DOI: 10.15825/1995-1191-2024-4-33-45

RIGHT LOBE LIVING DONOR LIVER TRANSPLANTATION – EXPERIENCE FROM THE DEPARTMENT OF HEPATOBILIARY SURGERY

K.O. Semash[1, 2], T.A. Dzhanbekov[1, 2]

[1] National Children's Medical Center, Tashkent, Uzbekistan
[2] Vakhidov Republican Specialized Surgical Research and Practical Medical Center of Surgery, Tashkent, Uzbekistan

Background. Living-donor liver transplant (LDLT) is a life-saving procedure for patients with end-stage liver diseases. **Objective:** to evaluate the outcomes of the first independent LDLT performed at the Department of Hepatobiliary Surgery, Vakhidov Republican Specialized Surgical Research and Practical Medical Center of Surgery, and to demonstrate that liver transplantation (LT) is a feasible procedure at our institution. **Materials and methods.** From October 2021 to December 2023, 40 right lobe LDLTs were performed in our department. Short-term and long-term outcomes in recipients were assessed. The outcomes of transplant hepatectomy were also evaluated. **Results.** Hepatic artery thrombosis developed in 1 case (2.5%); arterial anastomotic stenosis was detected in 3 cases (7.5%), which were repaired by endovascular balloon dilation; splenic artery steal syndrome was diagnosed in 3 cases (7.5%), which was resolved by endovascular splenic artery embolization. One patient (2.5%) developed portal vein thrombosis. Two patients (5%) had portal vein stenosis 10 months after transplantation; endovascular balloon angioplasty was performed with good clinical effect. Biliary complications accounted for 45%, of which 89% were biliary leaks and 11% were anastomotic biliary stricture. In-hospital mortality was 12.5%. **Conclusion.** The results of our experience and analysis of post-transplant complications are comparable with those of the world literature and are acceptable at the stage of implementation of the LT program. Transplantation is feasible at our center, but it is necessary to improve surgical and conservative treatment techniques in order to minimize early and late postoperative complications.

Keywords: liver transplantation, living-donor liver transplant, cirrhosis.

INTRODUCTION

Since Thomas Starzl performed the first human liver transplant (LT) in 1963 [1], the global transplant community has evolved from isolated clinical attempts to widespread acceptance of LT as a treatment for acute and chronic liver diseases, malignant tumors and other liver conditions. Over the decades, the spectrum of indications for LT has expanded to include numerous nosological entities. As global demand for LT continues to grow, living donor liver transplantation (LDLT) has emerged as a vital alternative for patients who might otherwise die while awaiting a cadaveric organ. In recent years, LDLT has been established as a safe and effective treatment, with outcomes comparable to those of deceased donor liver transplantation (DDLT). Importantly, LDLT also contributes to substantially expanding the limited donor organ pool [2].

The leading etiological factors in this region are chronic viral hepatitis B and C [3, 4]. Until 2018, there was no legal framework to support organ transplantation in the country. This changed in 2018, when the government enacted a decree officially authorizing LDLT. Subsequently, in February of the same year, a pioneering team from the Shumakov National Medical Research Center of Transplantology and Artificial Organs (Moscow, Russian Federation), led by Sergey Gautier – Fellow of the Russian Academy of Sciences – performed the first series of liver transplants in Uzbekistan. However, routine performance of these procedures began only in October 2021 [5].

Objective: the objective of this study was to evaluate the outcomes of the first 40 cases of LDLT performed at the Department of Hepatobiliary Surgery, Vakhidov Republican Specialized Surgical Research and Practical Medical Center of Surgery in Tashkent, in order to demonstrate the feasibility of LT in a hospital-based setting.

MATERIALS AND METHODS

The LDLT program in Uzbekistan commenced on a regular basis in October 2021 at the aforementioned center. Both the donor and recipient surgical procedures, as well as the postoperative management, were conducted

Corresponding author: Konstantin Semash. Address: 10, Kichik Halka Yuli, Tashkent, 100096, Uzbekistan.
Phone: +998 (94) 090-89-05. Email: mail@doctorsemash.com

under the direct supervision of two experienced transplant physicians.

This retrospective review was based on prospectively collected data from transplants performed between October 2021 and December 2023. The median follow-up period was 7 months (range, 1–26 months).

Recipients

During the study period, 40 adult right lobe liver transplants were performed. The cohort included 28 male patients (70%) and 12 female patients (30%), with a median recipient age of 40 years (range, 18–56 years). The mean Model for End-Stage Liver Disease (MELD) score was 18 (range, 10–30). The primary indications for LT were cirrhosis secondary to hepatitis B and D virus co-infection (34 cases), hepatitis C virus-related cirrhosis (3 cases), autoimmune hepatitis (2 cases), and toxic hepatitis (1 case).

All patients presented with portal hypertension and its complications, including esophageal varices (100%), variceal bleeding (7 cases), splenomegaly (100%), and cytopenia (100%). Seven patients underwent pre-transplant endoscopic variceal ligation to prevent bleeding, while three patients underwent splenic artery embolization due to hypersplenism. Two patients presented with stage 3 portal vein thrombosis, classified according to the Yerdel system.

