

THE COMPARISON OF THE RESULTS OF LAPAROSCOPIC AND OPEN SURGICAL
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Article Received on 13/05/2022

Article Revised on 03/06/2022

Article Accepted on 23/06/2022

ABSTRACT

Aim: The comparative analysis of the results of laparoscopic and traditional surgical treatment of patients with blunt abdominal trauma (BAT). **Patients:** The study included 160 patients with BAT with stable hemodynamics (BP system ≥ 90 mm Hg), operated in the Republican Research Center of Emergency Medicine (RRCM) in the period from 2010 to 2019. The control group consisted of 109 (68.1%) patients who underwent primary wide laparotomy without the use of laparoscopy, the main group included 51 (31.9%) patients whose surgical intervention was started with diagnostic laparoscopy. The mean age of the patients was 33.3 ± 11.4 years. There were 133 (83.1%) men and 27 (16.9%) women. **Results:** The average duration of laparoscopic procedures for BAT in patients with stable hemodynamics is 57.0 ± 40.8 minutes. Laparoscopy followed by conversion practically does not increase the average duration of the intervention compared to primary wide laparotomy (108.1 ± 28.6 versus 103.0 ± 48.7 min, $p=0.657$). Laparoscopy helps to reduce the duration of stay in the DRiTh from 2.8 ± 1.1 to 1.8 ± 1.0 days ($p<0.001$), inpatient treatment from 8.7 ± 3.4 to 5.3 ± 2.9 days ($p<0.05$), a noticeable decrease in the frequency of postoperative complications from 11.9 to 3.1% ($p=0.144$). **Conclusion:** In 62.8% of patients with BAT, injuries are detected intraoperatively, which can potentially be eliminated laparoscopically without any special technical difficulties using routinely used endosurgical instruments, which justifies the expediency of expanding the indications for laparoscopy in abdominal injuries.

KEYWORDS: Blunt abdominal trauma, Diagnosis, Surgical treatment, Laparoscopy, Laparotomy.

INTRODUCTION

Today, trauma is considered to be the fourth most important cause of death, and in people under the age of 45, the first cause of death.^[1,2] At the same time, abdominal trauma is the cause of death in 7-10% of victims.^[3] According to a recently published review.^[4] injuries to the abdominal organs are diagnosed in 28.2% of emergency operated persons injured in road accidents. Therefore, abdominal injuries in modern conditions are characterized by a high proportion of multiple and combined injuries, characterized by a high mortality rate that does not tend to decrease, reaching 85%.^[5] One of the main reasons for the unsatisfactory results of treatment of this category of victims is the mutual aggravation of combined injuries of different anatomical zones and the absence of a clear clinical picture of intra-abdominal bleeding against this background.^[6] The frequency of diagnostic errors, according to various authors, ranges from 20-to 45%, and in severe injuries increases to 73.1%.^[7,8] This circumstance has led to the ubiquitous tactics of early trial laparotomy, without

waiting for the development of diffuse peritonitis or hemodynamically significant intra-abdominal bleeding.^[9,10] However, the number of unjustified laparotomies, in which there are no signs of continued bleeding, and damage to the abdominal organs is not life-threatening, is 7-28.6%, and in severe concomitant injury, it increases from 50 to 80%.^[11,12] At the same time, it is obvious that the performance of unjustified diagnostic surgical interventions exacerbates the severity of the condition of patients, especially those with severe concomitant abdominal trauma.^[13] The invasiveness of laparotomy in such cases often turns out to be incomparable with the volume of the surgical intervention for which it is performed.

