



## Donor Outcomes in Right Lobe Adult Living Donor Liver Transplantation: Single-Center Experience in Egypt

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### ABSTRACT

**Introduction and objectives.** Living donor liver transplantation (LDLT) is an alternative source of organs for patients with end-stage liver disease (ESLD) in absence of deceased donor LT. In LDLT the greatest concern is donor safety. Our objective was to evaluate the outcome of donors after right lobe liver donation in a single LT center in Egypt.

**Patients and methods.** Fifty LDL resections were performed from 2001 to 2004. The mean donor age was  $29.2 \pm 6.4$  years. Residual liver volume was  $41.1 \pm 4.5\%$ . Mean operative time was  $560 \pm 62.2$  minutes; mean ICU stay, less than 24 hours; mean hospital stay,  $15.4 \pm 7.7$  days; and mean follow-up period, 6 months.

**Results.** There was no mortality. The overall complication rate was 68% (34 donors). Major complications included intraoperative bleeding in one, biliary leak in two, and pneumonia in three donors. Minor complications included mild pleural effusion in 13 donors, transient ascites in 10, mild depression in 7, intra-abdominal collections in 3, and wound infections in 1 donor. Residual liver volume did not affect the complication rate. None required reoperation. Return to predonation activity occurred within 6 to 8 weeks. No liver impairment occurred during follow-up.

**Conclusion.** Right lobe adult LDLT is a safe procedure with regard to donor outcome. Major complications occurred in only 10% of our series.

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**T**RANSPLANTATION IS THE treatment of choice for patients with end-stage liver disease. Living-donor liver transplantation (LDLT) offers a partial solution to the severe shortage of deceased donor liver grafts worldwide.<sup>1</sup> In certain countries, including Japan and Egypt, social, cultural, and religious issues are creating barriers to decreased donor liver transplantation. Regardless of the potential benefits that LDLT offers critically ill patients with end-stage liver disease, donor safety is a prime concern.<sup>2</sup> The advance of LDLT using mainly right lobe grafts has raised special concerns about the safety of living liver donors. Since LDLT was first performed in 1990,<sup>3</sup> it is estimated that at least 12 donors have died in different parts of the world, 7 in the United States,<sup>4</sup> 4 in Europe,<sup>2</sup> and 1 in Egypt (personal communication). Clearly, there are risks involved in living donation, but the current literature contains little documentation of the incidence rates of complications in living liver donors. The aim of this study was to assess complications and outcomes for adult living right-lobe liver donation at a single center in Egypt.

### METHODS

Between August 2001 and November 2004, 77 patients underwent right-lobe adult LDLT with the first 50 living donors for these operations being included in this study.