No ABO-incompatible transplantations were performed in this cohort. Perioperative care for all patients was conducted in accordance with the Enhanced Recovery After Surgery (ERAS) protocol [6]. Additionally, all patients with viral hepatitis received antiviral therapy preoperatively, continuing until a sustained virological response was achieved.

The demographic and clinical characteristics of the recipients are summarized in Table 1.

Donors

All recipients in the study underwent right-lobe LDLT. Of the 40 transplants performed, 37 involved living related donors. The donor-recipient relationships were as follows: 11 sons, 10 brothers, 9 sisters, 4 cousins, 1 father, 1 nephew, and 1 aunt. In accordance with national legislation in Uzbekistan, spouses may serve as organ or tissue donors if the marriage has lasted for at least three years. Based on this provision, three wives were approved as donors in this series.

All donors underwent evaluation following a standardized protocol, which was adapted to the specific requirements of our center [7]. This comprehensive assessment included initial screening of medical history, body mass index (BMI), and ABO blood group compatibility, as well as a full blood count, biochemical profile, coagulation tests, and virological screening for hepatitis B and C (HBV and HCV). Cardiopulmonary evaluation included electrocardiography (ECG), echocardiography, and chest radiography.

Imaging studies included abdominal ultrasound, contrast-enhanced computed tomography (CT) with evaluation of hepatic vascular anatomy, and magnetic resonance cholangiopancreatography (MRCP) for biliary tract assessment. Esophagogastroduodenoscopy was also performed. Donor liver steatosis was evaluated using liver elastometry.

In addition to medical testing, all donors underwent psychosocial evaluation and legal counseling to confirm their eligibility and to verify their relationship to the recipient.

Donors with cardiovascular disease, neurological or psychiatric disorders, and hepatic steatosis grade S1 or higher (as assessed by elastometry) were excluded from consideration. Additional exclusion criteria included a low graft-to-recipient weight ratio (GRWR), and variant portal vein anatomy. Only donors with type 1 portal vein anatomy, as defined by the Nakamura classification [8], were accepted.

Liver volumetric analysis was performed to ensure donor safety. Only those with an estimated residual liver volume of at least 35% were deemed eligible. Donors were also excluded if the right hepatic artery diameter was less than 2 mm. Donors with complex venous anatomy in hepatic segments V and VIII – specifically those with multiple segmental branches requiring technically demanding venoplasty – were not considered suitable candidates.

Perioperative donor management adhered to the ERAS Society guidelines [9].

Surgical technique

The graft used in all cases was the right liver lobe. Liver procurement was performed using a conventional surgical technique. Afferent and efferent vessels, along with the bile ducts of the right lobe, were carefully mobilized using precision techniques. The resection plane was identified by temporarily clamping the inflow to the right lobe, marking the demarcation line. In anatomically complex or unclear cases, intraoperative Doppler imaging was employed to assist in defining the resection plane. Parenchymal transection was conducted using a CUSA Excel device (Integra, USA) in combination with bipolar forceps, with continuous irrigation of the coagulation field using saline. Vascular structures supplying the left lobe were preserved. The bile duct was carefully dissected and transected without coagulation.

Histidine-tryptophan-ketoglutarate solution (HTK, Custodiol, Dr. F. Köhler Chemie, GmbH, Germany) was

used in all cases for graft preservation. Venoplasty was performed when segment V and VIII veins measured ≥5 mm in diameter; polytetrafluoroethylene grafts were used. In two cases, a conduit was fashioned using the donor's falciform ligament and the recipient's umbilical vein (Fig. 1). When multiple bile ducts were found in

Table 1

Baseline characteristics of recipients and the surgical features

Data	Values (n = 40)
Age, years	40 (18–56)
Sex, n (%)	
Men	28 (70%)
Women	12 (30%)
Indications for transplantation, n (%)	
Hepatitis B + D virus	34 (85%)
Hepatitis C virus	3 (7.5%)
Autoimmune hepatitis	2 (5%)
Toxic hepatitis	1 (2.5%)
MELD	18 (10–30)
Signs of portal hypertension	40 (100%)
Portal vein thrombosis before transplantation	2 (5%)
Follow-up after transplantation, months	7 (1–26)
Operation time, minutes	570 (410–785)
Blood loss	1200 (600–5000)
Graft weight, grams	720 (515–940)
GRWR, %	1.05 (0.7–2.0)
Graft phleboplasty	
Single RHV, no repair performed	28 (80%)
2 IRHV, no repair performed	3 (7.5%)
3 IRHV, joining the orifices	2 (5%)
Joining of the orifices of veins S8 and RHV	2 (5%)
PTFE graft, S5 vein	1 (2.5%)
PTFE graft, S8 vein	1 (2.5%)
PTFE graft, joining of S5 and S8 veins	1 (2.5%)
Falciform ligament conduit, joining of S5 and S8 veins	1 (2.5%)
Umbilical vein graft, joining of S5 and S8 veins	1 (2.5%)
Number of caval anastomoses	
1	26 (65%)
2	14 (35%)
Arterial anastomosis	
Split suture	17 (42.5%)
Twisted suture	21 (52.5%)
Split suture, anastomosis with splenic artery	2 (5%)
Splenic artery ligation	
HA diameter, mm	4.2 (2.8–6.0)
SA diameter, mm	8.6 (5.2–10.1)
Difference between SA and HA diameters, %	95 (4–239%)
SA ligation, n (%)	35 (87.5%)
Biliary reconstruction	
Bilio-biliary anastomosis (1 duct)	11 (27.5%)
Bilio-biliary + biliodigestive anastomosis	1 (2.5%)
Biliodigestive anastomosis (1 duct)	7 (17.5%)
Biliodigestive anastomosis (2 ducts, 1 anastomosis)	10 (25%)
Biliodigestive anastomosis (2 ducts, 2 anastomoses)	4 (10%)
Biliodigestive anastomosis (3 ducts, 2 anastomoses)	6 (15%)
Biliodigestive anastomosis (3 ducts, 1 anastomosis)	1 (2.5%)

