EARLY POSTOPERATIVE CLINICAL AND LABORATORY DYNAMICS IN LIVING DONOR LIVER TRANSPLANTATION

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Abstract. *Living donor liver transplantation (LDLT) is currently the treatment of choice for patients with end-stage liver disease, offering a life-saving alternative in settings where deceased-donor organs remain scarce. Assessment of perioperative laboratory dynamics provides important information on early graft function and the course of postoperative recovery, allowing clinicians to distinguish expected physiological responses from early signs of graft dysfunction. As our studies have shown, this retrospective single-center analysis of 38 adult patients who underwent LDLT at the National Medical Center, Tashkent, Uzbekistan, revealed clear and clinically meaningful trends in early postoperative laboratory parameters. Preoperative and early postoperative values were compared using the paired Student's t-test or Wilcoxon signed-rank test, depending on data distribution, and significant improvements were observed in platelet count, total and direct bilirubin, AST, PTI, and INR. ALT remained unchanged, while GGT increased transiently during the early postoperative period, reflecting the expected ischemia–reperfusion response rather than true graft dysfunction. No significant changes were detected in blood glucose, albumin, creatinine, amylase, or alkaline phosphatase ($p>0.05$). Improving the outcomes of patients undergoing LDLT is possible through careful perioperative monitoring, timely recognition of transient enzyme elevations, and consistent laboratory surveillance in the requirements of modern transplant surgery. LDLT was associated with significant early improvement in liver excretory function, coagulation status, and hematological parameters, confirming that routine laboratory monitoring remains essential for evaluating graft function and postoperative recovery.*

Keywords: *living donor liver transplantation, liver cirrhosis, laboratory parameters, graft function, bilirubin, coagulation*

Introduction.

End-stage liver disease and liver cirrhosis remain major causes of morbidity and mortality worldwide. Liver transplantation is the only definitive treatment for patients with irreversible liver failure and significantly improves long-term survival and quality of life [3,5,10]. Living donor liver transplantation (LDLT) has become an effective alternative to deceased-donor transplantation, particularly in countries with limited availability of deceased-donor organs [7,8,9]. In recent years, LDLT has been successfully implemented in Uzbekistan, contributing to the development of the national transplantation program and expanding access to life-saving treatment.

Assessment of clinical and laboratory parameters after liver transplantation is essential for evaluating early graft function and monitoring postoperative recovery. Routine laboratory tests — including liver enzymes, bilirubin, albumin, coagulation profile, and renal function indicators — provide valuable information on graft performance and facilitate the early detection of postoperative complications [4–10,11].

Objective: to evaluate changes in clinical and laboratory parameters before and after living donor liver transplantation.

Material and methods of research.

Study design and patients. A retrospective observational study was conducted involving 38 consecutive adult patients who underwent LDLT at the National Medical Center, Tashkent, Uzbekistan. Patients who underwent primary LDLT and had complete preoperative and early postoperative clinical and laboratory records were included in the study. Patients with incomplete medical records or those who underwent re-transplantation were excluded.

Data collection. Demographic, clinical, operative, and laboratory data were extracted from the institutional liver transplantation database and electronic medical records. Demographic variables included age, body weight, height, body mass index (BMI), and body surface area (BSA, Mosteller formula). Clinical characteristics included the etiology of end-stage liver disease, blood group, Child–Pugh class, MELD score, degree of liver fibrosis, presence of esophageal variceal ligation, and length of hospital stay (total, preoperative, intensive care unit, and postoperative). Operative variables included graft weight, use of a polytetrafluoroethylene (PTFE) vascular prosthesis, and operative duration.

Laboratory assessment. Preoperative and early postoperative laboratory parameters were evaluated, including hemoglobin, platelet count, blood glucose, total protein, albumin, total and direct bilirubin, alanine aminotransferase (ALT), aspartate aminotransferase (AST), gamma-glutamyl transferase (GGT), alkaline phosphatase (ALP), amylase, creatinine, urea, prothrombin index (PTI), activated partial thromboplastin time (APTT), and international normalized ratio (INR).

Doppler ultrasound evaluation. Early postoperative Doppler ultrasonography was performed to assess graft perfusion, including hepatic artery blood flow velocity, hepatic artery resistive index (RI), portal vein flow velocity, hepatic vein flow velocity, and biliary tract findings.

