THE INFLUENCE OF BLOOD TRANSFUSION ON THE SHORT-TERM SURVIVAL OF LIVER TRANSPLANTATION PATIENTS

A INFLUÊNCIA DA TRANSFUSÃO DE PRODUTOS SANGUÍNEOS NA SOBREVIDA EM CURTO TEMPO DE PACIENTES TRANSPLANTADOS HEPÁTICO

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ABSTRACT

Orthotopic liver transplantation (OLT) has been established as the definitive treatment for terminal liver disease. Bleeding and transfusion requirements may worsen perioperative morbimortality. We proposed to evaluate the relationship between one-year survival rate and transfusion of blood products in the perioperative OLT. Observational study involving 178 patients. The sample of patients was divided into two groups: the mortality group (MG), composed of patients who died within one-year post-OLT, and the survival group (SG), composed of those who remained alive at the end of the same period. The Model for End-Stage Liver Disease (MELD) score was higher in the MG (p<0.001). The number of units of RBCs and fresh-frozen plasma (FFP) was higher in the MG (p=0.010 and p=0.031, respectively). Mortality within one-year post-OLT was higher for those who received more than three units of RBCs (p=0.025) or FFP (p=0.005). One-year survival rate following OLT decreased significantly in association with the perioperative administration of over three units of RBCs or FFP. In the multivariate analysis, haemodialysis was an independent risk factor for increased mortality in the year post-OLT.

KEYWORDS: Liver transplantation; Survival; Mortality; Blood transfusion.

RESUMO

O transplante ortotópico de fígado (TOF) foi estabelecido como o tratamento definitivo para doença hepática terminal. Sangramento e necessidade de transfusão podem piorar a morbimortalidade perioperatória. Propomos avaliar a relação entre a sobrevida de um ano e a transfusão de produtos sanguíneos no perioperatório de TOF. Estudo observacional, onde foram incluídos 178 pacientes. A amostra de pacientes foi dividida em dois grupos: o grupo de mortalidade (GM), composto pelos pacientes que morreram em até um ano no pós-TOF, e o grupo de sobrevida (GS), composto por aqueles que permaneceram vivos ao final do mesmo período. O escore do modelo para doença hepática em estágio terminal (MELD) foi maior no GM (p < 0,001). O número de concentrado de hemácias (CH) e plasma fresco congelado (PFC) foi maior no MG (p = 0,010 e p = 0,031, respectivamente). A mortalidade em um ano no pós-TOF foi maior para aqueles que receberam mais de três CH (p = 0,025) ou PFC (p = 0,005). A taxa de sobrevida de um ano no pós-TOF diminuiu significativamente em associação com a administração perioperatória de mais de três CH ou PFC. Na análise multivariada, a hemodiálise foi um fator de risco independente para aumento da mortalidade em um no pós-TOF.

PALAVRAS-CHAVE: Transplante de fígado; Sobrevida; Mortalidade; Transfusão de sangue.

1. INTRODUCTION

Orthotopic liver transplantation (OLT) has been established as the only definitive treatment for terminal chronic liver failure[1]. It is a highly complex procedure, which may lead to difficult bleeding control

intraoperatively in patients who present with coagulopathy, portal hypertension or previous abdominal surgery. Historically, OLT has been associated with excessive blood loss and the need for transfusion of large amounts of blood products, with the transfusion volume making up about 10% of transplant costs[2,3].

There are several causes associated with increased blood loss and transfusion in OLT, such as increased severity of liver disease, high MELD score (Model for End-Stage Liver Disease), poor quality of grafts from marginal donors, old age, comorbidities, long cold ischemia time, significant hepatic steatosis, low haematocrit, surgical factors, hyperfibrinolysis, transfusion of fresh-frozen plasma (FFP), portal hypertension and haemodilution[1,3,4].

In recent years, the administration of blood products in the intraoperative period of OLT has been reduced, with an average number of red blood cell (RBC) units between 0.5 to 8 units per procedure[1]. This reflects efforts to reduce perioperative blood loss by the transplant teams as well as advances in surgical skills, graft preservation, anaesthesia techniques, coagulation monitoring based on algorithms, and perioperative management techniques such as lower central venous pressure, antifibrinolytic therapy, intravenous fluid restriction and reduction of FFP transfusion. In addition, it is also important to administer autologous blood recovered through the cell salvage system (cell saver) and synthetic blood products (prothrombin complex concentrate and fibrinogen concentrate) to reduce the need for allogeneic blood transfusion, thereby reducing morbidity and mortality[1,2,5].

