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Case Series

Transfusion Medicine Section

# Transfusion Approaches in Liver Transplantation: A Case Series from a Tertiary Care Hospital

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## ABSTRACT

Orthotopic liver transplantation is a complex procedure associated with significant haemostatic disturbances and variable transfusion requirements. Optimal perioperative blood management is essential to reduce morbidity and improve graft outcomes. The present case series describes transfusion strategies and outcomes in three patients (two males and one female) with end-stage liver disease of varying aetiologies undergoing deceased donor liver transplantation at a tertiary care centre. Preoperative evaluation included clinical assessment, blood grouping and typing, antibody screening, crossmatching, and reservation of blood components. Intraoperative and postoperative transfusion requirements were guided by serial monitoring of haemoglobin, platelet count, coagulation profile, fibrinogen levels, liver function tests, and overall clinical status. Intraoperative blood loss ranged from 440 mL to 5100 mL. Two patients required minimal transfusion support, whereas one patient developed major perioperative haemorrhage requiring massive transfusion support. Transfusion therapy included leukoreduced packed red blood cells, fresh frozen plasma, platelets, and cryoprecipitate administered in a targeted and individualised manner. Progressive improvement in coagulation parameters and liver function was observed in all patients following transplantation. No transfusion-related adverse events occurred, and all patients achieved satisfactory graft function and were discharged in stable condition. An individualised, goal-directed transfusion strategy combined with meticulous preoperative planning, judicious blood component utilisation, and multidisciplinary coordination can effectively manage diverse transfusion requirements during liver transplantation. Patient blood management principles and targeted correction of coagulopathy may optimise outcomes while minimising unnecessary exposure to blood products.

**Keywords:** Blood component therapy, Blood transfusion, Coagulopathy, Massive transfusion, Orthotopic liver transplantation, Patient blood management

## INTRODUCTION

Liver transplantation is presently a viable option for patients with end stage liver disease. Orthotopic liver transplantation is the replacement of a diseased liver with a healthy liver in the normal anatomic position. The operative procedure is extensive, complex and technically challenging with multiple vascular anastomoses [1]. Being associated with several haemostatic defects, transfusion services must be well equipped to deliver efficient massive transfusion support [2].

Haemostatic derangements in liver disease are dynamic, reflecting a rebalanced haemostatic state, wherein patients are susceptible to haemorrhagic and thrombotic events. This balance poses considerable challenges in determining the appropriate type and volume of blood components required during the perioperative period. Transfusion of blood products significantly increases post-transplant morbidity and mortality [2].

Transfusion support in liver transplantation involves a multidisciplinary approach, encompassing preoperative immunohaematological evaluation, ensuring timely availability of compatible blood components, intraoperative management of major haemorrhage and postoperative correction of coagulation abnormalities [3]. Blood component therapy typically includes leukoreduced packed red blood cells, fresh frozen plasma, platelets and cryoprecipitate, necessitating close coordination between the transplant team and transfusion medicine specialists.

A judicious and strategic approach to transfusion support is essential for optimising clinical outcomes. The present case series illustrates the implementation of a multidisciplinary, patient-centred transfusion strategy during deceased donor liver transplantation in a tertiary care hospital. Despite baseline coagulopathy and thrombocytopenia, blood component utilisation remained modest in two patients, while the third patient with substantial perioperative haemorrhage was successfully managed through targeted transfusion support.

The present case series describes the transfusion strategies employed in patients undergoing liver transplantation, with emphasis on the challenges encountered and the approaches adopted in blood component management.

