



A Successful Case of Cardiac Arrest due to Acute Myocarditis with COVID-19: 120 Minutes on Manual Cardiopulmonary Resuscitation then Venous-Arterial Extracorporeal Membrane Oxygenation

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Abbreviations:

COVID-19: coronavirus disease 2019
CPR: cardiopulmonary resuscitation
ECMO: extracorporeal membrane oxygenation
E-CPR: extracorporeal cardiopulmonary resuscitation
EF: ejection fraction
MAP: mean artery pressure
VA-ECMO: veno-arterial extracorporeal membrane oxygenation

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Abstract

Acute myocarditis is one of the common complications of coronavirus disease 2019 (COVID-19) with a relatively high case fatality. Here reported is a fulminant case of a 42-year-old previously healthy woman with cardiogenic shock and refractory cardiac arrest due to COVID-19-induced myocarditis who received veno-arterial (VA) extracorporeal membrane oxygenation (ECMO) after 120 minutes of cardiopulmonary resuscitation (CPR). This is the first adult case of cardiac arrest due to COVID-19-induced myocarditis supported by ECMO that fully recovered with normal neurological functions. The success of the treatment course with full recovery emphasized the potential role of ECMO in treating these patients.

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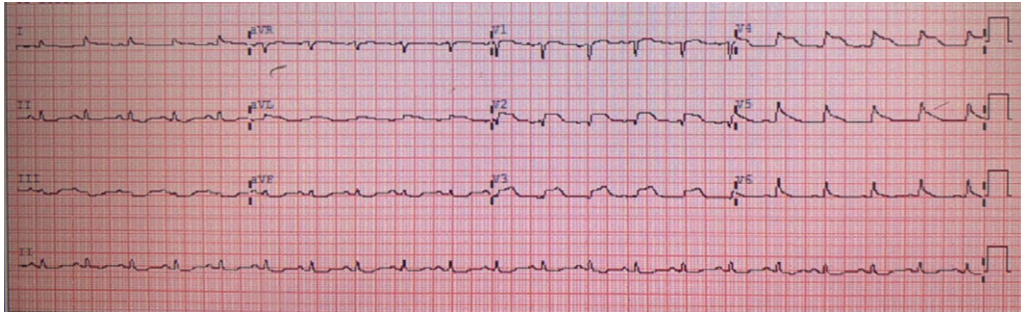
Introduction

Acute myocarditis is one of the relatively common complications of coronavirus disease 2019 (COVID-19), which can lead to serious conditions such as cardiac dysfunctions and cardiogenic shock without appropriate interventions.^{1,2} The prevalence of acute myocarditis among the hospitalized COVID-19 patients was 2.4% with biopsy and 4.2% without biopsy confirmation.¹ A systematic review reported the case fatality rate of myocarditis due to COVID-19 was 14%.²

In fulminant myocarditis due to COVID-19 with refractory cardiogenic shock, extracorporeal cardiopulmonary resuscitation (E-CPR) may be indicated.³ Zeng, et al⁴ reported the first case of fulminant myocarditis due to COVID-19 receiving extracorporeal membrane oxygenation (ECMO) support who did not recover. Recently, Buitrago, et al⁵ reported the first case of COVID-19-induced acute fulminant myocarditis presenting cardiac arrest in a 12-year-old child who successfully recovered with veno-arterial (VA)-ECMO as a bridge to full recovery. However, until now, there was a lack of information about E-CPR on acute myocarditis due to COVID-19, especially on adult patients. This paper reports the first adult case of acute myocarditis due to COVID-19 with cardiac arrest which was successfully treated with VA-ECMO. Written informed consent was obtained from the patient.

