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Incisional hernias after liver transplantation

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Abstract

Background. *One of the late complications of liver transplantation is postoperative hernia of the abdominal wall, which occurs in 5-46% of recipients. An incisional hernia reduces the quality of life, and is accompanied by various complications, such as adhesive disease, intestinal passage disorder, entrapment. In addition to other factors affecting the formation of an abdominal scar, traumatic surgical approaches are reviewed as predictors of herniation.*

Material and methods*. The results of treatment of 77 recipients after liver transplantation in the period 2018-2025 were evaluated. Related living donor transplantation was performed in 5 and cadaveric one in 72 patients. J-shaped approach was provided to 75 (97.4%) and "Mercedes" was used in 2 (2.59%) recipients.*

Results*. An incisional hernia of the abdominal wall complicated the late postoperative period in 38.9% of cases. Hernial defect was diagnosed*

0.5–7 years after transplantation, and in 50% of cases, the diagnosis of incisional hernia was made within 6 to 12 months after surgery. The locus minoris resistentiae of the J-shaped access is the white line and angle of the postoperative scar, where hernial defects appear more often.

Conclusion. *One of the factors of herniation after liver transplantation is the multidirectional, relatively traumatic J-approach, which implies the optimal methods for strengthening "weak" points or the use of other, mainly transverse approaches.*

Keywords: liver transplantation, laparotomy, J-shaped approach, postoperative abdominal wall hernia

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BMI, body mass index
IVC, inferior vena cava
LT, liver transplantation
MELD, Model for End-Stage Liver Disease
PH, postoperative hernia

Introduction

Liver transplantation (LT) is a high-tech and often the only definitive treatment option for patients with end-stage liver disease. According to the Russian Transplant Society Registry, 38 centers in this country perform approximately 800 LTs annually. Over the recent 10 years, the number of patients undergoing LT has increased 2.6-fold, reaching 5,150 [1].

Postoperative hernia (PH) is a common late complication of liver transplantation, reducing quality of life and increasing the risk of known complications. The incidence of PH after liver transplantation is unknown and ranges from 5 to 46%. Hernia formation is influenced by wound infection and relaparotomy [2]. Specific factors influencing the formation of anterior abdominal wall scar in transplant patients include: ascites with a history of decompression, immunosuppression, and a discrepancy between the donor liver size and the recipient's abdominal cavity volume [2–5].

The use of wide, rather traumatic approaches (J-shaped, “Mercedes”) can be considered as predictors of hernia formation [3, 6].

Prosthetic replacement of the abdominal wall with an implant in patients receiving immunosuppression is associated with a high risk of infectious complications, but this method is often the only alternative and the literature describes satisfactory results of using a mesh endoprosthesis for both the prevention and treatment of PH [3, 7].

Objective. To study possible predictors of the development of postoperative ventral hernias after liver transplantation.

Material and methods

From 2018 to 2025, 120 liver transplantations were performed at the Irkutsk Regional Clinical Hospital. A single-center retrospective study with a prospective dataset assessed the examination and surgical treatment outcomes of 77 liver transplant recipients.

Non-inclusion criteria: orthotopic liver transplantation in the Portal Hypertension Department of the Irkutsk Regional Clinical Hospital. Exclusion criteria: follow-up period after liver transplantation less than 6 months, recipient age under 18 years old, and fatal outcome.

There were 50 women (65%) and 27 men (35%). The median age of patients was 50.0 (45.0; 59.0) years. Indications for LT were: cirrhosis due to viral hepatitis in 33 (42.8%) patients, primary biliary cirrhosis in 10 (12.98%), cryptogenic cirrhosis in 10 (12.98%), alcoholic cirrhosis in 6 (7.79%), hepatocellular carcinoma in 6 (7.79%), primary sclerosing cholangitis in 4 (5.19%), autoimmune cirrhosis in 4 (5.19%), and alveolar echinococcosis of the liver in 4 (5.19%).

