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ACUTE KIDNEY INJURY AFTER ADULT CARDIAC SURGERY: TRYING TO FIND THE MAGIC GUN

To the Editor:

We highly appreciate the commentary by Montisci and colleagues,¹ “Commentary: The Lack of a Magic Bullet,” regarding our recently published article.² Montisci and colleagues¹ raised some points that in their view could affect the clinical relevance of the study. We are happy to discuss these particular issues, and we seize the opportunity of this letter to go more deeply into details.

Undoubtedly, acute kidney injury is a deadly complication after cardiac surgery.^{3,4} A drop in the kidney oxygen saturation ($k\text{So}_2$) to less than 65% and a decline of more than 20% from the baseline value during the postoperative stage were identified as independent predictors of cardiac surgery-associated acute kidney injury (CSA-AKI). Regarding the variability in threshold desaturation definitions, these findings were determined from both absolute and patient-specific $k\text{So}_2$ baseline values. Indeed, we agree that to draw conclusions from absolute threshold values might be relatively difficult, because normal $k\text{So}_2$ values vary from one patient to another. This is not the case for declines from patient-specific baseline values, however, which are consistent results that do not change regardless of any threshold value and therefore can be applied to any population.

Near-infrared spectroscopic measurements provide a time-limited window before irreversible organ failure occurs. We are convinced, however, that instead of seeking a “window for intervention,” it is much more worthwhile to look for a “window for prevention,” taking into account that the prevention is the criterion standard management of CSA-AKI, rather than its treatment. This was the primary reason that our efforts were directed toward the early recognition and the prevention of CSA-AKI, without the introduction of any external measure that might alter our

results. Ranucci and associates⁵ showed that the application of goal-directed perfusion strategy to maintain oxygen delivery during cardiopulmonary bypass greater than $280 \text{ mL} \cdot \text{min}^{-1} \cdot \text{m}^{-2}$ reduces the appearance of mild stages of CSA-AKI. As such, it is also a strategy aiming to prevent CSA-AKI.

Undeniably, a timely intervention requires a prompt recognition of potential CSA-AKI. An opportune recognition is thus crucial for an optimal treatment. Given the scarcity of evidence to establish an appropriate treatment to $k\text{So}_2$ desaturations, no interventions were introduced. Certainly, further clinical trials should be conducted to establish and validate goal-directed therapies enhancing $k\text{So}_2$, just like the already accepted protocols to reverse brain oxygen desaturations.⁶

Overall, on the basis of the complex pathogenesis of CSA-AKI, it is unlikely that its incidence can be significantly reduced by any single intervention.⁷ Just as contributing factors working in concert lead to this complication, the prevention and treatment of CSA-AKI require a multimodal approach in which not only the patient's underlying diseases or the knock-on effects of the cardiac surgical procedure itself must be taken into account, but also the altogether postoperative factors that still contribute to its appearance. Measurement of $k\text{So}_2$ seems to be a promising tool, at least in the fight for early recognition. It thus might be helpful to prevent postoperative CSA-AKI. Doubtless, before using the magic bullet, we need to find the “right weapon.”

Christian Ortega-Loubon, MD, MEd, PhD^{a,b}

Pablo Jorge-Monjas, MD, PhD^{b,c}

Eduardo Tamayo, MD, PhD^{b,c}

^aDepartment of Cardiac Surgery
Clinic University Hospital of Valladolid
Valladolid, Spain

^cAnesthesiology and Critical Care
Clinic University Hospital of Valladolid
Valladolid, Spain

^bBioCritic

Group for Biomedical Research in Critical Care Medicine

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ACUTE KIDNEY INJURY RISKS DURING CARDIAC OPERATIONS ARE TOO NUMEROUS TO COUNT? COULD

A SINGLE ACTIONABLE VARIABLE BE THE ANSWER?

Reply to the Editor:

An interesting aspect of articles that appear in the *Journal of Thoracic and Cardiovascular Surgery* is the dialog created by many of the articles and actually published along with the main research articles. Readers must realize that the Editor emphasizes these dialogs and nearly every article has an associated commentary and/or expert opinion about article findings. The discussions surrounding many of the Journal articles and the associated editorial comments often serve to elaborate and delve into nuances of article findings.

Perhaps more importantly, these discussions can stimulate new information, and can expand on research findings. An example of this is the series of articles generated by the study conducted by Ortega-Loubon and colleagues¹ that deals with measurement of kidney oxygen saturation (kSo₂) as a potentially actionable biomarker of acute kidney injury (AKI) after cardiac operations. The back-and-forth articles stemming from the original article both amplify the original findings of the sentinel article and clarify nuances and alternative findings of importance.^{2,3} This type of dialog is a tribute to the Journal, and whether readers realize it or not, this type of expansion and the extent of introspection around published original research is nearly exclusive to our Journal.

Over the past year and a half, some things have been described in the literature that influence AKI (see Table 1). With the abundance of complicating factors that can alter renal function during cardiac procedures in adults and children, surely it must be simplistic to focus on a single indicator like kSo₂ as an actionable variable that may improve AKI risk after cardiac operations. Ortega-Loubon and colleagues¹ suggest, but do not prove, that alterations that improve kSo₂ may lessen risk of AKI after operations

TABLE 1. Recent evidence base for prevention of acute kidney injury (AKI) associated with cardiac operations

Things that may reduce/improve AKI risk after cardiac operations
Cytochrome-eicosanoid inhibition and AKI ⁴
High estimated pulmonary artery systolic pressure to predict acute kidney injury ⁵
Enteral flavone glycoside reduces cardiac surgery-Associated AKI in rats ⁶
N-acetyl cysteine to prevent postoperative AKI in preexisting-renal-failure ⁷
Naturetic peptide is best drug with evidence for prevention of AKI ⁷
Low-dose doxycycline in rats is protective against AKI ⁸
Early peritoneal dialysis to prevent AKI in neonates ⁹
Things that do not work for AKI prevention
Mannitol not considered an evidence-based intervention to limit AKI ¹⁰
Corticosteroid treatment in neonates undergoing cardiac surgery did not reduce AKI ¹¹
N-acetylcysteine not helpful to reduce AKI (meta-analysis) ¹²
Allogeneic mesenchymal stem cells ¹³
Things with uncertain or conflicting evidence but being studied
Dexmedetomidine and acetaminophen ¹⁴⁻¹⁶
Slidenafil for AKI (randomized controlled trial) ¹⁷
Intra-aortic balloon ¹⁸
Vascular endothelial integrity ¹⁹
Remote ischemic preconditioning ^{20,21}
Dexmedetomidine and acetaminophen ¹⁴⁻¹⁶
Things that may worsen AKI risk during cardiac procedures
Perioperative statin therapy (but not preoperative only therapy) increases AKI risk ²²
Fibrinogen prophylaxis during heart transplant ²³
Advanced age ≥ 80 y ²⁴
Severe bleeding ²⁵

and improve functional outcomes. Believe me, I hope they are right, but a lot more work (eg, randomized trials and measurements of covariates) needs to be done to establish kSo₂ as an actionable variable that can limit AKI after cardiac operations. I welcome further dialog and even more well-designed comparative studies that prove the value of kSo₂.

Victor A. Ferraris, MD, PhD
Department of Surgery
University of Kentucky
Lexington, Ky

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