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Clinical Research

Results of Surgical Treatment of Patients with Liver Laceration from Blunt Abdominal Trauma

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Abstract

In this paper, the method developed to suture liver wounds is described in detail. The results of the surgical treatment of liver laceration with blunt abdominal trauma during the period 2001-2012 are presented. The technique developed for suturing liver wounds in patients with blunt abdominal trauma was evaluated. The method developed involving suturing of the liver wounds in patients with blunt abdominal trauma contributes to reliable hemostasis, significantly reduces the duration of surgery and the development of post-operative complications. IJBM 2012; 2(3):169-173.
Key words: *: liver wound, blunt abdominal trauma.*

Introduction

Liver injuries take second place among all the injuries of the abdominal organs and achieve between 15-20% [1-3]. Mortality from open liver injuries reaches 12%, while from closed injuries it amounts to 72% [3-5].

The treatment tactics for liver rupture includes primary debridement and lesion closure [5, 6]. Providing reliable hemostasis is the leading problem in liver injuries [6, 7]. To achieve final hemostasis during liver injuries, biological and synthetic film, suturing, adhesive compositions, and even noncontact methods (laser, plasma, argon plasma coagulation, and electrocautery) are commonly used. Often, necrosis of the liver parenchyma is formed in the suture area, which could lead to suppuration or secondary bleeding, and sometimes a biliary fistula can be formed, which could warrant reoperations [8, 9].

Currently, the question of which tactics of the surgical treatment of the liver injuries is not yet fully resolved [7, 8]. The search for optimal ways of technical improvement in organ-preserving operations in the case of traumatic lesions of the parenchymatous organs remains the actual and yet unresolved problem [5].

The aim of this study is to improve the results of the surgical treatment of patients with liver laceration with blunt abdominal trauma by developing and implementing the method of suturing the liver wounds.

Materials and methods

To achieve our objectives, clinical examination of 190 patients (Table 1) between 18 and 73 years of age with blunt abdominal trauma and consequent liver injuries was conducted. Between 2001 and 2012, suturing of the liver wounds and resection of the abnormal liver were performed in the Surgical Departments of the City Hospital Emergency Care, Ulyanovsk. Among the early postoperative complications in patients with blunt abdominal trauma and liver injuries, the following symptoms were observed: posttraumatic hepatitis in 65 (34.2%) patients, purulent-inflammatory complications of the surgical wounds in 24 (12.6%) patients, biliary fistulas in 12 (6.3 %) patients, and abdominal abscesses in 11 (5.8%) patients. Significantly, 68 (35.8%) patients had more than one complication.

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Postoperative mortality was marked in 0.5% of the patients. Posttraumatic hepatitis was diagnosed by a sharp increase in the total bilirubin to more than 32 mmol/L and transaminase activity by 1.5 times. In this study, 118 patients were included in the analysis. The inclusion criteria consisted of age 18 years and older, males and females, blunt abdominal trauma, liver injury and surgical suturing of the liver wounds. Exclusion criteria: age below 18 years, combined abdominal trauma, myocardial infarction, acute cerebrovascular accident and atypical liver resection.

The study included 118 patients (Table 2) with liver laceration caused by blunt abdominal trauma. The male to female ratio was 3.4:1. There were 90.7% patients of the working-age (from 18 to 60 years). All patients with liver injury were delivered in the clinic by the emergency criteria. Of these, 56 (47.5%) patients were delivered in the clinic within the first hour post injury, 42 (35.6%) patients within 6 hours, and 20 (16.9%) patients after more than 6 hours post injury. To achieve our objectives, clinical and laboratory, radiological, endoscopic, ultrasound and histological methods were employed.

Blood tests, blood chemistry (ALT, AST, bilirubin, amylase) and urine diastase were performed. The leukocyte intoxication index (LII) was calculated according to V.K. Ostrovsky.

All the patients underwent a laparotomy, suturing the liver wounds caused by blunt abdominal trauma and liver laceration. The patients were randomized into two groups based on the technique of suturing the liver wounds. No significant differences were found between the two groups in gender, age, and comorbidity.

The first group included 86 patients with abdominal trauma; suturing of the liver wounds was performed according to the traditional U-shaped sutures. The second group included 32 patients with abdominal trauma; suturing of the liver wounds was performed according to the proposed method. (Method of suturing the liver wounds. The decision to grant a patent of the Russian Federation of 04/27/12, the application number 2010154844, priority of 12/31/10).

