FIGURE 1. Kaplan-Meier survival curves until 90 days after initiation of venoarterial extracorporeal membrane oxygenation (VA-ECMO) support related to arterial lactate intervals and presence of ischemic heart disease (A) and absence of ischemic heart disease (B), at initiation of venoarterial extracorporeal membrane oxygenation in 105 patients with RPCS.

with absence of IHD, especially when IHD was combined with arterial lactate levels of 10 mmol/L or greater before VA-ECMO.

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<https://doi.org/10.1016/j.jtcvs.2018.12.046>

LACTATE MONITORING FOR RISK STRATIFICATION IN POSTCARDIOTOMY PATIENTS WITH EXTRACORPOREAL MEMBRANE

OXYGENATOR SUPPORT

Reply to the Editor:

Lactate is a useful marker of clinically relevant tissue malperfusion and cellular hypoxia before the development of catastrophic change in cardiovascular status. The importance of postoperative lactate level measurements, not only for monitoring patients after cardiac surgery but to predict when critically ill patients will require extracorporeal membrane oxygenator (ECMO) support as well.¹

Hyperlactatemia is known to be associated with adverse outcome with increased mortality and morbidity, and it appears to be related primarily to a state of inadequate perfusion of impaired peripheral microcirculation and end-organ hypoperfusion owing to a low cardiac output. The genesis and pathophysiology of hyperlactatemia are multifactorial in patients with refractory postcardiotomy cardiogenic shock. Hyperlactatemia is a result of both higher production and lower clearance due to the pathologic process during complicated cardiac surgery. Delayed clearance of lactate because of nonischemic hepatosplanchnic hypoperfusion may contribute to high lactate levels. The liver takes up approximately 60% of the circulating lactate, and most of that lactate is converted back to pyruvate by the hepatocytes. The kidneys are responsible for 30% of lactate metabolism through gluconeogenesis or complete oxidation; in contrast to the liver, however, the

Author has nothing to disclose with regard to commercial support.

ability of the kidneys to remove lactate is increased by acidosis.²

The prognostic impact of hyperlactatemia on mortality has been documented in a postcardiotomy setting, even if there is no cutoff value of lactate that is associated with worse outcome or that can guide resuscitation or hemodynamic management. Lactate clearance has been reported to be more reliable on clinical grounds than absolute value of lactate for risk stratification in refractory postcardiotomy cardiogenic shock.^{3,4} It has been published that lactate behaviors, particularly lactate clearance after ECMO support, are highly associated with in-hospital mortality in postcardiotomy patients.³ In addition, early lactate level reduction has also been seen to be predictive of successful weaning from ECMO.

Through the dynamic behavior of blood lactate with serial measurements, it is possible to estimate the effectiveness of ECMO therapy in restoring circulation and adequate tissue perfusion. If there is no reduction in high lactate levels despite ECMO support, further mechanical circulatory support or application of limb perfusion techniques should be considered.

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<https://doi.org/10.1016/j.jtcvs.2018.12.079>

NEW TRENDS IN CARDIAC SURGERY: TOWARD A LESS- INVASIVE SURGICAL PROCEDURE

To the Editor:

We read with interest the article by Quan and colleagues.¹ The authors report on a 41-year-old man with advanced cardiomyopathy complicated

with cardiogenic shock that was successfully treated. The article highlights 2 aspects: (1) the concomitant execution of venoarterial extracorporeal membrane oxygenation implantation and a transvenous atrial septostomy; and (2) in a delayed surgical procedure, the insertion of a left ventricular assist device (LVAD) (HeartWare HVAD, Medtronic, Minneapolis, Minn) using minimal access surgery (left median type upper ministernotomy and a left anterior mini-thoracotomy) in association with a percutaneous atrial septal closure with a 15-mm Amplatzer (Abbott, St Paul, Minn) septal occluder. A percutaneous transvenous technique with both atrial septostomy and the later closure of the created septal defect is a good alternative and uses less-invasive surgery. The implantation of an LVAD by means of minimally invasive cardiac surgery (MICS) is an attractive, innovative, and less-aggressive surgical procedure. Cardiac surgeons need to be informed of new, reliable, and efficient surgical modern modalities of treatment. Cardiac surgery continues to evolve and develop. New trends in cardiac surgery favor a less-invasive surgical intervention. MICS with the incorporation of new technology, such as advanced thoracoscopic systems, minimally invasive extracorporeal circulation equipment, modern and more reliable surgical instruments, image-guided surgical procedure instrumentation, and robotic-guided surgery, has been increasingly introduced into current surgical practice and will continue to expand. At present, a significant number of patients undergoing extracorporeal membrane oxygenation therapy need a subsequent LVAD implantation. In the future, the number of potential patients requiring cardiopulmonary mechanical assistance is expected to increase. LVAD implantation using a MICS access has been associated with good outcomes. In a retrospective 1-year outcome evaluation on 32 patients with Interagency Registry for Mechanically Assisted Circulatory Support 1, Wert and colleagues² demonstrated higher survival in the group of patients undergoing MICS (69.7% survival, 14 patients) versus the group of patients undergoing full sternotomy (50% survival, 18 patients). Anastasiadis and colleagues³ reported that minimally invasive extracorporeal circulation in cardiac surgery is related with less morbidity and a lower mortality in the coronary surgery group of patients. According to Dieberg and associates,⁴ MICS is as safe as conventional cardiac surgery. In a systematic review in robotic cardiac surgery (28 studies, 5993 patients), Doulamis and associates⁵ showed good results with a mean 30-day mortality of 0.7% to 0.9% and a late mortality of 0.8% to 1% with a mean follow-up period of 40.1 months.

MICS provides a better cosmetic result, smaller scars, less postoperative pain, less bleeding, fewer surgical wound infections, reduced hospital stay (intensive care unit and ward), and a faster postsurgical recovery. MICS is a work in progress. It requires specific training and skills, and the surgeon has to maintain an active surgical practice and