



Donor Complications Among 500 Living Donor Liver Transplantations at a Single Center

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ABSTRACT

Introduction. Living donor liver transplantation (LDLT) has become necessary because of the shortage of cadaveric organs. We retrospectively analyzed 500 living donor hepatectomies using the Clavien classification system for complications to grade their severity.

Materials and methods. We retrospectively identified and applied the Clavien classification to 500 consecutive donors who underwent right for LDLT left hepatectomy between January 2007 and August 2011.

Results. The 149 complications were observed in 93 of 500 (18.6%) donors who were followed for a mean 30 months. There was no donor mortality. Complications developed in 85 (18.6%) right 5 (35.7%) left, and 3 (10%) left lateral segment hepatectomy donors. The overall incidence of reoperations was 7.2%. Seventy-seven of 149 complications were grade I (51.6%) or 9 grade II (6%). The major complications consisted of 27 (18.1%) grade IIIa, 35 (23.4%) grade IIIb, and 1 (0.6%) grade IVa. Grade IVb and grade V complications did not occur. The most common problems were biliary complications in 14 of 181 donors (7.7%).

Conclusion. Donors for LDLT experienced a range of complications.

LIVING donor liver transplantation (LDLT) represents an alternative to enlarge the organ pool in countries that have been cadaveric sources.¹ Despite the satisfactory results of LDLT, there is concern that a healthy donor requires a complicated surgery to procure a liver graft. The increased number of liver LDLT has shown cases of mortality and uncertain outcomes, particularly with right lobar LDLT compared with live kidney donation.^{2,3} Because of the potential adverse outcomes of hepatectomy in a living donor for LDLT, this issue has become an important subject for ethical discussions.

The complication rate after right liver donation is approximately 31%, ranging from 0% to 67%.⁴⁻⁷ The estimated surgical mortality is 0.2% to 0.3%.⁵ There does not appear to be a significant difference in postoperative complication rates between right (RH) and left hepatectomy (LH).⁸ The Clavien classification system has been proposed to grade peri- and postoperative surgical complications.⁹ In this single-center study we retrospectively evaluated postoperative complications among 500 donor hepatectomies for LDLT according to the Clavien classification.

MATERIALS AND METHODS

We retrospectively identified the complications among 500 living donors who underwent hepatectomy for LDLT between January 2007 and August 2011. After the physical and psychiatric examinations, donors underwent blood group determinations, complete blood counts, biochemical laboratory tests, viral profiles, and urine cultures. Eligible donors were examined for hepatosteatosis by abdominal ultrasound and for vascular anatomy by tomographic abdominal angiography. Finally, candidates underwent computed tomography for volumetric estimation. A liver biopsy was performed on subjects with a body mass index greater than 30 or hepatosteatosis greater than 20%. Subjects were not accepted as donors if they had an incompatible blood group, a positive viral serology, a remnant volume less than 26%, or a hepatosteatosis ratio exceeding 5%.

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SURGICAL TECHNIQUE

First we performed a cholecystectomy. The RH was performed through a reverse T incision. The right lobe of the liver was mobilized by dividing the triangular ligament with ligation of the tiny hepatic veins draining the right caudate lobe. A right inferior hepatic vein larger than 5 mm was preserved for anastomosis. Afterwards, the hilar dissection freed the right hepatic artery and right portal vein. Peroperative cholangiography was performed routinely to identify the biliary anatomy. The demarcation line was determined by temporary clamping of the right portal vein and artery. Parenchyma transection was performed with using a Cavitron ultrasonographic aspirator (CUSA, Valleylab, Boulder, CO, USA) with the Pringle maneuver, if necessary. Hemostasis for vessels smaller than 3 mm was performed using hemoclips and bipolar coagulation. Larger vessels or biliary components were ligated with clips or sutures. The right hepatic duct was divided near the confluence of the bile ducts. The defect in the common hepatic duct was closed horizontally with 6-0 monofilament nonabsorbable sutures. The harvesting procedure was completed by clamping and dividing the right hepatic artery, right portal vein, and right hepatic vein. The right portal vein and hepatic vein stump were closed. The falciform ligament was sutured to the anterior abdominal wall to fix the remnant left lobe.

To remove the left lateral segment (segment 2 and 3; left liver hepatectomy) or the left liver (segments 2, 3, and 4, we free this part of liver from the connective tissues. Parenchyma transection performed as described above. The artery, hepatic vein, portal vein, and biliary duct branches were isolated and cut. One drain was placed into the hemihepatectomy cavity. Oral intake was started in the first day postoperatively.

