Acute Renal Failure and Cardiac Surgery: Marching in Place or Moving Ahead?

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Acute renal failure (ARF) after cardiac surgery is a well-recognized complication that generally occurs in 1 to 10% of patients (1–4). Patients who develop ARF have higher rates of mortality and resource utilization, with the worst values seen in dialyzed patients (5,6). Emerging evidence suggests that even small changes in creatinine after cardiac surgery are associated with significant effects on mortality (7,8). Whether ARF directly causes adverse outcomes is not entirely clear; however, an increase in infection and new-onset sepsis, congestive heart failure, and fluid overload may be contributory (1,7,9–11). Although the overall incidence of ARF is relatively low, approximately 75,000 cases of ARF would have been expected to have developed over a decade, with a significant number of patients dying in the hospital, given the increasing frequency of cardiac surgery procedures (1.9 million from 1993–2002 in the U.S.) (12). The continued poor outcomes associated with ARF highlight the importance of two fundamental questions: What do we know about the natural history of the disease and can we identify high-risk patients preoperatively to allow for appropriate interventions?

Two articles in this issue provide further insights to this problem. Loef et al. (13) describe the long-term outcomes of a cohort of cardiac surgery patients treated with cardiopulmonary bypass at a single European center. Patients with postoperative ARF (defined as >25% change in serum creatinine corresponding to a 20% reduction in Cockroft-Gault GFR from baseline within 1 wk post-surgery) not only had an increase in in-hospital mortality, confirming previous studies, but also had higher mortality rates >5 yr later. The long-term effect persisted even if the creatinine levels had returned to baseline at hospital discharge. Similar effects have been reported in patients with ARF after percutaneous coronary interventions, where 1-yr mortality is significantly higher (14–16). These findings highlight the consequences of renal functional deterioration but unfortunately do not shed any light on the potential mechanisms. Because ARF after cardiac interventions has a similar pattern and patients with ARF post-percutaneous transluminal coronary angioplasty (PTCA) have a higher incidence of myocardial infarctions within 1 yr, it is tempting to postulate that the episode of ARF may set in motion mechanisms for progression of cardiovascular disease that are well recognized in patients with CKD. None of the survivors in the Loef study developed ESRD; however, details on the levels of long-term renal function are not provided, making it difficult to ascertain whether the episode of ARF was associated with a progressive decline in renal function. Thakar et al. (17) address whether preoperative risk assessment can identify high-risk patients who will develop ARF requiring dialysis. Exploring a large database of >33,000 cardiac surgery patients accumulated over 11 yr at the Cleveland Clinic, they identified a cohort of patients with ARF requiring dialysis (defined as >50% decline in Cockroft-Gault GFR from baseline estimates derived from creatinine values up to 3 wk before surgery). A predictive model incorporating 10 variables, which can be determined preoperatively, was developed and validated in the dataset and a scoring system was devised that categorizes patients into four levels that can identify those destined for ARF requiring dialysis. Although several previous publications have identified pre- and intraoperative variables associated with a risk for developing ARF and described the factors associated with adverse outcomes, they have been limited to in-hospital mortality (18–21). Chertow et al. had developed an algorithm to identify patients with ARF using recursive partitioning techniques and, while this technique has been validated subsequently in two large data sets, it requires knowledge of intraoperative events (22,23). The new scoring system developed by Thakar et al. (17) utilizes variables that can be identified preoperatively, thereby making it more versatile and potentially more useful.

While these two studies provide new information, whether the knowledge will be used to improve the care of cardiac surgery patients is questionable. This skepticism is based on an evaluation of the literature in this field. Despite knowledge of the risk factors for development of ARF, there has been no reduction in the incidence of the disease, and renal protection and treatment strategies have not shown any benefit (24–26). The lack of progress, though disappointing, offers an opportunity to ascertain why we have not been successful. One major reason is the lack of a standard definition for ARF (27). Although serum creatinine is widely used as a marker for changes in GFR, the criteria used to define ARF is highly variable (28). What level of renal function should be labeled as evidence of pre-existing renal insufficiency is an additional consideration because this variable has a strong influence on the outcomes. The Loef and Thakar studies illustrate these points well because the patients classified as ARF in the two datasets are as com-
parable as tangerines and clementines, similar in nature but clearly not the same. The definitions used in these two studies do not match those used in the Society of Thoracic Surgeons (STS) database, making comparisons difficult (29). The variation in definitions is further compounded by a lack of consensus on indications for and timing of dialysis (30). For instance, dialysis could be utilized for indications other than a critical reduction in GFR and at varying time points in the disease course. The ability of the Thakar scoring system to identify high-risk patients in the Loef cohort will thus be influenced by the definitions and the criteria used for dialytic intervention. Another emerging concept is that the biologic and clinical responses to acute renal injury are not concurrent. Recent studies demonstrate that sensitive markers of tubular injury may be altered much earlier than a rise in serum creatinine and may allow us to define the time points when injury occurs (31,32).

These observations reinforce the notion that continued progress will require that we address several issues. We must develop a standard definition of ARF that is sensitive and specific to determine the true incidence of this complication, permit an accurate assessment of ARF on outcomes, and allow comparison of patients across centers. Emerging biomarkers may need to be incorporated in the definitions and may permit identification of earlier time points for intervention. The pre-operative risk assessment scores need to be validated prospectively using the standardized definition and should incorporate emerging knowledge of the interactions among patient characteristics and process of care elements (e.g., mitral valve surgery type (33)). Future studies could then be designed to identify high-risk individuals based on the score and provide timely interventions for prevention or amelioration of renal injury to obtain optimal outcomes. A key element is the dissemination of information across the continuum of care. This calls for multidisciplinary collaboration among cardiac surgeons, nephrologists, and allied personnel involved in patient care who may not be aware of study findings published in society journals and may limit the wide adaptation of the study findings, resulting in changes in practice. These multidisciplinary interactions could be facilitated at the society level by establishing formal collaborations between the American Society of Nephrology and the American Thoracic Society for joint projects, as has been done with other disciplines. Ultimately these collaborative efforts should result in consensus recommendations and evidence-based guidelines that can be utilized by caregivers to move ahead. Whether we will march in place or take large strides ahead will be influenced by the choices we make.

References


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