

## Original Article

# Postoperative Nosocomial COVID-19 Infection in Cardiac Surgery: An Uncommon Event With High Mortality Rate

Khalid Ridwan, MD, MSc, Benoit DeVarenes, MD, Christo Tchervenkov, MD, Dominique Shum-Tim, MD, Renzo Cecere, MD, and Kevin Lachapelle, MD

*Division of Cardiac Surgery, McGill University Health Centre, Montreal, Quebec, Canada*

### ABSTRACT

**Background:** The COVID-19 pandemic has had a major impact on cardiac surgery patients. Significant reductions in access to surgical treatment have forced surgeons to prioritise patients and follow strict COVID-19 protocols to protect surgeons, staff, and patients. Adult cardiac surgery and the COVID-19 pandemic: aggressive infection mitigation strategies are necessary in the operating room and surgical recovery. Nosocomial infections among cardiac surgery patients have been reported and are associated with a high mortality rate. As a COVID-19 tertiary care centre and a tertiary cardiac centre, we tried to balance the need to operate on urgent cardiac cases while protecting patients and staff from COVID-19.

**Methods:** During the first wave of the pandemic, we performed 579 surgeries. We report findings from an outbreak of 4 nosocomial infections.

**Results:** All patients tested negative within 24 hours of surgery or admission. Three patients were positive after surgery, suggesting an overall nosocomial rate during the first wave of 0.5% (3/579). One patient admitted for evaluation tested positive during mass screening. Two of the 4 patients died after respiratory complications. No health care worker (HCW) or family member with direct contact with these patients tested positive for COVID-19.

Since the World Health Organization (WHO) declared COVID-19 to be a global pandemic in March 2020, there have been more than 100 million confirmed cases with more than 2.5 million fatalities caused by COVID-19 around the world.

Because of increased demand for intensive care unit (ICU) beds and health care resources, most cardiac surgery centres have had to adjust their case volumes during the first wave to liberate resources to care for COVID-19 patients. The Canadian Society of Cardiac Surgeons has been actively involved in providing guidance for the safety

### RÉSUMÉ

**Contexte :** La pandémie de COVID-19 a eu des répercussions importantes sur les patients en chirurgie cardiaque. Les réductions importantes de l'accès aux traitements chirurgicaux ont obligé les chirurgiens à classer les patients par ordre de priorité et à suivre des protocoles COVID-19 rigoureux pour protéger les chirurgiens, le personnel et les patients. En ce qui a trait à la chirurgie cardiaque chez les adultes pendant la pandémie de COVID-19, des stratégies énergiques d'atténuation des infections sont nécessaires en salle d'opération et pendant la convalescence. Des infections nosocomiales ont été signalées chez des patients de chirurgie cardiaque; elles sont associées à un taux de mortalité élevé. Comme notre centre de soins tertiaires traite à la fois des patients atteints de troubles cardiaques et des patients atteints de la COVID-19, nous avons essayé de trouver un équilibre entre la nécessité d'effectuer les opérations cardiaques urgentes et la protection des patients et du personnel contre la COVID-19.

**Méthodologie :** Pendant la première vague de la pandémie, nous avons effectué 579 interventions chirurgicales. Nous rapportons les résultats d'une éclosion de quatre infections nosocomiales.

**Résultats :** Tous les patients ont obtenu un résultat négatif au test de dépistage dans les 24 heures suivant l'intervention ou l'admission. Trois patients ont obtenu un résultat positif à ce test après l'intervention, ce qui indique un taux global d'infection nosocomiale de 0,5 % (3

of both patients and medical personnel and providing effective methods to prioritize and follow up with preoperative patients to mitigate the risk of protracted waiting times.<sup>1</sup> However, it is clear that a balance is required between the need to treat COVID-19 and the need to treat cardiac patients while ensuring the safety of patients and health care workers (HCW). In small case series, the rate of nosocomial COVID-19 infection among cardiac surgery patients is deemed to be low, but it is reported to have a high mortality rate of up to 43%.<sup>2</sup> We report findings from an outbreak of 4 nosocomial infections among cardiac surgery patients during the first wave in a tertiary care hospital, which is also heavily involved in the treatment of COVID-19 patients.

### Methods

The first wave was defined to occur from March 16 to December 10, 2020. This period essentially reflects the

Received for publication May 7, 2021. Accepted May 31, 2021.

**Ethics Statement:** Data was collected retrospectively from electronic medical records, waiver of consent was obtained.