Median Child-Pugh score in liver transplant candidates was 8 (7; 10), and the median MELD score was 16 (11; 17). The median plasma albumin level was 35 (31.2; 39) g/L. Thirty-three (42.85%) patients had ascites, five (15.15%) of whom underwent decompressive laparocentesis.

The most common comorbidities were cardiovascular disease (27 cases, 35%) and diabetes mellitus (9 cases, 11.6%). Sixteen patients (20.7%) were smokers, and 12 (15.5%) were long-term alcohol users. Before transplantation, 4 (5.2%) patients had postoperative hernias, 12 (15.6%) had umbilical hernias." to "At the time of liver transplantation, 16 (20.8%) patients had hernias of the anterior abdominal wall, of which 12 (75%) were umbilical and 4 (25%) were postoperative median ventral (occurred after early interventions on the abdominal organs from the access - median laparotomy).

Median body mass index (BMI) before transplantation was 25.2 (23.08; 29.32) kg/m². In 30 (38.9%) patients, the BMI was within normal range. Pre-obesity was present in 27 (35%) patients, grade I obesity was present in 12 (15.58%) patients, grade II obesity was present in 2 patients (2.29%), and grade III obesity was present in 1 patient (1.29%). Underweight was seen in 5 (6.49%) patients.

Related living donor LT was performed in 5 patients (6.5%), cadaveric, including 2 split transplants, in 72 (93.5%). J-shaped access was used in 75 (97.4%) cases, "Mercedes" type access in 2 (2.6%).

Resection of the inferior vena cava (IVC) was performed in 45 cases (58.44%). Biliobiliary anastomosis was formed in 66 patients (85.71%), hepaticojejunostomy in 11 (14.28%).

Immunosuppressive therapy regimens: single-component regime in 51 (66.3%) patients; two-component therapy in 10 (12.9%), three-component in 16 (20.8%). Single-component immunosuppression included calcineurin inhibitor, two-component included calcineurin inhibitor + mycophenolic acid; in the three-component regimen methylprednisolone was added.

Based on the formation of incisional hernias after LT, the patients were divided into groups: the first included recipients who had a postoperative ventral hernia, the second included those without the formation of hernias.

The identified defects were classified according to SWR classification (Chevrel J. P., Rath A. M., 1999).

In addition to the generally accepted classification, for a detailed localization of the defect, the skin scar of the J-shaped access was divided into segments: vertical, lateral, and the angle of the scar (the place where the vertical laparotomy transitions to the lateral one) (Figure).

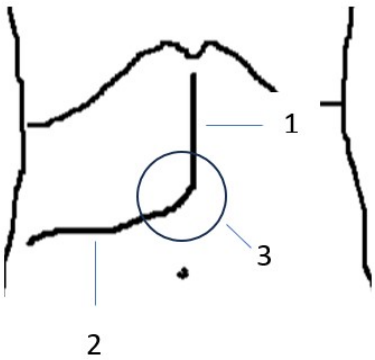

Figure. Schematic layout of the postoperative scar of the anterior abdominal wall. 1, the vertical segment; 2, the lateral segment; 3, the angle

Hernias were found in the area of the angle in 18 (62.1%) patients, in the vertical segment in 9 (31.1%), and in the lateral segment in 2 (6.8%).

Statistical analysis of the data was performed using the Statistica 10.0 for Windows software package. The data type was determined using the Shapiro–Wilk or Kolmogorov–Smirnov test. In all studied samples, the distribution deviated from normal. Continuous quantitative data are presented as the median with lower and upper quartiles (25^{th} and 75^{th} percentiles). The statistical significance of differences (p) in the compared samples was determined using the Mann–Whitney test (U). Categorical data are presented as the number of cases and the frequency as a percentage. The statistical significance of differences was determined using Pearson's (χ^2) test and Fisher's exact test for a four-field table. Correlation analysis was performed using the nonparametric Spearman coefficient (Rs). Multivariate nonlinear (logistic regression and fixed nonlinear regression) analysis was used to identify cause-and-effect relationships. Differences were considered statistically significant at $p<0.05$.

