RESEARCH ARTICLE

Achieving excellence in donor care: a decade-long experience in living liver donation at a single centre- a retrospective review

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Abstract

Objective: To determine morbidity and mortality among living liver donors.

Method: The retrospective review was conducted from January 26 to February 22, 2025, at the Liver Transplant and Hepatopancreatobiliary Surgery Unit of Dow University of Health Sciences, Karachi, and comprised data from May 10, 2015, to December 31, 2024, of living liver donors who underwent major hepatectomy. Donor characteristics, including age, height, weight, body surface area, body mass index, graft type, and vascular and biliary anatomy, were recorded. Postoperative outcomes were assessed, and major complications were classified as Clavien-Dindo grade ≥3. Independent predictors of morbidity were determined. Data was analysed using SPSS 22.

Results: Of the 177 living liver donors, 114(64.4%) were males and 63(35.6%) were females. The overall median age was 26 years (interquartile range: 22-31.5 years). There was no donor mortality. Major complications were observed in 22(12.4%) donors, with pleural effusion and intra-abdominal collections observed in 7(31.8%) and 5(22.7%) donors, respectively. Low future liver remnant ($p<0.001$) and multiple bile ducts ($p=0.039$) were the independent predictors of complications.

Conclusion: Donors with low future liver remnant and multiple bile ducts had a significantly higher risk of postoperative morbidity, emphasising the critical role of precise preoperative assessment, surgical expertise and perioperative optimisation.

Key Words: Living donor liver transplantation, Donor safety, Morbidity, Complications, Bile ducts, Hepatectomy.

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Introduction

Since its inception in 1989 and the success of the first adult living donor liver transplant (LDLT) in 1994, LDLT has gained unanimous acceptance as a preferred treatment option for patients with end-stage liver disease (ESLD), especially in South Asian countries,[1,2] because of cultural, religious and logistical factors posing constraints to deceased donor liver transplantation (DDLT). In Pakistan, the first successful liver transplant was performed in 2003 with international collaboration, followed by the emergence of indigenous transplant programmes in the country.[3]

Living liver donors (LLDs) are healthy individuals, and the transplant team approaches their evaluation with great sensitivity, guided by ethical principles that extend beyond the traditional 'Do No Harm' approach.[4] The concept of double equipoise ensures that the ethical balance is maintained between donor risk and recipient benefit, while triple equipoise further incorporates institutional and societal considerations, promoting fair and sustainable transplantation practices. These frameworks provide a more comprehensive ethical foundation for LDLT decision-making, ensuring that donor autonomy and safety are not compromised in the pursuit of improved recipient outcomes.[5,6]

Regardless of how favourable the recipient outcomes may be, donor safety remains the fundamental goal, as any adverse event affecting the donor could jeopardise the entire LDLT programme.[7,8] International statistics report donor morbidity rates of 20-40% and a mortality rate <0.5%.[9-11] Although rare, complications, such as infections as well as biliary and vascular issues, can significantly affect donor outcomes.[12]

Donor safety is linked to a meticulous donor selection process, comprehensive preoperative assessment, and technical and surgical aspects of graft procurement.[13] Ensuring donor safety begins with a detailed fitness evaluation involving thorough medical history, physical examination, and targetted laboratory and radiological investigations. A multidisciplinary team, including radiologists, transplant surgeons, and anaesthesiologists, works collaboratively to minimise donor morbidity and

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mortality.[14]

The Liver Transplant and Hepatopancreatobiliary (HPB) Surgery Unit of Dow University of Health Sciences (DUHS) in Karachi has been consistently performing LDLTs since 2015, and has achieved exceptional donor safety through elaborate screening, careful surgical planning, meticulous surgical techniques, and comprehensive perioperative care. Despite anecdotal evidence indicating excellent donor outcomes, the outcomes have not yet been formally analysed or published as verified data. The current study was planned to fill that gap by determining morbidity and mortality among LLDs.

Materials and Methods

The retrospective review was conducted from January 26 to February 22, 2025, at the Liver Transplant and Hepatopancreatobiliary (HPB) Surgery Unit at the Ojha Campus of DUHS, Karachi, and comprised data from May 10, 2015, to December 31, 2024, of LDs who underwent major hepatectomy. A non-probability consecutive sampling technique was employed. As this was a retrospective study utilizing existing data from available donor hepatectomies, a formal sample size calculation was not performed.