Statistical analysis. Statistical analysis was performed using Python (pandas, SciPy) Continuous variables were expressed as mean ± standard deviation (M±SD) for normally distributed data, or as median with interquartile range (Me [Q1–Q3]) for non-normally distributed data. Categorical variables were presented as numbers and percentages. The normality of distribution was assessed using the Shapiro–Wilk test. Preoperative and postoperative laboratory values were compared using the paired Student's t-test (normally distributed differences) or the Wilcoxon signed-rank test (non-normally distributed differences). A p value <0.05 was considered statistically significant.

Results and discussion.

The study included 38 patients (n=38) who underwent living donor liver transplantation. The mean age of patients was 42.6±9.5 years (range 25–67 years); mean body weight was 74.1±15.3 kg, mean height was 169.3±7.8 cm, and mean BMI was 25.9±5.5 kg/m² (Figure 1).

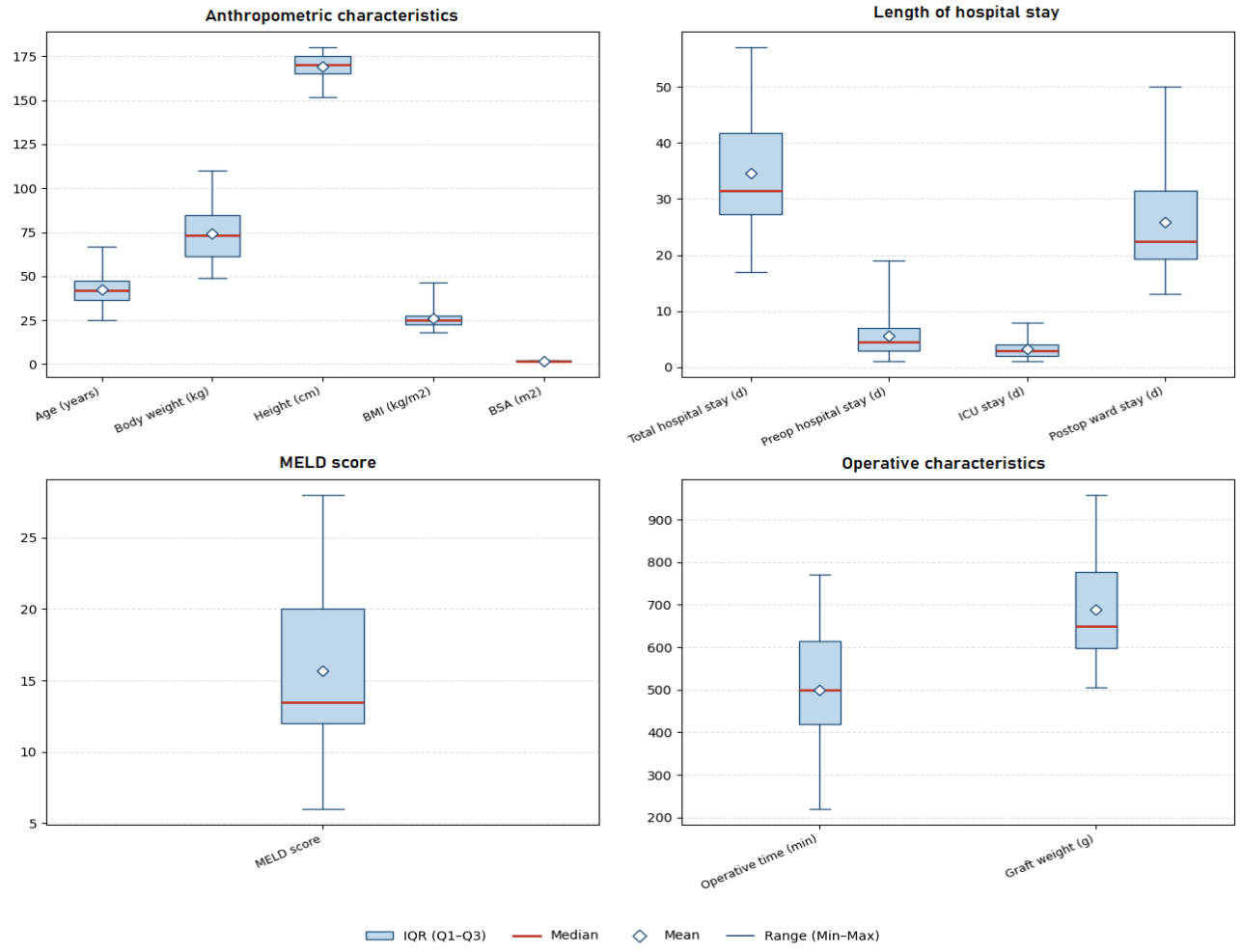


Figure 1. **Baseline demographic, clinical, and operative characteristics of adult recipients undergoing living donor liver transplantation (n = 38). Box-and-whisker plots show the median (red line), interquartile range (box), mean (diamond), and minimum–maximum values (whiskers)**

