

Acute kidney injury after liver transplantation is associated with viral hepatitis, prolonged warm ischemia, serum lactate and higher mortality

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Dear Editor,

We thank for the interest in our recent published article¹ and the letter from Prof. Xue, *et al.* Our findings evidenced that viral hepatitis, warm ischemia time and serum lactate are associated with acute kidney injury (AKI) development after liver transplantation (LT). Another important finding is that AKI was associated with death and chronic kidney disease (CKD) after LT.

The first concern raised by Prof. Xue was the lack of information about albumin levels, body mass index (BMI) and race. As it is a retrospective study, we do not have some data. Albumin levels were not determined in some patients, so we have not included in the analysis. We agree that hypoalbuminemia can be associated with death in different clinical settings,² including liver transplantation.^{3,4} Unfortunately, we did not include this data. However, we have used serum albumin to calculate CHILD score, which did not show any significant association with renal function and was not different when comparing patients with and without AKI. BMI was also not included in our analysis. The effect of BMI in the outcomes of LT is not well defined, as studies show discrepant results,^{5,6} so we believe the lack of this parameter do not invalidate our results. Furthermore almost all patients in our study had ascites and it leads to a bias in the BMI calculation, so we have decided not to use this parameter in our

study. Regarding race, it is important to clarify that in Brazil, due to historic facts, we do not have well defined races. Almost all Brazilians are a mixture of races (white, African descendents and American indians),⁷ so that race could not be considered as a variable in our studies.

Another point raised by Prof. Xue was the information about intraoperative bleeding, blood transfusion and the use of hydroxyethyl starch. The incidence of intraoperative bleeding was similar in both groups (AKI *vs.* non-AKI: 51 *vs.* 40%, $p = 0.2$), as well as volume of blood products (AKI *vs.* non-AKI: 60% *vs.* 47%, $p = 0.1$). Hemodynamic instability was not evaluated. We agree that this is an important complication that is associated with AKI in the setting of LT,⁸ but we do not have information about this. As the incidence of bleeding and transfusion was similar in both groups, we had considered that hemodynamic instability was also similar. Intravascular volume resuscitation was routinely done in all patients, according to individualized needs, and it was not done with hydroxyethyl starch, so this product was not cited in our study. Postoperative complications were not included in the analysis. In fact, there were few postoperative complications in our patients. There are many factors contributing for the low incidence of complications after LT in our center, including surgeons' large experience in transplantations, critical care support and pre-transplant patients' preparation. As the focus of the study was AKI, we did not collected detailed information about other postoperative complications, and, as few patients had other complications, we considered that it did not worth mentioning in this paper.

The AKI definition used was the AKIN⁹ based on serum creatinine. We considered the highest creatinine registered during the first 72 h after surgery. As stated in our paper, we do not have urine output registration in many patients, so we could not use

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this parameter to classify patients AKI stage. There were very few patients in the AKIN 1 stage, so we have excluded them from the analysis. We considered only AKIN 2 and 3 because it represents a more severe kidney injury, which has impact on patients' outcomes.

In summary, we have evidenced in our study the occurrence of important risk factors for AKI after LT (viral hepatitis, warm ischemia time and serum lactate) and highlight the association of AKI with mortality and CKD in this group of patients. We agree that this study has some limitations, the main being the retrospective design, but the lack of some data do not invalidate the results presented and the main message of the paper.

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