Results

Postoperative hernias developed in 30 (38.9%) patients after LT. The median time of hernia defect detection was 12 (6;24) months. Hernia was identified in 16 (53.3%) patients during the first year after LT, in 8 (26.6%) patients in the second year, in 5 (16.6%) in the third year, in 1 (3.5%) in the fourth year.

There were 26 (86.6%) median hernias (M), 3 (10%) lateral hernias (L), and a combination of lateral and median hernias (M, L) was reported in 1 case (3.4%). The size of the hernial orifice was up to 5 cm (W1) in 13 (43.33%) cases, from 5 to 10 cm (W2) in 7 (23.33%), over 10 cm (W3) in 10 (33.34%).

To identify possible predictors of PH formation, perioperative characteristics of recipients were assessed (Tables 1–3).

Table 1. Comprehensive data of patients from the first and second groups before transplantation

Parameters			The first group (n=30)	The second group (n=47)	p
Age, years			53 (47;58)	48.5 (44;59)	0.20
Gender	Men, n (%)		13 (43.4%)	14 (29.3%)	0.22
	Women, n (%)		17 (56.6%)	33 (70.2%)	
Indication for surgery	Liver cirrhosis caused by viral hepatitis, n (%)		12 (40%)	21 (44.7%)	0.68
	Hepatocellular carcinoma, n (%)		3 (10%)	3 (6.4%)	0.56
	Alcoholic liver cirrhosis, n (%)		1 (3.4%)	5 (10.6%)	0.24
	Primary biliary cirrhosis, n (%)		5 (16.6%)	5 (10.6%)	0.44
	Primary sclerosing cholangitis, n (%)		1 (3.4%)	3 (6.4%)	0.55
	Cryptogenic liver cirrhosis, n (%)		5 (16.6%)	5 (10.6%)	0.44
	Autoimmune liver cirrhosis, n (%)		1 (3.4%)	3 (6.4%)	0.55
	Liver alveococcosis, n (%)		2 (6.6%)	2 (4.3%)	0.64
Child-Pugh score, points			8 (7;9)	9 (7;10)	0.39
MELD sore, points			16 (11;16)	16 (11;19)	0.59
Blood albumin concentration, g/L			35 (32;39)	35 (30;39)	0.54
Ascites	Yes, n (%)		11 (36.7%)	22 (46.8%)	0.38
	No, n (%)		19 (63.3%)	25 (53.2%)	
Body mass index			25.7 (23.3;31.4)	24.4 (23.03;27.04)	0.13
Smoking		Yes, n (%)	4 (13.4%)	12 (25.5%)	0.19
		No, n (%)	26 (86.6%)	35 (74.5%)	
Alcohol		Yes, n (%)	3 (10%)	9 (19.2%)	0.28
		No, n (%)	27 (90%)	38 (80.8%)	
Diabetes mellitus		Yes, n (%)	3 (10%)	6 (12.8%)	0.71
		No, n (%)	27 (90%)	41 (87.2%)	
Laparotomy		primary, n (%)	3 (10%)	6 (12.8%)	0.71
		repeated, n (%)	27 (90%)	41 (87.2%)	

Table 1 shows that no significant differences in preoperative parameters were found between the compared groups.