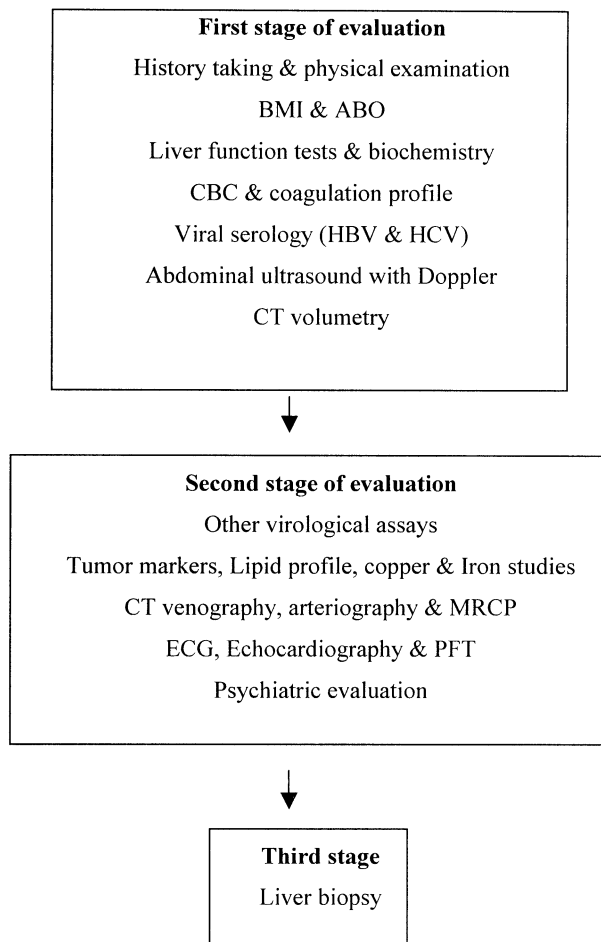
### Donors

Only individuals related to the recipient were considered for donation. Each potential donor between 20 and 47 years of age who volunteered for the procedure underwent a multidisciplinary medical and psychological evaluation (Fig 1). The ethics committee

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**Fig 1.** Preoperative evaluation for living liver donor.

for our transplantation program assessed the donors for possible coercion, and discussed the risks and benefits of the procedures. Donors were informed that they could withdraw at any time. Continued medical follow-up was ensured.

The first step in preoperative donor evaluation included clinical assessment, blood grouping verification, calculation of body mass index, and laboratory testing. The following step included liver and renal biochemistry, complete blood count, coagulation profile, and virologic assays for hepatotropic viruses. Imaging by abdominal ultrasonography, hepatic Doppler ultrasonography, and computed tomography (CT) measurements were used to estimate the volumes of the right and left liver lobes. Only donors with a graft recipient weight ratio (GRWR)  $>0.9\%$  were accepted.

This stage of assessment included serologic screening for human immunodeficiency virus, cytomegalovirus, Epstein-Barr virus, and testing for the tumor markers alpha-fetoprotein and carcinoembryonic antigen; lipid profile assessment; measurement of serum levels of copper and iron; CT scanning of hepatic arterial and venous anatomy; and magnetic resonance cholangiopancreatography to define the biliary anatomy. Electrocardiography, echocardiography, and pulmonary function testing were also performed.

If no problems or contraindications were identified in stages one or two, the candidate underwent a third stage of assessment, namely a liver biopsy to exclude abnormalities of the liver paren-

**Table 1. Demographics of Living Liver Donors**

Total number	50
Age	29.2 $\pm$ 6.4 years (20–47 years).
Gender: male/female	34/16
Residual liver volume	32–51.2% (41.1 $\pm$ 4.5%)
Operative time	560 $\pm$ 62.2 min
ICU stay	24 hours
Total hospital stay	15.4 $\pm$ 7.7 days (10 to 48 days)

chyma and quantify steatosis. Livers exhibiting more than 10% steatosis were excluded.

After donation and discharge from the hospital, the routine follow-up for each donor included weekly visits for the first month, biweekly visits in the second month, monthly visit for 4 months, and then yearly rechecks.

#### Operative Technique

The donor procedure involved several steps. First, cholecystectomy and intraoperative cholangiography were performed to delineate the biliary anatomy. Next, the right hepatic artery and right portal vein were dissected. Intraoperative ultrasound was then performed to define the hepatic venous drainage of the right liver lobe. In most of our donors, the middle hepatic vein was preserved to avoid outflow obstruction to the remaining donor segment 4. The right hepatic vein was then isolated and the attachments between the right lobe and the diaphragm divided to expose the inferior right hepatic veins (IRHVs), which drains the right lobe directly into the inferior vena cava. All IRHVs of more than 5 mm diameter were preserved for subsequent anastomosis to the recipient inferior vena cava. The right bile duct was then cut sharply. The hepatic parenchyma was then divided along Cantlie's line 1 cm to the right of the main stem of the middle hepatic vein using electrocautery and a Cavitron Ultra-Sonic Aspirator.

After the right lobe was completely separated, vascular clamps were applied to the right portal vein, right hepatic vein, and IRHVs. The lobe was removed, transferred to a back table, and flushed with a heparinized solution. Abdominal closure was performed in standard fashion.