## CASE SERIES

### Case 1

A 61-year-old male with end stage liver disease secondary to chronic hepatitis B infection was admitted for evaluation and planned for deceased donor liver transplantation. He was a known case of type 2 diabetes mellitus for the past 10 years and was on metformin therapy. He had been diagnosed with multifocal hepatocellular carcinoma two years prior to presentation and had undergone transarterial chemoembolisation. Blood group was B Rhesus D Antigen (D) positive. Preoperative evaluation revealed anaemia and thrombocytopenia. Liver function tests showed hyperbilirubinemia and elevated transaminases. A pretransfusion workup including ABO Blood Group System and Rh blood grouping, antibody screening, and crossmatching was performed. A total of 10 units of leukoreduced packed red blood cells, two units of single donor platelets, 15 units of random donor platelets, 10 units of fresh frozen plasma and 10 units of cryoprecipitate were requested preoperatively as per transplant team's order and kept reserved prior to surgery.

The patient underwent a deceased donor orthotopic liver transplantation. Intraoperatively, there was blood loss of 440 mL requiring transfusion support. He received four units of leukoreduced packed red blood cells and two units of fresh frozen plasma intraoperatively. The patient received transfusion of two units of leukoreduced packed red blood cells in the immediate postoperative period.

Serial laboratory monitoring demonstrated improving coagulation parameters over subsequent days. Coagulation parameters were normalised.

The procedure lasted approximately for 8.5 hours. During surgery, the patient remained haemodynamically stable and required only limited vasopressor support, with a low-dose norepinephrine infusion (0.02-0.05 µg/kg/min) administered mainly during the anhepatic phase. Intraoperative volume replacement consisted of approximately 2500 mL of crystalloid solutions and 500 mL of 5% albumin, resulting in an overall near-neutral fluid balance. Fibrinogen concentrations remained within acceptable limits during the perioperative period, measuring 220 mg/dL preoperatively and 190 mg/dL on first postoperative day, therefore cryoprecipitate transfusion was not indicated. Serial calcium measurements identified transient intraoperative hypocalcaemia (7.2 mg/dL), which was corrected with intravenous calcium gluconate. No antifibrinolytic therapy was used. Surgical drain output was 350 mL during the first postoperative day and progressively declined to below 100 mL/day by fourth post operative day**.** Blood component therapy was guided by evidence of active bleeding, laboratory values including International Normalised Ratio (INR) elevation and overall clinical assessment [Table/Fig-1] There were no transfusion related adverse events. The postoperative course was uneventful, and the patient was discharged with stable graft function and satisfactory haematological parameters.

## Case 2

A 45-year-old female with decompensated chronic liver disease, secondary to non alcoholic steatohepatitis was admitted for evaluation and planned for deceased donor liver transplantation. She had a history of recurrent ascites, for which she had undergone therapeutic paracentesis three years before. Blood group was B Rh(D) positive.

Baseline laboratory investigations revealed anaemia and thrombocytopenia, a complete pretransfusion work-up, including ABO and Rh typing, antibody screening, and crossmatching were performed. Adequate blood components were requested and reserved prior to surgery, including a total of 10 units of leukoreduced packed red blood cells, four Unit of single donor platelets, eight units of random donor platelets,10 units of fresh frozen plasma and 10 units of cryoprecipitate. The patient underwent deceased donor orthotopic liver transplantation. Intraoperatively, there was a blood loss of 500 mL. The patient received transfusion of two units of leukoreduced packed red blood cells, one unit of single donor platelet and three units of fresh frozen plasma. Postoperative monitoring revealed mild bleeding; however, the patient remained haemodynamically stable and did not require transfusion support.

The duration of surgery was approximately nine hours. Haemodynamic parameters remained satisfactory throughout the procedure, with only intermittent administration of low-dose norepinephrine (0.03-0.06 µg/kg/min). Fluid replacement included approximately 3000 mL of balanced crystalloid solutions together with 500 mL of albumin, resulting in a mildly positive fluid balance. Perioperative fibrinogen levels remained adequate, with values of 205 mg/dL preoperatively and 185 mg/dL on Postoperative day 1. Cryoprecipitate transfusion was not done. Calcium levels demonstrated transient postoperative hypocalcaemia, with a nadir value of 6.6 mg/dL, which responded to intravenous calcium given. Antifibrinolytic agents were not administered. Postoperative drain output measured 420 mL on POD1 and subsequently decreased without evidence of clinically on significant bleeding. Decisions regarding transfusion were based evidence of active bleeding, laboratory values including INR elevation and the patient's overall clinical status.

