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## Commentary: The dangers of postoperative acute kidney injury—Vulnerability despite early resolution

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In this month's *Journal*, the article by Cho and colleagues<sup>1</sup> addresses the issue of immediate postoperative acute kidney injury (AKI), acute kidney disease (AKD) at three months, and chronic kidney disease (CKD) diagnosed at 1 year in patients with valvular heart disease in whom preoperative renal function was normal. Furthermore, the article analyzes outcomes of patients who had complete resolution of their AKI within 3 days of surgery. Of the 1386 patients included in the study, nearly 25% had development of AKI according to Kidney Disease: Improving Global Outcomes criteria. This is consistent with other publications looking at postoperative AKI in cardiac surgery.<sup>2-6</sup> The incidence of AKD, defined as elevated creatinine at 3 months, was 15.1% in patients with AKI versus 4.7% in those without AKI; similarly, at 1 year, the incidence of CKD was 12.5% in patients with AKI versus 4.2% in those without AKI. As the severity of perioperative AKI increased, so did the risks of AKD and CKD. Most impressive was the fact that threefold increases in the incidences of AKD and CKD were seen in the 88% of patients who had rapid perioperative resolution of AKI.

Among many, we would like to emphasize 2 specific aspects of these results. First, cardiac surgeons need to be cognizant that any perioperative kidney injury, minor to severe, regardless of its resolution, significantly increases postoperative morbidity and mortality. In this study, even among patients in whom AKI had resolved before

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Disclosures: Authors have nothing to disclose with regard to commercial support.

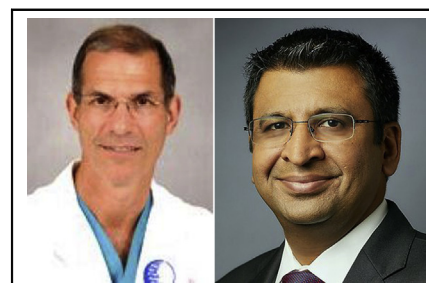
Dr Parikh is supported by National Institutes of Health grant RO1HL085757.

Received for publication Oct 22, 2019; revisions received Oct 22, 2019; accepted for publication Oct 22, 2019; available ahead of print Nov 5, 2019.

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J Thorac Cardiovasc Surg 2021;161:689-90  
0022-5223/\$36.00

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<https://doi.org/10.1016/j.jtcvs.2019.10.107>



Glenn J. R. Whitman, MD (left), and Chirag R. Parikh, MD, PhD (right)

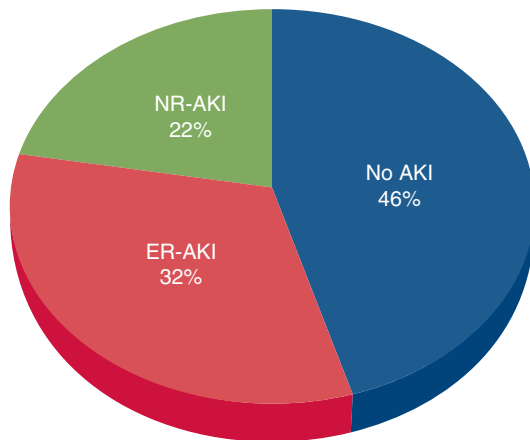
### CENTRAL MESSAGE

Even with resolution, post-cardiac surgery acute kidney injury leaves patients vulnerable to significant renal and cardiovascular morbidity. It is our responsibility to prevent or minimize this harm.

discharge, the risk of requiring dialysis at 3 months was 5.7%, versus 0.2% among those without AKI, and the risk of death was 3.6 versus 0.7%. In those with AKI without recovery, these risks were close to an order of magnitude higher (see [Figure 1](#)). That these events should befall patients with preoperative normal renal function is regrettable, for certain, and the burden of minimizing these long-term sequelae falls on our shoulders.

Parikh and colleagues<sup>7</sup> have described several biomarkers of injury and inflammation that are elevated after cardiac surgery and are associated with adverse cardiovascular and kidney outcomes. Even without a creatinine elevation, a complex interplay of adaptive and maladaptive biologic processes in these patients determines the development of AKD and CKD.<sup>8</sup> Close follow-up of these patients after discharge must occur to assist with optimizing blood pressure, minimizing heart failure by optimal volume and hemodynamic control, and prescribing appropriate medicines, such as renin-angiotensin-aldosterone system agents and sodium-glucose cotransporter-2 inhibitors, which have demonstrated renal and cardiovascular protection in clinical trials.<sup>9</sup>

Second, given that patients with normal preoperative renal function had early AKI occur, intraoperative injury must be playing a role. Recent evidence<sup>10,11</sup> has implicated a threshold oxygen delivery during cardiopulmonary bypass of roughly 250 mL O<sub>2</sub>/min/m<sup>2</sup> (eg, maintaining a cardiac index >2.4 with a hemoglobin 80 mg/mL) as instrumental



**FIGURE 1.** Distributions of the 3 types of postoperative renal function among the 99 patients who at 12 months had died or had chronic kidney disease develop. *NR*, No recovery; *AKI*, acute kidney injury; *ER*, early recovery.

in preventing clinical and subclinical AKI. Indeed, by addressing this as well as several other issues unique to cardiopulmonary bypass, Magruder and associates<sup>12</sup> decreased postoperative AKI by more than 50%.

We congratulate Cho and colleagues<sup>1</sup> for identifying the long-term sequelae of “clinically resolved AKI” at discharge. Further advances might be facilitated by perioperative scoring systems, identifying patients who would benefit from postdischarge follow-up to prevent CKD.

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