Currently, the use of diagnostic and therapeutic video laparoscopy in patients with suspected abdominal trauma is becoming more widespread.^[14,15]

Moreover, prof. A.M. Khadjibaev (2016) proposed the tactics of "safety video laparoscopy", which is used in

patients with combined trauma without clinical and instrumental signs of damage to the abdominal organs, but undergoing surgical interventions under general anaesthesia in other anatomical areas. This tactic allows for diagnosing intra-abdominal injuries in 27-30% of cases in patients with concomitant trauma, who had no signs of abdominal trauma before surgery.^[16]

The reports in the literature about the growing trend of using the therapeutic possibilities of laparoscopy, however, do not allow us to draw an unambiguous conclusion about the safety and effectiveness of the method due to the small number of observations included in published studies, the low quality of the studies performed, the retrospective observational nature of the studies (low level of evidence), the presence of a high risk of subjectivity and high heterogeneity of the results obtained by individual authors.

Aim

Comparative analysis of the results of laparoscopic and traditional surgical treatment of patients with blunt abdominal trauma.

MATERIAL AND METHODS

The study included 160 patients with blunt abdominal trauma (BAT) operated in the Samarkand branch of the RSC EMC in the period from 2010 to 2019 (Fig. 1). The criteria for inclusion of patients in the study were:

- Age of patients from 18 to 60 years;
- Stable hemodynamics (BP \geq 90 mm Hg) upon admission to the clinic;
- Stabilization of hemodynamic parameters as a result of preoperative anti-shock intensive therapy.

The exclusion criteria from the study were:

- Age of patients younger than 18 years and older than 60 years;
- Persistent hypotension (BP $<$ 90 mm Hg), resistant to ongoing intensive therapy.

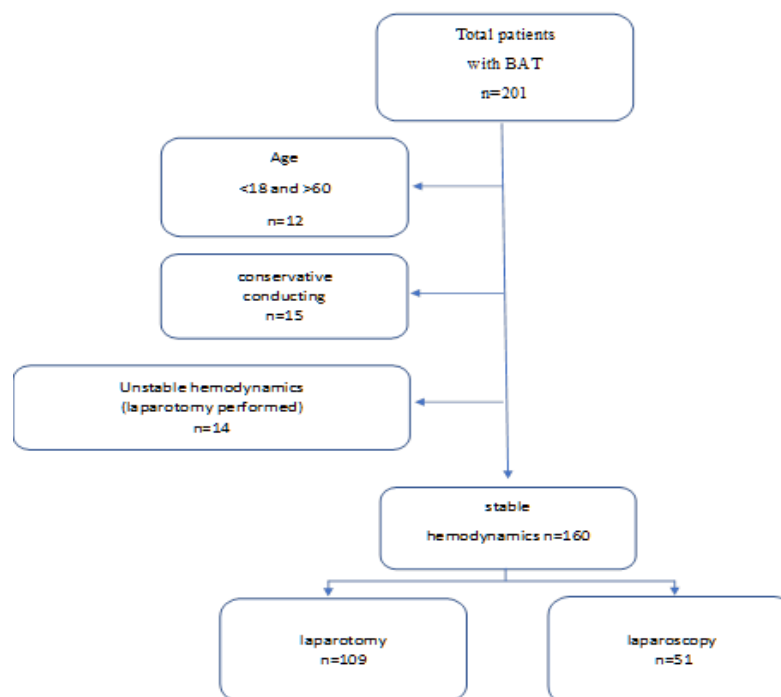


Figure 1: Research design.

Depending on the use of the video-laparoscopic technique at the stages of diagnosis and surgical treatment, the patients were divided into two groups: the control group consisted of 109 (68.1%) patients who underwent primary wide laparotomy without the use of laparoscopy, **the main group** included 51 (31, 9%) of victims whose surgical intervention was started with diagnostic laparoscopy.

The mean age of the patients was 33.3 ± 11.4 years (Table 1). As with all other types of mechanical injuries, males predominated among the victims with BAT - 133 (83.1%) versus 27 (16.9%) women. Due to the fact that

the study included patients with stable hemodynamic parameters (BP system \geq 90 mm Hg), the average value of systolic blood pressure at the start of the operation was 103.7 ± 11.7 mm Hg. (Table 1).