Serial clinical and laboratory assessments demonstrated progressive improvement. Coagulation parameters were normalised. The patient was discharged with normal graft function and normal haematological parameters [Table/Fig-2].

## Case 3

A 48-year-old male presented with chronic liver disease and Budd-Chiari syndrome was admitted for evaluation and planned for

| Variables | Hb (g/dl) | PCV (%) | TC (cells/µL) | PLT (x10$^3$/µL) | PT (sec) | PTT (sec) | INR | TB (mg/dl) | SGOT (U/L) | SGPT (U/L) | ALB (g/dl) | Calcium (mg/dL) | Fibrinogen (mg/dL) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRE OP | 10.4 | 34.2 | 7490 | 67 | 14.8 | 25.9 | 1.17 | 3.92 | 111 | 191 | 2.0 | 8.4 | 220 |
| INTRA OP | 10.0 | 33.6 | 9200 | 60 | 15.2 | 24.5 | 1.15 | 3.51 | 78 | 139 | 2.8 | 7.2 | ND |
| POD 1 | 10.4 | 30.2 | 13300 | 66 | 17.8 | 25.2 | 1.41 | 2.30 | 69 | 128 | 2.9 | 7.0 | 190 |
| POD 2 | 9.8 | 28.3 | 14400 | 67 | 16 | 26.9 | 1.12 | 2.05 | 37 | 112 | 3.4 | 7.5 | ND |
| POD 3 | 10.6 | 30.4 | 13470 | 93 | 14.2 | 26.5 | 1.03 | 1.18 | 28 | 94 | 3.3 | 8.0 | ND |
| POD 4 | 11.3 | 31.3 | 12310 | 101 | 13.1 | 26.1 | 1.01 | 1.15 | 25 | 58 | 3.4 | 8.3 | ND |
| POD 5 | 11.0 | 30.1 | 10130 | 90 | 13.0 | 25.9 | 1.11 | 0.45 | 40 | 45 | 3.2 | 8.5 | ND |
| POD 6 | 10.9 | 33.3 | 10700 | 121 | 13 | 25.6 | 1.10 | 0.38 | 26 | 57 | 3.6 | 8.6 | ND |

**[Table/Fig-1]:** Pre- and post-procedural blood investigation results for the First case.
POD: Postoperative day; PRE OP: Preoperative period; INTRA OP: Intraoperative period.
HB – Haemoglobin; PCV – Packed Cell Volume; TC – Total Leukocyte Count (Total White Blood Cell Count); PLT – Platelet Count; PT – Prothrombin Time; PTT – Partial Thromboplastin Time; INR – International Normalised Ratio; TB – Total Bilirubin; SGOT – Serum Glutamic Oxaloacetic Transaminase (Aspartate Aminotransferase; AST); SGPT – Serum Glutamic Pyruvic Transaminase (Alanine Aminotransferase; ALT); ALB – Albumin; Calcium – Serum Calcium; ND – Not measured; fibrinogen estimation was performed only at clinically indicated time points to guide transfusion therapy

