CASE REPORT

Coronary Artery Bypass Grafting complicated by post-operative coronavirus infection – two similar presentations with dissimilar outcomes

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ABSTRACT

Patients diagnosed with COVID-19 infection undergoing surgical procedures have been reported to have increased post-operative complications and mortality. These findings are important when considering cardiac surgical procedures, specifically coronary artery bypass grafting (CABG) during this pandemic, since the Society of Thoracic Surgeons (STS) describes most of these operations as 'urgent'. In addition, the majority of cardiac surgical patients are at increased risk of infection and death with COVID-19, as they are frequently of old age, obese, hypertensive, and diabetic, with severe cardiac or pulmonary diseases. This case series describes the clinical course following a CABG procedure in two patients that went on to develop COVID-19 infection post-operatively. We aim to illustrate the similarities in clinical presentation, but differences in eventual outcomes for both patients and hypothesize the reasons for the differences.

KEYWORDS: Coronavirus; cardiac surgery; post-operative complications; ECMO

INTRODUCTION

The Coronavirus Disease 2019 (COVID-19) pandemic continues to complicate surgical care delivery for patients suffering from cardiovascular disease. Additionally, the development of virulent coronavirus strains increases the need for literature on post-operative complications associated with COVID-19. Patients diagnosed with COVID-19 infection undergoing surgical procedures have been reported to have increased post-operative complications and mortality [1,2]. Knisely et al reported increased morbidity and mortality in patients who underwent urgent surgical procedures and contracted COVID-19 either pre- or post-operatively [3]. These findings are important when considering cardiac surgical procedures, specifically coronary artery bypass grafting (CABG) during this pandemic, since the Society of Thoracic Surgeons (STS) describes most of these operations as 'urgent' [4]. In addition, the majority of cardiac surgical patients are at increased risk of infection and death with COVID-19, as they are frequently of old age, obese, hypertensive, and diabetic, with severe cardiac or pulmonary diseases [5].

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This case series describes the clinical course following a CABG procedure in two patients that went on to develop COVID-19 infection post-operatively. We aim to illustrate the similarities in clinical presentation, but differences in eventual outcomes for both patients and hypothesize the reasons for the differences. Institutional review board approval was waived since this was a minimal risk, case series.

CASE SERIES

Patient 1: A 42-year-old, hypertensive gentleman, unvaccinated for COVID-19, presented with unstable angina and was diagnosed with triple vessel coronary artery disease by left heart catheterization. His initial hemodynamics and labs were within normal limits and are described in Table 1. Pre-operative arterial blood gas (ABG) analysis was normal on room air (Table 2). Patient tested negative for COVID-19 by reverse transcription polymerase chain reaction (RT-PCR) one day prior to the CABG procedure.

The patient underwent on-pump CABG x 3 (left internal mammary artery to the left anterior descending artery, sequential saphenous vein graft to the posterior descending and obtuse marginal arteries). The surgery was carried out uneventfully, and the patient was weaned off cardio-

Table 1. Patient Characteristics.

Characteristics	Patient 1	Patient 2
Age (years)	42	62
Sex	Male	Female
Clinical presentation	Unstable angina	Non-ST elevation myocardial infarction
Left heart catheterization	Three vessel disease	Three vessel disease
Co-morbidities	Hypertension	Hypertension Type 2 Diabetes mellitus Morbid obesity Chronic obstructive pulmonary disease Obstructive sleep apnea
Serum creatinine (mg/dl)	0.86	1.1
Pre-operative Carotid duplex scan	<50% stenosis of bilateral internal carotid arteries	>90% stenosis of left internal carotid artery; 50-69% stenosis of right internal carotid artery
STS risk of mortality	0.9%	2.7%
Pre-CPB TEE	Normal valves, LVEF 50%	Normal valves, LVEF 50%
Post-CPB TEE	Normal valves, LVEF 55-60%	Normal valves, LVEF 50%
Positive COVID-19 RT-PCR	Post-operative day 2	Post-operative day 6
Days on V-V ECMO	18	12
Length of hospital stay (days)	54	36
Other post-operative complications	Septicemia	Septicemia Clostridium difficile infection Heparin-induced thrombocytopenia Mesenteric ischemia
Clinical outcome	Recovered	Deceased

Table 2. Peri-operative Arterial Blood Gas Analysis.

