An Innovative ECMO Configuration for Refractory Hypoxemia in COVID-19-Induced ARDS

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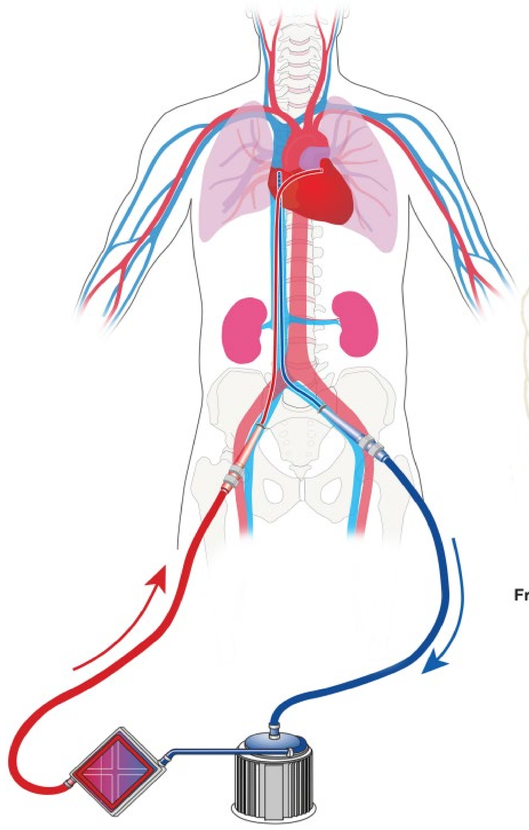
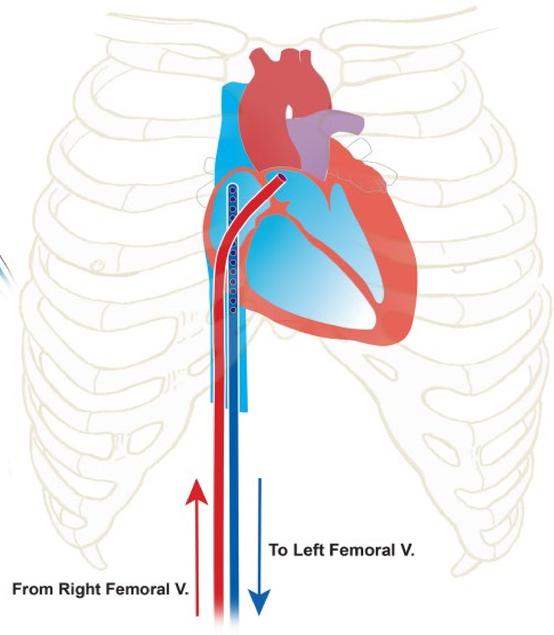
Introduction

The use of veno-venous extracorporeal membrane oxygenation (VV-ECMO) as a rescue therapy for patients with severe acute respiratory distress syndrome (ARDS) has proven mortality benefit without severe disability compared to conventional ventilator management strategies. Its use has become increasingly frequent during the current pandemic for patients with ARDS secondary to SARS-CoV-2 (COVID-19) pneumonia. However, insufficient oxygenation may persist due to multiple factors, including recirculation, shunting, and inadequate flow delivery secondary to supraphysiologic states such as sepsis. Similarly, left atrial veno-arterial (LAVA) ECMO has recently gained traction as a successful strategy for left ventricular unloading in patients requiring systemic hemodynamic support in cardiogenic shock. By combining principles of these techniques, our institution has developed a novel VV-ECMO configuration with placement of the return cannula directly into the left atrium for patients with refractory hypoxemia despite traditional cannulation previously.





Methods

During VV-ECMO, venous blood is drained into a pump-driven circuit where carbon dioxide is removed and blood is oxygenated before being returned into the venous system. In our novel approach, the inflow cannula is placed via the femoral vein and positioned in the cavoatrial junction as with a traditional configuration. The outflow cannula, however, is placed directly in the left atrium via transseptal puncture.

Results

VV-ECMO utilizing right atrial-to-left atrial cannulation has been successfully performed at our institution on two patients thus far, both of whom suffered from persistent and refractory hypoxemia despite the use of traditional VV-ECMO and maximum ventilatory support. Systemic oxygenation saturation was immediately improved upon reconfiguration of the ECMO circuit, with SpO2 of 98% or greater in both cases. Unfortunately, both patients developed progressive shock and multiorgan failure, and families elected to withdraw care before long-term data could be obtained.

Conclusion

The use of this innovative technique delivers oxygenated blood directly into the systemic circulation, thereby avoiding many of the common pitfalls experienced with traditional VV-ECMO in patients with severe ARDS from COVID-19 and therefore allowing patients to come off sedation and paralytics while awaiting lung recovery, or as a bridge to transplantation.