Note: MELD, Model for End Stage Liver Disease; GRWR, graft-to-recipient weight ratio; PTFE, polytetrafluoroethylene; RHV, right hepatic vein; IRHV, inferior right hepatic vein; HA, hepatic artery; SA, splenic artery.

close proximity, ductoplasty was performed by unifying the ducts with a continuous twisted suture using PDS 5/0 polydioxanone suture.

Where technically feasible, caval reconstruction was performed using the piggyback technique with lateral clamping of the hepatic veins, thereby preserving continuous blood flow through the inferior vena cava. In cases where the graft contained multiple right hepatic veins, additional caval anastomoses were performed as required. The recipient's portal vein was anastomosed to the graft portal vein in an end-to-end fashion using 5/0 Prolene suture.

Arterial anastomoses were carried out using various techniques, depending on vessel size and anatomical considerations. For donor right hepatic arteries with diameters less than 2.5 mm or in cases of significant size mismatch between donor and recipient arteries, interrupted sutures were placed using 7/0 Prolene under binocular magnification (3.5×). When the donor artery diameter exceeded 2.5 mm, a continuous twisted suture technique with 7/0 Prolene was employed. All arterial anastomoses were performed with the recipient's common hepatic artery; however, in two cases, the splenic artery was used due to marked intimal atherosclerosis of the common hepatic artery. Intraoperative Doppler ultrasound was routinely used to assess arterial inflow immediately following arterial anastomosis and again after biliary reconstruction and completion of hemostasis.

We also established specific criteria for splenic artery ligation to prevent splenic artery steal syndrome (SASS). In cases where the splenic artery diameter exceeded the hepatic artery diameter by 50% or more – as determined by preoperative contrast-enhanced CT imaging – splenic artery ligation was indicated. This procedure was performed either at the level of the splenic hilum or at the origin from the celiac trunk. To prevent arterial insufficiency and mitigate the risk of portal hyperperfusion [10–11], grafts with a GRWR of more than 0.9% were used.

Biliary reconstruction was performed using either duct-to-duct anastomosis or Roux-en-Y hepaticojejunostomy with external stenting [12]. A duct-to-duct biliary anastomosis was selected when the graft contained a single bile duct with a diameter exceeding 3 mm. In all other cases, a Roux-en-Y hepaticojejunostomy was performed, accompanied by the placement of external biliary stents [26].

Immunosuppressive therapy

Immunosuppression was initiated with basiliximab at 20 mg for induction. This was followed by intraoperative administration of methylprednisolone (10 mg/kg) immediately after portal vein reperfusion. The maintenance immunosuppressive regimen included tacrolimus in combination with low-dose methylprednisolone. Mycophenolate mofetil was added as clinically indicated. Target serum tacrolimus levels were maintained between 6 and 9 ng/mL. Decisions regarding discontinuation or substitution of immunosuppressive agents were guided by the occurrence of adverse effects and patient-specific tolerance.

