Temporary mechanical circulatory support for postcardiotomy shock: Don't come late to the party

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Postcardiotomy shock remains a vexing problem as outlined by the high mortality rate in the report by Li and colleagues.¹ Whereas <1% of all cardiac surgery cases required extracorporeal membrane oxygenation (ECMO) during this time interval, the survival rate (34%) reported by Li and colleagues¹ remains unchanged from similar single institution series dating back more than a decade.^{2,3} Why have we made no progress? Is survival of patients dependent on mechanical circulatory support (MCS) following cardiac surgery destined to remain below 50%? Have there been no technologic advances or management breakthroughs affording any meaningful improvements for postcardiotomy shock?

In fact, the opposite is true. There have been numerous developments touted to improve safety, reliability, and simplicity in the field of temporary MCS for failing hearts. For example, centrifugal pumps are now magnetically levitated, improving blood handling characteristics and biocompatibility. Further, extracorporeal oxygenators are made of polymethylpentene, greatly increasing durability and reliability. Integrated pump-oxygenator systems simplify priming and management, potentially making ECMO more accessible for inexperienced centers. Microaxial blood pumps can provide full left ventricular support from a single site of vascular access. With all of these advances, why do outcomes remain so poor? Are the engineering benefits overrated? Is mortality linked to complications incurred directly from temporary MCS devices?

In this study, both lactate levels and clearance of lactate over the initial period of ECMO support were strong predictors of death. Presumably this is a reflection of the degree of shock and injury acquired by end organs from cardiac dysfunction and low cardiac output before instituting MCS. Elevated hepatic transaminases were associated with persistent lactate elevation, suggesting visceral ischemia may not have been reversible, at least in a short time interval.

These findings can be helpful because clinicians must decide if it is appropriate to continue to expend vast resources on patients who may be unsalvageable. Furthermore, when lactate levels do not clear, increasing the degree of MCS should be considered; for example, converting to biventricular support, insertion of additional venous cannulae or a left ventricular vent, or applying limb perfusion techniques.

The more important questions to consider are, Why is the lactate level so high? How long does a patient need to wait in a low cardiac output state before physicians make the decision to support? and How long does it take to insert cannulae and initiate support? When patients fail to wean from cardiopulmonary bypass there is often reluctance to proceed with temporary MCS, despite what we know happens to patients dependent on high-dose pharmacologic infusions.⁴ What are the barriers to earlier initiation? Historically, ECMO and other forms of temporary MCS were fraught with complications from thromboembolism, bleeding, and infections from central cannulation. The few options available were expensive and would frequently expire unused on stockroom shelves, prompting administrators to leave surgeons with few alternatives. Management of patients receiving temporary MCS devices or ECMO was perceived to be complex, and there may have been a sense of intensive care unit panic when such a patient arrives from an operating room in centers that do it infrequently.

Although there continue to be challenges and limitations with temporary MCS, recent advances should at least diminish some of these previous concerns. So, what evidence do we have that earlier initiation would produce better outcomes? One study by Akay and colleagues⁵ reported simply that MCS instituted in operating rooms produced better survival than when support was provided at a later time in intensive care units. The recent multicenter prospective open label trial of the Impella 5.0 microaxial blood pump (Abiomed Inc., Danvers, Mass.) for postcardiotomy shock demonstrated survival of more than 80%, likely from earlier implantation or inclusion of a less ill cohort.⁶

How then can we offer a better outlook for patients with postcardiotomy shock? Perhaps it is time for a prospective, randomized trial. Although cost, consent, and clinical equipoise will invariably present tall hurdles, stagnant results in this area validate the need. In addition, our knowledge is largely based on single institution retrospective reports like that presented by Li and colleagues,¹ with the inherent limitations and biases. The Extracorporeal Life Support Organization maintains a voluntary international registry for patients supported with ECMO (Figure 1). Because the Society

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FIGURE 1. A, Extracorporeal Life Support Organization registry annual cases of patients older than age 16 years placed on extracorporeal membrane oxygenation for cardiac failure. B, Survival of patients older than age 16 years placed on extracorporeal membrane oxygenation for adult cardiac failure.

of Thoracic Surgeons national database and the Interagency Registry for Mechanically Assisted Circulatory Support have generated important knowledge from their multicenter prospectively collected data sets, the Extracorporeal Life Support Organization registry could potentially answer questions about when, how, and who benefits from postcardiotomy mechanical support. Clearly, surgeons have not been convinced that temporary MCS is easier and safer. If we are to ever achieve survival rates better than 50% in patients supported with ECMO, shortening the interval of low cardiac output and end organ ischemia will be required.

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