ABG analysis	Patient 1	Patient 2
Pre-operative	*On room air* pH 7.412 PCO2 38.1 mmHg PO2 78.6 mmHg	*On 2 liters/min O2* pH 7.395 PCO2 47.1 mmHg PO2 103 mmHg
First post-operative in ICU	*FiO2 100%, PEEP 10 mmHg* pH 7.42 PCO2 40 mmHg PO2 68.8 mmHg	*FiO2 100%, PEEP 10 mmHg* pH 7.335 PCO2 40.4 mmHg PO2 63 mmHg

pulmonary bypass on no inotropes, and on 0.03 micrograms/kg/min of nor-epinephrine. In the intensive care unit, the first ABG on a FiO2 of 100% was abnormal with a partial pressure of oxygen (PO2) of 69 mmHg (Table 2). A few hours after surgery, the patient became hypotensive with low cardiac indices. An epinephrine infusion was started, and vasopressors were escalated. The patient was initially dyssynchronous on the ventilator and needed deepened sedation. He continued to have low arterial saturations on escalating ventilatory support over the next 24-48 hours. A repeat COVID-19 RT-PCR was sent due to the ongoing difficulty with ventilation, which returned positive on post-operative day (POD)-2.

On POD-3, the patient was placed on peripheral veno-venous extracorporeal membrane oxygenation (VV-ECMO). He was initially placed on an ECMO flow rate of 4 liters/minute and a sweep gas flow of 5 liters/minute, with an arterial saturation of 99% and progressed well. The ECMO run was complicated by positive blood cultures, for which he was started on intravenous Cefepime (1 grams Q8H for 7 days) and Vancomycin (2 grams Q8H for 7 days, after loading dose and carefully following troughs). Per institutional protocols at the time, he was placed on intravenous Remdesivir (200 mg on Day 1, followed by 100 mg daily for 5 days) and Dexamethasone (6 mg daily for 10 days), and a heparin infusion to present thrombosis with a goal Anti Xa of 0.3-0.7. A percutaneous tracheostomy was performed on POD-15. After being supported on VV-ECMO for 18 days, the patient was successfully weaned off and decannulated. He was then slowly weaned off the ventilator, and after being on the tracheostomy for 22 days, he was then decannulated and discharged home.

Patient 2: A 62-year-old morbidly obese lady with sleep apnea, type-2 diabetes mellitus, chronic obstructive pulmonary disease, and hypertension, unvaccinated for COVID-19, presented to the hospital with non-ST elevation myocardial infarction. Her initial hemodynamics and labs were within normal limits (Table 1) except for a random blood sugar of 322 mg/dl and an HbA1c of 9.2%. Coronary angiography revealed critical three-vessel disease with multiple diffuse lesions, making her unsuitable for percutaneous coronary intervention. Her chest x-ray revealed bronchopneumonia of the right lower lobe, for which antibiotics were initiated. She was on intravenous antibiotics and respiratory adjuncts for 7 days, and her chest x-rays showed serial improvement. Her pre-operative ABG on 2 liters of oxygen/minute is depicted in Table 2. She tested negative for COVID-19 six days prior to surgery by RT-PCR.

After medical optimization, she underwent on-pump CABG x 3 (left internal mammary artery to the left anterior

descending artery, and individual reverse saphenous vein grafts to the obtuse marginal and right coronary arteries). The surgery was carried out uneventfully, and she left the operating room on no inotropes or vasopressors. Post-operatively, she developed hypoxia with escalating PEEP and FiO2 requirements (Table 2). Her cardiac indices were borderline low, and she was started on an epinephrine and milrinone infusion. Over the next 48-72 hours, the patient remained dyssynchronous on the ventilator and responded marginally to ketamine infusion. On POD-6, RT-PCR for COVID-19 returned positive, and she was started on intravenous Remdesivir (200 mg on Day 1, followed by 100 mg daily for 5 days) and Dexamethasone (6 mg daily for 10 days), as per institutional protocols. There was marginal improvement in oxygenation, and she was supported on the ventilator for another 7 days. On POD-14, the patient was placed on peripheral VV-ECMO. She responded favorably to an initial flow rate of 4.2 liters/minute and a sweep gas flow of 8 liter/minute, but later developed heparin-induced thrombocytopenia (HIT). An argatroban infusion was initiated with a goal partial thromboplastin time of 50 to 60 seconds, to prevent thrombosis. She also had intermittent fevers and escalating antibiotic requirements to intravenous Cefepime (1 grams Q8H for 7 days) and Vancomycin (1.5 grams Q8H for 7 days, after loading dose and carefully following troughs). A percutaneous tracheostomy was also performed. She showed respiratory improvement, and after 12 days on ECMO support, she was weaned off and decannulated. The patient remained stable for 24-48 hours, but then started developing significantly elevated liver function markers with abdominal distention. A rising serum lactate level led to the suspicion of bowel ischemia, and an exploratory laparotomy was performed. The laparotomy revealed extensive small bowel ischemia, and given the extent of the disease, a decision was reached with the family to make her comfort care.