First of all, they tried to use laparoscopic interventions in patients with dubious clinical and sonographic signs of hemoperitoneum, including the so-called “safety laparoscopy”^[17] in patients with combined abdominal trauma, which, apparently, was reflected in the difference in the average values of BP_{sys}. ($p=0.0029$) and pulse ($p<0.05$) in the compared groups.

Table 1: Distribution of victims by sex, Age and Severity of the injury.

Parameter	Main group, n=51	Control group, n=109	Total, n=160
Age:			
Max	58	60	60
Min	18	18	18
M±σ	30,2±8,7	34,8±12,3	33,3±11,4
Student's t-crit.	df=156, t-stat.=2,253, t-crit.=2,253, p=0,0257		
Sex:			
Men, abs. (%)	33 (64,7)	100 (91,7)	133 (83,1)
Women, abs. (%)	18 (35,3)	9 (8,3)	27 (16,9)
χ ² -test	χ ² =18.106, p<0,001		
ADsyst. before surgery, mm Hg			
Art., M±σ*	107,6±11,1	101,8±11,6	103,7±11,7
t-crit Стьюдента	df=156, t-stat.=3,0245, t-crit.=1,9751, p=0,0029		
Pulse, beats/min, M±σ	90,2±9,4	98,7±11,2	95,7±11,1
t-criteria Стьюдента	df=156, t-stat.=-4,6087, t-crit.=1,9753, p<0,05		
Blood hemoglobin, g/l., M±σ	86,6±19,3	86,4±15,4	86,5±16,7
Student's t-crit.	df=156, t-stat.=0,1351, t-crit.=1,9751, p=0,8926		
Injury severity according to the RTS scale, M±σ	7,25±0,66	7,11±0,68	7,15±0,67
Student's t-crit.	df=156, t-stat.=1,2049, t-crit.=1,9753, p=0,2301		
Combined injury of other anatomical zones, abs. (%)	17 (33,3)	38 (34,9)	55 (34,4)
χ ² -test	χ ² =0.036, p=0,850		
Combined TBI, abs. (%)	8 (15,7)	27 (24,8)	35 (21,9)
χ ² -test	χ ² =1.678, p=0,196		
Combined chest injury, abs. (%)	12 (23,5)	20 (18,3)	32 (20,0)
χ ² -test	χ ² =0.583, p=0,446		

Due to the fact that only patients with stable hemodynamics were included in this study, the injury severity scores assessed using the RTS (Revised Trauma Score) integral scale in the compared groups were statistically identical ($p = 0.2301$) and amounted to 7.25 ± 0.66 and 7.11 ± 0.68 points in the main and control groups, respectively (Table 1).

Patients with BAT with stable hemodynamics are characterized by a relatively low frequency of combined damage to organs of other anatomical zones - it occurred in 55 (34.4%) patients. In the group of laparoscopic interventions, a combined abdominal injury was found in 17 (33.3%) patients, and in the group of primary open interventions - in 38 (34.9%) ($p=0.850$).

RESULTS AND DISCUSSION

The frequency of detection of intra-abdominal complications of significant severity, unambiguously requiring open surgery with such volumetric interventions as suturing deep and extensive ruptures of

parenchymal organs, the walls of a hollow organ, resection or removal of an organ, was 43.8% (occurred in 70 victims) (Table .2). At the same time, it is interesting to note that this indicator in the control group of patients, a significant part of whom underwent a wide laparotomy due to the presence of sonographic signs of free fluid in the abdominal cavity with a volume of more than 500 ml (a contraindication to laparoscopy), was 62.4%.

Thus, in at least 37.6% of patients with BAT with stable hemodynamic parameters, abdominal surgical interventions are limited to a maximum of electrocoagulation of a bleeding vessel (Fig. 2), debridement and drainage of the abdominal cavity, or only revision of the abdominal organs (Table 2). As is known, all these manipulations are easily performed using a standard set of laparoscopic instruments without the need for a wide laparotomy, which, in itself, represents a significant additional injury for the injured organism.