The transfusion of blood products is associated with a negative impact on postoperative results, such as reduced graft function, infection, kidney injury, reoperation and increased short- and long-term morbidity and mortality[2,3]. Benson et al.6 raised the hypothesis that the FFP transfusion is associated with the presence of transfusion-related acute lung injury (TRALI), while RBC transfusion is associated with the presence of postoperative infection in a dose-dependent manner.

Although a progressive reduction of perioperative bleeding has been reported in transplantation centres worldwide, the relationship between blood transfusion and post-OLT mortality has not yet been defined. Thus, we proposed to investigate this subject, establishing in a single center the survival rate in the first year post-OLT, and its relationship with the transfusion of blood products in the perioperative scenario.

2. MATERIAL AND METHODS

This was a cohort study conducted at the General Hospital of Fortaleza, including 178 patients of both sexes, aged 18 or older, who underwent OLT from December 2009 to December 2018. Exclusion criteria were patients under the age of 18, medical records with incomplete or absent data and patient refusal to participate. For the prospective data, patients were informed about the study and the informed consent form was obtained from them, after approval of the ethics committee under number (503.188), excluding those who refused to participate. For the retrospective data, information was collected from medical records after approval of the ethics committee of the same institution under the number (791.692) and signature from a trustful custodian, excluding those with incomplete data.

Patient data were divided into two groups, according to survival within the first twelve months after OLT. The mortality group (MG) was composed of patients who died within one year after OLT and the survival group (SG) was composed of patients who remained alive at the end of the same period.

All patients were submitted to the same anaesthetic protocol, surgical technique (piggyback), hemodynamic monitoring and immunosuppressive treatment. Albumin solution (serum lactated 500 ml + 50 ml of 20% human albumin), norepinephrine, metaraminol, atropine and epinephrine were prepared for use. Ventilatory parameters were a tidal volume of 7 to 8 ml/kg, 50% inspired oxygen fraction and final expiratory pressure of 5 cm of water. The “cell saver” was used for all patients, except for those diagnosed with hepatocellular carcinoma and/or infection.

During the surgery, preconditions of haemostasis were maintained within adequate ranges: pH ≥ 7.3, central temperature ≥ 36 °C and ionic calcium ≥ 1.1 mmol/L. The blood product replacement was performed based on rotational thromboelastometry (ROTEM®, Pentapharm GmbH, Munich, Germany) or conventional laboratory tests in the absence of ROTEM® (Table 1). The target for transfusion of RBCs was to maintain haemoglobin at ≥ 8 g/dL. Blood products transfused during OLT were FFP, cryoprecipitate (CRYO), RBCs, platelet concentrates (PC), prothrombin complex concentrate (PCC), fibrinogen concentrate (FC) and RBCs recovered from the cell saver.

Table 1. Protocol for treatment of coagulation disorders during OLT

ROTEM®	Coagulopathy	Treatment Options
• EXTEM CT > 80-100 s. • PT > 1.5 X normal; INR > 1.5.	↓ Coagulation Factors	PCC: 25-40 IU/kg and/or FFP: 15-20 ml/kg.
• EXTEM A10 < 40 mm or MCF < 45 mm, FIBTEM normal. • Platelets < 50.000/mm3.	↓ Platelets	Platelets: 1unit for each 7 to 10 kg or 1 apheresis or 1 buffy coat.
• EXTEM A10 < 40 mm or MCF < 45 mm, FIBTEM MCF < 9 mm. • Fibrinogen < 1.5-2.0 g/L.	↓ Fibrinogen	• FC: 25-60 mg/kg or 2-4 g; CRYO: 1 unit / 5-10 kg. • ROTEM®: Fibrinogen (g) = MCF ΔFIBTEM (mm) x weight (kg)/140 • Plasma concentration: Fibrinogen (g) = ΔFibrinogen (g/L) x weght (kg)/140.
• INTEM CT > 240s and HEPTEMCT / INTEMCT < 0.8.	Heparin	Protamine: 50-100mg