The method was carried out according to the following procedures (Fig. 1). After the upper middle laparotomy, sanitation and revision of the abdominal cavity is done, determination of the bleeding source is identified, and deep U-shaped sutures (1) are imposed throughout the entire length of the wound at its bottom (2). To be able to achieve this, we should step back from the lower edge (3) of

Table 1
Early post-operative complications in patients with liver laceration from blunt abdominal trauma (between 2001 and 2012; n=190)

Early post-operative complications	Number of patients n (%)
Thromboembolism	1 (0.5)
Postoperative bleeding (from liver wounds)	5 (2.6)
Abdominal abscesses	11 (5.8)
Biliary fistula	12 (6.3)
Postoperative wound suppuration	24 (12.6)
Posttraumatic hepatitis	65 (34.2)
Pneumonia and pleurisy	10 (5.4)
Combined complications (more than one complication in one patient)	68 (35.8)
Total	190 (100)

Table 2
Characteristics of the patients by age and gender (n=118)

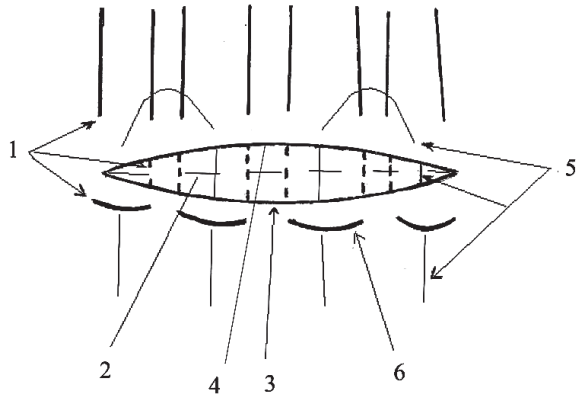
Age (years)	Gender		Number of patients	%
	males	females		
18-40	40	14	54	45.8
41-60	42	11	53	44.9
61 and older	9	2	11	9.3
Total:	**91 (77.1%)**	**27 (22.9%)**	**118**	**100**

the wound at 1-1.5 cm; a round needle (atraumatic) is then passed through the liver parenchyma; one end of the thread is passed at the bottom (2) of the wound with an exit to the opposite side at 1-1.5 cm from the top edge (4) of the wound. Then using the same technique the other end of the thread is passed, receding off the first entrance at 1-1.5 cm. Receding off the first deep U-shaped suture (1) at 1-1.5 cm, subsequent similar deep U-shaped sutures (1) are imposed throughout the entire length of the wound at its bottom (2). The ends of the threads previously are not banded together.

Thereafter, the surface U-shaped sutures (5) are imposed on 1/3 the depth off the wound surface in the opposite direction. Receding off the top edge (4) of the wound at 0.5-0.8 cm on the side of the exits of the deep U-shaped sutures (1) (on a mid-distance between the exits of the deep U-shaped sutures), a round needle (atraumatic) is passed through the liver parenchyma, and one end of the thread is passed on 1/3 the depth off the wound surface with an exit on the opposite side at 1-1.5 cm off the bottom edge (3) of the wound under the loop (6) of the deep U-shaped suture (1). Then the other end of the thread is passed through the middle of the distance between the exits of the second deep U-shaped suture (1). Receding off the top edge (4) of the wound on 0.5-0.8 cm, a round needle (atraumatic) is passed through the liver parenchyma, the thread is passed on 1/3 the depth off the wound surface with an exit on the opposite side at 1-1.5 cm off the bottom edge (3) of the wound under the loop (6) of the deep U-shaped suture (1). The subsequent surface U-shaped sutures (5) are imposed through the mid-distances between the exits of the deep U-shaped sutures (1) on 1/3 the depth off the wound surface throughout its entire length. After imposing all the sutures, all the thread ends of the deep U-shaped sutures (1) are bound simultaneously to each other on one side and all the thread ends of the surface U-shaped sutures (5) are bound simultaneously to each other on the other side. Depending on the length of the wound a few sutures are imposed.

All the patients in the study gave voluntary, informed consent for medical intervention. All the data was processed according to the variation statistics method using the software Statistica V. 6.0. For data with normal distribution, inter-group comparisons were performed using student's t-test for multiple comparisons. Then, statistical analysis was performed for each sex separately. To compare percentages, Fisher's exact test, was performed. P value less than 0.05 was considered significant.

Figure 1



1 - the deep U-shaped sutures, 2 - the bottom of the wound, 3 - the lower edge of the wound, 4 - the top edge of the wound, 5 - the surface U-shaped sutures, 6 - the loop of the deep U-shaped suture.

Results and discussion

Clinical studies have shown that the duration of the surgery in group 1 and in group 2 (with traditional interventions) was 61.2±9.2 minutes, respectively, while the duration of the method developed in this study was 50.4±8.1 minutes. Obviously, this method helped to reduce the duration of the surgery by 11 minutes ($p<0.05$) on average.