DISCUSSION

The COVID-19 pandemic continues to ravage surgical care of critically ill patients. Patients who undergo CABG and develop COVID-19 infection in the peri-operative period are at an increased risk of morbidities and mortality, requiring prolonged hospital stay [6]. In our series, both patients developed respiratory failure, needed VV-ECMO support, and had a prolonged hospital course. However, the patient with pre-existing comorbidities of morbid obesity, diabetes mellitus, hypertension, and COPD suffered a worse outcome in the end.

Since the beginning of the COVID-19 pandemic, hospitals have been brainstorming protocols to test asymptomatic patients being admitted for 'routine' cardiac surgeries. Initially, testing was limited to high-risk population groups but quickly extended to all patients undergoing surgery. In our case, both patients had negative pre-operative COVID-19 tests but tested positive soon after surgery. At the time of event, our institutional policy dictated one negative test at any time prior to surgery, which has since changed. At present, a COVID-19 test is mandated 24-48 hours prior to the surgical procedure. The potential that these initial test results were false-negatives [7] cannot be completely ruled out. However, evidence of COVID-19 infection was absent until clinical manifestation appeared in the early post-operative period. Even in healthy individuals, evidence suggests that cardiopulmonary bypass activates inflammatory responses which can lead to lung tissue damage as well as increased pulmonary endothelial permeability [8]. The cumulative effect of inflammation from CABG and COVID-19 is a possible source for the morbidity and mortality in patients with COVID-19 infection peri-operatively.

Both patients had similar clinical presentations, including ventilatory dyssynchrony, in the immediate post-operative period, leading to escalating ventilator parameters and sedation requirements. Veno-venous ECMO was initiated early on the first patient, one day after the diagnosis of COVID-19, whereas the second patient was not started on VV-ECMO until eight days after diagnosis and may be a confounder in the patients' differing outcomes. The role of early institution of VV-ECMO in severe COVID-19 infection is being investigated [9], specially in post cardiotomy patients.

Cardiac surgery volumes have dramatically reduced across the nation during the pandemic, with an even more dramatic increase in operative mortality [5]. In order to safely perform 'routine, low-risk' cardiac surgeries, one must have robust and effective pre-surgery screening protocols, and a low threshold for retesting patients post-operatively when clinically indicated. Moreover, it has been demonstrated that up to 54% of COVID-19 patients may have an initial false-negative RT-PCR test, reinforcing the need for repeat testing in patients with high clinical suspicion [7]. The judicious use of high-resolution computed tomography, pulmonary function tests, and measurement of D-dimers can serve as adjuncts to facilitate the detection of COVID-19 prior to surgery, and may be performed more liberally when the geographical area involved is seeing a surge of COVID-19 cases. Periodic COVID-19 testing of health-care workers and those responsible for caring for post-operative cardiac surgical patients may also limit COVID-19 infection in this population. Visitor limitation with insistence on vaccination against COVID-19 are additional hospital policies that could go a long way in preventing the spread of this virus. Patients with comorbidities such as advanced age, diabetes mellitus, obesity, hypertension, and COPD are possibly at increased risk of adverse outcomes should they contract COVID-19, and special care should be taken in this population. Early institution of VV-ECMO may be beneficial, but further studies are needed in this matter.

CONCLUSION

The COVID-19 pandemic continues to plague our population, and adversely affect surgical volumes and outcomes. It is essential to re-test patients early after surgery, even if they tested negatively prior to surgery, in case there is a strong clinical suspicion. Early institution of VV-ECMO in refractory hypoxia may be beneficial.

Compliance with ethical standards

- Conflicts of interest – None
- Research involving human participation and/or animals – N/A, retrospective case report
- Informed consent – Obtained from the patient/s and/or next of kin. Available on request. No opposition from patient/family to publication.

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