



## Improving the Diagnosis and Treatment of Thoracoabdominal Injuries

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ABSTRACT

A diagnostic and tactical algorithm has been developed to make a timely diagnosis of injuries and choose adequate therapeutic tactics. The important role of endovideosurgical methods in diagnostics and choosing treatment tactics of patients with posttraumatic thoracic and abdominal cavity injuries has been shown. The results of diagnostics and treatment of the patients with the thoracoabdominal injuries were analyzed using the diagnostic and treatment algorithm designed by the authors. The application of the treatment and diagnostic approaches developed by the authors improved the results of treatment of this severe category of patients.

**Keywords:**

traumatic thoracic and abdominal injuries, laparoscopy, thoracoscopy.

**Introduction:** Timely diagnosis and treatment of thoracoabdominal trauma victims is one of the most challenging surgical problems. The prevalence of chest and abdominal trauma, including thoracoabdominal trauma, is up to 40% of all injuries with modern technological advances. At the same time, this type of injury is the most difficult to diagnose and, sometimes due to the severity of injury, is characterised by ambiguous treatment outcomes[1,5].

In CIS countries, injury-related mortality ranks second in the overall mortality structure and is a major factor in its depopulation[6,7]. Thus, the number of lethal outcomes in the group of combined abdominal and thoracic injuries exceeds mortality in isolated injuries by 7-8 times.

Significant trauma in recent years due to the criminal situation, an increase in road traffic accidents, the number of victims of natural disasters, terrorist acts, mass

disturbances and military conflicts is the main cause of death of persons of most working age. Along with a sudden increase in the number of patients with thoracoabdominal wounds, there is still a high level of diagnostic and tactical errors in the treatment of this category of patients. They are caused by the severity of patient's condition and shock, masking symptoms of thoracic and abdominal cavity injuries, and narcotic or alcohol intoxication, often observed in these patients[6,12].

A feature of thoracoabdominal trauma is the severity of the condition due to most injuries to various organs, accompanied by high blood loss and shock in patients. The results of surgical treatment of patients with thoracoabdominal injuries are determined by a number of objective indicators. Among them, the most important are the volume of intraoperative blood loss, the number of postoperative complications, and their

structures [4,8,13,14]. This fact points to the need for minimal examination and urgent surgical intervention with revision of the thoracic and abdominal cavity organs from a rational access, as well as with the use of endovideosurgical technology and parallel antishock measures.

The choice of rational surgical tactics is still controversial, and the use of endoscopic methods of diagnosis and treatment in this category of patients is insufficiently covered [3,10,11,15]. Due to the lack of unified tactical guidelines for treatment and diagnostic tactics, optimal diagnostic and treatment methods are always chosen, which results in both delayed operative interventions and unwarranted expansion of the operation volume [2,9,16]. A large number of postoperative complications (up to 50%) and high mortality of 15.9-49.5% [4,5,6,10] necessitate summarizing the accumulated experience, tactical and technical additions in classification and treatment measures for thoracoabdominal trauma victims.

**Purpose of the study:** Improving the quality of medical care for victims of thoracoabdominal injuries at the hospital stage by developing and implementing a treatment and diagnostic algorithm, as well as introducing endovideosurgical methods of diagnosis and treatment into clinical practice.

**Material and research methods:** Over a period of 6 years, 190 patients with thoracoabdominal injuries were treated in the emergency surgery department of the Andijan branch of the Republican Scientific Center for Emergency Medical Care from 2017 to 2022. The case histories of 122 (64.86%) patients (in the control group treated from 2017 to 2020), with thoracoabdominal injuries, in which diagnostic and treatment stages were carried out according to the conventional scheme, were retrospectively analyzed. In the main group there were 65 (35.14%) patients with thoracoabdominal injuries, who were treated from 2021 to 2022, and in whom the diagnostic and treatment algorithm we developed was carried out using new technologies.

