

See Article page 97.



Commentary: Understanding the challenge of acute respiratory distress syndrome in the cardiothoracic surgical patient

Juan N. Pulido, MD

Acute respiratory distress syndrome (ARDS) is a feared complication after cardiothoracic surgery, given the high morbidity and mortality associated with this diagnosis and the limitations in some aspects of care that are currently deemed best practice in severe cases, such as prone ventilation and high positive end-expiratory pressure (PEEP). The definition of ARDS has evolved since its original description in 1967, and for many years, it was unclear and difficult to commit to this diagnosis, given the high prevalence of elevated pulmonary artery wedge pressure or left atrial hypertension in the cardiothoracic surgical patient. ARDS after cardiac surgery was relegated to the times in which, if a patient met criteria, there had to be a clear direct pulmonary insult, such as aspiration or nosocomial pneumonia; otherwise, it was frequently discarded as these are “cardiac patients.” Due to these uncertainties, patients likely received suboptimal ventilatory management and missed opportunities to improve outcomes. This lack of inclusion, and unclear definition, also contributed to the mixed results in earlier reports on this subject.

It was not until 2012, when the ARDS definition task force, a multinational effort, developed the Berlin definition of ARDS.¹ This effort standardized and clarified that the development of respiratory failure needed to occur within 1 week of a known clinical insult, direct or indirect, and that it should not be fully explained by cardiac failure or left atrial hypertension resulting in hydrostatic pulmonary



Juan N. Pulido, MD

CENTRAL MESSAGE

ARDS poses unique therapeutic challenges to the cardiothoracic patient. ECMO is a valuable rescue option.

edema. The definition, although not perfect, also included the level of PEEP to account for the impact of positive pressure in the partial pressure of oxygen, arterial/inspired oxygen fraction ratio as the main marker of severity. Since the Berlin definition, it has been easier to understand and fully assess a more accurate frequency of ARDS in the cardiothoracic patient. Nevertheless, a recent retrospective observational study of ARDS after cardiac surgery that found an incidence of 1.1% with mortality 30% also concluded that a similar incidence was found whether the Berlin definition was used versus the American-European Consensus Conference definition in 1994.² It is, however, different to assess this in a retrospective study, now that we have clear understanding that cardiac patients with elevated pulmonary artery wedge pressure can develop ARDS as well, as long as there is a clear insult, which could be cardiac surgery itself, occurring within a week of development of respiratory failure. Many of these patients, before 2012, would have been excluded.

Diagnosing ARDS is critical, as there are certain best practice treatment strategies that may conflict with the optimal care of the cardiac surgical patient, specifically patients with poor right ventricular function and patients with recent sternotomy. These strategies include the use of high PEEP, low tidal volume ventilation, permissive hypercapnia, and in cases of severe ARDS (partial pressure of oxygen, arterial/inspired oxygen fraction <100), prone ventilation. In cases in which standard best practices fail or can't be used safely for severe ARDS with refractory hypoxemia or hypercarbia, extracorporeal membrane

From Critical Care Medicine and Cardiovascular Anesthesiology, Swedish Medical Center, and US Anesthesia Partners – WA, Seattle, Wash.

Disclosures: The author reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

Received for publication Oct 20, 2021; revisions received Oct 20, 2021; accepted for publication Oct 20, 2021; available ahead of print Nov 8, 2021.

Address for reprints: Juan N. Pulido, MD, Swedish Medical Center, Anesthesiology, 747 Broadway, Seattle, WA 98122 (E-mail: Juan.Pulido@Swedish.org).

JTCVS Open 2021;8:106-7

2666-2736

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<https://doi.org/10.1016/j.jxjon.2021.10.031>

oxygenation is an appropriate next step, which has demonstrated survival benefit, is within the armamentarium of the cardiothoracic surgeon, and is commonly used in most cardiac intensive care units.

In this issue of the *Journal*, Copeland and colleagues³ explore the challenges of ARDS in the cardiothoracic patient. After a description of the problems with treating severe ARDS in patients with poor cardiac function or fresh sternotomies, the authors describe a section of pathophysiology of postcardiotomy ARDS, demonstrating that cardiac surgery itself, cardiopulmonary bypass, can trigger an inflammatory response with potential to contribute to the development of ARDS if other insults also arise or in the susceptible patient. The expert opinion paper then focuses on the use of ECMO for ARDS. This incorporates a review of the subject that includes decision-making on when to deploy ECMO, which type of ECMO, cannulation

strategies, anticoagulation, special situations, and weaning ECMO support. The cardiothoracic surgeon is well equipped to rescue these patients by implementing the appropriate extracorporeal support for the specific situation, providing rest to critical lungs, preventing further ventilator induced lung injury, and potentially improving the outcomes of this rare but severe disease.

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