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COMMENTARY

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The correlation between COVID-19 vaccination and cardiac surgery: When is safe to vaccinate?

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The COVID-19 pandemic necessitated prompt action to minimize further spread of the coronavirus infection. As such, numerous countries orchestrated vaccine programs as a matter of urgency to reduce the chance of acquiring this pathology.

Patients undergoing cardiac surgery as a result of pre-existing cardiovascular disease, have an increased propensity to poor health outcomes from COVID-19.[1] In particular, The American College of Cardiology warns that patients with coronary artery disease, ventricular arrhythmias, and heart failure are more likely to suffer adverse outcomes from COVID-19 infection,[2] further heightening the importance of being vaccinated. Despite this, some patients remain skeptical about receiving the vaccine, particularly in those with chronic health conditions, due to fear of suffering from vaccine side-effects.[3] International studies have found an association between mRNA COVID-19 vaccination and left ventricular dysfunction,[4] pericarditis,[5] as well as acute myocarditis, shown by late gadolinium enhancement via cardiovascular magnetic resonance imaging.[6] However, the benefits of COVID-19 vaccination outweigh the known and potential risks in protecting against severe disease.[7] A single vaccine dose is 80% effective in preventing hospital admission and can provide protection for more than 6 weeks.[8] While the uptake of the vaccine is paramount to maximizing health benefits, it is equally important to be aware of the ideal time to jab patients who are undergoing cardiac surgery. However, the optimum timing of COVID-19 vaccine administration postcardiac surgery remains a poorly documented subject.

In this issue of the *Journal of Cardiac Surgery*, Ho et al.[9] reported the results from a single-center retrospective, observational cohort study, finding that COVID-19 vaccination is generally safe, with only 3 out of 426 patients suffering from vaccine-related complications, in patients undergoing major cardiac surgery due to the low associated adverse effects and absence of observed vaccine-related mortality. This study included a combination of patients undergoing coronary artery bypass grafting (CABG), valvular, and aortic surgeries. The authors recommend vaccinations should be given 3–6 months postsurgery. This was based upon postcardiac surgery recovery times cited in the literature, which are limited in number and mostly refer to the return-to-work status after CABG being 13 weeks.

Furthermore, guidelines for vaccination of cardiac surgery are undeveloped compared to other surgical specialties. For example, a time frame of 1–2 weeks is recommended for postbreast surgery patients,[10] whereas 3 months is recommended for posttransplant surgery patients.[11] However, for the cardiovascular field, there still appears to be no general consensus to decipher the optimal time for vaccination, as demonstrated by The Society of Thoracic Surgeons guidance document 2021.[12] This advocated for shared decision-making between clinicians and patients, instead of specifying a particular time period. A study from Germany also termed the optimal timing of vaccination as "unknown," accentuating the quest to bridge the knowledge gap between COVID-19 immunization and the perioperative period.[13] However, there does appear to be more guidance regarding transplant surgeries as stated by the International Society for Heart and Lung Transplantation, that patients should wait "at least 1 month" after transplantation.[14]

Variations in clinical practice exist, as seen in multiple global settings as a result of this uncertainty. For example, the shared decision across cardiothoracic surgical teams in Hong Kong was to delay administrating the COVID-19 vaccination to patients until 3–6

months after surgery by accounting for differences in convalescent times as well as any postsurgery complications. For instance, for patients undergoing coronary bypass surgery, the median length of stay at a nursing facility is 10.6 days, with discharge being highly correlated to age.[15] Deferring vaccination until full recovery is also useful in avoiding unwanted reactogenicity, adverse (and potentially confounding) effects of COVID-19 vaccination when recuperating postoperatively. This is accentuated by the fact that most (up to 70%) patients who receive messenger RNA (mRNA) vaccines experience systemic adverse effects within 0–7 days of vaccination.[16] Similarly, Merritt-Genore et al.[12] recommend, in their multinational study, that cardiac patients should first recover from immediate major surgery and any accompanying postoperative complications, before vaccination. Thus, it is crucial to ensure patients have first recovered, which may be classified as the absence of a systemic inflammatory response, removal of respiratory aids and unremarkable wound healing.