Corresponding author: Dr Kevin Lachapelle, Professor of Surgery, Royal Victoria Hospital, 1001 Decarie Blvd, Block C, C07.1284, Montreal, Quebec H4A 3J1, Canada. Tel: +1-514-934-1934 ext. 36873; fax: +1-514-843-1602.

E-mail: [kevin.lachapelle@mcgill.ca](mailto:kevin.lachapelle@mcgill.ca)

See page 1220 for disclosure information.

Nosocomial COVID-19 infection is uncommon when adhering to safety protocols. Although uncommon, the mortality rate is high (50%) in our series.

**Conclusions:** As widespread vaccination of HCWs and high-risk individuals susceptible to COVID-19 is in progress, we suggest that cardiac surgery patients, when feasible, be vaccinated before surgery given this could prevent excess mortality, protect HCWs and reduce resource use.

impact on cardiac surgery cases starting with a significant reduction then a gradual increase to normal volumes to the start of another period of reduced activity. Preoperatively, all patients were carefully screened with a detailed history, physical examination, chest radiograph and a reverse transcriptase polymerase chain reaction swab test within 24 hours of surgery. Patients from other institutions were swabbed for COVID-19 and placed under contact-droplet precautions and remained under precaution for 14 days regardless of a negative COVID-19 result.<sup>3</sup> Patients from home were called to confirm absence of COVID-19 symptoms and history of exposure and remained under contact-droplet precautions until negative test results were achieved. During hospitalization, patients were isolated if they had COVID-19 symptoms and were tested. Only patients with a negative result had surgery. Strict operating room protocols were enforced and have been previously described.<sup>4</sup> All health care professionals, patients, and visitors wore a mask with application of hand hygiene, appropriate donning and doffing of personal protective equipment for contact-droplet precautions, and aerosol protection when indicated. Nosocomial infections were defined as patients that contracted the disease in the hospital and were symptomatic or tested positive 14 days after admission. Those who tested positive after 5 days from admission and had no presenting symptoms, were considered probable nosocomial infections, as it is also possible that they had a latent period of a community-acquired infection.

## Results

During this period, we performed 579 cardiac surgeries, representing 78% of our normal capacity. Three patients tested positive for COVID-19 after surgery, whereas a fourth patient with a left ventricular assist device (LVAD) tested positive as part of mass screening after being transferred to our centre from another hospital for management of gastrointestinal bleeding. All patients tested positive within 3 days of each other. The ward was quarantined, contact droplet precautions were applied to all patients, and mass screening was performed for all HCWs, patients, and family members every 5 days until 14 days of the last exposure. Two HCWs tested positive but were not directly involved in care of the positive patients.

Two patients died of respiratory failure related to COVID-19, whereas another patient recovered from the respiratory infection, albeit he suffered wound dehiscence and

/ 579) au cours de la première vague. Un patient admis pour évaluation a obtenu un résultat positif au moment du dépistage de masse. Deux des quatre patients sont morts après des complications respiratoires. Aucun travailleur de la santé ou membre de la famille ayant eu un contact direct avec ces patients n'a obtenu un résultat positif au test de dépistage de la COVID-19. L'infection nosocomiale à la COVID-19 est rare quand les protocoles de sécurité sont respectés. Mais même si elle est peu fréquente, le taux de mortalité associé est élevé (50 %) dans notre série.

**Conclusions :** Alors que la vaccination généralisée des travailleurs de la santé et des personnes à haut risque vulnérables à la COVID-19 est en cours, nous suggérons que les patients en chirurgie cardiaque soient vaccinés avant l'opération, si possible, car cela pourrait prévenir la surmortalité, protéger les travailleurs de la santé et réduire l'utilisation des ressources.

mediastinitis after starting steroids for his COVID-19 pneumonia. One patient was essentially asymptomatic. [Table 1](#) provides a summary of patients' characteristics.

### Patient 1

A 65-year-old man with a medical history of chronic renal failure on dialysis, hypertension, diabetes mellitus II, dyslipidemia, and atrial fibrillation presented with an ST-segment elevation myocardial infarction and had coronary artery bypass graft (CABG) × 3. He had postoperative pneumonia and was eventually transferred to the ward on postoperative day (POD) 6. While waiting for convalescence, he spiked a fever on POD 19, tested positive for COVID-19, and was transferred to the COVID-19 unit. After discharge, he was readmitted with worsening dyspnea, hypoxia, and infiltrates requiring intubation. He was treated with dexamethasone and intravenous (IV) antibiotics. His condition continued to deteriorate, and he died of respiratory complications of COVID-19 on POD 30.