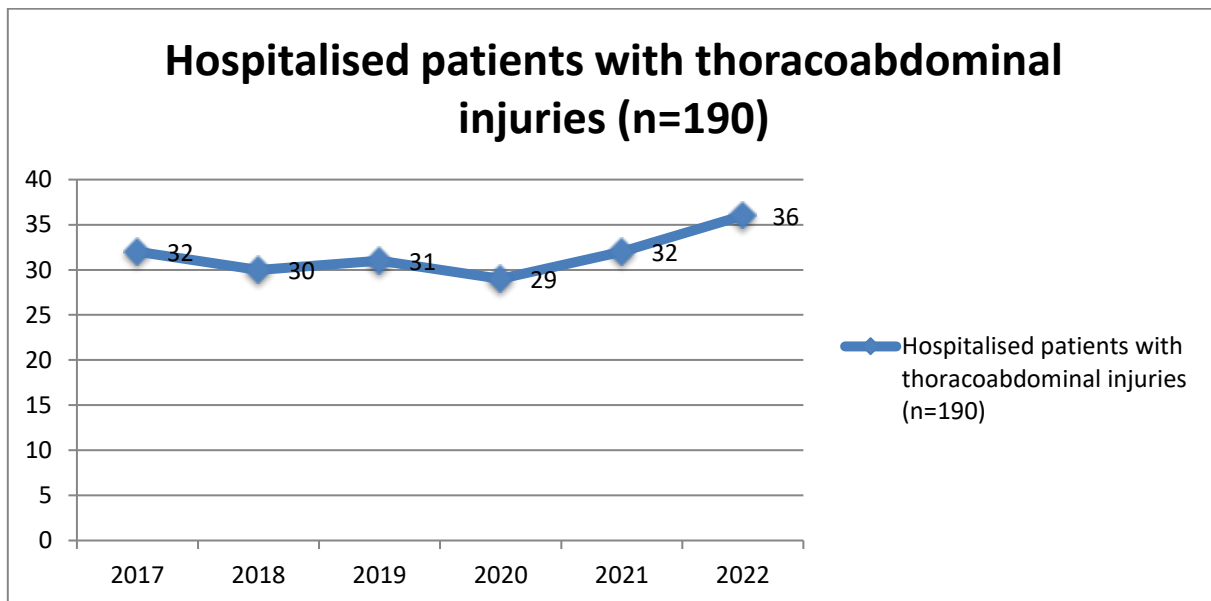


Fig.1. Distribution of hospitalised patients with thoracoabdominal injuries by year.

The age of the patients ranged from 19 to 88 years. The largest group of patients was aged between 19 and 30 years - 73 patients (38.4%).

There were 3.2 times more male than female patients, 76.3% versus 23.7% (Table 1).

Table 1

**Age and sex distribution of patients**

group	sex		Age of patients					total		
			19-30	31-40	41-50	51-60	61 и ст.			
Control group	M	N	38	20	18	11	9	96	122	64,2 %
		%	20	10,5	9,5	5,7	4,7			
	W	N	8	6	6	2	4	26		
		%	4,2	3,1	3,1	1,0	2,1	13,7		
Core group	M	N	19	13	8	5	4	49	68	35,8 %
		%	10	6,84	4,2	2,66	2,1	25,8		
	W	N	8	4	2	2	3	19		
		%	4,2	2,1	1,0	1,0	1,7	10		

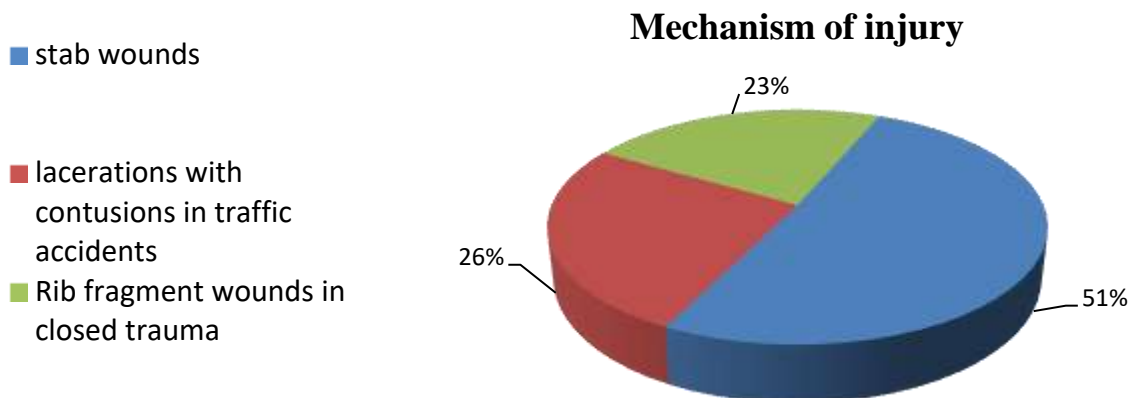
According to the time of arrival, 48 (25,26%) patients were delivered within the first hour of injury, 93 (48,94%) from 1 to 3 h, 16 (8,42%) from 3 to 6 h, 31 (16,3%) after 6 h, and 2 (1,05%) were undetected.

