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CASE REPORT

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Successful use of Impella 5.5 to manage cardiogenic shock complicated by COVID-19

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Abstract

Background: Acute decompensated heart failure in patients with coronavirus disease 2019 (COVID-19) is becoming increasingly common.

Aims: In this case report, we describe the successful use of an Impella 5.5 (Abiomed) to treat cardiogenic shock refractory to inotropic therapy.

Materials & Methods: Transthoracic and transesophageal echocardiography confirmed severely diminished left ventricular ejection fraction and a reverse-transcription polymerase chain reaction test revealed that the patient was COVID-19 positive during his hospital admission.

Results: Following initiation of inotropic therapy, we placed an Impella 5.5 for further cardiac support. The patient's LVEF and cardiac index improved after 21 days on the Impella 5.5 and was maintained following explant.

Discussion & Conclusion: The findings reported here demonstrate successful use of an Impella 5.5 to improve native heart function in refractory cardiogenic shock and further indicate its use as an option for those in acute decompensated heart failure who have tested positive for COVID-19 infection.

KEYWORDS
COVID-19, heart failure, Impella 5.5

1 | INTRODUCTION

Coronavirus disease 2019 (COVID-19) has spread globally, establishing widespread prevalence in under one year. As cases continue to rise among the unvaccinated population in the United States, there will likely be increases in the number of patients presenting with primary organ dysfunction in the setting of infection or following resolution of disease. One case series recently demonstrated that the use of a durable left ventricular assist device (LVAD) in patients with COVID-19 led to similar survival outcomes as non-LVAD patients with COVID-19 aged 70–79 years old.[1] Although several case reports have described the successful use of Impella 5.0 in COVID-19 positive patients,[2–4] to the best of our knowledge, the same findings with Impella 5.5 have only been described by the device manufacturer. Herein, we report successful Impella 5.5 use on a COVID-19 positive patient in cardiogenic shock (CS) refractory to inotropic therapy.

1.1 | Case description

A 65-year-old male with a history of hypertension, hyperlipidemia, atrial fibrillation, and nonischemic cardiomyopathy presented with worsening shortness of breath, lower extremity edema, and abdominal distension. He was hypotensive with mean arterial pressure of around 60 mmHg. The COVID-19 polymerase chain reaction test on

admission was negative. Bedside transthoracic echocardiography (TTE) revealed a diminished left ventricular ejection fraction (LVEF) of less than 10%. He was started on levophed for hypotension and dobutamine for inotropic support. Despite pharmacologic therapy, he remained in profound CS. He was subsequently sedated, intubated, and started on epinephrine for inotropic support, vasopressin for pressor support, and amiodarone to maintain sinus rhythm (Figure 1A).

A pulmonary artery catheter was placed to monitor hemodynamics. Transesophageal echocardiography confirmed a diminished LVEF of 5%–10% with no left atrial appendage thrombus nor ventricular apical thrombus, right ventricular dilation with systolic function moderately reduced, no evidence of aortic valve dysfunction, but severe mitral valve regurgitation and moderate tricuspid valve regurgitation (Supporting Information Video). Due to CS refractory to medical support, the patient was taken for successful Impella 5.5 implantation on Day 1 of admission with a backup plan of venoarterial extracorporeal membrane oxygenation (VA-ECMO) or percutaneous right ventricular assist device (RVAD) placement in case of acute hemodynamic decompensation or the RV not tolerating LVAD support. The anticoagulation protocol during Impella 5.5 implant followed the device manufacturer's recommendations.

On Day 1 of admission, the patient developed fever, which persisted through Day 4. His respiratory status acutely worsened on Day 4 on ventilator support with FiO_2 40% and an extrinsic positive end-expiratory pressure of 5 cm H_2O adjusted to 35% and 10 cm H_2O, respectively. The chest X-ray revealed bibasilar opacities despite a normal pulmonary capillary wedge pressure and cardiac index. This clinical picture gave reasonable suspicion to conduct a repeat COVID-19 test, which came back positive. Remdesivir was initiated on Day 5 immediately upon receipt of the positive result, though renal function significantly declined over the next 2 days, with creatinine uptrending to 3.0 mg/dl despite a normal cardiac index. Medication-induced acute kidney injury was suspected, and Remdisivir was discontinued. Intravenous dexamethasone was started to manage potential COVID-19 induced acute respiratory distress syndrome.

From Days 8 to 21, the patient was maintained on inotropic, pressor, and mechanical circulatory support (MCS). Liver function tests remained stable and there were no signs of obvious hemolysis clinically. His left heart function gradually improved, as evidenced by an increase in the cardiac index above 3.0 L/min/m^2 (Figure 1B) and an increase in LVEF to 30% with Impella 5.5 at P4 support. By Day 21, pulmonary capillary wedge pressure downtrend and stabilized at 10 mmHg (Figure 1C). His right heart function also improved, with pulmonary artery pulsatility index reaching 2.3 (Figure 1B) and central venous pressure stabilizing at 6 mmHg (Figure 1C) by Day 21. On Day 21, the Impella 5.5 was explanted and heart function was reassessed with TTE, which revealed