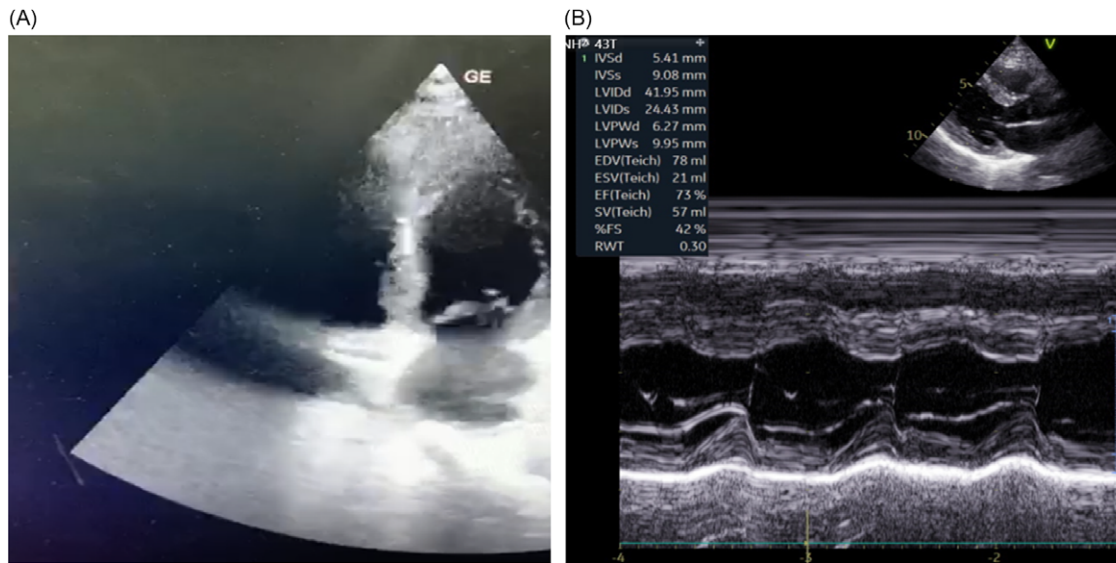
Case Report

A 42-year-old previously healthy female who had received a COVID-19 vaccine three times presented to the emergency department in 2022 with chest pain, dyspnea, lethargy, and fever lasting eight days. She was confirmed COVID-19 positive by reverse transcription polymerase chain reaction test with CT value of 17. Upon examination, she had a pulse of 130 beats per minute, blood pressure 80/40mmHg, and oxygen saturations at 90%. Oxygen, peripheral access lines, 0.9% normal saline, and vasoactive and inotropic was



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Figure 1. Electrocardiogram on Admission Significant for ST-Segment Elevations in V2-5.



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Figure 2. Echocardiogram Showed: (A) Reduced Left Ventricular Systolic Function with Normal Right Ventricular Systolic Function and Dimensions on Admission; and (B) Recovery of Ventricular Systolic Function and Ejection Fraction on Day 14.

given. Electrocardiogram showed significant ST segment elevation in V2-5 (Figure 1). Transthoracic echocardiogram showed the reduction of left ventricular systolic function with normal right ventricular systolic function and dimensions with an ejection fraction (EF) at 25% (Figure 2a). Laboratory findings showed an elevation of some markers: troponin T (3253ng/L); proBNP (10068pg/ml); D-dimer (3470ng/mL); GOT (122U/L); GPT (258U/L); CK (1792U/L); and CK-MB (121U/L). Both acute myocardial infarction and acute myocarditis were suspected.