The predominant etiology of end-stage liver disease was combined hepatitis B+D infection, observed in 86.8% of patients (n=33); other etiologies (autoimmune hepatitis, hepatitis C, unknown etiology) accounted for the remaining 13.2%. By Child–Pugh classification, most patients belonged to class B (52.6%, n=20) and class C (44.7%, n=17), with only one patient (2.6%) in class A. The mean MELD score at the time of transplantation was 15.7±5.1 points (range 6–28). The mean total hospital stay was 34.6±10.8 days, including 5.6±3.8 days preoperatively, 3.2±1.8 days in the intensive care unit, and 25.8±9.5 days in the postoperative ward. Mean operative duration was 499.3±150.2 minutes, and mean graft weight was 687.6±111.5 g. A polytetrafluoroethylene (PTFE) vascular prosthesis was used in 85.3% of cases (n=29) (Figure 1).

Continuous variables are presented as mean ± standard deviation (SD) and median (interquartile range, IQR). Normality was assessed using the Shapiro–Wilk test. Variables with $p > 0.05$ were considered normally distributed.

Comparison of preoperative and early postoperative laboratory parameters revealed statistically significant changes in the majority of the studied indices (Table 1). Hemoglobin concentration increased from 98.6±19.3 g/l preoperatively to 105.6±15.3 g/l in the early postoperative period

(paired t-test, p=0.048), and platelet count showed a marked increase from 72.9±45.7×10⁹/l to 163.1±88.0×10⁹/l (p<0.001), reflecting resolution of hypersplenism and improved bone marrow reserve following graft reperfusion.

Table 1.

Comparison of laboratory parameters before and after living donor liver transplantation

Parameter	Before transplantation	After transplantation	Statistical test	p value
Hemoglobin (g/L)	98.6 ± 19.3	105.6 ± 15.3	Paired t-test	0.048
Platelet count (×10⁹/L)	72.9 ± 45.7	163.1 ± 88.0	Paired t-test	<0.001
Blood glucose (mmol/L)	4.8 (4.5–5.3)	5.1 (4.6–5.9)	Wilcoxon	0.101
Total protein (g/L)	60.4 ± 8.6	50.4 ± 8.0	Paired t-test	<0.001
Albumin (g/L)	33.1 ± 6.5	33.7 ± 4.5	Paired t-test	0.637
Total bilirubin (µmol/L)	34.3 (21.2–44.9)	18.0 (15.1–26.6)	Wilcoxon	<0.001
Direct bilirubin (µmol/L)	11.1 (6.1–17.9)	6.5 (4.4–10.1)	Wilcoxon	0.005
ALT (U/L)	47.9 (32.4–64.7)	45.0 (34.5–85.2)	Wilcoxon	0.537
AST (U/L)	56.0 (36.7–73.9)	30.0 (22.6–44.5)	Wilcoxon	0.033
GGT (U/L)*	44.9 (35.4–58.5)	80.8 (54.0–122.0)	Wilcoxon	0.045
Amylase (U/L)*	57.0 (41.0–68.2)	43.0 (37.0–52.0)	Paired t-test	0.117
Alkaline phosphatase (U/L)*	121.5 (106.0–146.3)	92.4 (65.3–134.5)	Paired t-test	0.184
Creatinine (µmol/L)	68.9 (58.8–79.9)	63.5 (55.1–79.5)	Wilcoxon	0.197
Urea (mmol/L)	4.9 (4.4–5.6)	5.7 (5.0–6.9)	Wilcoxon	0.013
PTI (%)	67.9 ± 15.6	77.4 ± 11.7	Paired t-test	0.002
APTT (s)	39.2 (33.1–52.6)	38.0 (35.6–40.0)	Wilcoxon	0.014
INR	1.45 (1.30–1.62)	1.26 (1.19–1.35)	Wilcoxon	<0.001

A statistically significant decrease in total protein was observed, from 60.4±8.6 g/l preoperatively to 50.4±8.0 g/l postoperatively (p<0.001), whereas serum albumin did not change significantly (33.1±6.5 vs 33.7±4.5 g/l, p=0.637). Bilirubin metabolism showed clear improvement: total bilirubin decreased from a median of 34.3 [21.2–44.9] to 18.0 [15.1–26.6] µmol/l (Wilcoxon signed-rank test, p<0.001), and direct (conjugated) bilirubin decreased from 11.1 [6.1–17.9] to 6.5 [4.4–10.1] µmol/l (p=0.005), indicating recovery of hepatic excretory function.