Although the study by Ho et al.[9] proposes important recommendations for postcardiac surgery COVID vaccination, it does also have some notable limitations. A key criticism is the single-center nature of the study, thereby perhaps confining the results to this particular center, the Prince of Wales Hospital, Hong Kong. In addition, the relatively small sample size ($n = 426$) may seem insufficient to base recommendations upon. As a result, it would be favorable to conduct the same study across multiple cardiac centers as well as to form international collaborations to capture a larger cohort of patients on a wider scale, allowing the authors to better quantify their data statistically and more objectively, while increasing the generalizability of the findings.

Moreover, there is inconsistency regarding the type of COVID-19 vaccine uptake in patients, with them receiving either first, second, or third doses. Some patients (15%) had already received a first dose before surgery, whereas others (36%) had received their first dose after surgery which could have served as a confounding factor. Also, the study included patients who received either the Sinovac 36 CoronaVac (non-mRNA) or Pfizer BNT162b2 (mRNA) vaccine thus, further adding to the inconsistency. Evidence suggests that second doses of mRNA vaccines have higher reactogenicities and produce far greater systemic adverse effects (such as fatigue, headache, fever, and nausea) than first doses of mRNA and viral vector vaccines.[12] Studies have shown that mRNA vaccines have higher efficacy and less complications than non-mRNA vaccines, all of which could contribute to confound any cardiac surgery complications and extend the hospital stay length.[17] While it is unclear which of the 1.4% of patients reported vaccination-related complications, it may be that second dose patients reacted worse than their first dose counterparts. Such side-effects may also confound any postcardiac surgery complications.

Another criticism is based on the study's inclusion criteria and retrospective nature. All adult patients who underwent cardiac surgery at the Prince of Wales Hospital were included in the data collection phase. Although the data were classified based on the type of surgical procedure, the findings may still not be truly representative due to the lack of documentation of any patient preexisting medical conditions or comorbidities, which may have increased their likelihood of suffering post-surgery complications, in turn, increasing their time of recovery. For example, Ho et al. indicated that the number of patients who received one vaccine dose in the valvular disease category was 59, compared to 31 patients who underwent aortic surgery. Clearly, recovering from aortic surgery and treating valvular diseases can have starkly different convalescent times. There are a range of factors that may also contribute to a patient's postoperative recovery, including the type of surgery, quality of care, comorbidity, and lifestyle.[18] The EuroSCORE can serve as a useful, objective tool to assess the level of risk of morbidity postcardiac surgery.[19] Although Ho et al. employed this, they could further investigate the relationship between different EuroSCORE categories and the frequency and severity of postcardiac surgery complications to inform healthcare professionals about the timing of COVID-19 vaccination based on patients' individual risk level.

Importantly, the late postoperative stage is defined as the initial 6 weeks to 3 months; it refers to the time from hospital discharge to regaining preoperative health and well-being.[20] It is well-recognized that gender and age above 60 years are significantly associated with length of hospital stay.[21] Therefore, omitting these patient details renders it challenging to fairly assess the quality of the study findings in the context of all cardiac patients undergoing surgery. This is supported by Levy et al.[22] who, by taking into consideration the type of surgery, recommend that lung and cardiac transplant patients should be vaccinated a minimum of 2 weeks before surgery to achieve optimum levels of protection. While administering vaccines later may appear better to avoid the surgical complication period, it is important to note that delaying vaccination could also increase the risk of patients catching the deadly COVID-19 disease. Therefore, up to 6 months (3–6 months) seems a "safe" compromise, as suggested by Ho and colleagues.

Additionally, the data collection methodology for this study poses itself to be inclined to selection bias. The study heavily relied upon patients who received the COVID-19 vaccine, subsequently self-attending the clinic or being admitted into the hospital after suffering severe complications from the vaccine (the secondary outcome). However, as stated both in Ho and colleagues' study and the wider literature, these incidents are rare.[23] Also, the self-limiting nature of vaccine side-effects may have rendered patients' perceptions of their symptoms as unworthy of clinical attention, leading to under-reporting of patients with vaccine-related complications. This is crucial, considering the original number of patients studied was 426, of which 411 were discharged, thus constituting a large proportion of potential inaccuracies in data collection. To obtain higher accuracy and efficiency, the researchers may wish to consider undertaking a prospective cohort study, as this would lend them greater control over patient exposure data.

In general, Ho and colleagues' recommendation of deferring vaccination until 3–6 months postcardiac surgery appears to be a sound time frame, considering conferring literature and scientific reasoning. However, further research is vital to assess the representativeness and generalizability of these recommendations across all populations.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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