Table 2. Intraoperative data in the first and second groups of patients

Parameter		The first group (n=30)	The second group (n=47)	p
Access	J-shaped, n (%)	29 (96.6%)	46(97.8%)	0.74
	Mercedes-type incision, n (%)	1 (3.4%)	1 (2.2%)	
Surgery duration, min		330 (290;370)	310 (270;360)	0.25
Cold ischemia time, min		165 (145;191)	177 (150;230)	0.23
Warm ischemia time, min		40 (30;45)	34 (25;39)	**0.004**
Volume of blood loss, mL		1000 (800;1500)	800 (500;1500)	**0.034**
Ascites volume, mL		100 (50;500)	100 (50;100)	0.77
Reinfusion volume, mL		682 (330;920)	479 (300;702)	0.24
Packed red blood cell transfusion volume, mL		630 (310;1720)	880 (560;1210)	0.59
Caval reconstruction option	With resection of the inferior vena cava, n (%)	13 (43.4%)	32 (68.1%)	**0.031**
	Without resection of the inferior vena cava, n (%)	17(56.6%)	15 (31.9%)	

According to the data in Table 2, the warm ischemia time and the volume of blood loss in the first group were statistically significantly higher than in the second ($p<0.05$). Hernia formed in 53.1% of patients with preserved IVC, and in 28.8% patients after its resection ($p=0.031$).

A hernia developed in 10 of 33 patients (30.3%) who had had ascites before surgery and in 20 of 44 (45.4%) who had not ($p=0.089$). Ascitic fluid leakage through skin sutures was observed in 42 (54.5%) of the operated patients. A postoperative hernia developed in 16 of them (38.1%) and in 14 of 35 (40%) with a sealed postoperative suture ($p=0.074$).

Table 3. Data of the patients from the first and second groups after liver transplantation

Parameter	The first group (n=30)	The second group (n=47)	p
Volume of discharge through drains on the 1st postoperative day, mL	400 (250;700)	375 (200;850)	**0.99**
Hemoglobin on the 1st postoperative, g/L	95.5 (89;107)	97 (86;110)	**0.97**
Immunosuppression regimen			
One-component, n (%)	19 (63.3%)	32 (68.1%)	0.66
Two-component, n (%)	5 (36.7%)	5 (10.6%)	0.44
Three-component, n (%)	6 (20%)	10 (21.3%)	0.89
Complication grades by Clavien-Dindo Classification			
I, n (%)	**0**	**0**	**-**
II, n (%)	1 (3.3%)	2 (4.2%)	0.55
IIIA, n (%)	5 (16.6%)	3 (6.4%)	0.27
IIIB, n (%)	5 (16.6%)	5 (10.6%)	0.44
IV, n (%)	2 (6.6%)	**0**	0.20
IIIA - IV, n (%)	12 (40 %)	8 (17.02%)	**0.024**
Complications			
Relaparotomy, n (%)	4 (13.3%)	3 (6.4%)	0.30
Laparoscopy, n (%)	2 (6.6%)	1 (2.1%)	0.64
Stenting of biliary anastomosis stricture, n (%)	1 (3.3%)	1 (2.1%)	0.74
Stenting of arterial anastomosis, n (%)	1 (3.3%)	0	0.20
Suppuration of a postoperative wound, n (%)	3 (6.6%)	0 (0%)	**0.027**
Hematoma of the anterior abdominal wall, n (%)	0 (0%)	2 (4.2%)	0.25
Seroma of the anterior abdominal wall, n (%)	1 (3.3%)	1 (2.1%)	0.74

According to Table 3, on the first postoperative day, the hemoglobin level and the amount of drainage from the abdominal cavity in the first and second groups did not differ significantly ($p>0.95$). From the second day onwards, no statistically significant differences in these parameters were found ($p>0.05$). There were no significant differences in

the immunosuppression regimens between the first and second groups ($p>0.05$), either.

