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INVITED COMMENTARY

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Optimal therapeutic strategy using extracorporeal membrane oxygenation in patients with COVID-19

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In the current coronavirus disease 2019 (COVID-19) pandemic, severe hypoxemic respiratory failure refractory to conventional mechanical ventilation therapy is likely becoming a growing clinical concern in centers encountering a high-case load of patients infected with COVID-19. As a result, many centers are utilizing veno-venous extracorporeal membrane oxygenation (VV-ECMO) therapy in cases of refractory hypoxemia despite all available mechanical ventilation and oxygenation strategies.[1] Inherent risks of both prolonged mechanical ventilation and VV-ECMO exist, with no robust outcome-analyses available to accurately guide treatment strategies in these critically ill patients.

We sincerely congratulate Rinewalt et al[2] for their successful management of a patient with COVID-19 who was bridged to recovery using VV-ECMO, along with their reported techniques used to further trouble-shoot residual hypoxemia despite VV-ECMO support. We agree with the authors that strict center-specific inclusion criteria for these limited resources need to be established based on the anticipated benefit to the patient, consideration of ECMO-related risks (coagulopathy, cannulation-related complications), along with practitioner expertize and resources.

As more outcome data in patients with COVID-19 receiving salvage VV-ECMO therapy becomes available, a scoring system would potentially be useful to estimate prognosis following ECMO initiation. Ultimately, a patient can be supported for weeks on this therapy but if predicted odds of survival to discharge are low, an argument can be made not to initiate VV-ECMO if resources are scarce. Limited case-series thus far have reported mortality >50% in patients with COVID-19 on VV-ECMO[3]—clearly more data is needed to better ascertain survival benefit which can further inform appropriate use in the future cases. In the interim, a decision to proceed with VV-ECMO is best guided from protocols stemming from prior randomized control studies of patients with acute respiratory distress syndrome (ARDS) as directed by the ECMO for EOILA (severe acute respiratory distress syndrome) trial.[4]

Another concern is the optimal management of patients while on VV-ECMO. COVID-19 infection may also pose unique physiologic perturbations not seen in other cases of ARDS, including combined hemodynamic deterioration due to either vasodilatory or cardiogenic shock. As the authors described, hypoxemia may worsen in the event of high-cardiac output due to sepsis or febrile states, for which the flow from the VV-ECMO circuit cannot match. This results in a considerable component of the native cardiac output remaining deoxygenated when returning to the lungs from the outflow cannula of the ECMO circuit, potentially contributing to further hypoxemia. Instead of increasing the ECMO flow, which could precipitate recirculation between the inflow and outflow circuits thus mitigating any benefits, beta-blockers use may help optimize the ratio of ECMO blood flow to native cardiac output through attenuating myocardial inotropy, helping resolve this specific cause of hypoxemia.[5]

Management of tachyarrhythmia may also help in maximizing gas exchange during VV-ECMO support. As an alternative to esmolol that the authors used,[2] novel agents including landiolol for atrial fibrillation and ivabradine for sinus tachyarrhythmia may also be considered for further heart rate optimization.[6,7]

If COVID-19 related cardiac dysfunction develops requiring conversion to veno-arterial (VA) ECMO, invasive right heart catheterization can be extremely helpful for accurate and tailored hemodynamic management. Furthermore, invasive hemodynamics and echocardiography are crucial to assess for unintended hemodynamic effects of VA-ECMO in the setting of cardiac dysfunction, which include left ventricular distension, aortic valve closure, and pulmonary edema. In this scenario, percutaneous left ventricular assist device systems, such as the Impella (Abiomed, Danvers, MA), can be added to unload the left ventricle in the

setting of dramatic increases in systemic afterload that often occurs after peripheral VA-ECMO initiation.[8,9]

As stated by the authors, careful monitoring of coagulation parameters including assessment of markers of hemolysis, disseminated intravascular coagulation, and acquired von Willebrand disease are needed with long-term ECMO support, in addition to close assessment for catheter-related complications.[10]

Careful deliberation of both risks and benefits of escalation to VV-ECMO support in patients with COVID-19-related ARDS need to be taken, accounting for the possibility of eventual liberation from both ECMO and mechanical ventilation. Escalation to VV-ECMO to wean the patient mechanical ventilation may reduce the risks associated with prolonged mechanical ventilation including barotrauma and needs for deep sedation while allowing for the patient to participate in rehabilitation. Potential disadvantages of proceeding with lung bypass exclusively are alveolar derecruitment which may occur without mechanical ventilation. Ultimately, both strategies have advantages and disadvantages, though the ultimate outcome in these critically ill patients can vary considerably, with no current established exit strategy in the event of non-recoverable lung injury.

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