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ORIGINAL ARTICLE

Effectiveness of Rotational Thormboelastometry (ROTEM) Algorithm Guided Transfusion Practice in Living Donor Liver Transplantation: A Single Centre Analysis

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ABSTRACT

Background: Liver transplantation is a complicated surgical procedure that involves many complexities such as bleeding and the risk of transfusing blood components.
Aim: To investigate the effect of the Rotational Thormboelastometry (ROTEM) algorithm-based blood or blood product transfusion, in clinical outcome of living donor liver transplant (LDLT) patients.
Study design: Retrospective study
Place and duration of the study: Bahria Town international hospital Lahore from 1st January 2016 to 31st December 2020.
Methodology: Sixty patients of living donor liver transplant were enrolled. They were then divided into two groups as per the approved transfusion protocol. The first group named pre-ROTEM and the second was ROTEM group. Initial biochemical features, blood transfusion and patient outcomes were documented.
Results: The need for large-scale blood transfusion and transfusion-related products were statistically less in ROTEM group as compared to the pre-ROTEM group.
Conclusion: The ROTEM-based algorithms can be used effectively to reduce transfusion of blood components and may increase the chances of early transplant functioning.
Keywords: ROTEM algorithm, Blood transfusion, Liver transplant, ASA guideline, Thromboelastogram, TEG

INTRODUCTION

Live donor liver transplantation (LDLT) is a high-risk surgery that carries a risk of massive bleeding. Liver transplantation is an increasingly successful treatment option for end-stage liver disease and acute liver failure. In Pakistan liver disease is a significant problem and it is estimated that over 2.5 million people in Pakistan require liver transplantation[1]. In Pakistan, first liver transplant was performed in 2003 at the Sindh Institute of Urology and Transplantation in Karachi. Now Liver Transplants are being carried out at different hospitals throughout Pakistan as per international standards. Living donor liver transplantation (LDLT) is the only treatment option for these patients as cadaveric donors are not available[2].

This surgery involves transfusion of a massive amount of blood products and transfusion-related complications such as infection, immune modulation, elevated volume and damage to the respiratory membrane etc[3]. Routine laboratory tests such as INR and platelet counts could not predict or guide blood transfusion during hepatic transplantation[4]. But with the development and comprehension of ROTEM, improved transfusion practices, preventing unnecessary transfusions and decreasing overall blood transfusions.[5] In the liver transplant centre of the Bahira International Hospital in Lahore, the ROTEM algorithm was applied to patients as a predictor of massive bleeding and in cases of massive intra-surgical transfusion and compared with the American Society of Anaesthesiologists (ASA) transfusion guidelines for the management of bleeding during the peri-surgical period[6]. This retrospective study examined the impact of the adoption of the ROTEM transfusion algorithm on the practice of transfusion of blood products in LDLT recipients.

MATERIALS AND METHODS

This retrospective comparative study was conducted at Bahria International Hospital Lahore from 1st January 2016 to 31st December 2020 and comprised sixty patients. Patients with the chance of massive bleeding were recruited in this study. Cutt off value for massive bleeding defined as bleeding ≥70ml blood/kg. Parameters for the prediction of massive bleed were (i) INR ≥2 (ii) platelets ≤50x10^9/L (iii) haemoglobin ≤8 mg/dl (iv) model for end stage liver disease (MELD) ≥30 and (v) serum albumin ≤.2.5gm/dl. Patients were included in the study if one or more above mentioned parameter found before the day of surgery. The participants were further divided into two groups.

Group A (pre-ROTEM): The pre-ROTEM group, was managed on ASA guidelines for the transfusion of blood. According to the guidelines fresh frozen plasma (FFP) was used calculated value of 15ml/kg when the INR ≥2. Packed red blood cells (RBC) infused when haemoglobin showed cut off valve of less than 8gm/dl and for intra operative massive bleeding (blood loss ≥70ml/kg) FFP to RBCS to platelet 1:1:1 ratio protocol was considered.

Group B (ROTEM): In this group the blood transfusion was managed by the ROTEM criteria. The disturbances in coagulation profile were screen based on EXTEM and INTEM test. On the basis of the results further analysis were carried out named FIBTEM, APTEM and HEPTEM. The need of blood transfusion was estimated bases on Essener-Runde algorithm[7]. The most important parameter was used to detect the early disturbance and intervention was A10. Low amplitude of A10 in EXTEM indicates platelets deficiency or dysfunction when FIBTEM shows normal value. Similarly, a low A10 in both EXTEM and FIBTEM indicate fibrinogen deficiency. Prolonged clotting time (CT) calculated in INTEM and corrected in HEPTEM shows heparin or may be heparin-like effect (figure 1). Clot lysis indices (CLI) <85% within 60min shows fibrinolysis. To stop antifibrinolytic drugs APTEM test is used and based on this test we assessed the effectiveness of antifibrinolytic therapy. In both groups, pH, electrolyte, and body temperature were optimized as per institutional protocol. Statistical analysis was done by using the SPSS-20. Significance of variance was called by applying two-way independent sample test or chi square test. *P*-value less than 0.05 was considered significant.

