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.

to discharge, but 12 of these patients required discharge to a long-term acute care or rehab hospital and 2 of these individuals required readmission for ventilator weaning. Although one-third of those who survived were discharged directly home, we can assume that their recuperation continued for a significant length of time. In sum, the pandemic has exacted a toll not only on its victims but also on those who survive and the nurses and doctors who make exhaustive efforts to save a life.

Postpandemic, I believe that the role of venovenous (VV) ECMO in rescuing any number of patients who are positive for coronavirus disease 2019 will be heralded as a success story. As the authors mention, they chose not to include in their analysis the 2 patients who were initiated on venoarterial (VA) ECMO. Undoubtedly, the effectiveness of VA ECMO for this disease will not mirror that of VV ECMO. While a consensus statement from the ELSO Guideline Working Group does not specifically recommend against VA ECMO, enhanced discretion must be taken when selecting these patients, as anecdotal evidence has not been encouraging.[2]

The authors should be commended for their hard work in taking care of their patients and describing their experience. Unfortunately, this paper is just further evidence for what hasn't been done on a larger scale to prevent human suffering. What could have been will never be. Tragic.

References

1. Shih E, DiMaio JM, Squiers JJ, Banwait JK, Meyer DM, George TJ, et al. Venovenous extracorporeal membrane oxygenation for patients with refractory coronavirus disease 2019 (COVID-19): multicenter experience of referral hospitals in a large healthcare system. *J Thorac Cardiovasc Surg*. 2022;163:1071-9.e3.
2. Shekar K, Badulak J, Peek G, Boeken U, Dalton HJ, Arora L, 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;66:707-21.

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Commentary: COVID-19 extracorporeal membrane oxygenation: A long way from home

David A. Baran, MD, FACC, FSCAI, FHFSA,[a] and Hannah Copeland, MD[b]

David A. Baran, MD, FACC, FSCAI, FHFSA, and Hannah Copeland, MD

CENTRAL MESSAGE

Interest is increasing in the use of rescue venovenous extracorporeal membrane oxygenation to treat patients with COVID-19 infection. Careful patient selection and preparation for lengthy support times are imperative.

Before the current COVID-19 crisis, there was the H1N1 influenza pandemic in 2009.[1,2] This pathogen was associated with a high incidence of severe respiratory failure, and in that setting, use of veno-veno extracorporeal membrane oxygenation (VV-ECMO) became much more common in expert centers.[3-5] The majority of injuries from H1N1 were respiratory, although other effects were noted. Now, 11 years later, the world is battling the SARS-CoV2 virus and COVID-19. Naturally, the inclination is to examine previous strategies, in particular VV-ECMO.

From [a]Advanced Heart Failure Center, Sentara Heart Hospital, Eastern Virginia Medical School, Norfolk, Va; and [b]Cardiovascular Surgery, Lutheran Hospital, and Surgery, Indiana University School of Medicine, Fort Wayne, Ind.

Disclosures: Dr Baran has consulted for Getinge, LivaNova, Abiomed, and Abbott; has spoken for Pfizer; and serves on steering committees for Procyrion and CareDx. Dr Copeland has served as a consultant for Bridge to Life and Paragonix.

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Address for reprints: Hannah Copeland, MD, Lutheran Hospital, 7910 W Jefferson Blvd, Suite 102, Fort Wayne, IN 46804 (E-mail: hannahcopeland411@gmail.com).

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In this issue of the *Journal*, Shih and DiMaio[6] report the use of VV-ECMO in patients with COVID-19–related respiratory failure patients in a large US health care system. Their cohort comprised 37 patients with proven COVID-19 and respiratory failure who underwent VV-ECMO support at 4 centers in their health care system. These patients represented 1.4% of the 2557 patients who were hospitalized with COVID-19 and 12.5% of the 320 who were intubated. The strengths of this report include a uniform approach to patient management and strict criteria for using VV-ECMO across centers, as well as a full reporting of the outcomes. More than one-half of the patients survived to discharge (56.8%), but most were either sent back to the referring facility or transferred to a long-term acute care facility for ventilator weaning. Only 7 of 37 (18.9%) were able to go home directly, and there is no information on the postdischarge outcomes.

Clearly, COVID-19 is a multisystem illness, and using the same playbook as that used for the H1N1 pandemic will not suffice. The SARS-CoV2 virus is quite infectious, and the number of cases is staggeringly large. In addition to cardiac damage,[7] hypercoagulability,[8] neurologic issues[9] and others, this disease can result in irreversible lung damage necessitating lung transplantation. The experience with COVID ECMO is in sharp contrast to the H1N1 experience, where mortality was approximately 21% in one large study.[3]

A few points should be emphasized. First, patient selection is one of the most important aspects of an ECMO program. COVID patients must be screened carefully for other organ system dysfunction, including those that develop as a result of the viral infection. In the current report, ECMO was withdrawn for futility in 35.1% of patients, despite strict screening for candidacy. Perhaps with further research, we will be able to develop scoring systems specific to COVID respiratory failure to help teams avoid futile care.