Postoperative Management

All donors were admitted to the intensive care unit at least overnight for monitoring. The nasogastric tube and Foley catheter were removed at day 1 after surgery. Low-molecular-weight heparin was not routinely used. The abdominal drain was removed if there were no abnormal findings upon either physical examination or biochemical analysis, and if the amount of drainage was <50 mL per day. The alanine aminotransferase (ALT), total bilirubin, and prothrombin time were checked. After discharge, the donors were followed at 1, 3, 6, and 12 months thereafter with liver function tests. Complications were evaluated according to the Clavien classification system (Table 1).

RESULTS

The mean donor age was 32.1 ± 4 years (range, 18 to 65), and the mean follow-up 32 months (range, 2 to 58 months). Four hundred fifty-six (91.2%) donors underwent a right and 44 (8.8%) a left hepatectomy (Table 2). The mean follow-up was 30 months (range 2–58 months; Table 1).

In 500 donors RH was performed in 456 donors (91.2%), LH (segments 2,3, and 4) in 14 donors (2.8%), and left

Table 1. Clavien Classification of Surgical Complications

Grades	Definitions
I	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, and radiological interventions. Allowed therapeutic regimens are: drugs as antiemetics, antipyretics, analgetics, diuretics, electrolytes, and physiotherapy. This grade also includes wound infections opened at the bedside.
II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications; blood transfusions and total parenteral nutrition are also included
III	Requiring surgical, endoscopic or radiological intervention <ol style="list-style-type: none"> Intervention not under general anesthesia Intervention under general anesthesia
IV	Life-threatening complication (including CNS complications*) requiring IC/ICU management <ol style="list-style-type: none"> Single organ dysfunction (including dialysis) Multiorgan dysfunction
V	Death of a patient

Abbreviations: CNS, central nervous system; IC, intermediate care; ICU, intensive care unit.

*Brain hemorrhage, ischemic stroke, subarachnoidal bleeding, but excluding transient ischemic attacks.

lateral segment (LLS; segments 2 and 3) resection 30 (6%) donors.

We observed 149 complications in 93 of 500 (18.6%) donors (Table 3). There was no donor mortality. Complications developed in 85(18.6%) RH 5 (35.7%) LH, and 3 (10%) LLS donors. The incidence of reoperations was among all donors was 7.2%.

Seventy-seven of 149 complications were grade I (51.6%), and 9 were grade II (6%). Major complications consisted of 27 grade IIIa (18.1%), 35 grade IIIb (23.4%), and 1 grade IVa (0.6%). Grade IVb and grade V complications did not occur. The most-common complication 14 of 181 donors; 7.7% involved the biliary system (Table 3).

Grade 1 complications were treated with conservative medical therapy. Chylus drainage in one donor resolved by stopping oral intake and delivering total parenteral nutrition for 1 week. Brachial plexus injury in 2 donors healed with physical exercise. Treatments of grade 3 and 4 complication are shown in Table 4.

There were four different grade III complications. Pleural effusions in 3 donors were treated with pleurocath insertion: pneumothorax in two subjects with chest tubes. Bile leak and/or bilioma which occurred in 27 donors was treated with endoscopic retrograde cholangiopancreatography (ERCP) and/or endoscopic sphincterotomy (EST; n = 7), ERCP and nasobiliary catheter (n = 2), ERCP and insertion of an internal stent (n = 1) or USG-guided aspiration and pig-tail tube drainage (n = 11; Table 4).

There were 35 grade IIIb complications: incisional hernia (n = 11), intra-abdominal bleeding (n = 6), intestinal

Table 2. Donors LDLT Information (n = 500)

Age (years; range)	32.1 (18–65)
Gender (female/male)	204/296
Follow-up time (months), mean (range)	30 (2–58)
Volume of remnant liver (%), mean (range)	36 (26–88)
Mean operation time (minutes), mean (range)	340 (210–430)
Volume of blood loss peroperation (mL), mean (range)	350 (190–800)
Hospital stay (day), mean (range)	7.1 (5–12)
Body mass index (kg/m ²), mean (range)	26.8 (24.1–35.6)

obstruction (n = 3), bile leak and/or bilioma (n = 12), and biliary stricture (n = 3). Mesh placements were performed in 3 of 11 donors with incisional hernial; the other 8 subjects refused the operation because the hernia did not restrict their daily activity. Other grade 3b complications were treated as shown in Table 4. Budd Chiari syndrome developed in one case due to failure to suture the falciforme ligament to the abdominal wall. It required treatment by relaparotomy with placement of the sutures.