| | Hb (g/dl) | PCV (%) | TC (cells/µL) | PLT (x10$^3$/µL) | PT (sec) | PTT (sec) | INR | TB (mg/dl) | SGOT (U/L) | SGPT (U/L) | ALB (g/dl) | Calcium (mg/dl) | Fibrinogen (mg/dL) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pre OP | 9.0 | 27 | 5000 | 60 | 15.9 | 28.2 | 1.56 | 6.61 | 395 | 296 | 3.3 | 7.8 | 205 |
| Intra OP | 9.1 | 26.0 | 4580 | 62 | 15.5 | 27.4 | 1.35 | 5.57 | 286 | 284 | 3.7 | 7.0 | NA |
| POD 1 | 9.4 | 27.8 | 11260 | 67 | 17 | 31.8 | 1.49 | 6.14 | 210 | 279 | 3.8 | 6.6 | 185 |
| POD 2 | 8.5 | 24.4 | 10310 | 56 | 14.3 | 31.9 | 1.24 | 4.44 | 125 | 227 | 4.1 | 7.0 | NA |
| POD 3 | 8.6 | 25.5 | 9260 | 70 | 13.1 | 32.4 | 1.13 | 2.69 | 55 | 159 | 4.5 | 7.5 | NA |
| POD4 | 8.5 | 25.5 | 6450 | 73 | 12.6 | 32.0 | 1.08 | 2.50 | 63 | 130 | 3.2 | 7.8 | NA |
| POD 5 | 10.5 | 31.5 | 7230 | 96 | 12.5 | 33.7 | 1.02 | 1.64 | 46 | 117 | 4.6 | 8.2 | NA |
| POD 6 | 10.9 | 32.7 | 10090 | 101 | 12.6 | 35.4 | 1.01 | 1.08 | 49 | 90 | 3.2 | 8.4 | NA |

**[Table/Fig-2]:** Pre- and post-procedural blood investigation results for the Second case.
POD: Postoperative day; PRE OP: Preoperative period; INTRA OP: Intraoperative period
ND – Not measured; fibrinogen estimation was performed only at clinically indicated time points to guide transfusion therapy

deceased donor liver transplantation. He had a history of portal hypertension and hepatic vein thrombosis for the past three years. His blood group was B Rh(D) positive.

The patient was haemodynamically stable with no bleeding manifestations. Pretransfusion workup was done, including ABO and Rh blood grouping, antibody screening, and crossmatching. Adequate blood components were requested preoperatively and reserved prior to surgery including total of 12 units of leukoreduced packed red blood cells, two units of single donor platelets, 20 units of random donor platelets,12 units of fresh frozen plasma and 10 units of cryoprecipitate.

The patient underwent deceased donor liver transplantation. Intraoperatively, there was a major blood loss of 5100 mL. Intraoperative transfusion support included six units of leukoreduced packed red blood cells and two units of fresh frozen plasma. During the immediate postoperative period, persistent bleeding, worsening anaemia, and coagulation abnormalities required additional transfusion support with five units of leukoreduced Packed Red Blood Cells (PRBCs), three units of Fresh Frozen Plasma (FFP) and three units of cryoprecipitate. Thus, the patient received 11 units of PRBCs within the first 24 hours, fulfilling conventional massive transfusion criteria. Although the patient experienced major intraoperative blood loss, serial haemoglobin measurements remained relatively stable because of timely transfusion support and ongoing blood component replacement during surgery. Therefore, the intraoperative haemoglobin value does not reflect the nadir haemoglobin concentration during the haemorrhagic episode.

On postoperative day three, increased drain output of 1000 ml was noted and coagulation parameters were reassessed. Two units of leukoreduced packed red cell transfusions were done. No further transfusions were required. Further drain output was gradually decreased. Serial haematological and biochemical monitoring demonstrated gradual improvement in laboratory parameters.

The procedure was completed over a period of approximately 11 hours. Marked intraoperative blood loss resulted in haemodynamic instability, necessitating continuous norepinephrine support at doses ranging from 0.08-0.15 µg/kg/min, with temporary dose escalation during the neohepatic phase. Fluid resuscitation included approximately 4500 mL of crystalloid solutions and 1000 mL of 5% albumin, producing a positive fluid balance consistent with the requirements of massive transfusion. Serial fibrinogen assessment revealed severe hypofibrinogenemia, with levels of 58.3 mg/dL preoperatively. Following cryoprecipitate therapy, fibrinogen increased to 125 mg/dL on POD2 and 220 mg/dL by POD4. Repeated calcium measurements demonstrated significant hypocalcaemia, reaching a lowest value of 5.8 mg/dL on first day postoperative, necessitating intravenous calcium gluconate therapy. Due to substantial blood loss and suspected hyperfibrinolysis, tranexamic acid was administered intraoperatively. Drain output was approximately 800 mL on POD1 and 650 mL on POD2, subsequently increasing to 1000 mL on POD3, which prompted reassessment and additional PRBC transfusion. Thereafter, drain output gradually decreased to below 300 mL/day. Transfusion support was guided by active bleeding manifestations, laboratory values including INR elevation and overall clinical assessment [Table/Fig-3].

