Use of extracorporeal membrane oxygenation in cardiac arrest: Developing a new frontier

Rohit K. Singal, MD, MSc, FRCSC, and Rakesh C. Arora, MD, PhD, FRCSC

From the Cardiac Sciences Program, I.H. Asper Clinical Research Institute, St. Boniface General Hospital, Winnipeg, Manitoba, Canada.

Disclosures: Authors have nothing to disclose with regard to commercial support.

Received for publication Aug 7, 2015; accepted for publication Aug 8, 2015; available ahead of print Sept 15, 2015.

Address for reprints: Rakesh C. Arora, MD, PhD, FRCSC, Cardiac Sciences Program, 369 Tache Ave, CR 3012, St Boniface General Hospital/I.H. Asper Clinical Research Institute, Winnipeg, Manitoba, Canada R2H 2A7 (E-mail: rakeshcarora@gmail.com).

J Thorac Cardiovasc Surg 2015;150:1350-1

0022-5223/\$36.00

Copyright © 2015 by The American Association for Thoracic Surgery

<http://dx.doi.org/10.1016/j.jtcvs.2015.08.021>

Rohit K. Singal, MD, MSc, FRCSC, and Rakesh C. Arora, MD, PhD, FRCSC

Central Message

The versatility of ECMO in critically ill states is being used increasingly. ECMO-supported cardiopulmonary resuscitation is new frontier for the cardiothoracic surgical team.

See Article page 1344.

The goal of emergency cardiovascular care is to preserve life, restore health, relieve suffering, and limit disability.¹ In this issue of the *Journal*, Peigh and colleagues² have reported a retrospective review of their experience with extracorporeal membrane oxygenation (ECMO) support for in-hospital patients actively undergoing cardiopulmonary resuscitation (E-CPR). They report 30% survival to hospital discharge with reasonable neurologic recovery in patients who had a mean duration of cardiopulmonary resuscitation of 54 minutes. Of note, there were a wide variety of etiologies leading to cardiac arrest.

In addition to the impressive survival in a very ill population, Peigh and colleagues have provided information on certain risk scores at 24 hours of ECMO therapy (Model for End-Stage Liver Disease [MELD], Sequential Organ Failure Assessment [SOFA], Acute Physiology and Chronic Health Evaluation [APACHE II]) as well as certain biochemical measurements at this time point (serum lactate and bicarbonate) that appeared to be different between survivors and nonsurvivors. They have also demonstrated that there were no precannulation prognostic factors identified in their statistical analysis. Additionally, organ procurement from brain-dead patients was facilitated by this use of E-CPR.

In consideration of the potentially increasing use of E-CPR for both in-hospital and out-of-hospital cardiac arrest, important questions will need to be addressed. First, who should compose the team performing emergency ECMO cannulation? Peigh and colleagues have impressively ensured their entire cardiovascular intensive care consultant attending staff, who are also cardiothoracic surgeons, are qualified to place a patient on ECMO. This service is available in hospital during “regular working hours” and also 4 nights per week. Importantly, with the bedside expertise, their rate of cannulation and limb complications was very low to negligible. Although multidisciplinary decision making is paramount in these scenarios, it stands to reason that cardiac surgeons with critical care expertise are ideally suited to be major participants in these discussions while handling

the technical aspect of implementation, management, and decannulation.

Another question that will inevitably arise regards the cost-effectiveness of E-CPR. This is a complex question and will be influenced by several factors that make any analysis of this issue quite challenging. As reports of this nature increase in number, however, it is clear that many centers are “discovering the boundaries” with respect to the use of ECMO. As such, it may be that the “horse has left the barn” on the question as to *whether* we should be performing E-CPR. The appropriate question, therefore, may be whether to *continue* with ECMO once initiated. Furthermore, in the typical clinical scenario, few definitive prognostic variables have been shown to be robust enough to help in decision making with respect to implementation of E-CPR. For example, once major exclusions are considered (as summarized by Peigh and colleagues in their practice, age >70 years, do not resuscitate order, uncorrectable baseline disease, and uncontrolled sepsis or bleeding), treating teams have little else to predict definitively what to expect regarding the outcome of implementation of E-CPR. In many cases, time pressure and limited information under obviously high-risk conditions necessitate quick and committed decision making, and inevitably a proportion of patients with low chance of survival will end up receiving ECMO.

This then leads to the third question. What are the prognostic factors that can assist the health care team in determining the appropriate duration of therapy? The

ascertainment of prognostic information at an early stage of ECMO therapy may facilitate informed, shared decision making regarding the duration of therapy. Peigh and colleagues have demonstrated the potential utility of calculating risk scores and measuring biochemical markers at 24 hours of ECMO therapy in identifying survivors. Although this requires further study, identifying clinical or biochemical markers that would justify early support termination would have the benefit of sparing patients and their families the hardship of unnecessarily prolonged ECMO therapy, as well as increasing the efficient use of health care resources.

The fourth issue to be addressed is developing a standard for reporting outcomes in patients receiving E-CPR. Peigh and colleagues should be congratulated not only on their excellent results (considering the alternative), but also on their demonstration of clear process, excellent technique, and reporting of long-term outcomes. As use of this maximally intensive resuscitation is considered by our community, verification that patients benefit after hospital discharge is of paramount importance. This is especially true because at this stage survival is still not the norm, and evidence of long term benefit as justification for the resource-intensive nature of E-CPR is therefore necessarily required. Reports such as this one verify that there is a role for the use of ECMO after cardiac arrest for appropriately selected patients.

As this practice increases across centers and countries, there is an onus on our community to organize and pool

data to take the next big step in the development of selection criteria and the characterization of long-term outcomes. Others have identified the need for shared protocols to reduce differences related to the center experience and to increase further the availability of ECMO as part of a “bundled” approach for these patients.³ To date, information supporting the utility of E-CPR has largely been generated in the form of nonrandomized studies, case series, and case reports (see Swol and colleagues⁴ for recent review). The time for a multicenter investigative endeavor is now upon us. Once data sharing and analysis are a norm among centers, the possibility for prospective assessment of relevant aspects of technique and management would increase significantly. Ultimately, as a community we would generate the power to determine where, when, and how we can markedly improve outcomes for patients with cardiac arrest.

References

1. Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Part 2: ethical aspects of CPR and ECC. *Circulation*. 2000;102(8 Suppl):I12-21.
2. Peigh G, Cavarocchi N, Hirose H. Saving life and brain with extracorporeal cardiopulmonary resuscitation: A single-center analysis of in-hospital cardiac arrests. *J Thorac Cardiovasc Surg*. 2015;150:1344-9.
3. Lazzeri C, Valente S, Peris A, Gensini GF. Extracorporeal life support for out-of-hospital cardiac arrest: part of a treatment bundle. *Eur Heart J Acute Cardiovasc Care*. May 12, 2015 [Epub ahead of print].
4. Swol J, Belohlávek J, Haft JW, Ichiba S, Lorusso R, Peek GJ. Conditions and procedures for in-hospital extracorporeal life support (ECLS) in cardiopulmonary resuscitation (CPR) of adult patients. *Perfusion*. Jun 16, 2015 [Epub ahead of print].