Among liver enzymes, AST decreased significantly from a median of 56.0 [36.7–73.9] to 30.0 [22.6–44.5] U/l (p=0.033), consistent with resolution of the initial hepatocellular stress associated with cirrhosis and surgery. ALT showed no statistically significant change overall (median 47.9 [32.4–64.7] preoperatively vs 45.0 [34.5–85.2] U/l postoperatively, p=0.537); however, the postoperative mean was markedly elevated relative to the median (127.6±318.5 U/l) because of a small subgroup of patients with a pronounced early transaminase surge, including one case exceeding 1900 U/l.

This pattern is consistent with the transient ischemia–reperfusion injury of hepatocytes that is well described in the first 24–72 hours after graft implantation and typically resolves within 1–2

weeks, rather than indicating impaired graft function. GGT likewise increased significantly in the early postoperative period, from a median of 44.9 [35.4–58.5] to 80.8 [54.0–122.0] U/l (p=0.045; n=25 with paired data available). Because GGT is a biliary-canalicular enzyme, this early rise most likely reflects biliary anastomotic edema and cholangiocyte regeneration rather than hepatocellular injury, and — together with the ALT surge — should be interpreted as an expected early postoperative phenomenon; this is discussed further below. Amylase (p=0.117) and alkaline phosphatase (p=0.184) showed no statistically significant postoperative change.

Renal function remained stable: creatinine did not change significantly (81.4±60.9 vs 73.9±41.2 μmol/l, p=0.197), while urea showed a small but statistically significant increase, from a median of 4.9 [4.4–5.6] to 5.7 [5.0–6.9] mmol/l (p=0.013), remaining within the reference range in most patients. Blood glucose also showed no statistically significant change (p=0.101).

The coagulation profile improved significantly after transplantation. PTI increased from 67.9±15.6% to 77.4±11.7% (paired t-test, p=0.002), APTT decreased from a median of 39.2 [33.1–52.6] to 38.0 [35.6–40.0] sec (Wilcoxon, p=0.014), and INR decreased from a median of 1.45 [1.30–1.62] to 1.26 [1.19–1.35] (p<0.001), reflecting restoration of hepatic synthetic function and normalization of the coagulation cascade in the early postoperative period.

Discussion of the results. The present study demonstrated significant early postoperative improvement in several laboratory indicators following living donor liver transplantation. Platelet count, total and direct bilirubin, PTI, and INR improved significantly, indicating restoration of hepatic synthetic and excretory function together with correction of coagulation abnormalities. Similar early biochemical changes have been consistently reported after successful LDLT and are considered reliable markers of adequate graft function during the immediate postoperative period [3,5,6,7–10].

In contrast, serum ALT and GGT did not decrease during the early postoperative period. ALT showed a non-significant increase, whereas GGT increased significantly (p=0.045). These findings should not be interpreted as early graft dysfunction. Laboratory assessment was performed within the first 1–3 postoperative days, when transient elevation of hepatocellular and cholestatic enzymes is expected because of ischemia–reperfusion injury occurring immediately after graft implantation. Previous studies have shown that this biochemical response usually reaches its peak during the first postoperative days and gradually normalizes within 1–2 weeks in patients with uncomplicated graft recovery [1,2, 4,10].

Total protein decreased significantly after surgery, most likely reflecting perioperative hemodilution, surgical stress, blood loss, and increased protein consumption. In contrast, serum albumin remained unchanged, probably due to perioperative albumin supplementation and intensive postoperative fluid management, findings that are also consistent with previous reports [2,3,5,6].

Overall, the observed laboratory dynamics indicate successful early graft adaptation after LDLT. Comprehensive postoperative laboratory monitoring remains essential for distinguishing expected reperfusion-related biochemical changes from early graft dysfunction and other postoperative complications.

Conclusion.

Living donor liver transplantation was associated with significant early postoperative improvement in hematological, excretory, and coagulation parameters, including platelet count, total and direct bilirubin, AST, PTI, APTT, and INR, indicating satisfactory early graft function.

Transient postoperative elevation of ALT and GGT, particularly the significant increase in GGT, reflected the expected ischemia–reperfusion response rather than early graft dysfunction. Conversely, renal function, albumin, blood glucose, amylase, and alkaline phosphatase remained relatively stable during the early postoperative period.

These findings demonstrate that routine laboratory monitoring is essential for assessing early graft adaptation, differentiating physiological reperfusion-related changes from pathological graft dysfunction, and enabling timely detection of postoperative complications after living donor liver transplantation.

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