#### RESULTS

Of the 50 donors who underwent right hepatic lobectomy for living donation, 34 were men and 16 were women. The mean age was 29.2  $\pm$  6.4 years (range, 20 to 47 years). The patients' residual liver volumes (left liver lobes), as measured by CT analysis, ranged from 32% to 51.2% (mean, 41.1  $\pm$  4.5%; Table 1).

#### Donor Outcomes

All donors survived the procedure. The mean operative time was 560  $\pm$  62.2 minutes, the mean length of stay in the intensive care unit was less than 24 hours, and the mean hospital stay was 15.4  $\pm$  7.7 days (range, 10 to 48 days).

In the immediate postoperative period, all donors exhibited transient liver enzyme elevation, hyperbilirubinemia, and hypoalbuminemia. The liver profiles normalized after a mean of 14 days. Prothrombin time was prolonged in the early postoperative period, but in most cases this normalized within 15 days.

**Table 2. Complications of Living Liver Donation in Our Center (N = 50)**

Major complications	
Bile leakage	2
Intraoperative bleeding	1
Pneumonia	2
Minor complications	
Pleural effusion	13
Abdominal collection	3
Transient ascites	10
Wound infection	1
Mild depression	7

The mean follow-up time for the 50 cases was 6 months; overall complication rate was 68% (Table 2). Five donors (10%) developed early postoperative major complications, including intraoperative bleeding (one patient), biliary leakage (two patients), and pneumonia (two cases). The patient with hemorrhage required transfusion of 3 units of packed red blood cells. One of the cases of biliary leakage was successfully managed with endoscopic retrograde cholangiopancreatography (ERCP) and placement of a biliary stent, which extended the patient's hospital stay to 33 days. The stent was removed 6 weeks later and no further interventions were needed. The other patient with bile leakage developed a bilioma, which was managed with ultrasound-guided aspiration, and the leakage ceased spontaneously thereafter. Neither patient with bile leakage developed any long-term sequelae. Both cases of pneumonia were successfully treated with antibiotics.

The minor complications included mild pleural effusion (13 donors, 26%), significant intraabdominal collection requiring ultrasound-guided aspiration (3 donors, 6%), transient self-limited ascites (10 donors, 20%), wound infection (1 donor, 2%), and mild depression necessitating psychiatric evaluation (7 donors, 14%). The pleural effusion was on the right side in most cases. A single donor had to be readmitted 1 month after the operation for aspiration of a purulent subphrenic collection. All donors returned to their predonation daily activities within 6 to 8 weeks, and no liver impairment was noted during follow-up.

## DISCUSSION

The greatest concern with LDLT is the potential for donor morbidity or mortality. Adult LDLT carries higher donor risks because of the extensive liver resection. Also, the full impact of LDLT on adult recipients and donors has not been determined. Still, the frequency of adult LDLT is rapidly rising because of the severe shortage of deceased donors. In this study, we sought to evaluate the complications and outcomes of adult right-lobe LDLT based on the initial experience at a single center in Egypt.

The first LDLT at our center was performed in August 2001. To date, approximately 180 LDLTs have been carried out in Egypt. Two thirds of these cases were adults who received right lobe grafts, and one third, children who

received a left lobe or left lateral portion of the left lobe. Only 2 of the 79 total LDLTs performed at our center involved left lobe grafting. Currently, there are no other published data on donor outcomes or complications on LDLT in Egypt; thus it was not possible to compare with findings at other Egyptian centers.

A recent Asian survey of liver transplantation programs that are performing LDLT revealed great variability in the components of donor evaluation.<sup>5</sup> For example, donor liver biopsy is not routinely performed at all centers that currently perform this operation. After the 20th case in which the donor operation had to be aborted because of schistosomiasis detected on surgical exploration but not by any preoperative imaging, we started to perform preoperative donor liver biopsy routinely.