The nature and sequence of imaging studies were decided according to the clinical situation. The instrumental examinations were used both to confirm and

The nature of injuries to the chest and abdomen, as well as to diagnose other

complications of the trauma, concomitant diseases, and the degree of compensation for the functions of various organs and systems, were the objectives of the instrumental examination.

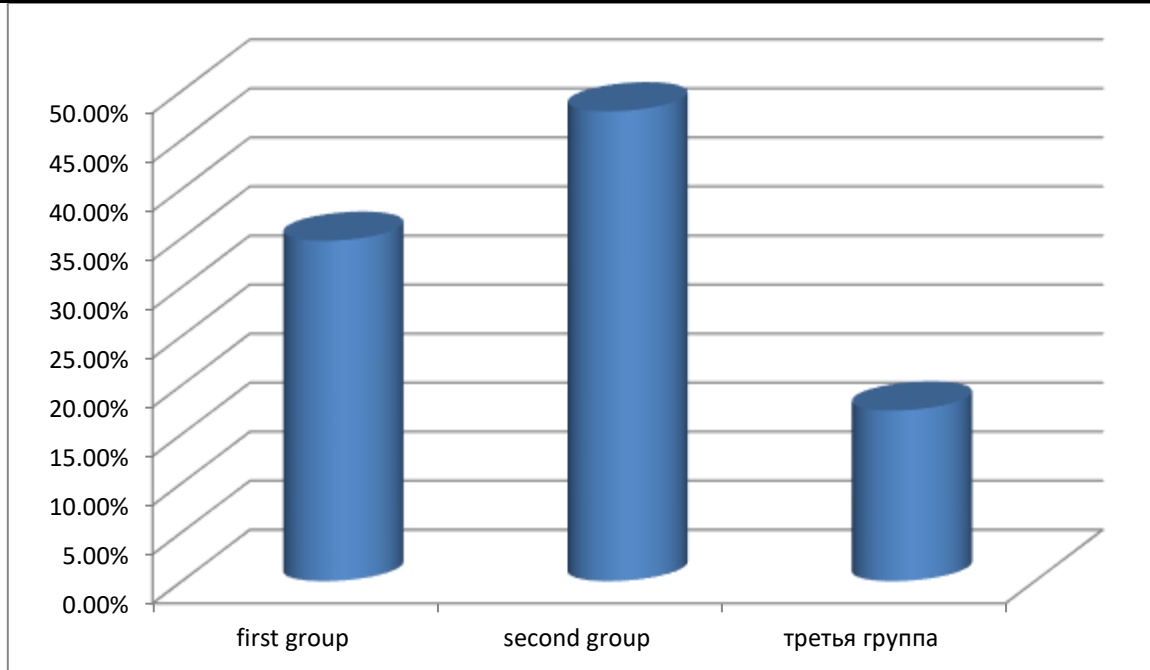
Stab wounds predominated in the mechanism of injury in 97 (51%) patients; lacerations with contusions in road traffic accidents in 49 (26%) patients, rib fragment wounds in closed trauma in 44 (23%) (Fig.2).



**Figure 2. Structural distribution of victims with thoracoabdominal wounds according to injury patterns.**

Depending on the predominance of one or another symptom, three groups of patients with different characteristics of injuries were clearly distinguished: 1) the first group - patients with predominant symptoms of thoracic injuries - 66 (34.7%); 2) the second

group - patients with predominant symptoms of abdominal injuries - 91 (47.9%); 3) the third group - patients with similar in complexity injuries of thoracic and abdominal cavities - 33 (17.4%) (Fig. 3).



**Fig.3. Characterization by symptomatology of patients with thoraco abdominal injuries**

A chest X-ray was used to diagnose the extent of the injury (except in extremely severe patients). X-rays were performed in the X-ray room of the emergency department or in the operating room using APELEM X-ray equipment.

To diagnose the dominant injury, ultrasound of abdominal, pleural and pericardial organs using DC-40 Mindray was performed in parallel. The results of clinical picture, radiography of the thorax and abdominal cavity organs, primary surgical treatment and revision of the wound channel, ultrasound investigation of the thorax and abdominal cavity organs made it possible to decide on surgical tactics and surgical access in 90% of cases.