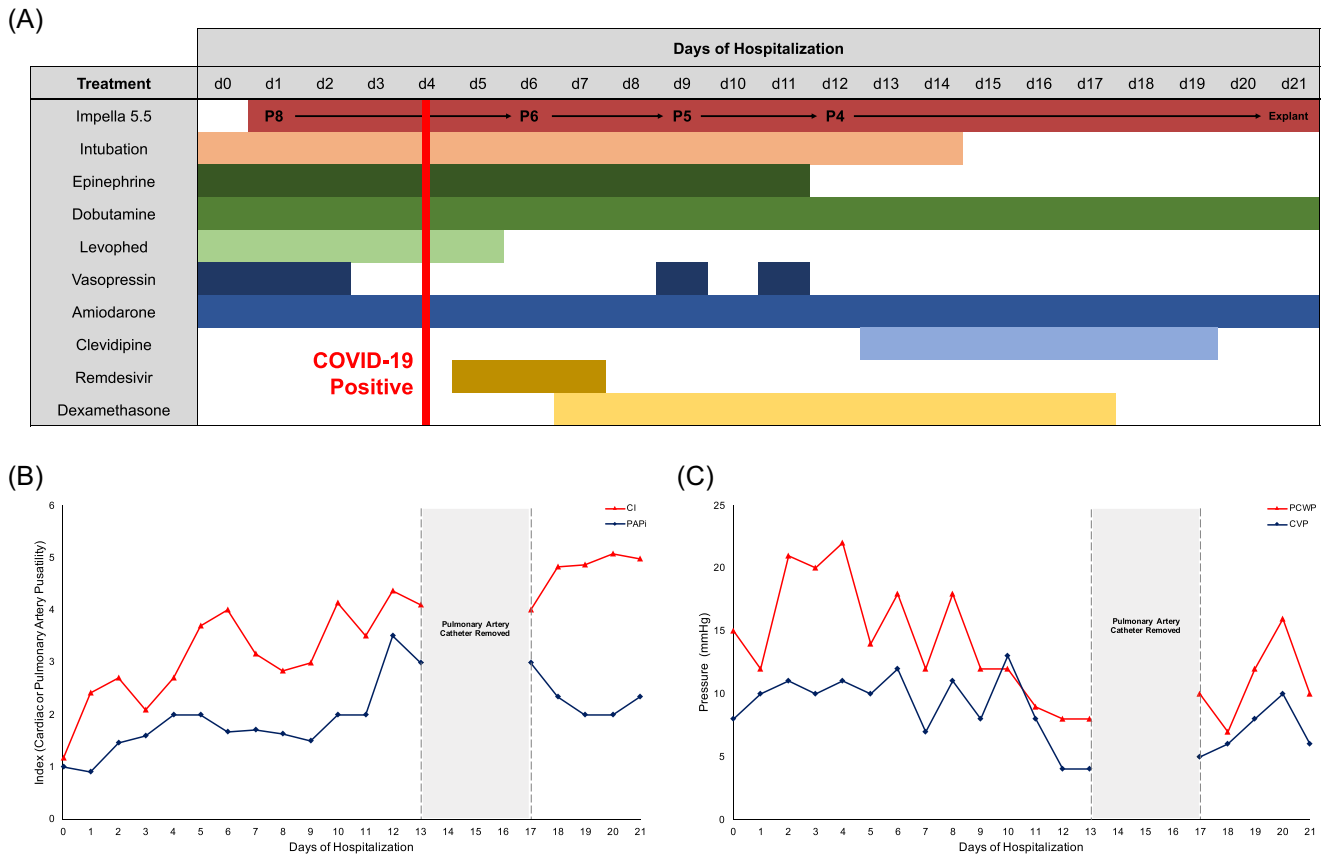

FIGURE 1 (A) Medications used during the Impella 5.5 implantation. (B) Hemodynamics showing cardiac index (CI), pulmonary artery pulsatility index (PAPi). (C) Central venous pressure (CVP) and pulmonary capillary wedge pressure (PCWP)

LVEF of 35% (Supporting Information Video). On Day 23, 2 days after Impella 5.5 explant, LVEF further improved to 40%.

2 | DISCUSSION

In the context of CS refractory to inotropic therapy, unloading the LV with MCS can improve native heart function.[5–7] Here, we report on a 65-year-old male with profound CS whose heart function improved with Impella 5.5 support. COVID-19 infection was initially managed with Remdesivir but discontinued due to acute kidney injury. He was subsequently started on dexamethasone, recently shown to reduce 28-day mortality among patients hospitalized with COVID-19.[8]

With COVID-19 on the rise among the unvaccinated, the threat to patients with heart failure becomes increasingly concerning. A retrospective cohort study by Bhatt et al.[9] revealed that one in four patients with heart failure hospitalized for COVID-19 died in-hospital.[9] However, the underlying mechanisms associating COVID-19 positivity to cardiovascular morbidity remain poorly understood. One explanation for myocardial injury is through direct entry and proliferation of virus in the myocardium,[10] although there is a paucity of data on COVID-19 pathology in the heart. Alternatively, the damage could be induced through inflammatory responses affecting myocardial structures.[11] A prospective cohort study by Weckbach et al.[12] demonstrated enhanced macrophage numbers but undetectable SARS-CoV-2 RNA in endomyocardial biopsies from five COVID-19 positive patients. This finding is consistent with reports of immune-mediated lung disease in patients with severe COVID-19.

Our patient had primary LV dysfunction with moderately reduced RV function and stable respiratory status with arterial blood gas maintained on a ventilator. The Impella 5.5 was therefore indicated as the primary MCS option with VA-ECMO or percutaneous RVAD as a backup for acute decompensation or RV failure during the procedure. The patient's improved hemodynamics following 21 days of Impella 5.5 and inotropic support indicated successful management of CS in the setting of COVID-19 infection.

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