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Ethical Dilemmas Encountered With the Use of Extracorporeal Membrane Oxygenation in Adults

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Extracorporeal membrane oxygenation (ECMO) can serve as a bridge to recovery in cases of acute reversible illness, a bridge to transplantation in circumstances of irreversible cardiac or respiratory failure, a bridge to ventricular assist device therapy in select cases of cardiac failure, or a bridge to decision when the prognosis remains uncertain. Recent advances in ECMO technology that allow for prolonged support with decreased complications, the development of mobile ECMO teams, the rapidity of initiation, and the growing body of evidence, much of which remains controversial, have led to a significant increase in the use of ECMO worldwide. This increasing use of a technology that is not a destination device in itself introduces many ethical dilemmas specific to this technology. In this article, we explore some of the ethical issues inherent in the decisions surrounding the initiation and withdrawal of ECMO by raising key questions and providing a framework for clinicians. We will address extracorporeal cardiopulmonary resuscitation, the inability to bridge a patient to transplant or recovery—the so-called "bridge to nowhere"—and the significance of resuscitation preferences in the setting of continual extracorporeal circulatory support. ***CHEST 2014; 145(4):876–882***

Abbreviations: DNR = do not resuscitate; ECMO = extracorporeal membrane oxygenation; ECPR = extracorporeal CPR; VAD = ventricular assist device

Extracorporeal membrane oxygenation (ECMO) refers to an extracorporeal circuit through which blood is oxygenated and CO_2 is removed. With current technology, severe respiratory or cardiac failure may be either partially or completely supported with ECMO. Advances in extracorporeal technology and techniques as well as the creation of mobile ECMO teams that can retrieve and transport patients on the mechanical device have contributed to the expansion of its use worldwide.[1,2] The ability of ECMO to replace the function of the heart or lungs, and to do so rapidly and for prolonged periods of time, allows ECMO to be used as a bridge to recovery in cases of potentially reversible organ failure, a bridge to transplant in cases of end-stage cardiac or respiratory failure, a bridge to device therapy in select cases of cardiac failure, or a bridge to decision when the prognosis remains uncertain, for instance, when used in cardiac arrest, referred to as extracorporeal CPR (ECPR) (Fig 1).[3-7] Given the numerous potential applications for ECMO in critically ill patients, ethical issues will inevitably emerge regarding its appropriate initiation and management.

The concept of extracorporeal device-based therapy for providing organ support is not new. The ventricular assist device (VAD), used to support refractory heart failure, is comparable to ECMO in that it can provide significant circulatory support, and ECMO may serve as a bridge to VAD therapy. However, in

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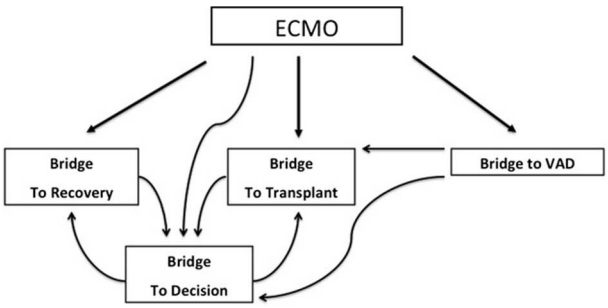

FIGURE 1. Decision tree for ECMO in cardiac or respiratory failure. ECMO = extracorporeal membrane oxygenation; VAD = ventricular assist device.

patients with refractory respiratory failure, no destination device option currently exists, meaning that patients receiving ECMO support are necessarily confined to the ICU. Circumstances may arise when a patient receiving ECMO is unable to be bridged to recovery, transplant, or destination device therapy, yet the patient is capable of surviving with ongoing ECMO support. Such an ethically challenging and emotionally charged situation is sometimes referred to as a "bridge to nowhere," with obvious implications for the patient, his or her family, the caregivers, the hospital, and the health-care system. Addressing the ethical issues that accompany ECMO becomes even more essential as the medical community has seen a significant expansion in case volume, due in part to the ease with which it can be initiated.[1] Despite its increased use, data regarding its efficacy are limited. The strongest evidence supporting ECMO for respiratory failure comes from the randomized controlled trial Efficacy and Economic Assessment of Conventional Ventilatory Support Versus Extracorporeal Membrane Oxygenation for Severe Adult Respiratory Failure (CESAR), which evaluated the use of venovenous ECMO for severe hypoxemic respiratory failure.[8] Although one may conclude that referral to an ECMO-capable center improves survival over conventional management at non-ECMO centers, methodological flaws limit the interpretation of this trial. Other evidence supporting the use of venovenous ECMO is limited to randomized trials with outdated technology or observational studies,[9-14] with propensity analyses demonstrating mixed results.[3,15,16] The data for venoarterial ECMO for ECPR, cardiac failure, and bridge to transplantation are even more limited.[4,5,7,17-20] The use of resource-intensive technology in the absence of data that establish a clear benefit raises ethical issues and, to some degree, requires a societal judgment on the acceptable use of expensive, unproven interventions. This issue is mitigated to some degree by the context in which ECMO is applied. For hypoxemic respiratory failure, it remains a salvage therapy for those unable to be managed with conventional support, with a multicenter randomized controlled trial currently underway to better define its role (ECMO to Rescue Lung Injury in Severe ARDS [EOLIA]).[21] In cases where ECMO serves as a bridge to lung transplantation, randomized trials of ECMO vs invasive mechanical ventilation are difficult to design because of the inevitability of death in those patients in whom ECMO is believed to be the only salvage option.[22] We are, therefore, left with observational studies that have inherent limitations in determining efficacy, although such studies have recently demonstrated improved posttransplant outcomes with ECMO as bridging therapy.[23,24] Ultimately, more data, including cost-benefit analyses, are needed before the medical community and governing bodies that regulate health-care systems will know how to best implement this technology. In the meantime, its judicious use should be based on the medical facts of each case, with careful consideration of the existing evidence and the available resources.

In the current context of expanding ECMO use and increasingly sophisticated technology, even in the absence of high-level evidence, it is important to anticipate and analyze the ethical dilemmas that will inevitably arise and to discuss potential approaches to resolving these complex clinical situations. In this article, we address some of these ethical issues—the use of ECPR, the bridge to nowhere, and the meaning of do not resuscitate (DNR) and CPR on ECMO—through the prism of real clinical scenarios and attempt to provide a framework to approach these dilemmas.

Case One: A 50-year-old man with no known past medical history arrives in the ED with unstable angina. Thirty minutes later he suffers a witnessed cardiac arrest with ventricular tachycardia noted at the outset. Despite 10 min of uninterrupted advanced cardiac life support, there is no return of spontaneous circulation. The attending physician calls a surgery consultation for consideration of ECMO.

To whom should ECPR be offered?

To answer the question of whether to offer ECPR, it is important to first address the role of conventional CPR in cardiac arrest. The use of CPR dates back to 1960. Since the 1970s, CPR has become the default resuscitation status in all cases of cardiac arrest, regardless of cause.[25,26] Although the decision to withhold CPR has been framed as an issue of patient autonomy,[27] others have argued that such decisions should be left to physicians to determine when CPR is futile.[28-30] Still others have suggested changing the default status of CPR when there is a very remote chance of benefit and near certain harm.[26] In such circumstances, a physician should recommend withholding CPR to protect the patient. Although disagreement remains regarding when it is appropriate to withhold CPR, a position advocating for the withholding of ECPR, when the likelihood of survival is remote, is even more compelling.