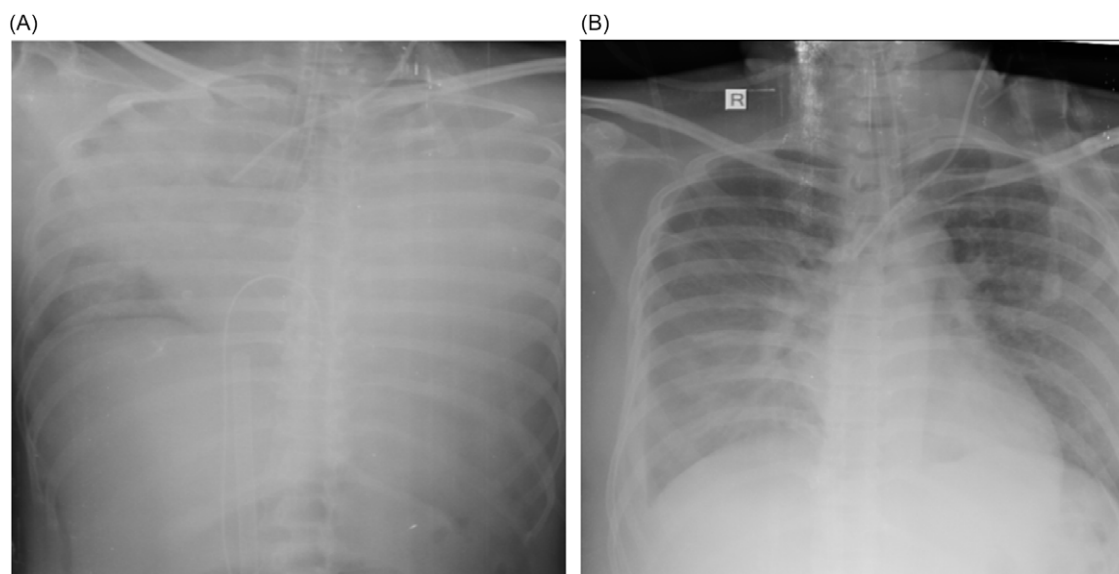
Coronary arteriography showed no stenosis (Figure 3). During the procedure, cardiac arrest occurred with pulseless ventricular fibrillation, which did not respond to defibrillation and cardiopulmonary resuscitation (CPR) for 120 minutes. Then, VA-ECMO was initiated with femoral cannulation at the bedside. The flow was established at 3.2L/minute, remaining mean artery pressure (MAP) at least 65mmHg. When the patient was stable, a back flow cannula was performed.

Acute myocarditis was diagnosed clinically based on the criteria proposed by the European Society of Cardiology (Brussels, Belgium) in 2013 without myocardial biopsy.⁶ The course of treatment included: vancomycin, imipenem, methylprednisolone, invasive ventilation; and continuous veno-venous hemodiafiltration during VA-ECMO because of uremia and lactic elevation acidosis.



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Figure 3. Normal Function of Coronary Artery on Coronary Arteriography.



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Figure 4. Chest X-Ray Showed: **(A)** Pulmonary Edema on Admission; and **(B)** Improvements on Day 7.

Chest x-ray revealed pulmonary edema (Figure 4a) with worsening oxygenation.

On hospital Day 3, the patient recovered consciousness. On Day 4, the kidney function improved and the hemodiafiltration was terminated. The hemodynamics stabilized (a pulse pressure was 15mmHg, and MAP was over 65mmHg without vasoactive and inotropic support), and the patient started weaning off VA-ECMO slowly. On Day 7, the patient tolerated clamping ECMO cannula; echocardiogram showed improved left ventricular systolic function with an EF of 60%; chest x-ray was improved (Figure 4b). Decannulation and extubation was performed on the same day. On Day 14, the patient was discharged home from the hospital with stable cardiopulmonary function and the echocardiogram showed the recovery of ventricular systolic function (Figure 2B) and full neurologic recovery.

Discussion

To the authors' knowledge, this is the first reported adult patient of COVID-19-induced acute myocarditis with cardiac arrest who fully recovered after VA-ECMO support. Conventional CPR was performed for 120 minutes until bedside ECMO could be placed. Despite this delay, due to unavailability of the ECMO team in the hospital, the use of ECMO was decided because of the following reasons: the patient was young; the arrest occurred in a hospital, was witnessed, and high-quality CPR was started immediately, therefore the "no flow time" was zero; and good recovery of neurologic function was expected. The longer the time between cardiac arrest and initiation of E-CPR, the worse the prognosis tends to be. It is reported that only approximately 15% of the patients survive when arrest to E-CPR interval exceeded 40 minutes.⁷

Because of poor outcomes among cardiac arrest patients due to COVID-19 with conventional CPR, E-CPR may be considered

for a certain group of cardiac arrest patients with young age and shockable initial rhythms, particularly when they have reversible conditions such as acute myocarditis. Such patients have relatively favorable outcomes.^{3,8} Thus, E-CPR can buy time to reverse the reversible conditions. This case had all of these conditions, and it was decided to perform VA-ECMO even after 120 minutes of cardiac arrest.