Endoscopic studies included diagnostic laparoscopy, thoracoscopy, and fibroesophagogastroduodenoscopy (FEGDS). Laparoscopy allowed to confirm, based on direct and indirect signs, not only the presence of blood in the abdominal cavity, but also to determine the source of bleeding, thereby indicating the operations on the abdominal cavity organs and surgical access. Emergency thoracoscopy was one of the leading diagnostic

techniques and was performed in 12 (6, 3%) patients at admission and in 2 (1, 1%) in the postoperative period for diagnosis and treatment of complications.

Gastrointestinal tract injuries were detected and diagnosed by FEGDS in 13 (6.8%) patients. In general, FEGDS was performed in suspected gastroduodenal wounds and lacerations, both preoperatively and intraoperatively.

General blood and urine tests were performed in all patients on admission to the hospital. The remaining laboratory tests (electrolytes, PTI, coagulogram, clotting time, blood enzymes, control of general blood and urine) were performed individually during the hospitalization of the patient.

Injuries to internal organs detected in the victims were also of a different nature. As can be seen from Table 2, the most frequent injuries were observed in the following organs: lungs, liver, spleen, omentum, stomach and major vessels. In our patients, lung and stomach, liver, small intestine and large intestine injuries were more often combined, with multiple traumas.

**Table 2  
Nature of damage to internal organs**

Nature of damage	Quantities	%
No damage	17	8,9
Injury to the arteries of the chest wall	27	14,2
Pericardial/cardiac injury	3	1,6
Lung injury/trauma	42	22,1
Wounds/injury to the diaphragm	13	6,8
Wounds/injuries to the liver (ruptured capsule, superficial wound up to 3 cm long and 1.5 cm deep, massive injury - lobe tear)	31	16,3
Injury/trauma to the spleen (rupture of the capsule, damage to the pole, damage to the gate area)	23	12,1
Gastric trauma/injury (inertial rupture of the visceral peritoneum of the stomach)	16	8,4
Injury/trauma to small intestine (non-tensioned mesenteric haematoma, rupture of visceral peritoneum, detachment of intestine from mesentery, direct wound)	6	3,2
Colon injury/trauma (mesenteric haematoma, serous membrane tear, mesenteric tear, direct wound)	11	5,8
Trauma to the gallbladder	2	1,1

On admission, 59 (31%) victims were in first-degree shock, 21 (11%) were in second-degree shock, and 31 (16.3%) were in third-degree shock.

The severity of the combined injury was assessed using the Injury Severity Score (ISS), with a score of  $17.8 \pm 4.9$  in the control group and  $18.2 \pm 4.2$  in the main group.

**Study results.** Clinical experience has shown that to select the most rational treatment with consistent application of surgical and conservative measures, a classification and a certain therapeutic-diagnostic algorithm of actions, which serve as a guide for the actions of practitioners, are necessary.

In the course of our studies the treatment-and-diagnostic algorithm of actions which serves as a guide for practical doctors is developed, and new localizations of injuries and complications accompanying this trauma are proposed (certificate DGU<sup>1</sup> 18223 of

24.08.2022, the Intellectual Property Agency under the Uzbek Ministry of Justice).

According to the algorithm, victims with thoracoabdominal injuries in all cases undergo revision of the wound canal followed by primary surgical wound care (PCC). It should be noted that revision of the wound canal was performed in the emergency room in order to determine the penetrating nature of the wound into the cavity. In case of the penetrating character PCC was carried out in the operating room. It was carried out simultaneously with resuscitation measures, during anesthesia management. To diagnose the dominant injury of the abdominal and pleural cavity organs, ultrasound, chest and abdominal radiography, and endoscopic methods of examination were used, which allowed determining the surgical and surgical access in 90% of cases.

The operative tactics depended on the nature and severity of the injury and the general condition of the victims. The volume of surgical interventions and accesses in victims with

thoracoabdominal injuries and the volume of combinations of accesses: (Table 3)  
injuries were performed using the following

**Table 3**  
**Nature of surgical interventions and accesses**

№	Type of access and extent of surgical intervention	Control group		Core group	
		Number of casualties and обследованных	Number of patients in %	Number of casualties and обследованных	Number of patients in %
1	Thoracotomy followed by laparotomy	9	4,7	4	2,1
2	Thoracophrenotomy	2	1,1	3	1,6
3	Laparotomy and pleural drainage without thoracotomy	18	9,5	7	3,7
4	The first stage is a laparotomy, the second a thoracotomy	9	4,7	2	1,1
5	Simultaneous thoracotomy and laparotomy	2	1,1	1	0,5
6	Thoracophrenolaparotomy	1	0,5		
7	Laparotomy	38	20	16	8,4
8	Thoracotomy	10	5,2	3	1,6
9	Laparoscopy	1	0,5	10	5,2
10	Thoracoscopy	0	0	8	4,2
11	Pleural drainage without thoracotomy	18	9,5	12	6,3
12	PCU	13	6,8	2	1,1
Total		122	64,2	68	35,8