### Patient 2

An 80-year-old man with hypertension and dyslipidemia presented with a non-ST-segment elevation myocardial infarction and an ascending aortic aneurysm of 5.2 cm and underwent CABG × 4 with hemiarch replacement. He was extubated and transferred to the floor on POD 1. On POD 2 he was readmitted to ICU for noninvasive respiratory support and IV antibiotics for aspiration pneumonia and was discharged again to the floor on POD 4. On POD 12, while waiting for convalescence, he complained of shortness of breath; a chest radiograph showed bilateral lung infiltrates, and he tested positive for COVID-19. He was admitted to the COVID-19 unit for 6 days and started treatment with dexamethasone and IV antibiotics before being transferred to the ICU for severe dyspnea and increased oxygen requirement. He was eventually intubated and had acute renal failure. He died after 10 days in the ICU of respiratory failure.

### Patient 3

A 57-year-old man with hypertension, diabetes mellitus II, and previous ischemic stroke presented with acute congestive heart failure. He was found to have multivessel coronary artery disease with severe mitral regurgitation. He underwent

**Table 1. Summary of patient characteristics and COVID-19 infection timeline**

	Patient 1	Patient 2	Patient 3	Patient 4
Sex	Male	Male	Male	Male
Age, y	65	80	57	75
Diabetes mellitus	Yes	Yes	Yes	Yes
Hypertension	Yes	Yes	Yes	Yes
Smoker	No	No	Ex-smoker	Ex-smoker
COPD	No	No	No	No
Chronic kidney disease	End-stage renal disease on dialysis	Yes	No	Yes
LVEF, %	40	60	25	30
Operation	CABG × 3	CABG × 4 + hemiarch replacement	CABG × 5 + mitral valve repair	LVAD (2015)
STS-PROM, %	2.96	2.33	3.02	—
Tested COVID-19 positive	POD 20	POD 12	POD 16	—
ICU readmission stay, d	15	10	—	4
Outcome	Died	Died	Discharged	Discharged
Hospital stay, d	39	34	52	8

CABG, coronary artery bypass graft; COPD, chronic obstructive pulmonary disease; ICU intensive care unit; LVAD, left ventricular assist device; LVEF, left ventricular ejection fraction; POD, postoperative day; STS-PROM, Society of Thoracic Surgeons Predicted Risk of Mortality.

CABG × 5 and mitral valve repair. The ICU course was uncomplicated, and he was transferred to the floor on POD 3.

While on the floor, fever developed, COVID-19 test result was negative. He was swabbed again after persistent fever and tested positive for COVID-19 on POD 16.

He was admitted to the COVID unit on minimal oxygen support and treated with dexamethasone. He was transferred back to the cardiac surgery floor after he recovered from his COVID-19 pneumonia. A sternal wound infection developed that required treatment with IV antibiotics and a pectoral flap. He was discharged after spending 52 days at the hospital.

**Patient 4**

A 75-year-old man presented with a previous LVAD surgery in 2015. His medical history included hypertension, dyslipidemia, chronic renal failure, and diabetes mellitus II. He was transferred from another institute after he presented there with gastrointestinal bleeding less than 48 hours earlier. He tested negative for COVID-19 on admission. He later had a positive test on day 4 of admission as part of a mass screening.

The patient remained asymptomatic and required no oxygen support. He was admitted to the ICU instead of the COVID-19 unit for simultaneous management of LVAD. He was discharged home after 4 days.

Overall, 4 patients were infected, 2 patients died of respiratory failure related to COVID-19, while 1 recovered and 1 was asymptomatic. Of 579 cardiac cases, 3 patients had nosocomial infections (0.5%). Suspicion of infection was pyrexia in patients 1 and 3, chest radiograph changes in patient 2, and mass screening in patient 4.

All 3 post-operative patients were waiting for transfer to a rehabilitation centre when tested positive and had a subsequent prolonged hospital stay.

**Discussion**

COVID-19 nosocomial infection has been a feared complication for patients admitted to the hospital, especially those subjected to cardiac surgery, given that surgery may induce both an inflammatory and immunocompromised state. Our

experience during the first wave of the pandemic found that the risk of transmission is low even in a tertiary hospital at the centre of the pandemic. Our case volume slowly improved after nearly 4 weeks of shut down starting March 16 and were fully functional until the start of the second wave. During this time, we were able to perform 579 surgeries, which represents 78% of our normal volume. An outbreak occurred on the ward that infected 4 patients, 3 of which were waiting for discharge 12-19 days after surgery. Unfortunately, 2 patients died after a prolonged ICU stay.

No doubt that the application and adherence of strict COVID-19 policies and procedures had a beneficial effect in limiting the number of nosocomial infections and outbreaks.

