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## Brief Report

# Characteristics and Outcomes of Patients With a Left Ventricular Assist Device With Coronavirus Disease-19

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The coronavirus disease-2019 (COVID-19) pandemic has afflicted more than 4 million people in the United States and carries a high mortality rate. Preexisting cardiovascular diseases such as coronary artery disease, hypertension, diabetes mellitus, and older age have been associated with an increased risk of COVID-19.<sup>1</sup> Thromboembolic events are common during COVID-19 infection, and the approach to both prophylactic and therapeutic anticoagulation is not clear.<sup>2</sup>

Patients with left ventricular assist devices (LVAD) might represent a particularly vulnerable patient population, owing to the presence of multiple comorbidities, a relatively immunocompromised state, and an elevated inflammatory profile.<sup>3</sup> In addition, these patients are at an increased risk of thromboembolic events such as stroke and pump thrombosis, requiring maintenance antithrombotic therapy. Preliminary case reports have not indicated a disproportionate impact of COVID-19 on the LVAD population.<sup>4</sup> The goal of this series was to share our experience with patients with LVADs who were diagnosed with COVID-19, with particular emphasis on their initial presentation, disease course, treatment management and final outcome.

We retrospectively reviewed all adult patients with LVADs who are presently followed at 2 large centers in New York City. Only patients diagnosed with COVID-19

through polymerase chain reaction analysis were included in the study and followed through August 5, 2020. Baseline characteristics and echocardiographic and laboratory data were extracted using electronic medical records. This study was approved by the institutional review boards of both centers.

Among the 190 patients with LVADs followed by our centers, we have identified 6 patients (3.1%) who were diagnosed COVID-19. The low prevalence of diagnosed disease may be explained by limited testing. One suspected patient had sudden death at home but was never tested owing to mild symptomatology. The number of negative tests performed is not available for analysis.

Patients' age range was 30–79 years, 4 were male, and time on LVAD ranged from 1 day to 6.8 years (Table 1).

Patient comorbidities included hypertension (4/6), diabetes mellitus (2/6), obesity (1/6), and end-stage renal disease requiring dialysis (1/6). One patient with Fontan circulation with hypoplastic right ventricle and superimposed acute lymphocytic myocarditis predating the COVID pandemic was transitioned from a temporary support to a permanent device during the index hospitalization. The initial presentation of COVID-19—included dyspnea and cough (4/6), fever (2/6), and diarrhea (1/6). Four patients were admitted to the hospital and 3 required care in the intensive care unit. Laboratory results are summarized in Table 1. All patients had lymphopenia, and elevations of troponin. Ferritin levels ranged from 59 ng/mL to 1623 ng/mL and D-dimer was greater than 1 µg/L in 3 patients. In 2 patients with an echocardiogram during the present admission, no changes in left ventricular ejection fraction or left ventricular end-diastolic dimension were noted.

Supplemental oxygen was required in all but 1 hospitalized patient, and 2 patients required intubation. None of the patients underwent prone positioning. One patient required de novo dialysis. During hospitalization, heparin was administered in 2 patients, and 1 patient was transitioned from heparin to argatroban with suspected Fontan related thrombus on an echocardiogram. One patient who had not previously been anticoagulated, owing to a

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**Table 1.** Patient Characteristics

Variables	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6
Age, years	76	74	79	30	74	75
Sex	Male	Male	Male	Female	Male	Female
HF etiology	ICM	NICM	NICM	Congenital	NICM	NICM
CAD	Y	N	N	N	Y	N
HTN	Y	Y	N	N	Y	Y
DM	Y	N	Y	N	N	N
Stroke	N	N	N	N	N	N
Type of LVAD	HMII	HVAD	HM3	HM3	HMII	HM3
Intent of therapy	DT	DT	DT	BTD	DT	DT
Time post-LVAD, months	64.8	81.6	10.8	0.03	70.8	12
Laboratory parameters						
WBC, / $\mu$ L	3.8	6.3	4/9	20/3	N/A	4.83
ALC (initial)	270	500	600	1200	N/A	1030
ALC (trough)	240	500	300	500	N/A	1030
CRP (initial), mg/L	162	61	46	163	N/A	0.5
CRP (peak), mg/L	163.5	161.5	100	167	N/A	N/A
IL-6, pg/L	N/A	6	N/A	97	N/A	N/A
Ferritin, ng/mL	370.1	688.2	1623	1366	N/A	59.1
D-Dimer, $\mu$ g/mL	0.8	1.3	2.4	10.4	N/A	651
Troponin T, ng/dL	26	96	N/A	N/A	N/A	N/A
Troponin I, ng/dL	N/A	N/A	0.3	1.2	N/A	N/A
Time of follow-up after COVID diagnosis	5 days	5 months	4.5 months	12 days	4.5 months	1.5 months
Status at last follow-up	Deceased	Recovered	Recovered	Deceased	Recovered	Recovered

ALC, absolute lymphocyte count; BTD, bridge to decision; CAD, coronary artery disease; CRP, C-reactive protein; DM, diabetes; DT, destination therapy; HF, heart failure; HM, Heartmate; HTN, hypertension; HVAD, HeartWare; ICM, ischemic cardiomyopathy; N/A, not available; NICM, nonischemic cardiomyopathy; WBC, white blood cell count.

history of bleeding, was started on subcutaneous enoxaparin at discharge. Three patients were on chronic aspirin therapy, and it was discontinued in one. Hydroxychloroquine was given to 3 patients, high-dose corticosteroids to 2 patients, and an IL-1 antagonist was administered to 1 patient owing to severe cytokine storm. None of the patients received an IL-6 receptor antagonist. There were no occurrences of neurologic events, bleeding events, or right ventricular failure during the disease course. Two patients died during the index hospitalization: one owing to profound hypoxemia from COVID-19 pneumonia (Supplementary Fig. S1), leading to asystolic arrest and the second owing to cytokine storm and suspected Fontan thrombosis. The other 4 patients recovered completely. All surviving patients were followed for a range of 1.5–5.0 months.

The known manifestations of COVID-19 lead to special considerations in the LVAD population. These include a propensity for thromboembolic events and the risk of developing right ventricular failure. Even though we have not encountered this event in our small case series, a high index of suspicion was maintained. The use of prone positioning might be of concern in an LVAD population owing to the risk of driveline damage, outflow graft compression, and worsening of right ventricular hemodynamics owing to increased thoracic pressure and impaired venous return.

In conclusion, patients with LVADs represent a vulnerable population at high risk for significant complications associated with COVID-19 disease; their management can

be particularly challenging and requires a multispecialty approach.

### Disclosures

Paolo Colombo serves as an Abbott Consultant without honoraria and received an Abbott Research grant. Gabriel Sayer received consulting fees from Medtronic and Abbott. Yoshifumi Naka serves as consultant for Abbott. Irina Sobol, Melana Yuzefpolskaya, Koji Takeda, Zachary Roth, Evelyn Horn and Nir Uriel do not have any relevant disclosures.

### Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:[10.1016/j.cardfail.2020.09.011](https://doi.org/10.1016/j.cardfail.2020.09.011).

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