• INTEM CT > 240s and HEPTEMCT / INTEMCT ≥ 0.8. • aPTT > 1.5 X normal.	↓ Plasma factors	FFP: 15 a 20 ml/kg
• EXTEM ML > 15% and APTEM ML < 15%.	Hyperfibrinolysis	EACA: 50 mg/kg

Orthotopic liver transplantation (OLT); Clotting time (CT); Prothrombin time/International normalized ratio (PT/INR); Amplitude of clot firmness 10 min after clotting time (A10); Maximum clot firmness (MCF); Activated partial thromboplastin time (aPTT); Maximum Lysis in 60 minutes (ML); Prothrombin complex concentrate (PCC); Fresh frozen plasma (FFP); Fibrinogen concentrate (FC); Cryoprecipitate (CRYO); Epsilon aminocaproic acid (EACA).

Protocol for coagulation management in liver transplantation of the General Hospital of Fortaleza, Brazil. Adapted from Kozek-Langenecker *et al.* (2017)[7], Carvalho et al.7 and Görlinger *et al.* (2019)[9]. Statistical analysis

The D'Agostino and Pearson and Kolmogorov-Smirnov tests were used to test the normality of the data. The absolute and relative frequencies were calculated for the categorical variables and means ± SD for the numerical variables. Fisher's exact test or the Mann-Whitney test was used to compare frequencies or averages, respectively. The patients' survival curves were calculated using the log-rank test (Mantel-Cox). Spearman's R correlation with 95% confidence interval (CI) was used to correlate the data. A direct logistic regression model was used for multivariate analysis of the data. In all tests, $p < 0.05$ was considered significant. Statistical analyses were performed using the GraphPad Prism 5 software (GraphPad Software, Inc., La Jolla, California, USA).

3. RESULTS

Demographic and surgical characteristics

In total, 178 patients undergoing OLT participated in the study, of which 56 [38 (67.9%) male, 18 (32.1%) female] were allocated to the MG and 122 [85 (69.7%) male, 37 (30.3%) female] were allocated to the GS. The average age was 47.3 ± 14.3 for the MG versus 51.0 ± 12.9 for the SG, the average weight was 72.0 ± 16.5 kg for the MG versus 72.0 ± 14.3 for the SG, and the average MELD-score was significantly higher in the MG (28.0 ± 7.5) compared with the SG (23.7 ± 7.8) ($p < 0.001$) (Table 2). The most common liver diseases in patients in the MG and the SG undergoing OLT were, respectively: alcoholic cirrhosis [14/56 (25.0%) vs. 31/122 (25.4%)], hepatitis C [8/56 (14.2%) vs. 12/122 (9.8%)] and cryptogenic cirrhosis [6/56 (10.7%) vs. 22/122 (18.0%)]. The surgical time was higher in the MG when compared to the SG (323 ± 78 min vs. 315 ± 64 min, respectively), without statistical significance (Table 2).

The starting international normalized ratio (INR) value was significantly prolonged in the MG when compared to the SG (2.31 ± 1.8 vs. 1.69 ± 0.8, $p = 0.006$, respectively). The starting total platelet count value reserve was significantly higher in the MG than in the SG (115.5 ± 80.2 vs. 85.0 ± 63.3, $p = 0.013$, respectively), and the starting urea value was significantly lower in the SG when compared to the MG (41.5 ± 26.5 vs. 54.4 ± 32.3, respectively, $p = 0.015$). There was no significant difference in the other analyses such as initial haemoglobin, haematocrit and creatinine.

Table 2. Demographic and surgical characteristics of patients undergoing OLT.