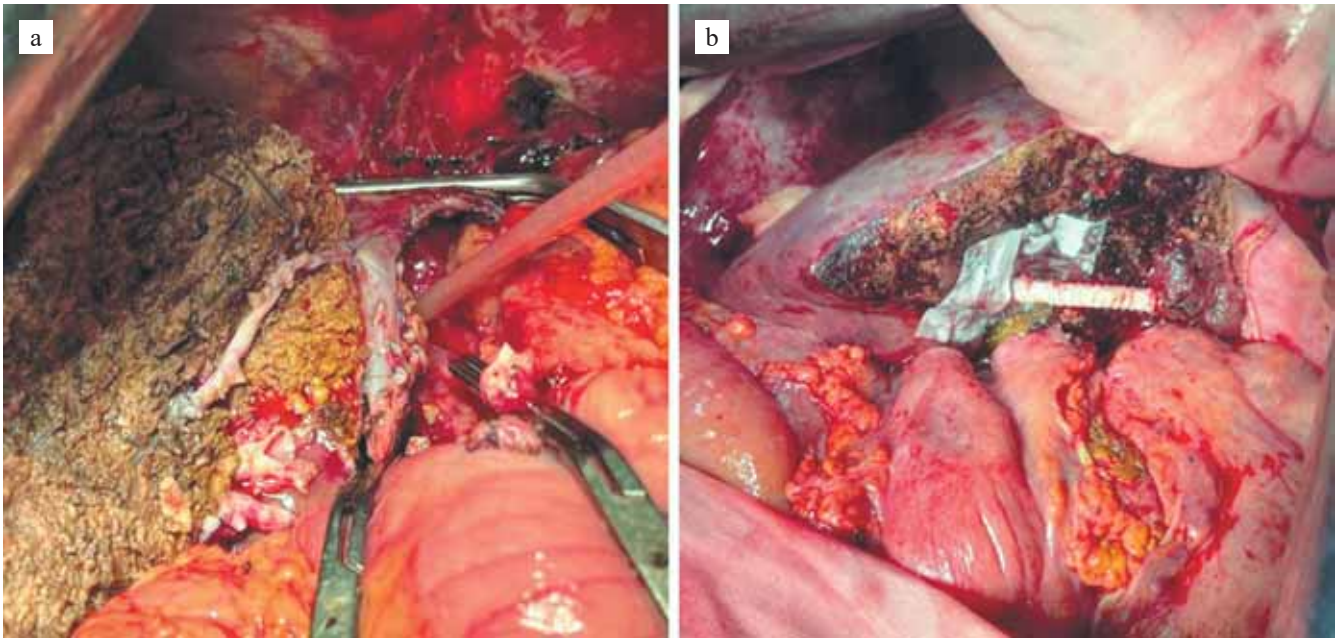

Fig. 1. Venous outflow reconstruction variations: a, vein reconstruction of segments 5 and 8 using the donor's falciform ligament; b, vein reconstruction of segments 5 and 8 using a polytetrafluoroethylene graft

Postoperative vascular monitoring and prophylaxis against vascular complications

All patients received comprehensive thromboprophylaxis to minimize the risk of vascular complications. Prophylaxis against postoperative arterial complications included the administration of alprostadil (prostaglandin E1) immediately following arterial reperfusion. Starting on the first postoperative day, low-molecular-weight heparin (LMWH) was administered, and low-dose aspirin was introduced on postoperative day 4. Alprostadil was discontinued 7 days postoperatively, while LMWH was continued for 2 weeks after transplantation. Aspirin therapy was maintained for 3 months postoperatively. In cases of significant coagulopathy, signs of bleeding, or platelet counts below 50×10^9/L, thromboprophylaxis was modified or temporarily halted until the complications were addressed. Additionally, intravenous fluid support was provided with daily monitoring of fluid balance.

For the first 7 days following transplantation, patients underwent regular ultrasound monitoring using Logiq P6 (General Electric, USA) and DC-40 (Mindray Medical International Limited, China) ultrasound systems, both equipped with standard C6-2 convex sensor units. The initial postoperative ultrasound to assess arterial blood flow was performed after the patient was transferred to the intensive care unit. Subsequent ultrasound exams were conducted every 6 hours during the first week postsurgery. After the first week, monitoring was reduced to once daily. In cases with complications, ultrasound monitoring continued for more than 1 week as needed [11].

The following Doppler ultrasound findings were considered indicative of deteriorating hepatic arterial blood flow: difficulty visualizing the artery, changes in the resistive index (RI) – either an increase above 0.85 or a decrease below 0.5 – and a reduction in arterial peak systolic velocity to less than 15 cm/sec. In such cases, we initiated continuous heparin infusion, beginning with a bolus dose of 80 U/kg followed by a maintenance infusion at 18 U/kg/hr. Activated partial thromboplastin time was monitored every 6 hours [11, 13, 14].

If hepatic arterial flow was not visualized by ultrasound, an emergency contrast-enhanced CT scan was performed, or the patient was urgently transferred to the endovascular suite for diagnostic angiography. Upon confirmation of arterial insufficiency, immediate revascularization was undertaken [15].

To monitor portal vein blood flow, Doppler ultrasound was used to assess both volumetric and linear flow velocities. If signs of occlusive portal vein thrombosis were detected within the first 72 hours post-transplant, the patient underwent relaparotomy with revision of the anastomosis. In other cases, heparin prophylaxis was initiated.

Variables evaluated and statistical processing

Baseline variables including age, sex, body weight, and date of surgery were analyzed for both donors and recipients. Postoperative complications were classified according to the Clavien–Dindo classification system [16]. For patients who experienced complications, the Comprehensive Complication Index (CCI) [17] was additionally calculated. Unlike the Clavien–Dindo system, which records only the highest-grade complication per patient, the CCI accounts for the cumulative burden of all complications, providing a more comprehensive measure of postoperative morbidity and overall patient severity.