After obtaining an exemption from the institutional ethics review board, data was retrieved from the archival database related to healthy donors of either gender aged 18-45 years who were legally related to the recipient, and had identical/compatible blood group. The process of donor selection had been meticulous, including detailed history, physical examination, laboratory and radiological assessments. Computed tomography (CT) volumetry and magnetic resonance cholangiopancreatography (MRCP) had been performed to assess the volumetry, as well as vascular and biliary anatomies. Potential donors having future liver remnant (FLR) <30% or complex biliary and vascular anatomy had been excluded.

Donor eligibility had been determined based on the Human Organ Transplant Authority (HOTA) regulations[15] and the institutional ethical guidelines. In the light of the emphasis on donor safety, rigorous selection criteria had been implemented, particularly concerning donor age, body mass index (BMI), and liver attenuation index (LAI). In order to mitigate surgical risks and exclude significant graft steatosis, a BMI range of 18-30kg/m^2 and LAI >1 were preferred. Additionally, psychosocial concerns, such as the absence of voluntary and well-informed consent, coercion or psychological distress, as assessed by a psychiatrist, were considered contraindications.

The main outcomes were postoperative complications and mortality after the donor surgery. Clavien-Dindo grade 3 and above was considered a major postoperative complication.[16] Donors were categorised into two groups: those with complications (Group 1: grade ≥3) and those without complications (Group 2: grade <3). Major complications included reactionary haemorrhage, pleural and/or intra-abdominal collection, bile leaks, pulmonary embolism, and wound complications requiring radiological intervention in the postoperative period.

Other variables included donor demographics (age and gender), height (cm), weight (kg), BMI (kg/m^2), body surface area (BSA) (m^2), estimated graft-to-recipient weight ratio (GRWR) (%), LAI, FLR (%), type of graft (right lobe vs. left lobe), portal venous anatomy (conventional [type A] vs. variant [types B and C]), number of bile ducts (one, two, or three), intensive care unit (ICU) stay (<2 days vs. >2 days), and length of hospital stay (LOS) (<8 days vs. >8 days).

Data was analysed using SPSS 22. Descriptive analyses included median with interquartile range (IQR) for continuous variables and frequencies with percentages for categorical variables. Univariate comparative analysis was done using chi-square or Fisher's exact test for categorical variables, and Mann-Whitney U test for continuous variables. On univariate analysis, variables with $p<0.1$ were considered for binary logistic regression analysis to identify the factors responsible for major complications. Odds ratios (ORs) and 95% confidence interval (CI) were calculated. $P<0.05$ was considered statistically significant.

Results

Of the 177 LLDs, 114(64.4%) were males and 63(35.6%) were females. The overall median age was 26 years (IQR: 22-31.5 years). Right lobe hepatectomy was performed in 166(93.8%) donors, whereas 11(6.2%) donors underwent left lobe hepatectomy. ICU stay <2 days was noted in 169(95.5%) LLDs, and LOS <8 days in 162(91.5%). No donor mortality was observed, and 155(87.6%) LLDs had no major postoperative complications. There were significant differences in terms of postoperative complications related to FLR, portal venous anatomy, and biliary anatomy (Table 1).

On regression analysis, donors with a low FLR had a 51.6% increase in the likelihood of postoperative complications (OR: 1.517, 95% CI: 1.240-1.857, $p<0.001$). A single bile duct was associated with a 63.9% reduction in the risk of complications (OR: 0.361, 95% CI: 0.138-0.948, $p=0.039$) (Table 2).

Major postoperative complications were observed in

Table-1: Donors' characteristics.