Characteristics	MG (n=56)	SG (n=122)	p
Age, mean ± SD, yr	47.3 ± 14.3	51.0 ± 12.9	0.099
Weight, mean ± SD, kg	72.0 ± 16.5	72.0 ± 14.3	0.708
Gender n (%)			
Male	38 (67.9)	85 (69.7)	0.862
Female	18 (32.1)	37 (30.3)	
MELD score, mean ± SD	28.0 ± 7.5	23.7 ± 7.8	<0.001
Liver disease n (%)			0.822
Alcoholic cirrhosis	14 (25.0)	31 (25.4)	
HCV cirrhosis	8 (14.2)	12 (9.8)	
Cryptogenic	6 (10.7)	22 (18.0)	
Fulminant	9 (16.1)	5 (4.1)	
Autoimmune, PBC and PSC	1 (1.79)	14 (11.5)	
Retransplantation (vessel thrombosis and graft rejection)	5 (8.9)	9 (7.4)	
#Indetermined	9 (16.1)	20 (16.4)	
*Other	4 (7.1)	9 (7.4)	
Starting hemoglobin value, mean ± SD, g/L	9.9 ± 1.9	10.2 ± 2.0	0.550
Starting hematocrit value, mean ± SD, %	29.8 ± 5.8	30.9 ± 6.7	0.429
Starting INR value, mean ± SD	2.31 ± 1.8	1.69 ± 0.8	0.006
Starting platelet count, mean ± SD, x 109/L	115.5 ± 80.2	85.0 ± 63.3	0.013
Starting urea value, mean ± SD, mg/Dl	54.4 ± 32.3	41.5 ± 26.5	0.015
Starting creatinine value, mean ± SD, mg/dL	1.3 ± 0.7	1.4 ± 1.4	0.091
Duration of surgery, mean ± SD, min	323 ± 78	315 ± 64	0.506

Data are presented as number (%) or mean ± SD. Mann–Whitney test; Fisher exact test. *$p < 0.05$, statistically significant. #Indeterminate: combination of two or more causes; *other diagnoses include alpha 1 antitrypsin deficiency, hemochromatosis, Budd-Chiari syndrome, Wilson's disease, polycystic liver disease, NASH: nonalcoholic steatohepatitis; congenital liver fibrosis, hepatic neuroendocrine tumor, Hepatitis B.MG, mortality group; SG, survival group; PBC: primary biliary cirrhosis; PSC: primary sclerosing cholangitis; MELD: Model for End-Stage Liver Disease; INR: international normalized ratio.

Blood product administration

Regarding the number of patients transfused, 87.5% of the MG received transfusion of RBCs, a significantly higher percentage ($p = 0.014$) compared to 69.7% of the SG. In terms of the number of RBC units transfused per patient, the average was significantly higher in the MG (5.12 ± 7.33) when compared to the SG (3.09 ± 3.66) ($p = 0.010$) (Table 3).

In the analysis of the number of FFP units administered per patient, the average was significantly higher in the MG (2.54 ± 3.76) when compared with the SG (1.39 ± 2.26) ($p = 0.031$). Other haemostatic interventions during OLT were evaluated, but the results

were not statistically significant (Table 3).

Table 3. Transfusion support in perioperative OLT.

Variables	MG (n=56)	SG (n=122)	p
Patients transfused: RBCs, n (%).	49 (87.5)	85 (69.7)	0.014
RBCs transfused (units, mean ± SD).	5.12 ± 7.33	3.09 ± 3.66	0.010
Patients transfused: FFP, n (%).	32 (57.1)	50 (41.0)	0.053
FFP transfused (units, mean ± SD).	2.54 ± 3.76	1.39 ± 2.26	0.031
Patients transfused: CRIO and/or patients treated: FC, n (%).	26 (46.4)	55 (45.1)	0.873
CRYO transfused (units, mean ± SD).	7.23 ± 17.0	6.04 ± 11.1	0.914
FC administered (g, mean ± SD).	0.68 ± 1.55	0.83 ± 1.89	0.981
Patients treated: PCC, n (%).	17 (30.4)	35 (28.7)	0.860
PCC administered (IU, mean ± SD).	616 ± 104	586 ± 112	0.717
Patients transfused: PC, n (%).	15 (26.8)	33 (27.0)	1.000
PC transfused (units, mean ± SD).	3.44 ± 9.07	2.91 ± 5.96	0.981
Patients transfused: Cell saver, n (%).	22 (39.3)	58 (47.5)	0.333
Cell saver blood transfused (ml, mean ± SD).	367 ± 690	307 ± 533	0.774
Patients treated: EACA, n (%).	36 (64.3)	84 (68.8)	0.606
EACA administered (g, mean ± SD).	NA	NA	NA

Data are presented as number (%) or mean ± SD. Mann–Whitney test; Fisher exact test. *p < 0.05, statistically significant. MG, mortality group; SG, survival group; CLTs, conventional laboratory tests; RBCs, red blood cells; FFP, fresh–frozen plasma; CRYO, cryoprecipitate; FC, fibrinogen concentrate; PCC, prothrombin complex concentrate; IU, International unit; PC, platelet concentrate; EACA, epsilon aminocaproic acid; NA, not applicable.

