Can Timely ECMO Initiation Mitigate Pre-ECMO Risk Factors for Acute Kidney Injury?

To the Editor:

Hsiao and colleagues [1] report increased mortality in patients with acute respiratory distress syndrome (ARDS) and who had lower urine output on the first day of extracorporeal membrane oxygenation (ECMO) support. The nonsurvivors in this study were also older and exhibited greater severity of illness and extrapulmonary organ involvement. The use of venoarterial ECMO in 25% of the patients could indicate greater disease severity or a delay initiation of venoarterial ECMO. Equally, data regarding pre-ECMO diuretic use, fluid balance, and ultrafiltration, if any, would have provided more clarity to the urine output data.

Acute kidney injury (AKI) during ECMO significantly increases mortality [2]. Although the pathophysiology of AKI in this population is complex, it appears that pre-ECMO factors play a significant role. An isolated respiratory failure upon presentation can transform into multiorgan failure because of complex interactions of the pulmonary system with cardiovascular [3] and renal systems [4] and partly because of interventions directed at optimizing the pulmonary system.

Lung protective ventilation results in hypercapnia, which can significantly influence hemodynamics and renal blood flow [4]. Hypercapnia and resulting acidosis, hypoxia, and poor pulmonary compliance can result in progressive right ventricular failure, shock, and organ dysfunction. The primary disease process and ongoing ventilator induced lung injury both can further exacerbate organ injury. Use of diuretic drugs or preemptive hemofiltration in such patients who are already taking high dose vasoactive agents in an attempt to minimize extravascular lung water and to improve gas exchange and pulmonary compliance can further exacerbate AKI [5].

Given the effects of AKI on ECMO outcomes, the pre-ECMO risk factors need scrutiny. The use of ECMO to salvage patients with multiple organ failure results in poor outcomes. ECMO technology has evolved significantly, and current outcomes are promising despite its use as salvage therapy. Timely extracorporeal respiratory support in ARDS may reduce AKI and minimize the risks of AKI. Although prospective clinical studies might answer this question in future, studies in animal models [6] could provide mechanistic insights into the pathophysiology of AKI in ECMO.

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Reply
To the Editor:

We are pleased to have received the expert opinions from Dr Shekar and colleagues [1] from Prince Charles Hospital, Queensland, Australia. In a previous study by our group, Chang and colleagues [2] reviewed the medical records of 119 critically ill patients who were successfully weaned from extracorporeal membrane oxygenation (ECMO). Successful weaning was defined as weaning from ECMO support followed by survival longer than 48 hours. The overall rate of in-hospital mortality was 26%. The most common condition requiring ECMO support was cardiogenic shock. During ECMO treatment, aggressive diuresis is attempted whenever possible; if necessary, ultrafiltration is implemented to facilitate a conservative fluid management strategy. Multiple logistic regression analysis indicated that daily urine output (UO) on the second day of ECMO removal, mean arterial pressure, and sequential organ failure assessment score on the day of ECMO removal were independent predictors of hospital mortality. Urine volume is a more sensitive marker for the early detection of acute kidney injury (AKI) than is serum creatinine level. Decreased UO on the day of ECMO removal is attributed to decreased cardiac output after decannulation and is correlated with acute cardiorenal syndrome type 1. For patients with improved systolic function, UO may increase gradually in the following days; for other patients, decreased UO progresses and causes fluid overload, which likely increases preload and may contribute to circulatory failure.

Hypotension is related to worsening renal function for patients receiving ECMO. Damaged cardiac function creates a situation with low cardiac output and therefore hypoperfusion; if this is not promptly corrected, prerenal AKI can progress to intrinsic AKI and even corticral necrosis, which results in irreversible loss of renal function. During the first 24 to 48 hours of ECMO, oliguria and acute tubular necrosis associated with capillary leakage and intravascular volume depletion are common because ECMO triggers an acute inflammation-like reaction. Decreased UO represented renal hypoperfusion resulting from low cardiac output (cardiogenic shock) or systemic vasodilatation (sepsis) [3].

Finally, given the limitations of this study [4], we agree that, as mentioned by Dr Shekar and colleagues, prospective clinical and basic studies may minimize the risks of AKI and provide mechanistic insights into the pathophysiology of AKI in ECMO.