RESULTS

No statistically significant differences were found between two groups (Table 1). Table 2 shows the transfusion of blood components across the two groups. Transfusion of red blood cells (RBCs), FFPs units and Mass Transfusion Protocol (MTP) application were found statistically significant lower in the group B

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(ROTEM group) as compared to group A (pre-ROTEM group). Otherwise, no differences were found between the two groups with respect to intraoperative blood loss, platelet transfusion requirement, volume of cell saver treated that was measured as the incidence of packing to control bleeding.

Table 1: Perioperative characteristics in both studied groups (n=60)

Variable	Group A	Group B	P value
Age (Years)	52±11	48±8	0.91
BMI (kg/m^2)	24±6	28±6	0.33
Gender (M/F)	23/7	24/6	0.58
Pre-operative INR	1.7	1.6	0.265
Pre-operative MELD	15	16	0.94
Preoperative Platelet count (10/litre)	39	41	0.34
Basal Haemoglobin level(gm/dl)	9.7±1.7	9.9±1.2	0.47
Basal Serum Albumin (gm/dl)	2.9	2.8	0.48
HCC (%)	34%	32%	0.26

BMI (body mass index), MELD (Model for end-stage liver disease), INR (International normalized ratio), HCC (hepatocellular carcinoma)

Table 2: Comparison of blood products used on in both groups in peri-operative period

Variable	Group A	Group B	P value
PRBCs	8	4.9	0.01*
FFP	12.7	5.9	0.001*
MTP	27%	21%	0.005*
Platelets	4	5	0.09
Cell saver treatment[1]	1.6	1	0.79

FFP (Fresh frozen plasma), MTP (Massive bleeding protocol), *P is significant (P<0.05)

1= "Cell savers" are instruments that collect blood lost during surgery. The RBCs are washed with normal saline and concentrated to make an approximate 225 mL unit with a haematocrit of ~ 55%. RBC units can be either directly transfused into the patient or washed again and stored.

DISCUSSION

Liver donor liver transplant is a complex surgery that is usually associated with massive intra-operative haemorrhage that may require a transfusion of blood components. Blood transfusion associated with many reactions and complications such as acute lung injury, transfusion associated volume overload, poor graft healing process and greater chances of infection.[8]Uncontrolled blood transfusion also puts a numerous burden to the limited resources of a hospital blood bank. A number of efforts were made to access the pre-define estimation of blood transfusion during LDLT. Not very precise, but with the help of lab tests such as PT, APTT, INR, Fibrinogen and Platelet levels a rough calculation of blood transfusion can be made[9].

With the advancement of scientific knowledge and research in the domain of coagulation monitoring, a point of care algorithm named ROTEM algorithm evolved. ROTEM used the cell-based model to estimate haemostatic therapy as compared to the conventional method such as ASA guidelines based on standard laboratory tests. ROTEM creature is found to be remarkably effective in early diagnosis of haemostatic defects and helping the rapid and in time initiation of specific medications, coagulation concentrates of other blood products as shown.[10] Another important benefit of the ROTEM bases algorithm is early diagnosis (A10= 10 minutes) as compared to the lab bases detection, which at least take 45 minutes[11]

ROTEM based algorithm can be used in other excessive bleeding associated problem like trauma, cardiac surgery beside the living donor liver transplant. In all kinds of blood transfusion related procedure, it can reduce the need of blood components need. Grlinger et al[12] looked at the effect of ROTEM on transfusion of blood components in three different hospitals in Germany and Australia. They found a significant decrease in CBR, FFP in transplantation cases with significantly smaller massive transfusion episodes. Also in a Cochrane review, the use of ROTEM reduced bleeding episodes, but was not associated with improved patient outcomes[13]. The same results can be seen in the current study done in Bahria Town international hospital Lahore. The result of the present study is much similar as seen in the earlier studies which prove that increase use of blood products is associated with the worse results.[5,14-17]We didn't find any significant difference between two groups in case of platelets transfusions. Other research also showed that the ROTEM is not sensitive to detect the platelets transfusions despite the fact EXTEM and FIBTEM may be helpful in detection of platelets deficiency.[18] A more promising result can be obtained in this study and the availability of fibrinogen and prothrombin concentrate is also important to get the better results of the study currently done.

CONCLUSION

ROTEM based algorithms can be the future of blood transfusion analysis and can help to get the better outcomes in complicated surgeries like liver transplant.

Conflict of interest: Nil

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