Short-term outcomes were defined as events occurring during the initial hospitalization period. Long-term outcomes were assessed over a follow-up period of up to 26 months postoperatively. Continuous variables were reported as medians with corresponding ranges, while categorical variables were expressed as absolute numbers and percentages. Patient survival rates were estimated using the Kaplan–Meier method. A p-value of less than 0.05 was considered statistically significant. Statistical analyses were conducted using Microsoft Excel (USA), Orange3 (Slovenia), and IBM SPSS Statistics version 26 (USA).

RESULTS

Recipients

The median operative time for recipients was 570 minutes (range: 410–785 minutes), with a median intraoperative blood loss of 1,200 mL (range: 600–5,000 mL). In 28 cases (70%), the right lobe grafts had a single right hepatic vein (RHV) without significant accessory veins; these cases required only a single caval anastomosis, and venoplasty was not performed. In 5 cases (12.5%), accessory inferior RHVs (iRHVs) were present: 1 iRHV in three cases (7.5%) and 2 iRHVs in two cases (5%). In patients with two iRHVs, the RHVs were combined into a single venous orifice and two caval anastomoses were performed during reconstruction. In cases with a single iRHV, dual caval anastomoses were performed without additional venoplasty.

In 3 patients, polytetrafluoroethylene grafts were used for venous outflow plasty due to the presence of significant S5 and S8 veins. In one case (2.5%), a conduit fashioned from the donor liver's falciform ligament was used for venoplasty of the S5 and S8 branches. In another case, the recipient's dilated umbilical vein served as a conduit for similar reconstruction. Overall, 14 patients (35%) required 2 caval anastomoses.

All arterial anastomoses were performed using the recipient's common hepatic artery, except in 2 cases where the splenic artery (SA) was used due to severe atherosclerotic changes in the common hepatic artery. In 35 cases (87.5%), the SA diameter exceeded the hepatic artery (HA) diameter by 50% or more. The mean HA diameter was 4.2 mm (range: 2.8–6.0 mm), while the mean SA diameter was 8.8 mm (range: 5.2–10.3 mm). The median difference in diameter between the SA and HA was 95% (range: 4–241%). The median GRWR was 1.1 (range: 0.7–2.0).

In all 35 cases where the SA diameter exceeded the HA diameter by ≥50%, SA ligation was performed to prevent SASS. Among these, the SA was ligated at the splenic hilum in 3 patients, and at the level of the celiac trunk in 27 patients.

Due to anatomical variations in the donor bile ducts, different techniques were employed for biliary reconstruction (see Fig. 2). A duct-to-duct (biliobiliary) anastomosis was performed in 11 patients, while a Roux-en-Y hepaticojejunostomy was used in 28 cases. One patient had an aberrant right hepatic duct, requiring a combined reconstruction approach: a Roux-en-Y hepaticojejunostomy for the main bile duct and a separate biliobiliary anastomosis for the aberrant duct. Perioperative characteristics of all patients are summarized in Table 1.

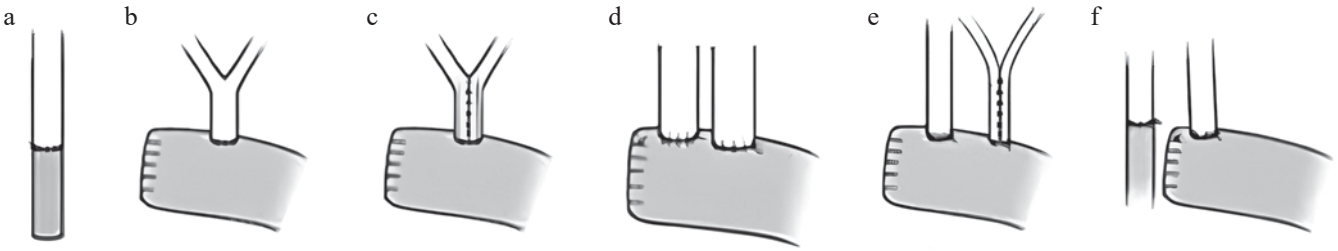

Fig. 2. Biliary reconstruction variations: a, bilio-biliary anastomosis; b, biliodigestive anastomosis on the Roux-en-Y jejunal loop; c, ductoplasty (joining) of two or three ducts and biliodigestive anastomosis on the Roux-en-Y jejunal loop; d, two separate bile duct anastomoses with the Roux-en-Y jejunal loop; e, three bile ducts on the graft – ductoplasty (joining) of two ducts and imposition of two separate bile duct anastomoses with Roux-en-Y jejunal loop; f, common bile duct anastomosis with Roux-en-Y jejunal loop and bilo-biliary anastomosis with aberrant bile duct of the liver right lobe

Table 2

Vascular complications

Total complications, n	8 of 40 (20%)
Arterial complications, n (%)	
HAT	1 (14.4%)
HAS	3 (42.8%)
Steal syndrome	3 (42.8%)
HAS when ligating the SA at the splenic hilum	3 of 3 (100%)
HAS when ligating the SA at the celiac trunk	–
Steal syndrome after SA ligation	–
Steal syndrome without SA ligation	3 of 5 (60%)
Postoperative day of complication (range)	
HAT	7 (7)
HAS	3 (3)
Steal syndrome	4 (0–7)
Portal vein complications, n (%)	
Complication, n	
PVT	1 (2.5%)
PVS	2 (5%)
Postoperative day of complication (range)	
PVT	Postoperative day 2
PVS	Postoperative month 10.5 (9–12)

Note: HAT, hepatic artery thrombosis; HAS, hepatic artery stenosis; SA, splenic artery; PVT, portal vein thrombosis; PVS, portal vein stenosis.

