

Is “Intra–operating Room” Thromboelastometry Useful in Liver Transplantation? A Case-Control Study in 303 Patients

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ABSTRACT

Coagulation monitoring during liver transplantation (LT) is, even today, fundamental to reduce blood loss during surgery. Thromboelastometry (TEM) is a proven technique for controlling the various parameters that influence coagulation. However, there are no studies linking “intra–operating room” TEM (orTEM) with LT outcomes. We describe a case-control study in 303 liver graft recipients analyzing variables associated with operative complications and long-term LT outcomes. The results showed that orTEM reduced the use of blood products in patients with Model for End-Stage Liver Disease scores of ≥ 21 , retransplantation, and high surgical difficulty and important intraoperative bleeding. In addition, results in survival and postoperative complications were better when orTEM was used. In conclusion, we confirm that use of orTEM is associated with less use of blood products and a lower rate of complications after LT.

IN ORTHOTOPIC liver transplantation (LT), optimal management of blood coagulation is able to reduce blood loss and minimize the transfusion of blood products.^{1,2} Rotation thromboelastometry (TEM) and thromboelastography (TEG) are point-of-care techniques that provide a comprehensive real-time assessment of hemostasis from the start of clot formation to fibrinolysis.³ Several studies have shown the usefulness of coagulation monitoring with TEM, decreasing both transfusion volumes and the number of patients undergoing transfusion.^{4–6} However, very few studies have attempted to clarify whether TEM actually produces benefits in survival, morbidity, and mortality in LT recipients.

Transplant patient anemia has been linked to an increase in the number of complications and reduced survival.⁷ Greater control of homeostasis should generate greater intraoperative tissue oxygenation, reducing the risk of pulmonary, cardiac, and neurologic complications in the postoperative period. Therefore, we wondered whether the use of an “intra–operating room” TEM (orTEM), and consequently minimization of blood products during LT, modifies the pattern of complications. This study had 2 main objectives: 1) to estimate the influence of orTEM on graft survival and patient morbidity and mortality after LT compared with classic laboratory tests (non-orTEM); and 2) to identify differences in transfusion requirements.

MATERIALS AND METHODS

Of 303 consecutive LTs performed at the Virgen del Rocío Hospital, 168 patients underwent LT without TEM, and 135 patients underwent LT with orTEM located within the operating room. Recipient age and Model for End-Stage Liver Disease (MELD) score and donor age were significantly higher in the orTEM group ($P < .05$). Regarding other preoperative data, both groups were similar. To identify those patients where orTEM was useful, groups were established related to the risk of intraoperative bleeding: 1) 123 patients with a preoperative risk (PRG group): MELD score ≥ 21 and patients undergoing retransplantation (re-LT): 66 patients transplanted without orTEM (non-orTEM) and 57 patients transplanted with orTEM; and 2) patients who received ≥ 5 red blood cell units during the LT (PT group): 80 non-orTEM patients and 32 orTEM patients. Continuous variables were expressed as median and interquartile range. The chi-square test or Fisher exact test was used for qualitative or dichotomized variables, and the Mann-Whitney test for continuous variables. A 2-tailed P value of $< .05$ was taken to represent significance.

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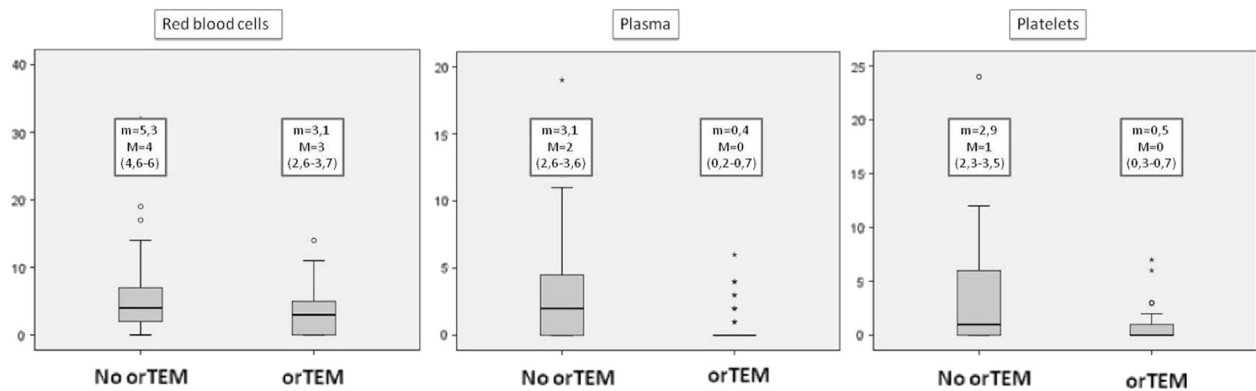


Fig 1. Blood requirements in the orTEM and non-orTEM groups (m = average; M = median).

