was presented as means  $\pm$  standard deviation (SD); continuous variables tested non-normally distributed with Shapiro–Wilk test was presented as median (interquartile range, minimum, and maximum). Analyses were performed using GraphPad Prism (Version 8.4.2 for Windows, GraphPad Software).

## 3 | RESULTS

### 3.1 | Patients and cardiac surgery characteristics

A total of 426 patients underwent adult cardiac surgery at our institute from January 2021 to December 2021 were identified. The median age was 64 (13, 19, 87) and the mean follow-up time was 236 $\pm$ 108 days. There were 117 (27%) isolated coronary artery bypass grafting operations (CABG), 111 (26%) valvular operations, and 97 (23%) aortic operations. All electronic clinical records were available upon data extraction with no missing data.

The median logistic EuroSCORE for the overall cohort, isolated CABG, and valvular surgery was 5.9 (10.8, 0.9, 95.2), 2.0 (2.4, 0.9, 37), and 5.3 (6.1, 1.2, 77.9), respectively. Mean logistic EuroSCORE for aortic surgery was 22.6 $\pm$ 16.0. The overall in-hospital mortality of the cohort was 3.1%, in which isolated CABG and emergency aortic surgery in-hospital mortality were 0% and 3.1%, respectively. The overall 3-months postoperative survival was 96%.

### 3.2 | Rate of vaccination and timing

Cutoff date for data collection was set on March 8, 2022. The number of discharged patients from the cohort was 411; overall vaccination rate with at least 1 dose was 52% ( $n = 212$ ), in which 15% ( $n = 63$ ) patients had their first dose before cardiac surgery while 36% ( $n = 149$ ) of patients had their first dose after cardiac surgery. The overall rate of postoperative completion of second and third dose of vaccination were 22% ( $n = 89$ ) and 4.9% ( $n = 20$ ), respectively.

Decision to receive either Sinovac CoronaVac vaccine, or Pfizer BNT162b2 vaccine was at individual patient's discretion, with 55% ( $n = 116$ ) and 45% ( $n = 96$ ) respectively among the vaccinated group. There was no mixing of vaccines between the first and second doses in those vaccinated.

The mean timing of first dose for vaccination after cardiac surgery was  $216 \pm 84$  days from surgery. In the preoperative vaccination subgroup, the median time of vaccination before cardiac surgery was 97 (84.5, 8, 291) days.

### 3.3 | Vaccination complications

Complications from vaccination were recorded in this study as any vaccination-related hospitalization or outpatient clinic attendance as charted on the CMS. There were 3 (1.4%) recorded vaccination-related complications, in which two patients from the postoperative vaccinated group developed myalgia and headache. The other patient, in the preoperative vaccinated group, developed Guillain Barre Syndrome after the first dose of Pfizer BNT162b2 vaccine.

### 3.4 | COVID-19 infection postcardiac surgery and vaccination rates

None of the patients in our cohort had COVID-19 infection before cardiac surgery and 13 patients (3.2%) were infected with COVID-19

after cardiac operations. Among those infected, no hospitalization or mortality was recorded.

Among the 13 infected patients, vaccination rates of the first, second and third doses were 46.1% ( $n = 6$ ), 7.7% ( $n = 1$ ), and 0%, respectively. Vaccination characteristics are listed in Table 1.

## 4 | DISCUSSION

The COVID-19 pandemic has led to a global public health challenge, requiring the best use of latest clinical evidence. Amongst various measures, the COVID-19 vaccine is considered of paramount importance in the pandemic, to reduce hospitalization, rate of severe infections, and overall mortality. However, there is no specific recommendation on the timing of vaccination after cardiac surgery,<sup>5-9</sup> which might lead to vaccination hesitancy.

The fifth wave of COVID-19 infection in Hong Kong spiked in March 2022, with more than 1 million cumulative infected cases.<sup>1</sup> More than 70% of deaths occurred in patients who had not yet received at least two doses of COVID-19 vaccination.<sup>2,3</sup> Balancing the cardiac manifestation of COVID-19 infection, safety profile, and risks of cardiac complications after mRNA COVID-19 vaccination,<sup>10,11</sup> the clinical benefit of COVID-19 vaccination in cardiovascular patients is obvious.

The Society of Thoracic Surgeons guidance document recommends shared decision-making for COVID-19 vaccination after cardiothoracic surgery<sup>7</sup>; that is to balance the vaccine-related reactogenicity and adverse events of COVID-19 vaccination during the postoperative period. Deferment of vaccination from the time of cardiac surgery was recommended to allow adequate recovery postoperatively, to effectively mount a robust immune response following vaccination.<sup>7</sup> We believe the such a decision should be evaluated on (1) overall safety of COVID-19 vaccine, (2) timing of complicated cardiac manifestation postvaccination, and (3) timing of recovery of general status.

**TABLE 1** Data of postcardiac surgery vaccination of Hong Kong SAR, China as of March 8, 2022

	Overall discharged patients ( $n = 411$ )	Isolated CABG ( $n = 117$ )	Valvular diseases ( $n = 111$ )	Aortic surgery ( $n = 97$ )
Completion of two doses of vaccination rate (%)	89 (22%)	30 (26%)	32 (29%)	22 (23%)
Completion of one doses of vaccination rate (%)	149 (36%)	47 (40%)	60 (54%)	31 (32%)
Mean separation duration postcardiac surgery (day)	$216 \pm 84$	$213 \pm 77$	$216 \pm 78$	$216 \pm 96$
Overall recorded complication (%)	2 (0.9%)			
Common complication (headache/myalgia)	2	0	0	2
Recorded vaccination mortality	0	0	0	0
Types of vaccine				
Sinovac CoronaVac	83 (56%)	27 (57%)	34 (57%)	14 (45%)
Pfizer BNT162b2	66 (44%)	20 (43%)	26 (43%)	17 (55%)

Abbreviation: CABG, coronary artery bypass grafting.