Various operative interventions were performed in all patients. It follows from data in the table, firstly thoracotomy followed by laparotomy - 13 (6.8%); thoracotomy and frenotomy - 5 (2.6%) respectively; laparotomy and drainage of pleural cavity without thoracotomy - 25 (13.2%), firstly laparotomy, secondly thoracotomy - 11 (5.8%), thoracophrenolaparotomy-1 (0.5 %). Simultaneous thoracotomy and laparotomy were performed in 3 (1.6%) patients. At the same time, the operation was completed by minimally invasive access without thoracophrenotomy or laparotomy in 19 (10%)

patients. At the same time, it was possible to suture defects of various organs as well as of the diaphragm. Before endovideosurgical treatment methods were introduced the thoracic stage of the operation in 8 ( 4.2%) patients was limited to drainage of the pleural cavity. Thoracotomy in this category of patients was indicated in case of suspected injury to the heart or large vessels, or in case of continuous bleeding.

It should be noted that diagnostic thoracoscopies and laparoscopies, regardless of the presence or absence of internal

abdominal injuries, did not produce false negatives in all cases.

During diagnostic thoracoscopy ( 6(3,2%) of all operations, 8(4,2%) of all thorascopies) no thoracic organ pathology was detected in thoracoabdominal trauma, which was confirmed during the follow-up of patients and a true negative result was obtained.

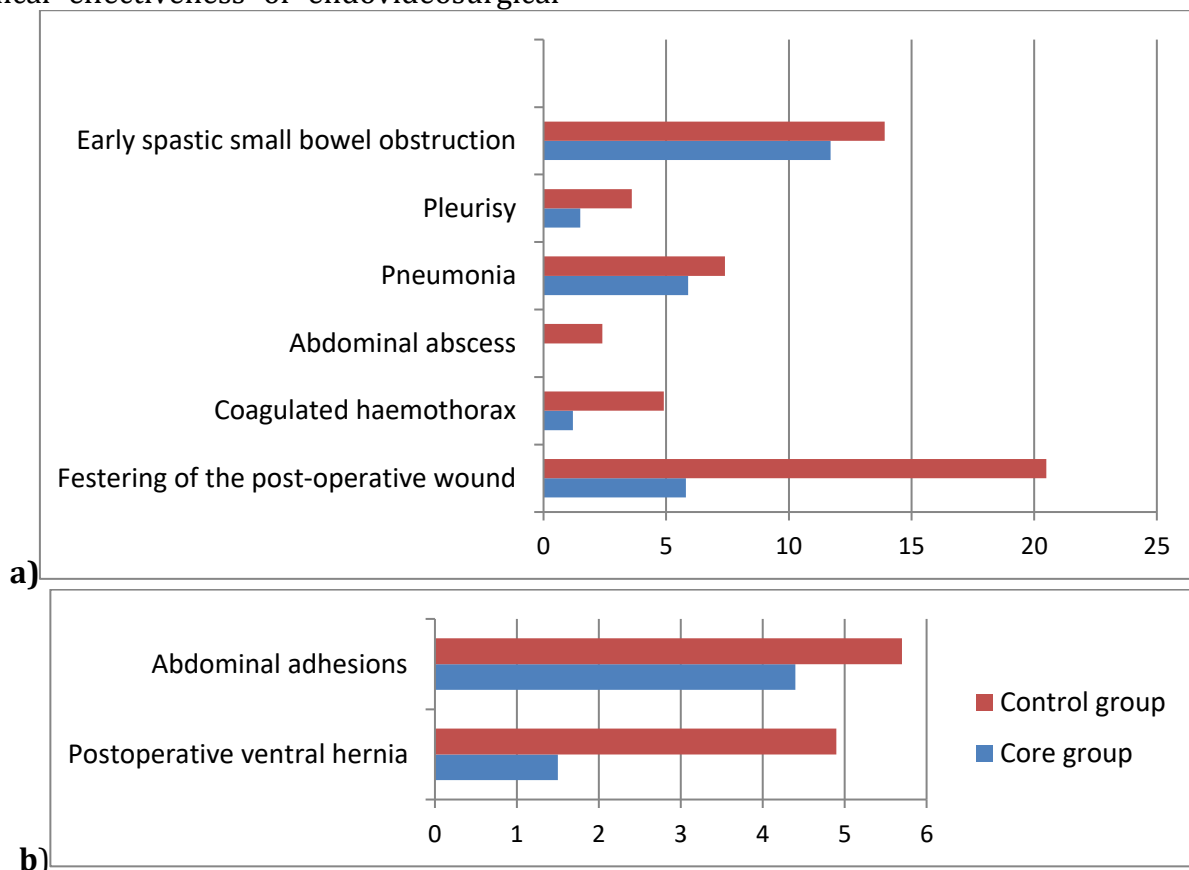
During 2 (1.1%) diagnostic thorascopies, an indication for conversion of surgical access - massive intrapleural haemorrhage in stab wound of the chest and lung and in multiple lung injury - was identified. The described causes of massive bleeding were revealed only during thoracotomy and did not allow visualizing these injuries during endovideosurgical diagnostic operation.