Total	Postoperative Complications		p Value
	Group 1	Group 2	
	22 (12.4%)	155 (87.6%)	
Age (years) [Median (IQR)]	25 (21.2-29.5)	26 (22-32.5)	0.360
Gender			0.555
• Male	14 (63.6%)	100 (64.5%)	
• Female	08 (36.4%)	55 (35.5%)	
Height (in cms) [Median (IQR)]	166 (160-169)	166 (157-171)	0.965
Weight (in kg) [Median (IQR)]	65.5 (57.2-69)	61 (54.1-71)	0.455
BMI (kg/m2) [Median (IQR)]	24.2 (20-27.7)	22.8 (20.5-26.4)	0.431
BSA (m2) [Median (IQR)]	1.7 (1.6-1.8)	1.69 (1.5-1.8)	0.174
Type of graft			0.550
• Right lobe graft	20 (90.9%)	146 (94.2%)	
• Left lobe graft	02 (9.1%)	09 (5.8%)	
Estimated GRWR (in %) [Median (IQR)]	0.97 (0.81-1.10)	1.0 (0.83-1.18)	0.314
FLR (in %) [Median (IQR)]	31.55 (30.17-32.97)	38 (34.85-40.30)	<0.001
LAI [Median (IQR)]	8 (6.2-9)	9 (6-11)	0.388
Portal venous anatomy			<0.001
• Type A	12 (54.6%)	138 (89%)	
• Type B	09 (40.9%)	13 (8.4%)	
• Type C	01 (4.5%)	04 (2.6%)	
Number of bile ducts			0.006
• One duct	06 (27.3%)	93 (60%)	
• Two ducts	14 (63.6%)	59 (38.1%)	
• Three ducts	02 (9.1%)	03 (1.9%)	

BMI: Body mass index, BSA: Body surface area, GRWR: Graft-to-recipient weight ratio, FLR: Future liver remnant, LAI: Liver attenuation index, IQR: Interquartile range.

Table-2: Logistic regression showing factors related to postoperative complications.

Variables	Odds Ratio	Confidence Interval	p-value
FLR	1.517	1.24 – 1.85	<0.001
Portal venous anatomy	0.427	0.13 – 1.33	0.143
Number of bile ducts	0.361	0.14 – 0.95	0.039

FLR: Future liver remnant.

22(12.4%) donors. The most frequent complications were pleural effusion 7(31.8%) and intra-abdominal collection 5(22.72%), requiring percutaneous ultrasound-guided drainage (Figure).

Discussion

The current study reveals a comprehensive evaluation of donor safety in LDLT at a single centre. Over the past decade, the DUHS centre recorded no donor mortality and a major complication rate of 12.4%, consistent with international benchmarks, indicating donor morbidity of 20% to 40% and mortality <0.5%.[9-11] The most common complications, pleural effusion and intra-abdominal collections, were managed with percutaneous radiological intervention. The current findings underscore the importance of thorough preoperative planning, careful donor selection, and diligent postoperative care in reducing risks, as corroborated by earlier studies.[9,17-19] Importantly, a low FLR was linked to increased postoperative risk, whereas having a single bile duct correlated with improved outcomes, highlighting the