#### 4.1 | Overall safety of COVID-19 vaccine

From our cohort, 36% of patients received at least one dose of COVID-19 vaccination, with only a 3.2% infection rate after cardiac surgery. The rate of vaccination-related complications was only 1.4%. There is no vaccine-related death or COVID-19 infection-related death. These findings confirmed the general safety profile of the COVID-19 vaccines available in Hong Kong (Sinovac CoronaVac and Pfizer BNT162b2 vaccine).<sup>12,13</sup>

#### 4.2 | Timing of postvaccination complicated cardiac manifestations

A systemic review reported vaccination-related cardiac complications can occur anywhere between 3 and 30 days after receiving the vaccine.<sup>10</sup> Furthermore, most side effects occur within 7 days of vaccine administration and were mild to moderate in severity with maximum vaccination efficacy achieved at 2 weeks after the final vaccine dose.<sup>12,13</sup> Chest pain was the most frequent cardiac complication post mRNA COVID-19 vaccine, usually appeared within 3 days of vaccination,<sup>10</sup> suggesting chest pain 3–5 days after vaccination was a typical feature of immune-related myocarditis.<sup>14</sup>

#### 4.3 | Timing of recovery of general status

One of the major concerns of COVID-19 vaccination is the level of induced immune response for best protection against COVID-19. Regarding recovery of general status postcardiac surgery, there are only limited studies reporting the return-to-work status after CABG. Return-to-work is observed between 8 and 13 weeks after surgery in two studies, in patients who have received isolated CABG, and were not participating in cardiac rehabilitation programs.<sup>15,16</sup>

#### 4.4 | Timing of vaccination after cardiac surgery

In this study, the mean timing of first dose vaccination after cardiac surgery was  $216 \pm 84$  days. Early in the pandemic, the local consensus suggested at least 90–180 days after cardiac surgery, upon a shared decision-making process with patients. Considering that cardiac-related complications post COVID-19 vaccinations occurs within 30 days from vaccine administration,<sup>11</sup> and along with the finding that the return-to-work status after CABG was observed to be up to 13 weeks,<sup>16</sup> the HKSAR cardiac surgery consensus recommendation to defer COVID-19 vaccination after cardiac operations for 90–180 days, is reasonable. Although the shortest time to vaccination postoperatively (28 days) in our cohort was from a patient who had undergone emergency aortic root surgery, shortening the time period for postoperative vaccination cannot be generalized from this data set.

#### 4.5 | Limitations and future directions

This retrospective observational study carries several limitations. First, despite data completion in this cohort, the requirement for clinic attendance or hospitalization from the complications of COVID-19 vaccination is rare. The basic understanding of the self-limiting reactogenic effect from COVID-19 vaccine from the public could be a reason. This could lead to a selection bias from this chart review design, failing to capture and underreporting the exact incidence rate of specific vaccine-related complications. However, all-cause mortality was completely captured via the public CMS system in HKSAR, hence the COVID-19 vaccine-related death should be accurately represented.

Second, data from a single center has a limited sample size. Without the previous article measuring the effect size between cardiac surgery and complication from COVID-19 vaccination. Presuming the population proportion of 50% for the unknown effect and the calculated margin of error for postoperative vaccination as 4.64% (36% of the total 411 discharged patients) and a 95% confidence interval, the calculated effective sample size was 447 patients. We believe the 8% underpower would still bring data in supporting for the suggested shared discussion with patients advised by The Society of Thoracic Surgeons.<sup>7</sup> Our cohort included all adult cardiac surgery patients hence the heterogeneity of patients' risk profile. Nonetheless, it is a true reflection of the real-world data from a single center. The descriptive analysis from the various subgroups was listed in Table 1.

Third, the identity of the specific strains of SARS-CoV-2 was not available in our current cohort of patients who eventually became infected postoperatively. This is partly due to the surge of the fifth wave of COVID-19 cases in late Feb 2022, whereby the authorities in HKSAR accepted rapid antigen testing (RAT) in addition to RT-rtPCR as a means of formal diagnosis. RAT could be performed individually on a voluntary basis based on symptomatology experienced by patients. This was a means to alleviate the mounting public health pressure experienced during the fifth wave, and to expedite public health decision making.<sup>17</sup> Hence the true number of COVID infections may be much larger than currently reported, as patients may not have received any testing due to a lack of symptoms, and even so, RAT results are not readily available on the CMS and are reported only at individual patients' discretion. Thus, there is also limited data on the various strains of COVID-19, as part of the virological diagnosis.

At the moment, data on postoperative use of COVID-19 vaccination is limited,<sup>7</sup> our study inferred information on the future use of COVID-19 vaccination against the ongoing COVID-19 pandemic. Given the development on the second generation of vaccines against specific strains of SARS-CoV-2, additional booster doses are expected in the foreseeable future.<sup>18</sup> This study offers a baseline time frame for future investigations of shortening the time to vaccination after cardiac operations and would benefit from global initiatives to bring future insights for the surgical population.<sup>19</sup>

## 5 | CONCLUSION

In conclusion, this retrospective chart review reported the safe use of COVID-19 vaccination postcardiac surgery with low recorded vaccine-related complication and mortality; infected postcardiac surgical individuals had stable clinical course with uncomplicated recovery. The timing of vaccination 3–6 months post-cardiac surgery recorded in this study offers a baseline timeframe for future investigations. Global initiatives to bring future insights would allow better understandings in the use of booster doses and next generations of COVID-19 vaccines.

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### CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

### ETHICS STATEMENT

Institutional ethics committee approved the retrospective evaluation of data and waived the need of patient written informed consent.

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