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Choice of Right Ventricle—Pulmonary Artery Conduit in Infants

To the Editor:

We read with interest the article by Poynter and colleagues [1]. They evaluated the durability of different pulmonary conduits in infants who underwent placement of the right ventricle to the pulmonary artery (RV-PA) conduit. They concluded that implanted bovine jugular venous valved conduits (JVVC) rather than allografts and the use of larger conduits was associated with increased durability.

Valved allografts were first used during late 1960s, and they were the most frequently used valved conduits to ensure continuity of RV-PA until the mid-1980s. However, stenosis and conduit valve regurgitation may develop during mid-term and long-term follow-up, and reoperation is required for the solution of these problems. Diameter mismatch, calcification, and stenosis were the most frequent replacement causes of allografts. Additionally, degeneration of aortic and pulmonary allografts develops faster when they are used in infants [2]. This occurs because of the immunologic response to viable endothelial cells inside allograft conduits. Difficult procurement is another problem of allografts. When we review the study of Poynter and colleagues, JVVC, which is a xenograft, is seen as a solution because it has better durability and is easy to procure compared with allografts, but we are suspicious about the primary choice of JVVC in infants. First, JVVC does not have growth potential, and this causes it to be relatively inadequate while the child grows up, in which situation a change of the conduit is a must. In addition, the minimum diameter of JVVC is 12 mm. The choice of JVVC in infants with a very small body surface area causes patient–conduit size mismatch, which is an important cause of early graft dysfunction. The study of Breymann and colleagues [3] supports our worries, as already mentioned. They presented the 7-year results of the European Contegra Multicenter Study involving 165 nonadult JVVC implants. In this study, at the 5-year follow-up visit, freedom from any event was only 13% for infants.

We believe that body surface area is most important criterion determining the choice of conduit in infants. Allograft must be the first choice in small infants. JVVC may be chosen in larger infants because allografts are difficult to procure.

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On Breast Implants, Belly Button Piercings, Transumbilical Thoracic Sympathectomy, and the Big Picture

To the Editor:

The technical skill of Chen and colleagues [1] using an umbilical approach to thoracic sympathectomy cannot be denied, but the report is unsettling regarding our role as surgeons and physicians. Their approach purports to have better cosmesis than standard thoracoscopic sympathectomy does, and it avoids damaging breast implants. The chest incision is eliminated, “catering to the cosmetic demand of some women.” It was alleged that women with breast augmentation “are not eligible for conventional thoracoscopic sympathectomy.” The procedure is recommended for women with “higher cosmetic demands, such as models who want to preserve their perfect breasts.” The cosmetic benefit of the umbilical approach was further improved by “belly button piercing, a fashion that seems to be becoming popular in China.” One fourth of their patients had such piercings done.

The first point to refute is that conventional thoracoscopic sympathectomy is contraindicated in the presence of breast prostheses. We perform it routinely and cosmetically using two 5-mm midaxillary line trocar sites [2] without even remote danger of implant penetration with attentive technique. The reference to Dewey and colleagues [3] describes an isolated unilateral rupture of a breast implant with the ports placed more anteriorly than our incisions. Their article in no way implies that women with breast augmentation are ineligible for conventional thoracoscopic sympathectomy.

Second, what cultural priorities require thoracic surgeons to “cater” to cosmetic demands of “models who want to preserve their perfect breasts”, whose tiny umbilical incisions undergo belly button piercings to hide further? What are our priorities as thoracic surgeons and as physicians? Are the “perfect breasts” we are preserving meant for the authentic dignity and beauty of women, or is it for a “culture gone wild,” influenced in no small way by a pornographic subculture? Who is benefitting?

We are in dire need of a reality check. The World Health Organization estimates that in 2012, worldwide death tolls were 600,000 from malaria, 1.3 million from tuberculosis, and 1.6 million from AIDS. Three million children die of hunger each year. Over 800 million people are hungry to the point of malnourishment. The lives of 40 million unborn humans are aborted worldwide yearly by medical personnel, including over 10 million in China with its government-forced one-child policy. Pregnancy terminations based on nothing more than sex selection are not uncommon.

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References