No transfusion-related complications occurred, and the patient was discharged with satisfactory graft function and improving haematological parameters.

## DISCUSSION

Orthotopic liver transplantation remains the definitive treatment for end-stage liver disease, but it is associated with complex haemostatic disturbances and variable transfusion requirements. Patients with chronic liver disease exhibit a rebalanced haemostatic state, with alterations in both procoagulant and anticoagulant pathways, predisposing to risks of bleeding and thrombotic complications [4]. Hence, transfusion support in liver transplantation requires a judicious and individualised approach supported by coordinated multidisciplinary management [2].

The surgical procedure is typically divided into three phases: the pre-anhepatic phase (native hepatectomy), anhepatic phase (clamping of portal flow until graft reperfusion), and neohepatic phase (post-reperfusion until completion of biliary anastomosis), each associated with distinct haemostatic challenges [5].

Preoperative planning plays a pivotal role in optimising transfusion support. In the present series, a substantial inventory of blood components was reserved before surgery because liver transplantation is associated with an unpredictable risk of catastrophic haemorrhage. However, actual blood utilisation was considerably lower than anticipated in Cases 1 and 2, where transfusion requirements remained minimal despite extensive preoperative reservation. This resulted in a high crossmatch-to-transfusion ratio, highlighting the need to balance preparedness for major bleeding with efficient blood inventory management. These findings emphasise the importance of periodic blood utilisation audits and suggest that institutional Maximum Surgical Blood Ordering Schedules (MSBOS) may be optimised based on local transfusion requirements and patient blood management principles to improve inventory utilisation while maintaining patient safety [6].

Patient blood management is an evidence-based strategy aimed at improving outcomes by preserving the patient's own blood, correcting anaemia and thrombocytopenia, minimising iatrogenic blood loss, and ensuring targeted correction of coagulopathy. The World Health Organisation published policy emphasising the importance of patient blood management in improving patient outcomes in liver transplant recipients and promoting overall health and well-being [2].

Coagulopathy in liver disease is multifactorial, involving thrombocytopenia, reduced coagulation factor synthesis, and disturbances in fibrinolysis [2]. Portal hypertension, extensive vascular dissection,

| Variables | Hb (g/dl) | PCV (%) | TC (cells/µL) | PLT (x10$^3$/µL) | PT (sec) | PTT (sec) | INR | TB (mg/dl) | SGOT (U/L) | SGPT (U/L) | ALB (g/dl) | Fib (mg/dl) | Calcium (mg/dl) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pre OP | 12 | 36 | 5200 | 81 | 15.5 | 27.4 | 1.36 | 5.01 | 772 | 218 | 2.9 | 58.3 | 7.6 |
| Intra OP | 12.5 | 37.5 | 5800 | 80 | 17 | 31.8 | 1.35 | 4.52 | 602 | 188 | 3.1 | NA | 6.0 |
| POD 1 | 9.4 | 28.2 | 6320 | 67 | 14.3 | 29.5 | 1.49 | 2.38 | 311 | 145 | 4.0 | 58.3 | 5.8 |
| POD 2 | 8.4 | 24.6 | 7190 | 50 | 13.5 | 28.2 | 1.24 | 2.33 | 248 | 159 | 3.9 | 125 | 6.5 |
| POD 3 | 8.2 | 24.8 | 7110 | 51 | 13.1 | 24.5 | 1.16 | 2.69 | 111 | 172 | 3.5 | 180 | 7.2 |
| POD 4 | 8.6 | 26 | 8090 | 47 | 12.6 | 23.7 | 1.23 | 2.04 | 90 | 164 | 4.7 | 220 | 7.8 |
| POD 5 | 9.0 | 27.1 | 8520 | 53 | 12.9 | NA | 1.08 | 2.23 | 54 | 124 | 4.6 | NA | 8.0 |
| POD 6 | 9.3 | 27.9 | 9080 | 62 | 12.5 | NA | 1.10 | 1.93 | 42 | 98 | 4.6 | NA | 8.0 |