RESULTS

Analyzing both groups, there was a significant decrease in the number of blood products used in the orTEM group ($P < .05$; Fig 1). More patients required ≥ 5 units of red blood cells (PT group) in the non-orTEM group than in the orTEM group (33.9% vs 23.7%; $P < .05$). We found a greater number of patients in the PRG and PT groups requiring a greater number of blood units when no orTEM was used than when it was used. The PRG group had a lower rate of complications when orTEM was used during LT ($P < .05$), decreasing the incidence of postoperative renal failure, surgical complications, postoperative bleeding, hematopenia, primary graft dysfunction, and re-LT. The early mortality rate was lower when orTEM was used. However, we detected a greater number of viral infections (cytomegalovirus [CMV]) and ascites in the orTEM group. We detected fewer complications in the PT group when LT was performed with orTEM, with significant ($P < .05$) differences in reperfusion syndrome, primary dysfunction, biliary complications, renal failure, surgical complications, bleeding, reoperations, and re-LT. In addition, use of orTEM in this group was associated with a lower rate of postoperative mortality ($P < .05$). We observed lower survival in the non-orTEM group than in the orTEM group,

although the differences were not significant ($P = .76$ in nonorTEM; $P = .68$ in orTEM; Fig 2).

DISCUSSION

The use of orTEM resulted in control of coagulation parameters and was very reliable to rule out the need for transfusion of red blood cells, platelets, and plasma, and it had high positive predictive accuracy for blood-derived products. The LT patients not controlled with orTEM needed more blood-derived products than those controlled with orTEM. It is possible that with quick control of coagulation parameters, using an orTEM device, bleeding is less than when TEM control takes place outside the operating room, so we need less blood-derived products. This was the case in our series, more so than we expected, even though the case group (orTEM) was worse than the control group (nonorTEM) in that the recipients were older, and had a higher MELD score and older donors. In this sense, the characteristics of our patients were similar to those reported in other recent LT series.^{8,9}

We identified 2 groups in which use of orTEM was associated with less use of blood products: those patients with an increased risk of intraoperative bleeding owing to

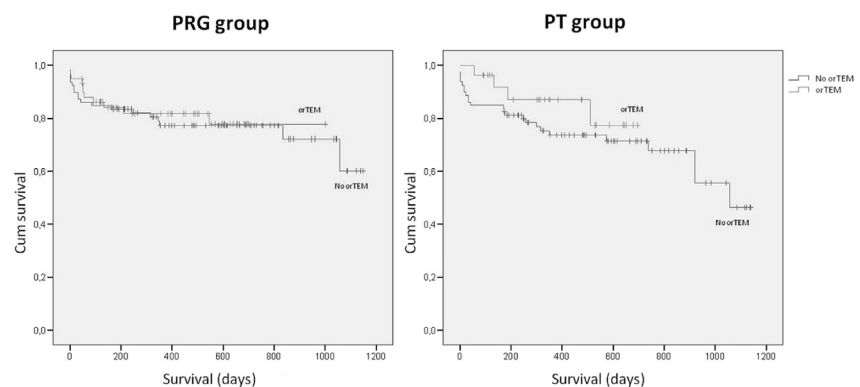


Fig 2. Patient survival in PRG and PT groups ($P < .05$).

their advanced stage of cirrhosis (MELD scores ≥ 21) and those with predictable surgical complexity (re-LT; PRG group). When orTEM was used, the patients had a lower rate of postoperative bleeding and hematopenia ($P < .05$), possibly related to the lower rate of blood loss compared with the group in which the traditional test was used. We also detected, when orTEM was used, a lower rate of complications such as postoperative renal failure, surgical complications, primary graft dysfunction and re-LT ($P < .05$), perhaps related with improved tissue oxygenation, both renal and hepatic tissue, derived from the reduction in blood loss. Also, the early mortality rate was lower when orTEM was used ($P < .05$). However, we detected a greater number of viral infections (CMV) in risk patients in whom orTEM was used during LT ($P < .05$). Although we are unable to offer an explanation for this, several articles have described the relationship between the need for transfusion and occurrence of CMV infection.¹⁰⁻¹²

We also identified an increased benefit of orTEM in patients who for technical reasons or for their coagulation state presented major hemorrhage during surgery, patients needing ≥ 5 red blood cell units (PT group), with a lower rate of surgical complications, bleeding, re-LT, biliary complications, and renal failure ($P < .05$). The liver graft also seems to benefit from the use of orTEM, because there was a lower incidence of reperfusion syndrome, primary dysfunction and re-LT, perhaps owing to the better oxygenation of liver parenchyma secondary to less bleeding. However, as in the risk group (PRG group) we also detected an increased incidence of CMV infection when orTEM was used ($P < .05$).

Similarly, postoperative mortality was also lower in polytransfused patients when orTEM was used ($P < .05$). In terms of survival, we detected no significant differences associated with using orTEM, although the trend was to better survival at 1 and 3 years, at least in the PT group.

In conclusion, our results show that, in patients with a foreseeable risk of bleeding or those with high blood loss during surgery, orTEM was associated with: 1) a reduction in the use of blood products during LT; b) reduced complications and postoperative renal failure; and 3) better preservation of the liver graft, with lower rates of dysfunction and re-LT. We also identified 2 groups with greater

benefit from orTEM: 1) patients with MELD scores of ≥ 21 ; and 2) patients polytransfused due to important intra-operative bleeding. Prospective and randomized studies are necessary to confirm these data.

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