Rejection. Among the patients examined, 10% had an episode of acute rejection, occurring between postoperative days 2 and 14. Pulse methylprednisolone therapy was effective in 50% of these cases. However, two patients succumbed to acute graft dysfunction in the early postoperative period. In all cases of suspected graft rejection, the corticosteroid dose was tapered following pulse therapy, and mycophenolic acid was introduced as a third-line agent in the immunosuppressive regimen.

Vascular complications. Hepatic artery complications occurred in 7 patients, as detailed in Table 2. All episodes of arterial insufficiency developed within the first postoperative week. Hepatic artery thrombosis (HAT) occurred in one patient. Hepatic artery stenosis (HAS) was diagnosed in 3 patients (42.8%), while SASS developed in another three. Notably, all SASS cases occurred in patients whose SA had not been ligated.

Selective celiacography was performed in all cases of arterial insufficiency. The patient diagnosed with HAT was treated with balloon angioplasty followed by stent placement in the HA. All HAS cases were managed with balloon angioplasty alone, without stenting. Patients diagnosed with SASS underwent SA coil embolization.

In one patient with SASS, the arterial anastomosis of the graft was inadvertently damaged during selective angiography, necessitating an emergency relaparotomy to control hemorrhage and subsequent ligation of the SA. No recurrent episodes of arterial insufficiency were observed during the follow-up period.

Portal vein (PV) complications are summarized in Table 2. PV complications occurred in 3 patients. One patient developed acute occlusive portal vein thrombosis (PVT) on postoperative day 2, confirmed by Doppler ultrasound. This was accompanied by a marked elevation in liver transaminases (ALT: 2500 U/L; AST: 1800 U/L) and hyperbilirubinemia (210 μmol/L). The patient underwent emergency laparotomy with revision of the portal vein anastomosis and thrombectomy. Despite restoration of adequate hepatic blood flow and intensive treatment, including extracorporeal detoxification, the patient developed severe liver graft dysfunction and died on postoperative day 9.

Two patients developed portal vein stenosis (PVS) within one year after transplantation. Clinically, PVS presented with signs of graft dysfunction (elevated bilirubin levels and cytolytic syndrome), along with features of portal hypertension (cytopenia, ascites). Both patients were successfully treated with percutaneous balloon angioplasty. They are currently under outpatient follow-up with satisfactory liver graft function [18].

Biliary complications. Biliary complications were observed in 16 patients, with bile leakage being the most common presentation (14 cases). Two patients developed late-onset biliary strictures: one experienced an anastomotic stricture of a bilio-biliary anastomosis 18 months after transplantation, and the other developed a stricture at the site of a biliodigestive anastomosis 12 months post-transplant.

Among patients with arterial complications, biliary complications were also noted in 4 cases (57.1%): one with HAT, two with SASS, and one with HAS. All four experienced bile leakage, but no biliary strictures were detected in this subset.

In one patient with a biliodigestive anastomosis, a biloma was managed by ultrasound-guided percutaneous drainage. Another patient with a bilio-biliary anastomosis underwent endoscopic retrograde cholangiopancreatography (ERCP) with biliary stent placement, which successfully controlled the bile leak. In the remaining patients, bile leakage occurred while intra-abdominal drainage tubes were in place and resolved spontaneously without the need for additional intervention.

By comparison, among patients without arterial complications, bile leakage occurred in 10 cases (30.3%) during the early postoperative period ($P = 0.039$). In this same group, the previously described cases of late-onset anastomotic bile duct strictures also occurred, both of which ultimately required reconstructive surgical intervention.

Other complications. All complications were classified as either early or late and are summarized in Table 2. Among the early complications, two patients developed wound seromas (Clavien–Dindo grade I), seven patients experienced pleural effusions requiring drainage, and one patient had gastrointestinal bleeding (Clavien–Dindo

Table 3

Early and late post-transplant complications

Complication (Clavien–Dindo grade)	Early complications, n	Late complications, n
Stage 1		
Seroma/wound infection	2	
Stage 2		
Biliary leak	6	
Acute rejection	2	
Chronic rejection		1
De novo hepatitis B virus		1
Stage 3a		
Biliary leak	6	
Right-sided pleurisy	5	
Bilateral pleurisy	2	
Gastrointestinal bleeding	1	
Liver transplant abscesses		3
HAT	1	
HAS	3	
SASS	2	
PVS		2
Stage 3b		
Biliary peritonitis	2	
Anastomotic stricture		2
Intra-abdominal hemorrhage	2	
SASS	1	
Stage 4		
Seizure syndrome	1	
Demyelination of the pons	1	
Biliary sepsis		1
Aspiration	1	
Sepsis	3	
Stage 5		
PVT	1	
Sepsis, MOD	2	
Acute rejection	2	
Covid-19 pneumonia		1
Aspiration		1
Chronic rejection (non-compliance)		1
Median CCI (for patients with complications)	42.6 (8.7–100)	80.1 (39.7–100)