DISCUSSION

Donor mortality is the most important aspect in LDLT surgery. Donor hepatectomy is a complex operation that can cause some complications that limit application of the procedure. Our LDLT program was started in 1997; it constitutes 85% of our liver transplantations to the present.

An extensive literature has focused on the incidence and type of complications after living donor liver donation. Morbidity rates in these reports range from 0% to 67%.^{10–12} The wide range is probably due to the variable extent of donated liver segments and the lack of consensus on the definition of complications. We observed 149 complications among 93 of 500 (18.6%) donors at our center.

Renz JF et al reported higher complication rates in centers that performed fewer transplantations.¹³ Because right lobe donors have smaller remnant organ than left lobe

Table 4. Treatments of Grade 3 and 4

Complication	Treatment
Grade IIIa	
Pleural Effusion (n = 3)	Pleurocan insertion
Pneumothorax (n = 2)	Chest tube insertion
Biliar leak/bilioma (n = 21)	ERCP/EST (n = 7) ERCP/nasobiliary catheter (n = 2) ERCP/internal catheter (n = 1) USG guided aspiration and pig-tail tube drainage (n = 11)
Biliary stricture (n = 1)	PTK (internal-external catheter insertion)
Grade IIIb	
Incisional hernia (n = 11)	Hernioraphy (n = 3)
Intraabdominal bleeding (n = 6)	Hemostasis
Intestinal obstruction (n = 3)	Bridectomy
Biliar leak/bilioma (n = 12)	Hepaticojejunostomy (n = 1) Suturing biliary leak on cut surface and T-tube insertion (n = 2) Suturing biliary leak on cut surface (n = 9)
Biliary stricture (n = 3)	Hepaticojejunostomy
Grade IVa	
Budd chiari (n = 1)	Suturing of falsiform ligament to abdominal wall

Abbreviations: ERCP, endoscopic retrograde cholangic pancreatography; EST, endoscopic sphincterotomy; USG, ultrasonography; PTK, percutaneous transhepatic cholangiography.

donors, morbidities are observed more frequently in the former cases. Our results showed a greater percentage of complications in LH than RH or LLH donors possibly due to our small experience with this procedure.

A multicenter study from Japan including 3565 living donors revealed the incidence of reoperation to be 1.35% (n = 48). The most frequent complications were bile leakages and wound infection.¹⁴ Our reoperation rate was 7.2%. The most common complications were biliary com-

Table 3. Complications of 500 Donors Classified According the Clavien System

Complication	Grade I	Grade II	Grade IIIa	Grade IIIb	Grade IVa	Complication (n)
Wound Infection	47					47
Pneumonia		6				6
Pleural effusion	13		3			16
Incisional hernia				11		11
Pneumothorax			2			2
Chylose drainage		1				1
Brachial plexus injury		2				2
Budd chiari					1	1
Intra-abdominal bleeding				6		6
Intestinal obstruction				3		3
Biliar leak/bilioma	17		21	12		50
Biliary stricture			1	3		4
Total (n = 149)	77 (51.6%)	9 (6%)	27 (18.1%)	35 (23.4%)	1 (0.6%)	149

plications (10.8%) and wound infections (9.4%). Biliary complications seem to produce the most morbidity. Knowing the anatomy of the biliary tree preoperatively and carefully closing the injured biliary tree after hepatectomy may help to diminish biliary complications. We have preferred preoperative cholangiography to visualize the biliary tract in our routine during the living donor operation.

Donor mortality has reported after this surgery. According a worldwide report in 2006, there had been 19 reported donor deaths mostly due to sepsis and liver failure.¹⁵

Data from 84 centers showed a donor mortality rate of 0.2%.¹⁶ There was no donor mortality in our center. The most serious complication in our study was Budd-Chiari syndrome caused by torsion or rotation of the remnant left liver after right hepatectomy because of an inappropriate falsiform hepatectomy. The patient underwent relaparotomy with hepatectomy using the divided falciform ligament.

Some complications occur in the perioperative period: injuries to major hepatic vessels, bile ducts or liver parenchyma as well as to other organs that which must be corrected during the operation.¹⁷⁻²⁰ Although preoperative complications are not a subject of this study they can cause or increase the severity of postoperative complications as well as require abortion of the procedure.

In conclusion, LDLT is accompanied by complications which are the targeted for future investigations.

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