However, in terms of pain relief there was no significant difference between the two groups. The time taken for recovery of intestinal motility and diarrhea in the second group was significantly two times faster than in the first group.

In the 2nd group, the LII significantly decreased to the 4th day and its mean was 4.1±0.4; in the 1st group, the LII was significantly two times higher: 8.6±0.2 ($p<0.05$).

In the post-operative period, the development of posttraumatic hepatitis was noted in 25 patients (29.1%) of the 1st group and in only 3 patients (9.4%) of the 2nd group. The bilirubin levels were noted to be increased in both groups on the 2nd post-operative day, but the mean was significantly lower in the patients of the 2nd group (32.5± 1.4 micromole/L) than in patients of the first group (68.1±3.3 micromole /L), $p<0.05$ (Table3). Bilirubin levels returned to the normal value on the sixth postoperative day.

The ALT and AST levels (Table 4) post surgery were increased in both groups, but in the 2nd group they were significantly lower by the comparison with the first group on the 2nd-, 4th-, and 6th days. The ALT and AST levels in both groups returned to normal values on the sixth postoperative day.

A comparative evaluation of the incidence of post-operative complications (Table 5) showed that complications occurred less often in the second group than in the first group. The following complications were noted in the first group: posttraumatic hepatitis in 25 (29.1%) patients, subhepatic abscesses in 8 (9.3%), biliary fistula in 4 (4.6%), and wound suppuration in 15 (17.4%) patients.

In the second group, abdominal abscesses and biliary fistula were not noted at all, posttraumatic hepatitis was observed in only 3 (9.4%) patients, and wound suppuration in 3 (9.4%) patients. Pneumonia and pleurisy were observed in 10 (11.6%) patients of the first group, and in 2 patients (6.2%) of the second group; however, these complications were treated conservatively.

The method of suturing the liver wounds developed in this study promotes efficient juxtaposition of the wound surfaces, improves the healing process, thereby reducing posttraumatic hepatitis, and eliminates the formation of abdominal abscesses and biliary fistulas.

Postoperative mortality in the 1st group was

Table 3
Total serum bilirubin level (micromole/L)

Observation Dates	1st group (n=86)	2nd group (n=32)
2nd post-operative day	68.1±3.3	32.5±1.4*
4th post-operative day	36.2±3.0	25.2±2.3*
6th post-operative day	28.3±2.5	21.7±1.2*

Note: *the differences were statistically significant when compared with the indicators of the 1st group: *-p<0.05*

Table 4
Level of ALT and AST (U/L)

Observation Dates	1st group (n=86)		2nd group (n=32)	
	ALT	AST	ALT	AST
2nd post-operative day	103.4±13.4	58.1±11.6	84.2±4.2*	35.5±2.2*
4th post-operative day	81.3±10.1	51.1±11.2	60.3±3.4*	35.3±2.2*
6th post-operative day	72.3±10.4	41.4±9.2	59.7±5.1*	35.5±2.2*

Note: *the differences were statistically significant when compared with the indicators of the 1st group: *-p<0.05*

Table 5
Character of post-operative complications

Early post-operative complications	Number of complications (%)	
	1st group (n=86)	2nd group (n=32)
Thromboembolism, acute cardio-vascular failure	1 (1.2)	-
Postoperative bleeding (from liver wounds)	5 (5.8)	-
Abdominal abscesses	8 (9.3)	-
Biliary fistula	4 (4.6)	-
Postoperative wound suppuration	15 (17.4)	3 (9.4)
Posttraumatic hepatitis	25 (29.1)	3 (9.4)
Pneumonia and pleurisy	10 (11.6)	2 (6.2)
Total	86 (100)	32(100)

1.2%. The common causes of postoperative death were thromboembolism and acute cardiovascular failure in 1 patient (1.2%). Postoperative death was not observed at all in the 2nd group. The average duration of the hospital treatment for patients in the first group totaled to 17.4±0.2 days, while for those in the second group it was 13.2±0.5 days, an average of 3 days less. Time of observation in the late postoperative period in both groups ranged from one to three years. In the first group, good results were obtained in 39 (45.3%) patients, fair results in 20 (23.3%), and poor results in 27 (31.4%). In the second group, good results were obtained in 22 (68.8%) patients, fair results in 5 (15.6%), and poor results in 5 (15.6%). Thus, the best results of surgical treatment were observed in patients after suturing of the liver wounds by using the method developed.

Conclusions

The method developed involving suturing of the liver wounds in patients with blunt abdominal trauma contributes to reliable hemostasis and significantly reduces

the duration of surgery, on an average by 11 minutes. The method proposed, of suturing the liver wounds, contributes to a reduction in the development of posttraumatic hepatitis by 20% and eliminates the formation of abdominal abscesses and biliary fistulas in patients with blunt abdominal trauma.

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