**[Table/Fig-3]:** Pre- and Post-Procedural Blood Investigation Results for the Third Case. POD: Postoperative day; PRE OP: Preoperative period; INTRA OP: Intraoperative period. Fib: Fibrinogen; NA: Not available

and multiple anastomoses further increase the risk of major haemorrhage during transplantation. Successful management of this global haemostatic imbalance is essential.

Transfusion requirements are influenced by perioperative factors including vitamin K deficiency, hyperfibrinolysis, impaired synthesis of clotting factors, and thrombocytopenia, which may predispose to bleeding and disseminated intravascular coagulation. Haemostatic disturbances vary across operative phases, while postoperative bleeding may occur due to graft dysfunction-induced coagulopathy [7].

Disease severity scoring systems such as Model for End-Stage Liver Disease (MELD) score and Child–Turcotte–Pugh (CTP) classification remain useful predictors of transfusion requirements and perioperative risk [8]. In all cases, a standardised transfusion strategy was followed, antigen-negative, crossmatch-compatible, Transfusion transmitted infections negative units were arranged. Leukoreduced blood components were utilised to reduce the risk of alloimmunisation, febrile non haemolytic transfusion reactions, and cytomegalovirus transmission.

The first two cases required minimal transfusion support, reflecting the evolving trend towards restrictive and goal-directed transfusion practices. Transfusion decisions were guided by clinical parameters rather than laboratory thresholds alone.

The third case required increased transfusion support in response to ongoing coagulopathy and bleeding, fulfilling massive transfusion criteria. Massive transfusion is commonly defined as replacement of more than one blood volume within 24 hours [9]. Balanced component transfusion with an initial PRBC: FFP: platelet ratio of 1:1:1 is recommended, and the administration of plasma and cryoprecipitate along with PRBCs reflects an effective goal-directed strategy in managing significant coagulopathy [9]. Massive transfusion is associated with complications such as dilutional coagulopathy, metabolic acidosis, electrolyte imbalance, and hypothermia.

Component therapy in all cases was administered in a targeted manner. Fresh frozen plasma was used selectively in response to deranged coagulation parameters rather than as prophylaxis. Platelet transfusion was done judiciously, in cases with significant thrombocytopenia or bleeding. Cryoprecipitate was administered in third case to address hypofibrinogenemia.

Blood transfusion has been associated with increased postoperative complications, graft dysfunction, and mortality, possibly due to transfusion-related immunomodulation [2]. However, no transfusion-related adverse events were observed in the present cases, likely due to optimal component selection, strict compatibility testing, leukoreduction, and vigilant monitoring.

A restrictive transfusion strategy is considered safe in stable patients, although transfusion thresholds should be individualised during active bleeding [10]. Lower transfusion triggers such as haemoglobin <7 g/dL, platelet count around 40,000/µL, INR 1.5-2, and fibrinogen >100 mg/dL have been associated with reduced blood product utilisation [10].

Viscoelastic point-of-care testing such as thromboelastography and rotational thromboelastometry may further rationalise component use and facilitate correction of coagulation abnormalities enabling targeted transfusion therapy [7]. However, in the present series, transfusion decisions were primarily guided by conventional coagulation parameters, including PT, PTT, INR, platelet count, fibrinogen levels, and clinical assessment. A limitation of this study is the reliance on conventional laboratory tests rather than routine viscoelastic monitoring. The use of Thromboelastography (TEG) and Rotational Thromboelastometry (ROTEM) could potentially have provided a more comprehensive real-time assessment of coagulation status, enabling more individualised component therapy and potentially reducing unnecessary transfusions. In the first two cases, viscoelastic testing may have supported a more restrictive transfusion approach, whereas in the third case it could have facilitated targeted management of severe coagulopathy and hypofibrinogenemia during massive transfusion.