One-year patient survival after OLT related to blood transfusion

In total, 109 patients were transfused with up to three units of RBCs, with an average of 1.19 units per patient; these patients had a mortality rate of 26.6%. Sixty-nine patients received more than three units of RBCs, with an average of 7.75 units per patient; these patients had a significantly higher mortality rate of 39.13% (p = 0.025) (Figure 1A).

Overall, 144 patients were transfused with up to three units of FFP, with an average of 0.85 units per patient. These patients had a mortality rate of 27.08%, while the 34 patients who received a transfusion of more than three FFP had an average of 4.15 units per patient, with a significantly higher mortality rate of 50% (p = 0.005) (Figure 1B). Thirty-one patients had not been transfused with any blood components and had a lower mortality rate (12.9%), but this difference was not statistically significant when compared to the 147 patients who received at least one blood product and had a 35.37% mortality rate (Figure 1C).

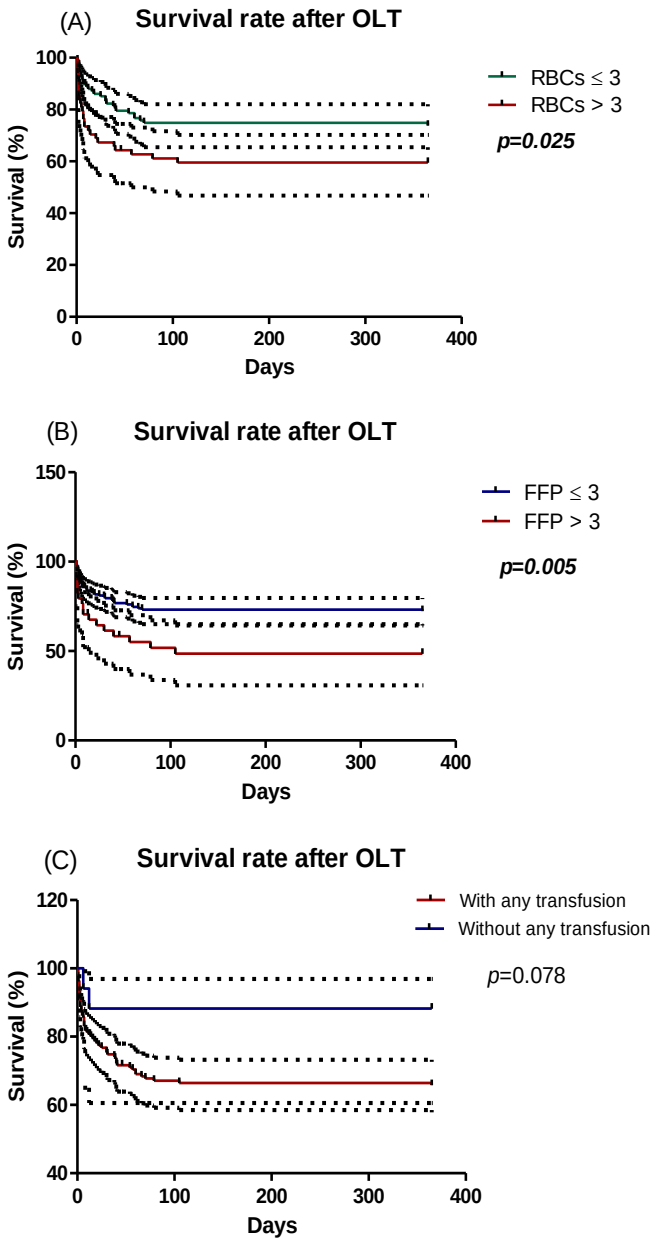

Figure 1. One-year survival after orthotopic liver transplantation. (A), patients who received up to 3 or more than 3 red blood cell concentrates (RBCs); (B), patients who received up to 3 or above 3 fresh frozen plasma (FFP) and (C), patients who received or did not receive at least one blood product. Orthotopic liver transplantation (OLT)