Note: HAT, hepatic artery thrombosis, HAS – hepatic artery stenosis, PVS, portal vein stenosis; SASS, splenic artery steal syndrome; PVT, portal vein thrombosis; MOD, multiple organ dysfunction; CCI, comprehensive complication index.

grade IIIa). Severe complications included two cases of biliary peritonitis requiring surgical intervention and two cases of internal bleeding – one due to disseminated intravascular coagulation and the other from arterial bleeding at the remaining coronary ligament of the liver (Clavien–Dindo grade IIIb).

Additionally, three cases of sepsis and one case of severe aspiration (on postoperative day 7) were successfully managed. One patient experienced seizures due to elevated tacrolimus levels, which resolved with dose reduction and administration of valproic acid. Another patient developed central pontine myelinolysis, presenting with neurological deficits, reduced consciousness, and aphasia. This occurred in the context of rapid plasma sodium correction (an increase of 11 μmol/L within 24 hours) on the first postoperative day, with clinical symptoms appearing on day 8. Diagnosis was confirmed by brain MRI. The patient was discharged in improved condition on postoperative day 30 and remains under neurological follow-up.

Among the late complications, one episode of chronic rejection was recorded, as well as one case of *de novo* HBV, which was managed conservatively. Three patients developed liver abscesses, all of which were successfully treated with percutaneous drainage. One patient was urgently admitted to the intensive care unit 35 days post-transplant with acute cholangitis. Management included temporary cessation of immunosuppressive therapy and initiation of broad-spectrum antibiotics. The patient was discharged after 10 days and continues to be followed on an outpatient basis.

Mortality. A total of eight patients died during the follow-up period. In-hospital mortality was 12.5%. The causes of death included sepsis (2 patients), acute rejection (2 patients), and liver failure secondary to PVT (1 patient). Among the long-term deaths, the causes were COVID-19-associated pneumonia, aspiration, and chronic rejection in a non-compliant patient. Overall patient survival is illustrated in Fig. 3.

Donor results

Among the donors, 13 were female and 27 were male. The mean BMI was 23.2 kg/m^2. Based on perioperative data, the median operative time for donors was 342.5 minutes (range: 230–440 minutes), and the median intraoperative blood loss was 250 mL (range: 50–850 mL) (Table 4).

Donor complications are summarized in Table 4. Wound seroma occurred in two donors. One donor developed renal failure during antibacterial prophylaxis with sulperazone, presenting with oliguria, proteinuria, hematuria, edema, and pleural effusion. The condition resolved after sulperazone was discontinued and diuretic therapy was initiated. Two donors experienced wound infections that required prolonged local wound care and antibiotic therapy. Hospital-acquired pneumonia (Clavien–Dindo grade II) was diagnosed in one donor. Pleural effusion developed in two donors, both of whom underwent drainage procedures. Bilomas requiring per-