Furthermore, we had no other incidents of outbreaks or any further nosocomial infections to date. Unfortunately, because nearly all HCWs, patients, and families tested negative for COVID-19, the source of the outbreak is not known. This finding underlines the necessity to continue to adhere to COVID-19 guidelines and to remain vigilant. Testing must be done postoperatively to rule out COVID-19 when the clinical situation is appropriate.

Given the low rate of nosocomial infection, patients should have some reassurance that they are relatively safe from COVID-19, and life-saving procedures should take precedence over fear of contracting COVID-19.

However, we were fortunate in that our outbreak was limited. The situation could have been much worse with a potential of infecting more than 30 patients on the ward and more than 100 HCWs. Given the high mortality rate and high resource use in COVID-19 patients, this could have been a catastrophe for patients and the hospital. Because we are unsure how the outbreak started in the first place, the best approach would be to maximize prevention. Strict adherence to COVID-19 policies continues to be essential, and, as was seen with the LVAD patient, asymptomatic infections can be encountered in the cardiac surgery unit. Proper practice of personal protection equipment and mass screening helped diminish the risk of such asymptomatic patients from spreading the infection and becoming a source of another outbreak.

Moreover, LVAD patients present a special subset of cardiac surgery patients for whom their hospital readmission rates are higher than other cardiac surgical patients, and they

require frequent outpatient follow-up. Follow-up makes these patients more vulnerable to infection; therefore, these patients should be treated diligently with applications of personal protection equipment when being seen in the clinic or hospital setting. Furthermore, they should be encouraged to get vaccinated to help reduce this risk and allow for safer care in the ward or the clinic.

Rapid discharge from the hospital would also seem to be appropriate, as 3 of these patients were waiting in the hospital as a consequence of reduced convalescence beds, even though there have been reports of outbreaks in long-term care facilities at the beginning of the pandemic. These outbreaks were attributed to poor adherence to contact precautions and lack of widespread testing. Increased awareness, better preparations, and strictly admitting patients that test negative for COVID-19 in these centres make them a viable option for patients that can't be discharged home, particularly when they are hospitalized in a referral centre dealing with COVID-19 patients. With the availability of vaccinations, they can be immunized after surgery before being transferred.

### Conclusions

The results of our case series can be limited because of the small number of confirmed nosocomial infections, single centre result, and the treatment options of these patients.

Currently, we still don't have enough evidence of what the best treatment option for postoperative patients with nosocomial COVID-19 infections might be; to our knowledge they should be treated like any other COVID-19 patients according to the severity of the disease. The latest National Institutes of Health guideline recommends dexamethasone for severe illness requiring mechanical ventilation (strong recommendation) or dexamethasone plus tocilizumab (moderate recommendation) within 24 hours of ICU admission. Treatment with antiviral medications such as remdesivir is not recommended as a monotherapy and had moderate rating of recommendation in combination with dexamethasone in

severe illness not requiring intubation or extracorporeal membrane oxygenation.<sup>5</sup>

Lastly, our cohort consisted of nonvaccinated patients, and all HCWs were not vaccinated at that time. Vaccination before surgery could be an important component in limiting deadly outbreaks and infection. Many cardiac surgery patients can wait 2 weeks to allow for vaccination. As the roll out starts, cardiac patients should be prioritized for vaccination, not only for their safety but also for the safety of the hospital and staff.

### Funding sources

None.

### Disclosures

The authors have no disclosures to report.

### References

1. Hassan A, Arora RC, Lothar SA, et al. Ramping up the delivery of cardiac surgery during the COVID-19 pandemic: a guidance statement from the Canadian Society of Cardiac Surgeons. *Can J Cardiol* 2020;36:1139–43.
2. Yates MT, Balmforth D, Lopez-Marco A, et al. Outcomes of patients diagnosed with COVID-19 in the early postoperative period following cardiac surgery. *Interact Cardiovasc Thorac Surg* 2020;31:483–5.
3. Lauer SA, Grantz KH, Bi Q. The incubation period of coronavirus disease 2019 (COVID-19) from publicly reported confirmed cases: estimation and application. *Ann Intern Med* 2020;172:577–82.
4. Moka E, Paladini A, Rekatsina M, et al. Best practice in cardiac anesthesia during the COVID-19 pandemic: practical recommendations. *Best Pract Res Clin Anaesthesiol* 2020;34:569–82.
5. COVID-19 Treatment Guidelines Panel. coronavirus disease 2019 (COVID-19) treatment guidelines. National Institutes of Health. Available at <https://www.covid19treatmentguidelines.nih.gov/>. Accessed May 1, 2021.