

after surgery of the same group of patients whose early postoperative results were reported in a previous publication.<sup>2</sup> Fluid management was based on hemodynamic optimization according to noninvasive cardiac output measurements, and it was provided by a closed-loop system. The study groups were defined by the type of fluids infused by means of a goal-directed fluid therapy strategy that consisted of multiple 100-ml mini-fluid challenges using either a crystalloid solution or a synthetic colloid solution (hydroxyethyl starch).

Eight of the 80 patients in the crystalloid group had anastomotic leakage and five had bleeding that required reoperation in comparison with none of the 80 patients in the colloid group.<sup>2</sup> In addition, the operation took longer in the crystalloid group.

The power analysis that the authors performed was based on changes in Post-Operative Morbidity Survey under the hypothesis that the only difference between treatment groups will be the type of fluid management. However, there could hardly be any argument that a patient's recovery from surgery depends on numerous factors other than fluid management.

A recent review that appeared in *ANESTHESIOLOGY* suggests that the effect of various types of fluid management should be evaluated in addition to the complexity of the surgery.<sup>3</sup> In the current study, the authors performed the analysis by intention-to-treat, with which we concur. However, when 16% of patients in one group had significant surgery-related events *versus* 0% of patients in the other group, a different analysis is needed to prevent potentially misleading conclusions of the study findings. Although the authors provided a list of the specific sources of surgical complications that were encountered (*i.e.*, bleeding that required reoperation, anastomotic leakage, peritonitis, and reoperation), the data analysis ascribed all of the postoperative sequelae solely to fluid management. Reoperation attributable to bleeding or anastomotic leakage requires prolonged treatment and could affect kidney function as well as the patients' overall health condition no less than—and possibly more than—the type of fluids given intraoperatively. Moreover, the issue of group differences in surgical risk was not addressed.<sup>3</sup>

The second article analyzes patient wellbeing and renal function 1 yr after the surgery, and the authors used the power analysis of the Post-Operative Morbidity Survey on postoperative day 2 from the first study.<sup>1</sup> The intention to connect long-term recovery to intraoperative fluid management is understandable; however, the underlying medical condition and the type of surgery that the patient underwent a year earlier must also be taken into account.

### Competing Interests

The authors declare no competing interests.

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## Crystalloid/Colloid Renal and Disability Outcomes: Reply

### In Reply:

We thank Drs. Pizov and Gelman for their interesting comments regarding our two recent publications, which compared the effects of crystalloids and colloids on short- and long-term outcomes in high-risk surgical patients.<sup>1,2</sup> Although we agree that surgical complexity could be a potential confounding factor for immediate postoperative complications and for its long-term consequences, we do not think that patients in the crystalloid group underwent more complex surgeries than those randomized to the colloid group. Indeed, beyond the surgical time, we have no data to support this hypothesis. Surgical procedures and incidences of high-risk surgery were comparable in the two groups, and blood loss, which is often considered as a marker of surgical complexity, was also not different between the two groups. A longer surgical time did

not necessarily indicate a more complex procedure. As an example, when reviewing the 102 patients who underwent a gastrointestinal anastomosis, surgical time was not different between those experiencing a postoperative anastomotic leakage and those who did not (240 min [204 to 387] *vs.* 268 min [185 to 336], respectively;  $P = 0.850$ ). In contrast, fluid balance was significantly higher among patients developing an anastomotic leakage compared to those who did not ( $6.0 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{h}^{-1}$  [5.1 to 8.4] *vs.*  $3.1 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{h}^{-1}$  [1.7 to 5.0], respectively;  $P = 0.021$ ). These data confirm the impact of intraoperative fluid volume administration on the incidence of postoperative complications independently to the length of surgery. Although we cannot formally exclude that a longer operating time might have contributed to our results, we remain confident that the results we observed are mainly related to the type of fluid used to optimize hemodynamic management in our high-risk surgical population. Finally, the finding that hydroxyethylstarch solutions did not have a negative impact on long-term outcome (arguably what is most important to the patients), in line with the results of other recent articles,<sup>3,4</sup> is reassuring with regard to the use of these solutions for intraoperative fluid management of patient undergoing high-risk abdominal surgery.

### Competing Interests

Dr. Joosten reports consulting for Edwards Lifesciences (Irvine, California). Dr. Rinehart reports ownership interest in Sironis (Newport Beach, California), a company developing closed-loop systems, and consulting for Edwards Lifesciences. Dr. Van der Linden has received, within the past 5 yr, fees for lectures and consultancies from Fresenius Kabi GmbH (Bad Homburg, Germany) and Janssen-Cilag SA (Olen, Belgium).

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