Risk factors for mortality

In the MG, RBC transfusion was directly and moderately correlated with FFP (r = 0.665; p < 0.001), CRYO (r = 0.502; p < 0.001) and PC (r = 0.587; p < 0.001) transfusions, respectively. While in the SG, RBC transfusion was directly and weakly correlated with FFP (r = 0.486; p < 0.001), CRYO (r = 0.366; p < 0.001) and PC (r = 0.493; p < 0.001) transfusions, respectively (Figs. 2 A, B and C).

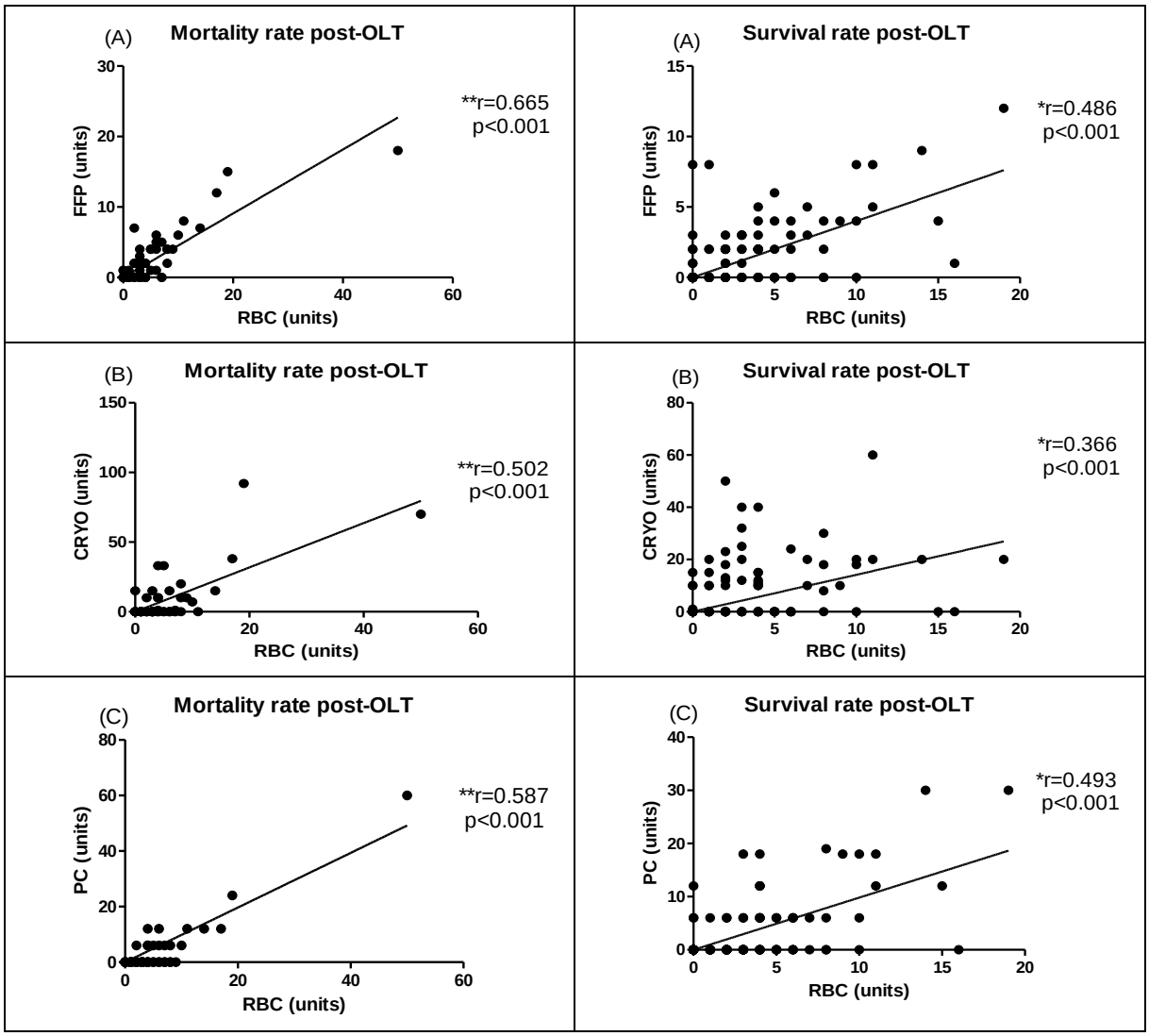

Figure 2. Spearman correlation between blood products and one-year post-OLT survival. Spearman (r); **moderate correlation; *weak correlation; p <0.05 is significant. (A) Correlation between administration of red blood cell concentrate (RBC) and fresh frozen plasma (FFP); (B), between CH and cryoprecipitate (CRYO) and (C), between RBC and platelet concentrate (PC). Orthotopic liver transplantation (OLT).

Risk analysis for mortality within one year after OLT

In the analysis of mortality risk adjusted for age, MELD, RBC, FFP and haemodialysis within one year after OLT, haemodialysis presented a 0.343 times higher risk of mortality according to multiple logistic regression analysis (OR = 0.343; 95% CI = 0.163–0.720; p = 0.005) (Table 4).

Table 4. Logistic regression between mortality and variables in one-year post-OLT.

Logistic regression	Mortality			
	O.R.	95% CI		p
Age	0.989	0.963	1.015	0.400
MELD (Model for End-Stage Liver Disease)	1.043	0.996	1.092	0.074
Red blood cell concentrate	1.044	0.933	1.169	0.449
Fresh frozen prasma	1.049	0.877	1.256	0.599
Hemodialysis	0.343	0.163	0.720	0.005

O.R. - odds ratio; 95% CI – confidence interval. Postoperative outcomes.

Regarding postoperative outcomes, the following variables were analysed: need for haemodialysis (p = 0.154), length of stay in the intensive care unit (ICU) (p = 0.291), tracheal extubation in the first 6 hours (p = 0.411), length of stay in hospital (p = 0.222), reoperation for bleeding in the first 24 hours (p = 0.416) and graft rejection (p = 0.812). There was no statistical significance between the analyses (Table 5).