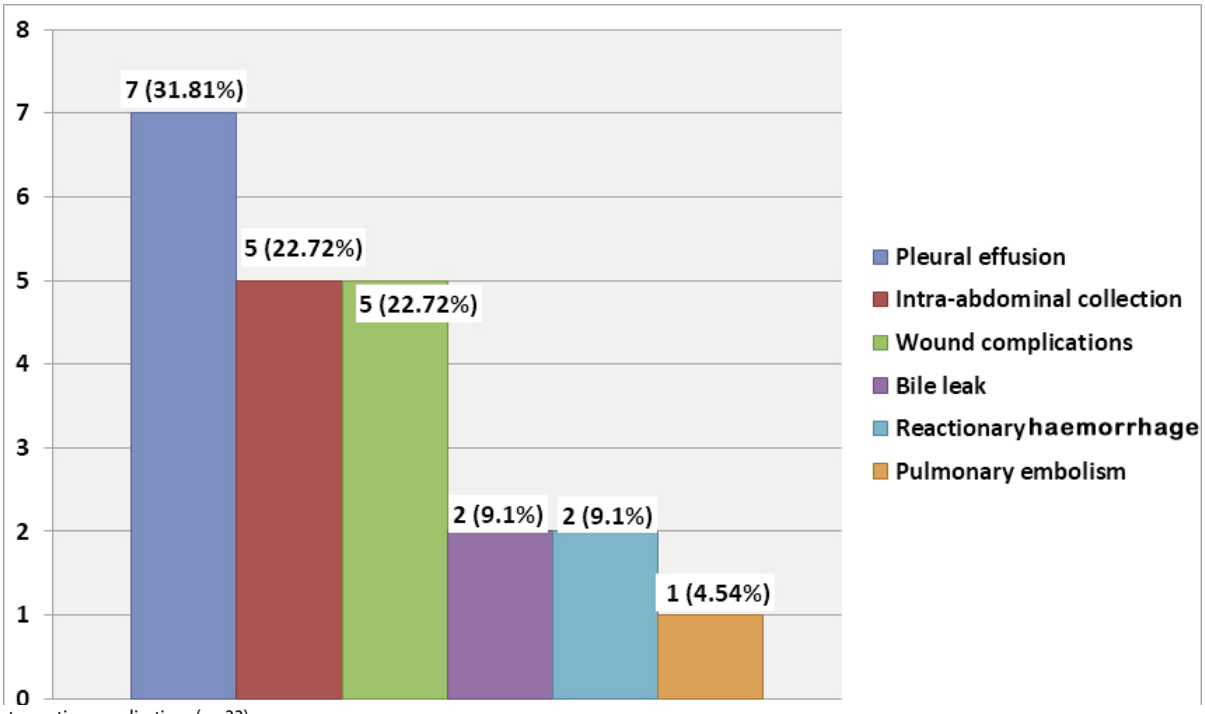

Figure: Postoperative complications (n=22).

significance of detailed anatomical evaluation in surgical planning. These results align with recent studies that stress the influence of advanced surgical techniques and perioperative care in reducing donor risks, further supporting the safety and long-term sustainability of LDLT programmes.[20-22]

The current study shows that donors with a reduced FLR exhibited a 51.6% increased likelihood of experiencing complications, highlighting the essential role of FLR in maintaining post-hepatectomy liver function.[23,24] Current guidelines recommend an FLR of at least 30% to mitigate postoperative risks.[19,25-27] The advent of three-dimensional (3D) volumetric CT scans has improved FLR assessment and donor selection.[28,29]

The anatomy of the biliary system is essential for donor results. The current research shows that donors possessing a single bile duct had a 63.9% diminished chance of problems relative to those with multiple ducts, as changes in bile duct morphology influence surgical complexity. Recent advancements in preoperative MRCP and intraoperative fluorescence cholangiography have significantly improved biliary mapping, hence increasing the safety of donor hepatectomy.[30-32]

While portal venous anatomy was notable in the univariate analysis, it did not emerge as an independent predictor in the multivariate model (p=0.143) in the current study. This may be due to its collinearity with other significant predictors, such as FLR and biliary anatomy, which have a more direct impact on donor outcomes. The limited number of donors with variant portal venous anatomy might have constrained the statistical power necessary to establish an independent association with complications. Nevertheless, portal venous anatomy may still indirectly influence donor complications through its association with these anatomical factors, underscoring the importance of comprehensive preoperative vascular evaluation and customised surgical planning.[19,33]

The current study has several limitations. As a single-centre retrospective analysis, the findings may not be generalisable to other institutions with varying patient demographics, surgical techniques, and perioperative care protocols. In this context, multicentre studies are necessary to validate these findings across diverse clinical settings. Additionally, the study primarily concentrated on short-term donor outcomes, necessitating further research with long-term follow-up, particularly concerning hepatic regeneration, metabolic consequences, and overall quality of life.

The current study did not reveal a significant link between complication rates and donor age, BMI and LAI, which is likely due to the rigorous selection criteria and enhanced perioperative care. However, multicentre studies with extended follow-up periods are necessary to improve risk assessment. Although a low LAI suggests graft steatosis,[20] the minor variations observed in the current study did not notably affect donor outcomes, possibly because of the strict donor selection process. Likewise, even though right lobe grafts are typically linked to higher complication rates due to the larger liver volume resection and increased surgical complexity,[33] the current results did not indicate a significant difference. This could be attributed to the careful donor selection, perioperative management, and surgical expertise that help mitigate the anticipated risks, highlighting the need for further research in larger study groups.

Despite the limitations, however, the current findings contribute to the global discourse on donor safety, and reinforce the foundation of sustainable LDLT programmes in Pakistan and beyond.

Conclusion

The 10-year audit showed excellence in donor care, as demonstrated by the low complication rate and zero donor mortality. Critical factors influencing donor morbidity included FLR and biliary anatomy, highlighting the necessity of thorough donor evaluation and selection.

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