Acute and fulminant myocarditis requires prompt management, whereas sometimes differentiation of myocarditis from acute myocardial infarction is difficult because of their similar symptoms and test results. Both diseases present typical or atypical chest pain, abnormal ST on electrocardiogram, wall motion abnormalities on echocardiogram, and elevated markers;^{9,10} however, treatments for these two diseases are quite different. Waiting for myocardial biopsy or cardiac magnetic resonance as a definitive diagnosis is unacceptable in critical cases. The European Society of Cardiology proposed criteria for clinical diagnosis to prompt the management of acute myocarditis.⁶ The Chinese expert consensus recommended coronary arteriography to clinically differentiate between them.

Coronary arteriography does not increase a risk of death among myocarditis patients, although it is an invasive test.¹¹ In this case, pulseless-ventricular fibrillation suddenly happened during the angiography, but there was no evidence to suggest that cardiac arrest was related to coronary angiography, particularly in cardiogenic shock.

Conclusion

With a successful treatment and complete recovery of neurological function, this was the second reported case of successful recovery from COVID-19-induced acute myocarditis with cardiac arrest, and the first adult case world-wide. This successful case emphasizes the potential role of VA-ECMO in treating COVID-19-related cardiac arrest patients.

References

1. Ammirati E, Lupi L, Palazzini M, et al. Prevalence, characteristics, and outcomes of COVID-19-associated acute myocarditis. *Circulation*. 2022;145(15):1123–1139.
2. Haussner W, DeRosa AP, Haussner D, et al. COVID-19-associated myocarditis: a systematic review. *Am J Emerg Med*. 2022;51:150–155.
3. Shekar K, Badulak J, Peek G, et al. Extracorporeal life support organization coronavirus disease 2019 interim guidelines: a consensus document from an international group of interdisciplinary extracorporeal membrane oxygenation providers. *ASAIO J*. 2020;66(7):707–721.

4. Zeng JH, Liu YX, Yuan J, et al. First case of COVID-19 complicated with fulminant myocarditis: a case report and insights. *Infection*. 2020;48(5):773–777.
5. Buitrago DH, Munoz J, Finkelstein ER, Mulinari L. A case of fulminant myocarditis due to COVID-19 in an adolescent patient successfully treated with venous arterial ECMO as a bridge to recovery. *J Card Surg*. 2022;37(5):1439–1443.
6. Caforio AL, Pankuweit S, Arbustini E, et al. Current state of knowledge on etiology, diagnosis, management, and therapy of myocarditis: a position statement of the European Society of Cardiology Working Group on Myocardial and Pericardial Diseases. *Eur Heart J*. 2013;34(33):2636–2648.
7. Yukawa T, Kashiura M, Sugiyama K, Tanabe T, Hamabe Y. Neurological outcomes and duration from cardiac arrest to the initiation of extracorporeal membrane oxygenation in patients with out-of-hospital cardiac arrest: a retrospective study. *Scand J Trauma Resusc Emerg Med*. 2017;25(1):95.
8. Shao F, Xu S, Ma X, et al. In-hospital cardiac arrest outcomes among patients with COVID-19 pneumonia in Wuhan, China. *Resuscitation*. 2020;151:18–23.
9. Fraser M, Agdamag ACC, Maharaj VR, et al. COVID-19-associated myocarditis: an evolving concern in cardiology and beyond. *Biology (Basel)*. 2022;11(4):520.
10. Inciardi RM, Lupi L, Zaccone G, et al. Cardiac involvement in a patient with coronavirus disease 2019 (COVID-19). *JAMA Cardiol*. 2020;5(7):819–824.
11. Wang D, Li S, Jiang J, et al. Chinese Society of Cardiology expert consensus statement on the diagnosis and treatment of adult fulminant myocarditis. *Sci China Life Sci*. 2019;62(2):187–202.