Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Letter to the Editor

Fulminant myocarditis in COVID-19 and favorable outcomes with VA-ECMO

To the editor,

Since the beginning of the COVID-19 pandemic, fulminant myocarditis (FM) has been recognized as one of the cardiac complications of COVID-19 disease caused by SARS-CoV-2 virus. FM is characterized by life threatening heart failure and cardiogenic shock, and often requires mechanical circulatory support (MCS). While recently there has been a significant interest regarding the rare incidence of COVID-19 vaccine related myocarditis, there is limited data on management of FM associated with COVID19 disease with veno-arterial extracorporeal membrane oxygenation (VA-ECMO). We report a case series of nine patients with COVID-19 disease associated FM who were managed with VA-ECMO at the Cleveland Clinic Health System.

From 6/10/20 to 10/28/21, 13 patients were managed on VA ECMO for COVID-19 disease. Nine patients were identified to have FM based on the clinical features, laboratory analyses and imaging findings. Average age of these patient was 40 years. 5 out of the 9 patients had cardiac arrest. The mean duration of VA ECMO support was 6.8 days. 7 out of the 9 patients survived to hospital discharge.

Table 1 – Patient characteristics, laboratory values, ECMO and hospital course and outcome.

Patient Number	1	2	3	4	5	6	7	8	9
Age (yrs.)	22	53	28	27	46	68	26	66	24
Sex	M	F	F	F	M	M	F	M	M
COVID-19 vaccination status	None	None	None	None	None	None	JJ Vaccine*	None	None
CRP (mg/dL)	53.9	26.3	23	4.9	14.6	12.9	2.1	52.1	24.8
ESR (mm/hr)	N/A	9	N/A	27	17	26	2	67	N/A
Peak Troponin T (ng/mL)	0.201	9.9	4.3	5.6	<0.01	12.16	1.34	2.08	1.88
Cardiac Arrest	PEA arrest	No	PEA arrest	No	No	No	PEA arrest	VF/VT arrest	VF arrest
LVEF	25%	EF 5%	36%	22%	8%	20%	10%	10%	15%
Duration of VA ECMO	5 days	9 days	5 days	10 days	6 days*	2 days	9 days	8 days	7 days
Survival to Discharge	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes
COVID-19 treatment	Steroid, remdesivir	Steroid, remdesivir, convalescent plasma	Steroid, remdesivir, tocilizumab, IVIG	Steroid, remdesivir, IVIG	Steroid, IVIG, remdesivir	Steroid	Steroid	Steroid	Steroid
Post ECMO LVEF	55%	45%	55%	55%	30%	N/A	55%	50%	57%
Total Hospital LOS	15 days	35 days	104 days	56 days	27 days	2 days	50 days	35 days	17 days
ICU LOS	9 days	16 days	104 days	38 days	27 days	2 days	34 days	35 days	11 days

Sex: M = Male; F = Female; ESR Erythrocyte Sedimentation Rate; CRP: C reactive Protein.

JJ Vaccine – Johnson and Johnson Vaccine received 6 months prior to fulminant myocarditis in this patient.

PEA, pulseless electrical activity; VT, pulseless ventricular tachycardia; VF, ventricular fibrillation.

ICU, intensive care unit; LOS, length of stay; LVEF; left ventricle ejection fraction.

The mean total length of stay was 38 days and ICU length of stay was 31 days. All 7 of the patients who survived showed recovery of the ejection fraction post VA ECMO. Of these 9 patients, 8 were unvaccinated and one had received Johnson and Johnson vaccine (see Table 1).

In our case series, 7 out of 9 patients with FM survived to hospital discharge. Although long-term data on the management and outcomes of FM in COVID-19 is not available, we provide a clear evidence of VA ECMO use and favorable outcome in COVID-19 disease associated FM. Previously, Zeng et al reported the first case of FM requiring ECMO support.[1] Subsequently, Papageorgiou et al. and Marcinkiewicz et al also highlighted the role of VA-ECMO in this patient population with both patients surviving.[2,3] Currently, the incidence of myocarditis after COVID-19 infection is estimated at 150 cases per 100,000 patients and although heavily publicized, the incidence of myocarditis after vaccine administration is rare and the clinical outcome favorable (i.e. not leading to FM). For example, Diaz et al reported the incidence of myocarditis after vaccination at 1 in 100,000 and Montgomery et al reported myocarditis in 23 military personnel out of 2.8 million vaccines administered.[4,5] Notably studies by Diaz and Montgomery et al demonstrated only a minority of patients with diminished ejection fraction (5/20) and (4/23), respectively, while the 9 cases in our study all presented with an ejection fraction of less than 25%. Suggesting de-novo infection and vaccine induced myocarditis may cause different levels of severity in disease phenotype.

In summary, our case series highlights the risk that COVID-19 poses to unvaccinated patients and the severity of FM in COVID-19 disease. We report a favorable survival trend after FM secondary to COVID-19 with VA ECMO support. We also acknowledge that access to this therapy is limited and long-term sequelae of COVID-19 disease and prolonged hospitalization related complications are still underrecognized.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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REFERENCES

1. Zeng J-H, Liu Y-X, Yuan J, et al. First case of COVID-19 complicated with fulminant myocarditis: a case report and insights. Infection 2020;48:773–7. https://doi.org/10.1007/s15010-020-01424-5.
2. Papageorgiou J-M, Almroth H, Törnudd M, van der Wal H, Varelogianni G, Lawesson SS. Fulminant myocarditis in a COVID-19 positive patient treated with mechanical circulatory support – a case report. Eur Hear J Case Rep 2021;5:ytaa523. https://doi.org/10.1093/ehjcr/ytaa523.
3. Marcinkiewicz K, Petryka-Mazurkiewicz J, Nowicki MM, et al. Acute heart failure in the course of fulminant myocarditis requiring mechanical circulatory support in a healthy young patient after coronavirus disease 2019. Kardiol Pol 2021;79:583–4. https://doi.org/10.33963/KP.15888.
4. Barbaro RP, MacLaren G, Boonstra PS, et al. Extracorporeal membrane oxygenation support in COVID-19: an international cohort study of the Extracorporeal Life Support Organization registry. Lancet (London, England) 2020;396:1071–8. https://doi.org/10.1016/S0140-6736(20)32008-0.
5. Montgomery J, Ryan M, Engler R, et al. Myocarditis Following Immunization With mRNA COVID-19 Vaccines in Members of the US Military. JAMA Cardiol 2021;6:1202. https://doi.org/10.1001/jamacardio.2021.2833.

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