Ten percent of our donors experienced major complications. Bleeding is a major risk factor in liver resection, and the ultimate goal in donor hepatectomy is a bloodless operation. Problems with hemorrhage can necessitate transfusion, which carries additional risks. Only one donor in our series (2%) required blood transfusions. Two donors developed bile leakage. One of these cases was managed endoscopically, and the other was managed with ultrasound-guided intervention. Two other donors developed pneumonia. All these forms of morbidity extended the hospital stay beyond average. It is difficult to determine the true incidence of living liver donor complications worldwide because of the lack of uniformity in defining and reporting these complications. The reported incidence of complications in donors for adult LDLT varies, but is likely in the range of 10% to 20%.<sup>6</sup> According to literature from the United States; this rate varies much more widely from 9% to 67%.<sup>7</sup> In a recent survey of 1158 donors for adult LDLT in the United States, 14.5% experienced at least one complication: 6% of patients developed biliary leakage or stricture; 4.9%, required nonautologous blood transfusion; 4.5%, reoperation; 1.1%, a major postoperative infection; and three, died (0.26%).<sup>5</sup> In a series of 1508 liver transplant donors from five centers in Asia performing both adult and pediatric LDLT, the overall complication rate was 15.8%.<sup>2</sup> Of these 1508 living donors, 561 donated a right lobe; 34 patients in this group (6%) developed bile leakage; 2 (0.36%) developed pneumonia; and 8 out of 1508 donors (0.53%) required blood transfusions.

None of the 50 adult liver transplant donors in our series developed hepatic vascular complications or deep venous thrombosis. Pomfret et al<sup>8</sup> reported life-threatening portal vein thrombosis in 1 of 561 donors (0.18%) and pulmonary embolism in 3 (0.53%) patients. However, it is difficult to compare our results with those reported elsewhere because of differences in donor demographics, body build, selection criteria, and perioperative management. To make valuable comparisons in the future, it is important that researchers use a standardized grading system, such as the Clavian system for Classification of Negative Outcomes in General Surgery and Solid Organ Transplantation.<sup>7</sup>

The donors in our series developed no long-term complications during a mean follow-up time of 6 months. They returned to predonation daily activities within 6 to 8 weeks after surgery. The complications described as "minor" were frequently encountered in our series; for the purpose of standardization we recommend considering a postoperative event as a complication only if it required an invasive interventional procedure, a change in medications from the routine postoperative protocol or prolonged hospital stay beyond 10 days. Otherwise those events were considered as apart of uneventful postoperative course.

Much longer follow-up of these donors is needed because the impact of liver donation on donor health and quality of life remains largely unknown. We suggest that national and international collaboration is needed to standardize future reporting about donor outcome in adult LDLT, and the long-term effects and quality-of-life issues for these patients.

## REFERENCES

1. Chen CL, Fan ST, Lee SG, et al: Living donors liver transplantation: 12 years of experience in Asia. *Transplantation* 75:S6–S11, 2003
2. Chung-Mau L: Complications and long-term outcome of living liver donors: a survey of 1508 cases in five Asian centers. *Transplantation* 75:S12, 2003
3. Strong RW, Lynch SV, Ong TH, et al: Successful liver transplantation from a living donor to her son. *N Engl J Med* 322:1505, 1990
4. Surman OS: The ethics of partial-liver donation. *N Engl J Med* 346:1038, 2002
5. Humar A: Donor and recipient outcomes after adult living donor liver transplantation. *Liver Transplant* 9(Suppl 2):S42, 2003
6. Brown RS Jr, Russo MW, Lai M, et al: A survey of liver transplantation from living adult donors in the United States. *N Engl J Med* 348:818, 2003
7. Ghobrial R, Saab S, Lassman C, et al: Donor and recipient outcome in right lobe adult living donor liver transplantation. *Liver Transplant* 8:901, 2002
8. Pomfret EA, Pomposelli JJ, Lewis D, et al: Liver adult liver transplantation using right lobe grafts. *Arch Surg* 136:425, 2001