Table 2: The volume of surgical interventions performed in the abdominal cavity in patients with BAT.

Scope of operation	Main group, n=51		Control group, n=109		Total, n=160	
	abs.	%	abs	%	abs	%
Damage to internal organs was not detected	3	5,9	2	1,8	5	3,1
Sanitation and drainage of the abdominal cavity	5	9,8	5	4,6	10	6,3
Electrocoagulation of a bleeding vessel	17	33,3	13	11,9	30	18,8

Sewing up the gap I st. according to Moore parenchymal organ	2	3,9	16	14,7	18	11,3
Suturing of deserialized sections of the intestine, ruptures of the mesentery and b. omentum	3	5,9	5	4,6	8	5,0
Sewing up the gap \geq II st. according to Moore parenchymal organ	-	-	28	25,7	28	17,5
Resection and removal of the organ	-	-	37	33,9	37	23,1
Suturing the wall of a hollow organ, the diaphragm	2	3,9	3	2,8	5	3,1
Conversion	19	37,3				
- Splenectomy	14	73,7				
- Suturing the wall of a hollow organ	3	15,8				
- Suturing of liver rupture \geq II st. by Moore	2	10,5				



Fig. 2: Laparoscopic electrocoagulation of a rupture of the VII segment of the liver.

The frequency of situations when injuries are detected during the primary operation, which, by their nature and severity, can potentially be eliminated laparoscopically without any special technical difficulties (44.4%), was even higher in the main group, where 51 patients were selected with a volume of free fluid in the abdominal cavity, according to ultrasound, no more than 500 ml, and amounted to 58.8% (30 cases) (Table 2). In this group of patients, the conversion rate was 37.3% (19 patients), the reason for which was the need to perform splenectomy in 14 cases, suturing the wall of a hollow

organ in 3 cases, and liver rupture \geq II stage. according to Moore - in 2.

We are confident that as skills improve and clinical experience is gained in performing emergency laparoscopic interventions for injuries of hollow and parenchymal abdominal organs, the list of conditions requiring conversion will steadily decrease. Thus, we already have a single experience of successful laparoscopic suturing of a ruptured diaphragm (Fig. 3) and small intestine (Fig. 4).



Fig. 3: Laparoscopic suturing of a ruptured diaphragm.