Table 5. Postoperative outcomes of OLT

Outcomes	MG (n=56)	SG (n=122)	p
Need for hemodialysis, n (%)	27 (48.2)	23 (18.8)	0.154
Length of stay in the ICU (d)	7.68 ± 11.6	4.5 ± 4.17	0.291
Tracheal extubation in the first 6 hours, n (%)	11 (19.6)	68 (55.7)	0.411
Length of hospital stay (d)	18.1 ± 22.1	19.9 ± 15.9	0.222
Bleeding reoperation in the first 24 hours, n (%)	8 (14.3)	8 (6.6)	0.416
Graft rejection, n (%)	16 (28.6)	6 (4.9)	0.812

Data are presented as number (%) or mean ± SD. Mann–Whitney test; Fisher exact test. p < 0.05, statistically significant. Days (d); Intensive Care Unit (ICU).

4. DISCUSSION

Factors such as improvement of surgical and anaesthetic techniques, adoption of transfusion protocols, reduction of surgical time, use of rotational thromboelastometry, antifibrinolytics and blood products, as well as normovolemic maintenance, corrections of hydroelectrolytic and acid-base disorders, and the preservation and quality of the graft have allowed the reduction of blood transfusions in the perioperative period of liver transplantation[3,10,11]. Authors have argued that OLT can be performed without the need for RBC transfusion in patients with less severely advanced liver disease and operated on using the "piggyback" technique[12]. In that study, 17.4% of patients had not been transfused with any blood components. However, other authors have found a higher percentage (30.5%) of OLT cases without RBC transfusion[13].

In terms of the surgical and demographic characteristics, the average (28.0) MELD score was associated with increased mortality in the year after OLT. Corroborating these findings, Alonso et al. (2015)[11] found that the need for intraoperative blood transfusion and shorter survival were significantly associated with a higher MELD score, over 25. Other authors have also shown reduced survival with a MELD score above 2114. On the other hand, Solves *et al.* (2015)[15] identified no difference in survival in their MELD analysis.