The analysis of the results of our studies of endovideosurgical techniques in the diagnosis and treatment of patients with thoracoabdominal trauma (intraoperative and postoperative complications, mortality rate) and the results of operations by thoracotomy or laparotomy allowed us to reveal the degree of clinical effectiveness of endovideosurgical

techniques. Thus, 18 (9,5%) out of 19 endovideosurgical diagnostic and treatment operations were considered to be efficient, 26,5% of the number of operations in the group II). Complications were registered in 38 cases (31,2% of the total number of operations, 74,6% of the number of operations in the control group I) and in 2 cases (2,9%) and 9 cases (7,4%) of lethal outcome respectively in the group of operations performed by the open surgical access.) The clinical efficacy of endovideosurgical diagnostic and therapeutic operations is on average 1.1 times higher than that of open surgery.

Thus, the data obtained testify to a high degree of efficacy of endovideosurgical diagnostics in thoracoabdominal trauma. The obtained results analysis has permitted to determine that endovideosurgical diagnostic methods at thoracoabdominal trauma provide on the average 1,09 times higher sensitivity, 1,68 times higher specificity, and 1,16 times higher accuracy.

The frequency and structure of postoperative complications in comparison between the groups is shown in Figure 4.



**Fig.4. Complications of surgical treatment of victims with thoracoabdominal trauma. a-early postoperative complications; b-remote postoperative complications.**

A good clinical effect was achieved by treating patients in the main group of patients using endovideosurgical interventions. Thus, in the postoperative period, the pain syndrome was less pronounced, there was no need for long-term observation and treatment in the intensive care and reanimation unit. Besides, we revealed 32 % less postoperative complications (including early by 26,1 % and late by 5,9 %), good cosmetic effect, reduced an

average stay in the hospital by  $4,3 \pm 0,34$  bed-days and decreased postoperative mortality by 11,7 %. There was no cosmetic defect on the chest and abdominal wall.

The mortality rate was one of the main indicators of the treatment outcome, which was 25.6%. 7 (6.4%) people died of shock, 13- (10.6%) of multiple organ failure, 5 (4.1%) - of VTE (Table 8.)

**Table 4**  
**Causes of mortality in thoracoabdominal injuries**

No	Causes of death	Main group (n=)	%	Control group (n=)	%
1	Traumatic, haemorrhagic shock	1	1,5	6	4,9
2	Multiple organ failure	5	7,3	8	6,5
3	TELA	2	2,9	3	2,5
Total		8	11,7	17	13,9

The success of any surgical treatment for thoracoabdominal wounds is determined by a number of objective circumstances and their indicators.

The most important of these are the amount of blood loss, the number and structure of postoperative complications, the mortality rate, and the duration of hospital treatment, reflecting the economic aspect of the problem. At the same time, to estimate the results reliably it is necessary to take into account the fact that the main and the control groups of the patients should be randomized in comparison.

Thus, the therapeutic and diagnostic algorithm and surgical tactics developed by us can be used in the diagnosis and treatment of thoracoabdominal trauma victims.

### Conclusions.

1. The classification of thoracoabdominal injuries we have applied justifies the timely use of minimally invasive (laparoscopic and thoracoscopic) therapeutic and diagnostic manipulations.

2. The application of the developed therapeutic and diagnostic algorithm can reduce the number of unwarranted laparotomies (5.2%) or the resulting surgical trauma.
3. The clinical effectiveness of endovideosurgery in thoracoabdominal trauma is on average 1.1 times greater than the effectiveness of diagnostic and therapeutic surgical techniques using open surgical access.

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