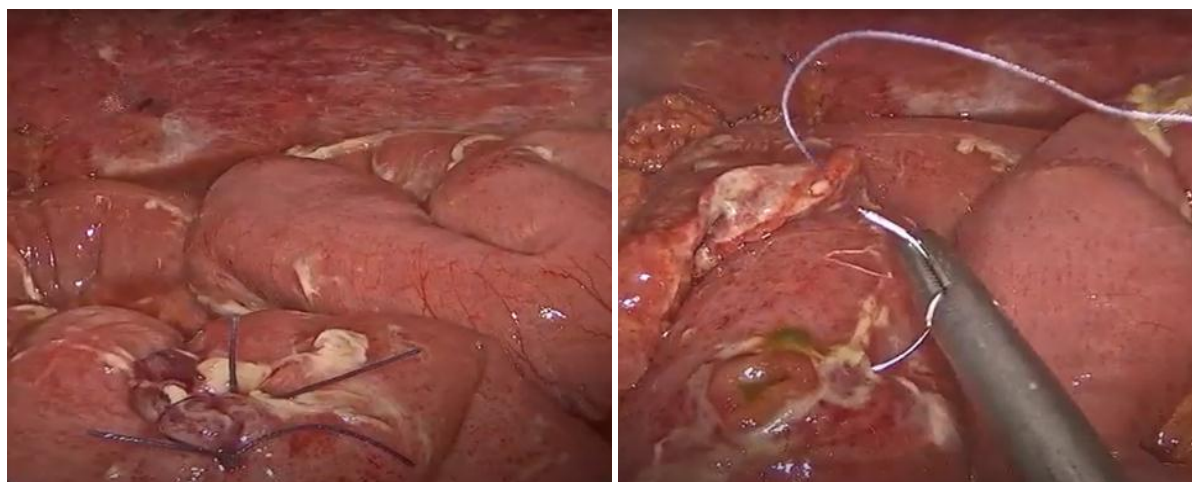


Fig. 4: Laparoscopic suturing of the small intestine.

In our opinion, one of the important advantages of using laparoscopy in patients with TD is the possibility of excluding cases of unnecessary laparotomy. In our observations in the group of primary wide laparotomy (n=109), in 2 (1.8%) cases intraoperatively, no damage to the abdominal organs was detected (Table 2), which required surgical procedures, which we regarded as a “vain laparotomy” (Table 3).

We do not use this definition in relation to diagnostic laparoscopy, since after 3 (5.9%) cases of exploratory endovideosurgery in patients with BAT, we did not note the development of postoperative specific complications associated with this surgical procedure in any case. Those. the use of laparoscopy in these cases made it possible to reliably exclude intra-abdominal damage without any negative consequences for patients.

Table 3: Main results of surgical treatment of BAT in patients with stable hemodynamics.

Index	Laparoscopy, n=32	Laparoscopy+ conversion, n=19	Control group, n=109	R
	1	2	3	
In vain laparotomy, abs. (%)	-	-	2 (1,8)	
Operation duration, min, $M \pm \sigma$	57,0 \pm 40,8	108,1 \pm 28,6	103,0 \pm 48,7	<0,001 ¹⁻² <0,001 ¹⁻³ =0,657 ²⁻³
Total blood loss, ml, $M \pm \sigma$	837 \pm 681,3	902,4 \pm 658,5	1141,7 \pm 676,1	<0,01 ¹⁻² <0,001 ¹⁻³ >0,05 ²⁻³
Conducted blood transfusion, the number of patients, abs. (%)	3 (9,4)	7 (36,8)	51 (46,8)	0,017 ¹⁻² <0,001 ¹⁻³ 0,422 ²⁻³
Length of stay in the ICU	1,8 \pm 1,0	2,9 \pm 1,1	2,8 \pm 1,1	<0,001 ¹⁻² <0,001 ¹⁻³ =0,755 ²⁻³
Terms of inpatient treatment, days, $M \pm \sigma$	5,3 \pm 2,9	8,3 \pm 6,5	8,7 \pm 3,4	0,0013 ¹⁻² <0,05 ¹⁻³ =0,759 ²⁻³
Complications, abs. (%)				
- Suppuration of the wound	1 (3,1)	2 (10,5)	13 (11,9)	=0,278 ¹⁻² =0,144 ¹⁻³ =0,861 ²⁻³
- Peritonitis	0	1	8	
- Pancreatitis	0	0	1	
- Pneumonia	1	1	2	
Died	1 (3,1)	0	4 (3,7)	

Note: p^{1-2} - reliability of the difference between the indicator of columns 1 and 2;

P^{1-3} - reliability of the difference between the indicator of columns 1 and 3;

P^{2-3} - reliability of the difference between the indicator of columns 2 and 3.

Taking into account the relative safety and sufficient efficiency of diagnostic laparoscopy, we have somewhat expanded the indications for its use in patients with BAT with stable hemodynamic parameters. So, if before 2009 the main condition for the use of video nonsurgical technique in BAT was the presence of free fluid in the

abdominal cavity on ultrasound no more than 400 ml,^[32] then after this period, laparoscopy was also used in patients with a large amount of hemoperitoneum, provided that hemodynamic parameters were stable.