Second, the program must be prepared for lengthy intensive care unit (ICU) stays and the associated resource requirements. In this report, the median ICU length of stay was 31 days among survivors, with a median total hospital length of stay of 44 days. This is similar to other ECMO experiences,[4,5,10,11] and thus hospitals need to consider the availability of ICU beds when committing to supporting a COVID patient with VV ECMO.[2,12]

Finally, there are recent unpublished reports of lung transplantation in COVID patients who cannot be weaned from support.[13] Transplantation may be an option for a rare subset of patients, but it will be important for ECMO centers to partner with those groups offering such high-risk lung transplants to appropriately identify candidates for this therapy.

In the end, however, VV ECMO and lung transplant are very limited and precious resources. The majority of critically ill patients with COVID-19–related refractory respiratory failure will die, and even those who are rescued with VV-ECMO face a daunting gauntlet to overcome. With <20% of patients recuperating sufficiently to be directly discharged to home following ECMO support, we need to allocate these resources in a very focused fashion. Most patients with COVID-19 will remain a long way from home.

References

1. Kumar A, Zarychanski R, Pinto R, Cook DJ, Marshall J, Lacroix J, et al. Critically ill patients with 2009 influenza A(H1N1) infection in Canada. *JAMA*. 2009;302:1872-9.
2. Hubmayr RD, Farmer JC. Should we "rescue" patients with 2009 influenza A(H1N1) and lung injury from conventional mechanical ventilation? *Chest*. 2010;137:745-7.
3. Davies A, Jones D, Bailey M, Beca J, Bellomo R, Blackwell N, et al. Extracorporeal membrane oxygenation for 2009 influenza A(H1N1) acute respiratory distress syndrome. *JAMA*. 2009;302:1888-95.
4. Chan KK, Lee KL, Lam PK, Law KI, Joynt GM, Yan WW. Hong Kong's experience on the use of extracorporeal membrane oxygenation for the treatment of influenza A (H1N1). *Hong Kong Med J*. 2010;16:447-54.
5. Freebairn R, McHugh G, Hickling K. Extracorporeal membrane oxygenation for ARDS due to 2009 influenza A(H1N1). *JAMA*. 2010;303:941-2; author reply 942.
6. Shih E, DiMaio JM, Squiers JJ, Banwait JK, Meyer DM, George TJ, et al. Venovenous extracorporeal membrane oxygenation for patients with refractory Coronavirus disease 2019 (Covid-19): multicenter experience of referral hospitals in a large healthcare system. *J Thorac Cardiovasc Surg*. 2022;163:1071-9.e3.
7. Fried JA, Ramasubbu K, Bhatt R, Topkara VK, Clerkin KJ, Horn E, et al. The variety of cardiovascular presentations of COVID-19. *Circulation*. 2020;141:1930-6.
8. Terpos E, Ntanasis-Stathopoulos I, Elalamy I, Kastritis E, Sergentanis TN, Politou M, et al. Hematological findings and complications of COVID-19. *Am J Hematol*. 2020;95:834-47.
9. Waldman G, Mayeux R, Claassen J, Agarwal S, Willey J, Anderson E, et al. Preparing a neurology department for SARS-CoV-2 (COVID-19): early experiences at Columbia University Irving Medical Center and the New York Presbyterian Hospital in New York City. *Neurology*. 2020;94:886-91.
10. Freed DH, Henzler D, White CW, Fowler R, Zarychanski R, Hutchison J, et al. Extracorporeal lung support for patients who had severe respiratory failure secondary to influenza A (H1N1) 2009 infection in Canada. *Can J Anaesth*. 2010;57:240-7.
11. Noah MA, Peek GJ, Finney SJ, Griffiths MJ, Harrison DA, Grieve R, et al. Referral to an extracorporeal membrane oxygenation center and mortality among patients with severe 2009 influenza A(H1N1). *JAMA*. 2011;306:1659-68.
12. Dalton HJ, MacLaren G. Extracorporeal membrane oxygenation in pandemic flu: insufficient evidence or worth the effort? *Crit Care Med*. 2010;38:1484-5.
13. Chen JY, Qiao K, Liu F, Wu B, Xu X, Jiao GQ, et al. Lung transplantation as therapeutic option in acute respiratory distress syndrome for coronavirus disease 2019-related pulmonary fibrosis. *Chin Med J (Engl)*. 2020;133:1390-6.