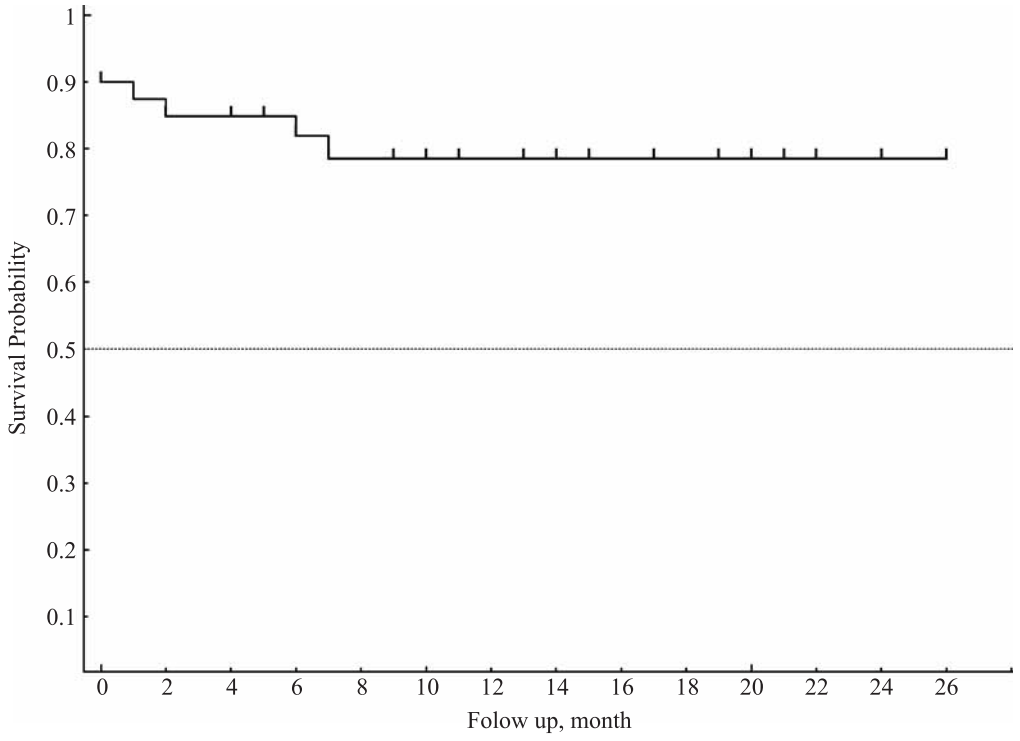

Fig. 3. Survival of right lobe liver recipients

Table 4

Donor characteristics and clinical outcomes

Data	Values (n = 40)
Age, years	40 (18–56)
Sex, n (%)	
Male	27 (67.5%)
Female	13 (32.5%)
BMI	23.2 (18–28.3)
Surgery time	342.5 (230–440)
Blood loss	250 (50–850)
Blood loss (Clavien–Dindo)	
Stage 1	
Seroma	1
Stage 2	
Kidney failure	1
Pneumonia	1
Wound infection	2
Hemorrhagic wound discharge	2
Stage 3a	
Right-sided pleurisy	2
Biliary leak (biloma).	2
Stage 3b	
Inferior vena cava hemorrhage	1
Biliary leak	2
Median CCI (for donors with complications)	33.7
Hospitalization period, days	10 (7–28)

Note: BMI, body mass index; CCI, comprehensive complication index.

cutaneous drainage were observed in two patients, while another two patients with biliary effusion underwent open surgical revision. One donor experienced hemorrhage due to dislodgement of a clip from the inferior vena cava, necessitating emergency surgical intervention. The median postoperative hospital stay was 10 days (range: 7–28 days). No late complications were observed among donors.

DISCUSSION

LDLT has emerged as a life-saving option for adult patients with end-stage liver disease in settings where deceased donor LT is not available [19]. Despite its generally favorable outcomes, LDLT in adult recipients presents significant challenges and risks. Donors are required to undergo major hepatic surgery, which carries the potential for serious complications and necessitates a prolonged recovery period. Ethical concerns are also inherent in the procedure, as the decision to donate a portion of one's liver involves balancing altruistic motivations with the potential impact on the donor's health [20]. In the Republic of Uzbekistan, the absence of a legal framework for DDLT means that LDLT remains the sole viable treatment option for patients in critical need of LT.

Furthermore, LDLT is associated with a higher incidence of post-transplant surgical complications compared to DDLT, with reported in-hospital mortality rates ranging from 3.6% to 18.9% [21–23]. In our study, the complications most frequently associated with mortality included infection, acute graft rejection, and liver graft dysfunction due to PVT. Among the two acute graft rejection cases, both patients exhibited persistent elevation of liver enzymes – alanine aminotransferase and aspartate aminotransferase – alongside rising bilirubin levels, in the absence of clinical or imaging evidence of obstructive jaundice. Infectious causes, including acute cytomegalovirus infection, as well as vascular complications, were ruled out. The primary indications for transplantation in these two patients were autoimmune hepatitis and HBV. Despite the initiation of intensive therapy, including pulse methylprednisolone therapy and extracorporeal detoxification, liver function failed to recover.

Vascular complications in our series were observed at a slightly higher frequency than reported in the literature [11]. We attribute this discrepancy to the learning curve associated with the first 15–20 LDLT procedures performed [24, 25]. Among the patients with arterial complications, three died during the follow-up period. However, the causes of death in these cases were unrelated to the arterial complications themselves. One patient with arterial stenosis succumbed to severe COVID-19-induced pneumonia two months post-transplant. A second patient with SASS died from aspiration at home one month after discharge. The third patient, also with SASS, passed away two months following transplantation due to ovarian apoplexy complicated by sepsis, a diagnosis that had been missed by the local healthcare providers.

Biliary complications continue to be a significant challenge in LT and are more prevalent in LDLT recipients. The incidence of these complications varies across transplant centers, but it can reach as high as 30%, with an associated mortality rate of 10%, making them a serious concern for post-transplant patients [26]. Most biliary complications, primarily biliary leakage, occurred in recipients with complex donor bile duct anatomy and those who had arterial complications.

In-hospital mortality in our study was 12.5%, which is comparable to the data reported in the literature [19, 21]. Survival at 26 months of follow-up was 80%.

Regarding LDLT donors, the reported complication rate in the literature is around 25%, with some studies indicating rates as high as 40% [27, 28]. Mild complications are reported in 17% of cases, while major complications account for approximately 5.5%. In our cohort, donor outcomes aligned with these figures.

CONCLUSION

Our experience with LDLT and the analysis of post-transplant complications are consistent with world literature and align with acceptable standards for the implementation stage of an LT program. Transplantation is feasible at our center, but there is a need to enhance both surgical and conservative therapeutic approaches to minimize the incidence of early and long-term post-operative complications.

The authors declare no conflict of interest.

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The article was submitted to the journal on 30.04.2024