Optimisation of haemodynamics using vasopressors to reduce portal pressure helps in reducing intraoperative blood loss [11]. The administration of iso-oncotic albumin allows the restoration of volume and fluid losses [2]. Additional strategies such as intraoperative blood salvage and autotransfusion reduce dependence on allogeneic transfusions, mitigating risks including immunomodulation [12]. Autologous transfusion also has been described in a Jehovah's Witness patient undergoing liver transplantation [13]. Antifibrinolytics such as tranexamic acid and epsilon aminocaproic acid reduce hyperfibrinolysis and recombinant factor VIIa may improve haemostasis during liver transplantation [1].

Postoperative transfusion requirements were minimal in all cases, reflecting effective intraoperative management and good graft function. Restoration of hepatic synthetic function after transplantation leads to rapid normalisation of coagulation parameters. Serial monitoring showed improving INR, platelet counts, and liver function tests, consistent with favourable graft function.

Cadaveric liver transplantation presents additional challenges, as graft quality and prolonged cold ischaemia may lead to ischaemia-reperfusion injury, haemodynamic instability, worsening coagulopathy, and increased transfusion requirements. Therefore, optimal transfusion support requires a well-equipped transfusion service with adequate inventory, trained manpower, donor mobilisation strategies, validated systems for component preparation including leukoreduction and preparedness for switch-over strategies such as group O PRBCs (preferably O negative in women of childbearing age) and group AB plasma during emergencies.

In the present series, several perioperative variables such as MELD score, Child–Pugh classification, and cold and warm ischaemia times were not uniformly documented due to its retrospective nature, and therefore could not be analysed. Their absence limits assessment of disease severity, graft preservation characteristics, and their potential influence on perioperative transfusion requirements.

Effective multidisciplinary coordination among transfusion medicine specialists, anaesthesiologists, and transplant surgeons ensured the timely availability and appropriate utilisation of blood components. Such a collaborative approach is crucial for optimising patient outcomes while minimising transfusion-related risks.

The significance of the present case series lies in its focus on transfusion support rather than solely on transplant outcomes. The present study examines perioperative blood management and component utilisation. Two patients underwent transplantation with relatively low transfusion requirements despite underlying haematological and coagulation abnormalities, demonstrating the effectiveness of a conservative and individualised transfusion approach. In contrast, the third patient required massive transfusion support, providing insight into the management of severe perioperative bleeding through protocol-driven administration of blood components. Collectively, these cases illustrate how tailored transfusion strategies can be successfully applied across a spectrum of clinical scenarios.

## CONCLUSION(S)

The present case series demonstrates that orthotopic liver transplantation can be safely managed with an individualised, goal-directed transfusion strategy, resulting in favourable outcomes and reduced reliance on allogeneic blood products. Careful preoperative planning, judicious blood component reservation, and intraoperative transfusion guided by clinical parameters and laboratory monitoring

were key to optimising blood utilisation. Most patients required minimal transfusion support, while one case highlighted the need for targeted component therapy and adherence to massive transfusion principles when indicated. The study reinforces the value of a multidisciplinary patient blood management approach involving transplant surgeons, anaesthesiologists, and transfusion medicine specialists. Restrictive transfusion thresholds, rational component use, and close perioperative monitoring contributed to improved graft function and uneventful recovery in all cases. The favourable outcomes in all three patients highlight the importance of meticulous preoperative preparation, continuous laboratory monitoring, appropriate blood component support, and effective multidisciplinary communication. This series also provides practical insights into blood inventory management and transfusion strategies during liver transplantation Overall, structured transfusion protocols can effectively minimise transfusion-related risks and improve outcomes in liver transplantation, emphasising the need for standardised, evidence-based strategies in future practice.

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