Postoperative complications were found in 23 (29.9%) cases, 20 (86.9%) of which corresponded to Clavien–Dindo class IIIa – IV. Thus, there were 8 (34.8%) cases of class IIIa complications: 2 biliary anastomotic strictures, 1 arterial anastomotic stenosis, 2 anterior abdominal wall seromas, 2 anterior abdominal wall hematomas, and 1 postoperative wound suppuration. Class IIIb complications were identified in 10 (43.8%) patients: 5 intra-abdominal hemorrhages, 1 biliary anastomotic leak, 3 bile leaks, and 1 anterior abdominal wall phlegmon. Class IV complications were observed in two (8.7%) patients: one developed liver graft dysfunction due to late hepatic artery thrombosis, and the other developed acute kidney injury in the early postoperative period. Postoperative complications of class IIIa-IV were more common in patients with incisional hernias (12 (40%)) compared to patients without them (8 (17%)) ($p=0.027$).

Relaparotomy was performed in 7 patients (9.1%), due to postoperative bleeding in 5 (6.4%) cases, bile leakage in 1 (1.2%) case, and biliary anastomosis dysfunction in 1 (1.2%) case. Sanation laparoscopy due to bile leakage after biliary drainage removal was performed in 3 patients (3.9%). There were no differences between the first and second groups in the frequency of relaparotomies and sanation laparoscopies ($p>0.05$). Local complications were identified in 7 (9.1%) cases: seromas in 2 cases (28.5%), soft tissue hematomas in the anterior abdominal wall in 2 cases (28.5%), and the postoperative wound suppuration in 3 cases (43%). The latter parameter was significantly higher in the first group than in the second ($p=0.027$).

Discussion

In our series, hernias developed in 38.9% of cases after LT, which was twice the rate after general abdominal surgery [8, 9]. Fifty percent of hernias developed in the first year, while the remainders were detected over the next 4 years. Consequently, one-third of patients after LT require repeat surgeries in the long term. Chronic immunosuppression increases the risk of postoperative complications after surgery [4, 10].

Among the preoperative parameters studied: BMI, severity of liver failure, ascites, concomitant pathology, history of laparotomy, albumin level, and others, no predictive factors for hernia formation were identified (see Table 1). E. Piazzese et al., N. Garmpis et al., J.V.V. Ferri et al. found an association between bilateral subcostal approach with vertical extension, male gender, BMI>35, MELD>22, immunosuppressive therapy with steroids, diabetes mellitus and the development of postoperative hernia [6, 12, 13].

Hernias were more common in patients with Clavien-Dindo grade IIIa–IV complications. Postoperative hernias also developed more frequently after wound infection, the phenomenon also observed in other abdominal surgery types [13, 14].

H. Maki et al. refer repeated interventions (relaparotomy, relaparoscopy) to the risk factors for failure of the anterior abdominal wall scars [14]. In our series, no such relationship was found.

In this article, we compared risk factors for the formation of postoperative hernias in a cohort of patients who underwent LT. Further discussion of this issue requires a clinical comparison group of patients undergoing laparotomy for other reasons. The frequent development of incisional hernias after LT is likely related to the initial status of recipients [7, 11, 12].

We did not identify any clear predictors of the development of hernias among patients after LT, but it can be assumed that one of the significant factors is the shape of the incision used to form access. Hernias in the lateral segment were 13 times less common (6.8%) than in the vertical (31.1%) and angle (62.1%) ones. Preventive measures may include additional strengthening of the linea alba and angle, or abandoning the medial component and using approaches with a predominantly transverse direction. This is supported by studies by M. Donataccio et al., and J.V.V. Ferri et al., who consider the complex configuration of the access, which has multidirectional stretching with maximum stress in the area of the angle, as predictors of hernia formation [6, 15]. There are studies that have proven the advantages of transverse approaches over longitudinal ones [16, 17].

Conclusions

1. Incisional hernias after liver transplantation were identified in 39.8% of patients, with half of the cases being identified within the first year.

2. After J-shaped access, the hernia defect is formed more often in the vertical segment and the corner of the postoperative scar (93.2%) (locus minoris resistentiae).

3. The incidence of postoperative complications of class IIIa-IV Clavien-Dindo and wound infection was higher in patients with postoperative hernias compared to patients without them ($p=0.024$ and $p=0.027$, respectively).

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