This approach, although it increased the conversion rate to 37.3% (Table 2), nevertheless was not accompanied by iatrogenic intraoperative complications, and practically did not increase the average total intervention time (108.1 ± 28.6 min during laparoscopy with subsequent conversion versus 103.0 ± 48.7 min in the primary wide laparotomy group, $p=0.657$) (Table 3). However, in cases where it was possible to perform all diagnostic and treatment manipulations laparoscopically without resorting to conversion, the average duration of the intervention was 57.0 ± 40.8 min ($p<0.001$ for the conversion and laparotomy groups).

The desire of some of our laparoscopist surgeons to expand indications for the use of laparoscopy even in patients with a free fluid volume in the abdominal cavity of more than 500 ml, especially in patients with late admission (more than a day from the moment of injury), provided that they maintain stable hemodynamic parameters, reflected in the indicator "total blood loss" - in the group of laparoscopic interventions without conversion ($n=32$), the average volume of blood in the abdominal cavity was 837 ± 681.3 ml, which significantly exceeds the limit of 500 ml set by us (Table 3).

However, at the current stage and the level of proficiency in the laparoscopic technique of most of our surgeons, we consider it appropriate to limit the indications for the use of laparoscopy in patients with BAT to no more than 500 ml of free fluid in the abdominal cavity. Another confirmation of the expediency of such a limitation of indications for laparoscopy is, in our opinion, the average volume of hemoperitoneum detected in patients who had to resort to the conversion of laparoscopic intervention, which amounted to 902.4 ± 658.5 ml, which is approximately corresponded to the same indicator in the control group. - 1141.7 ± 676.1 ml ($p>0.05$).

Moreover, compliance with the proposed ultrasound criterion "free fluid volume is more or less than 500 ml" when selecting patients for laparoscopy and primary laparotomy made it possible to minimize the frequency of unnecessary laparotomy (2 (1.8%) cases per 109 laparotomies), not only due to the widespread use of diagnostic laparoscopy but at the expense of the predictive effectiveness of the chosen ultrasound criterion. The diagnostic efficiency of our scale for calculating the volume of free fluid in the abdominal cavity using ultrasound,^[18] which made it possible to predict the presence of milder or more severe intra-abdominal damage in patients with BAT before surgery, was indirectly confirmed by the number of situations that required blood transfusion. Thus, when the volume of free fluid in the abdominal cavity was up to 500 ml, we

predicted easier damage to the internal organs and resorted to primary laparoscopy.

In this group of patients ($n=51$), the total frequency of blood transfusion was 10 (19.6%) cases (3 cases in the "laparoscopy" subgroup and 7 cases in the "laparoscopy + conversion" subgroup), while in the control group of patients who underwent primary laparotomy ($n=109$), red blood cell transfusion was performed in 51 (46.8) patients ($p<0.001$) (Table 3).

With initial comparable indicators of hemodynamics ($p=0.0029$), the overall severity of injury on the RTS scale ($p=0.2301$) and the frequency of associated injuries in other anatomical regions ($p=0.850$) (Table 1), minimally invasive and low-traumatic laparoscopic interventions, together with a lesser severity of intraoperatively detected intra-abdominal injuries in the main group of patients, contributed to a significant reduction in the duration of stay in the DRiTh (Department of Resuscitation and intensive Therapy) from 2.8 ± 1.1 to 1.8 ± 1.0 days ($p<0.001$), inpatient treatment from 8, 7 ± 3.4 to 5.3 ± 2.9 days ($p<0.05$), a noticeable decrease in the frequency of postoperative complications from 11.9 to 3.1% ($p=0.144$) (Table 3).

None of the postoperative complications was associated with an intra-abdominal injury or pathology that was not diagnosed during the operation.

