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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Editorial

Extracorporeal Membrane Oxygenation – Crucial Considerations during the Coronavirus Crisis

Introduction

THE ILLNESS caused by severe acute respiratory syndrome–related coronavirus-2 commenced in December 2019 and is now a worldwide crisis.[1,2] Although patients with this infection may have mild-to-moderate disease with clinical recovery, some may develop severe respiratory failure with or without cardiovascular collapse.[3,4] The high risks of infection have mandated rigorous infectious precautions and adjusted workflows for patient care, including airway management, echocardiography, cardiothoracic and vascular procedures, and extracorporeal membrane oxygenation (ECMO).[5-11]

The purpose of this freestanding editorial is to highlight the considerations in ECMO for critically ill patients with this important disease. The Extracorporeal Life Support Organization recently released a guideline to outline strategies for this mechanical therapy in this setting.[5] The present clinical focus includes best practices to disseminate the highest standards for care of both our patients and ourselves during this crisis. The provided references also can serve as a guide for health care teams as they manage the demands of the pandemic at their respective institutions.

Consider the Key Components and Indications for ECMO

The key components for the planning and provision of ECMO services in this pandemic include the following considerations: personnel, equipment, facilities, and support systems.[11-16] Although ECMO has been recommended by the World Health Organization in settings with access to this expertise at experienced centers, current guidelines from the Extracorporeal Life Support Organization further emphasize that ECMO primarily should be considered as a supportive modality in experienced centers.[12-16]

Furthermore, an additional key consideration is that ECMO is a rescue strategy for severe adult respiratory distress syndrome.[5] The initial management priorities in this challenging scenario include treating the underlying cause, securing the airway, optimizing protective low-stretch lung ventilation, and providing judicious fluid therapy and titrated diuresis.[5,14] In the setting of these management approaches, oxygenation still may deteriorate as measured by decreases in the blood oxygen tension/inspired oxygen ratio.[14,15] When this ratio decreases to less than 150 mmHg, additional recommended interventions include recruitment maneuvers, prone positioning, neuromuscular blockade, titration of positive end-expiratory pressure, and inhaled pulmonary vasodilators such as nitric oxide and epoprostenol.[5]

If the ratio decreases to less than 80 mmHg for 6 hours, or to less than 50 mmHg for 3 hours, then ECMO should be considered in the absence of institution-specific contraindications.[12-14] A third recognized indication for ECMO in this setting is based on a deteriorating arterial blood gas, namely a pH less than 7.25 with a blood carbon dioxide tension greater than 60 mmHg for at least 6 hours.[5] Although ECMO is the primary strategy for management of refractory hypercarbia in this clinical setting, extracorporeal carbon dioxide removal may have a role in highly selected patients.[16,17]

The contraindications for ECMO in patients with coronavirus virus infection must be hospital-specific, taking into account factors such as experience with ECMO and availability of resources in real time during the pandemic.[12-14] Furthermore, patient comorbidities such as advanced age, frailty, chronic lung disease, diabetes, heart failure, and prolonged mechanical ventilation significantly increase mortality risk in severe coronavirus infection and consequently may be contraindications to ECMO.[14-16] The indications and contraindications to ECMO during the coronavirus crisis should be adjusted in real time to local factors.

Consider the Personnel in ECMO

The assignment and management of personnel in the delivery of ECMO services at an experienced center should be centralized.[18,19] There should be a clear chain of command that can dynamically lead the ECMO service line through the pandemic landscape.[20,21] It is important to have flexible staffing models that maintain both the institutional standards and adequate

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reserves that can accommodate staff attrition.[12-14] Experienced centers may have to augment their relationships with referring centers with respect to advice, support, and transport protocols to accommodate the full effect of this pandemic, including the highly infectious nature of the coronavirus infection.[1-4,22]

All ECMO personnel will require site-specific intensive training for the unique considerations of active coronavirus infection. These unique considerations cover indications and contraindications for ECMO; infectious hygiene; full barrier precautions, including personal protective equipment; and control of aerosolization during airway management, echocardiography, and transport.[5-12] Patients may have to be grouped into cohorts for ECMO support in clearly designated hospital areas that are equipped and managed appropriately for maximal precautions.[12-14]

Consider the Equipment in ECMO

The management of the ECMO equipment is essential to facilitate a smooth hardware process during the surge phase of the pandemic.[23] There should be a record of all equipment that can track hardware movement throughout the health system in real time. This tracking and managing of hardware are best managed centrally with attention to reserves, changes in demand, control of waste, and avoidance of regional hoarding.[12-14] In the setting of a mobile lung rescue service, this hardware should be added to the central registry, including mobile echocardiography.[22-24] The availability of all hardware supplies also could be a combination of regular supplies and additional supplies specific for a patient with suspected or known coronavirus infection. The titration of clinical simulation can greatly enhance best practices for appropriate use of all these supplies across all team members and member institutions.[12-14]

Consider the Facilities

The preparations and management of the ECMO service line during the coronavirus crisis ideally should be part of the coordinated response from the health system in question.[25,26] A flexible strategy to accommodate infected patients requiring ECMO support may necessitate thoughtful development of bed capacity across the health system, including regional coalition with neighboring hospitals as needed.[25] These plans for bed capacity also should include resilient and synergistic approaches within and across centers to address clustering of cases, infection control, patient transport, and waste management.[12-14] The ECMO teams should be protected and supported through the crisis with a dedicated leadership team, a focus on infection prevention, and an emphasis on high-quality open and transparent communication.[25,26]

Consider the Support Systems

The support systems for the delivery of high-quality ECMO services should focus on the dynamics of the personnel, hardware quality and supply, and the clinical space.[25,26] Key processes in this arena include communication, coordination, resource allocation, contingency planning and management, information tracking, quality assurance, and focused research opportunities.[12-14] Critical information should be transmitted in a timely and agile fashion to all team members via multiple platforms including team meetings, a telephone hotline, text-based messages, and e-mail groups.[25]

The support of the health care team members and their families is an important component for successful navigation through the coronavirus crisis.[25-28] The negative psychological effect of quarantine can be considerable, including confusion, anger, and posttraumatic stress disorder.[27,28] The factors that can significantly increase the effect of quarantine on psychological well-being include stressors such as quarantine duration, levels of frustration and fear, boredom, perceived risks of infection, deficiencies in supplies and information, financial loss, and stigma.[28] The management of these stressors can mitigate to a large extent the negative psychological effects of quarantine for team members and their families who are navigating this process.

Conclusions

The current coronavirus crisis has challenged the delivery of high-acuity care worldwide, including the planning and providing of ECMO services. The delivery of the best care in ECMO for patients with coronavirus infection ideally should include consideration of the following factors in this challenging setting: indications, contraindications, personnel, equipment, health care facilities, and support systems. A sustained focus on infection control to prevent transmission of coronavirus remains essential during the conduct of ECMO in this pandemic.

Conflict of Interest

The author has no conflict of interest.

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