Unlike the MELD value, the preoperative haemoglobin value and previous abdominal surgeries were not associated with mortality and one-year survival after blood product transfusion. Lei et al. (2012)[16] found that a lower preoperative haemoglobin value, the severity of the recipient's disease assessed by the MELD score and a previous history of abdominal surgery showed a significant relationship with the indication for intraoperative transfusion in live donor OLT, in the analysis of haemoglobin levels. Authors have found that low haemoglobin values with a mean of 10.2 (SD 1.5) g/dL pre-OLT were not associated with one-year survival[17].

In the MG, we found a prolonged starting INR value and a greater impairment of renal function with a high starting urea value. On the other hand, these patients had a better platelet reserve. In contrast, authors have reported that when preoperative liver function is most affected, cirrhosis and splenomegaly can lead to a low platelet count with subsequent blood clotting disorders. Also, in a univariate analysis, there was no reduction in one-year survival in the presence of an initially high INR5. While we found a better platelet reserve in patients with shorter one-year survival, previous reports have pointed to reduced one-year survival in patients with low platelet reserve[18,19].

In this series, we identified that RBC transfusion of over three units was associated with a significant reduction in the one-year survival rate after OLT. Similarly to these findings, but with a reduction in the number of transfusions of over six units of RBCs in the intraoperative period of OLT, authors identified a significant reduction in one-year survival20,21. Massicotte *et al.* (2012)[22] showed a significant reduction in the one-year survival rate after OLT with the transfusion of more than four units of RBC intraoperatively. A report has also documented reduced survival associated with RBC transfusion higher than the median volume (> 1254 mL)[14]. Other authors have also suggested that intraoperative RBC transfusion is an independent risk factor for patient survival post-OLT[19]. Han et al. (2018)[23] identified that the transfusion of up to six units of fresh RBCs had a negative impact on the survival of patients undergoing OLT, which was also seen when only one to two units were transfused, even with leukoreduction and irradiation, suggesting that even small amounts of fresh RBCs may be associated with a worse prognosis. Therefore, in immunocompromised patients, allogeneic leukocytes are responsible for adverse reactions to RBC transfusion.

We also found that FFP transfusions of over three units were associated with a significant reduction in the one-year survival rate after OLT. Considering the other blood products such as CRYO, PC, FC and PCC, there was no association seen in the analysis of one-year survival after OLT. There was also no association seen in those patients who received at least one blood product when compared with those who were not transfused.

In this study, in the MG, RBC transfusion was moderately and directly correlated with FFP, CRYO and PC transfusions. While in the SG, this correlation was weak, pointing to a greater association with blood product transfusion in patients who died within one year. Supporting these results, authors have found that FFP transfusion correlated strongly with RBC transfusion, reducing survival at one year, and that reduced PFC transfusion was associated with a decrease in RBC transfusion needs during OLT[22,24]. Considering blood transfusion based only on conventional laboratory tests, authors have identified a direct and moderate correlation between FFP and RBCs[25].

In the analysis of age-adjusted mortality risk, MELD, RBCs, FFP and haemodialysis within one year after OLT, haemodialysis presented a higher risk of mortality according to multiple logistic regression analysis. Corroborating this finding, authors have shown that the mean survival time was significantly reduced in patients who underwent haemodialysis after OLT or before and after OLT[26]. Other studies have also documented that patient with end-stage liver disease and kidney dysfunction have an increased risk of complications and reduced survival after OLT[27,28].

Regarding the postoperative outcomes, unlike our findings, Rana et al.10 showed a significantly higher rate of reoperation due to bleeding in patients who received a volume of RBCs greater than 28 units. Contrary to our results, authors identified that acute liver rejection, delay of extubation and stay in critical care unit were associated with decreased recipient survival[14].

The observational and retrospective nature of the present study is a limitation, as is the evaluation of a relatively small sample of patients and limiting the period of survival analysis to one-year post-OLT. Thus, it is important to carry out further research to generate more consistent results.

5. CONCLUSION

In conclusion, one-year survival rate following liver transplantation decreased significantly in association with the perioperative administration of over three units of RBCs or FFP. In the multivariate analysis, haemodialysis was an independent risk factor for increased mortality in the year after OLT. Despite the limitations of this study, we observed that the one-year post-OLT survival was lower in patients with more severe disease and less haemostatic reserve, who underwent haemodialysis or blood transfusion.

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