For a long time, the historically established tactic for managing patients with BAT, in whom ultrasound or CT revealed the presence of hemoperitoneum, was an emergency laparotomy and a thorough revision of the abdominal cavity and retroperitoneal space for damage. Late diagnosis of intra-abdominal complications is accompanied by the development of peritonitis and sepsis, the lethality of which increases to 30.8%.^[19] With the accumulation of more and more data on the relatively low incidence of serious intra-abdominal injuries in patients with PTG, as well as with the increase in the therapeutic possibilities of laparoscopic techniques for these injuries,^[20,21,22] the indications for primary emergency laparotomy gradually began to narrow against the background of increasing expansion indications for laparoscopy. Moreover, in recent years, the so-called non-surgical treatment of injuries has become more widespread, which is proposed to be used in selected patients with no or a small amount of free fluid in the abdominal cavity, provided there are no clinical signs of peritonitis and severe abdominal pain.^[23,24] When choosing a specific strategy for the treatment of patients with BAT, they are now increasingly guided by the results of computed tomography performed according to MSCT protocols of the entire abdomen or the entire trunk, which significantly increase the information content of the diagnosis.^[25] However, due to the limited availability of MSCT equipment, the complexity of its use in seriously ill patients, the presence of other negative aspects of the

study associated with a high dose of radiation and the side effects of a large dose of iodine-containing contrast agent, this method of radiation diagnostics has not yet become a routine method for examining patients with suspected trauma. belly.

Therefore, in our practice, when choosing the tactics of surgical treatment of patients with BAT with stable hemodynamics, we mainly focus on the volume of free fluid measured by ultrasound according to our proposed method.^[18] Taking into account the statistically significant prognostic value ($RR=4.862$) of the criterion “presence of free fluid >500 ml”, in which serious intra-abdominal injuries are diagnosed with a high degree of probability.^[18] we chose this criterion as the main one when choosing the tactics of surgical treatment of patients with BAT with stable hemodynamic parameters.

In view of the fact that against the background of publications showing the expediency of using diagnostic laparoscopy in patients with penetrating abdominal injuries, especially the upper abdomen, there are still doubts among surgeons about the effectiveness of the method for BAT.^[26] we hope that the results of our study on the evaluation of therapeutic -diagnostic capabilities of laparoscopy for blunt abdominal injuries will bring their small contribution to the general treasury of knowledge in this area.

Moreover, in recent years, the results of large clinical trials demonstrating the effectiveness of laparoscopy in the diagnosis and treatment have been increasingly published. In particular, V.Justin et al.^[27] conducted a thorough review of the literature and showed the important role of diagnostic laparoscopy in this category of patients in detecting damage to the mesentery or walls of hollow organs. M.Mathonnet et al.^[28] in their 16-year retrospective study, having studied the diagnostic value of laparoscopy in detecting intestinal ruptures in 250 patients with PTG, showed that the sensitivity and specificity of the method are almost 100%, while the similar indicators of MSCT are 83.3 and 22.2 %, respectively.

CONCLUSION

In 62.8% of patients with BAT, injuries are detected intraoperatively, which can potentially be eliminated laparoscopically without any special technical difficulties using routinely used endosurgical instruments, which justifies the expediency of expanding the indications for laparoscopy in abdominal injuries. The average duration of laparoscopic procedures for BAT in patients with stable hemodynamics is 57.0 ± 40.8 minutes. Laparoscopy with subsequent conversion practically does not increase the average duration of the intervention compared to primary wide laparotomy (108.1 ± 28.6 versus 103.0 ± 48.7 min, $p=0.657$).

The selection of patients for laparoscopic interventions using the proposed algorithm, the minimally invasive

and low-traumatic nature of this surgical tool contribute to a significant reduction in the duration of stay in the DRiTh from 2.8 ± 1.1 to 1.8 ± 1.0 days ($p<0.001$), inpatient treatment from 8.7 ± 3.4 to 5.3 ± 2.9 days ($p<0.05$), a noticeable decrease in the frequency of postoperative complications from 11.9 to 3.1% ($p=0.144$).

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