

MEDICAL SCIENCES

ENDOVIDEOSURGICAL TECHNOLOGIES IN DIAGNOSIS AND SURGICAL TREATMENT OF COMBAT ABDOMINAL INJURY

Khomenko I.,

PhD, MD, professor, Ukrainian Military-Medical Academy, Kyiv, Ukraine

Yenin R.,

PhD, MD, Odessa National Medical University, Odessa, Ukraine

Shapovalov V.,

PhD, MD, Odessa National Medical University, Odessa, Ukraine

Gerasimenko O.,

PhD, MD, Odessa National Medical University, Odessa, Ukraine

Karadyaur D.

M.D. Assistant professor, Odessa National Medical University, Odessa, Ukraine

Abstract

The aim of the study was to improve the results of treatment of the wounded with combat abdominal trauma at the expense of the improved system of diagnosis using pulse oximetry, FAST-protocol and surgical treatment applying endovideosurgical technologies.

Keywords: Evidoesurgery, combat abdominal trauma, pulse oximetry, FAST-protocol, surgical treatment applying endovideosurgical technologies.

Urgency. The problem of a high level of complications in the treatment of combat abdominal traumas remains urgent for military surgery. One of the most important tasks in the study of the combat abdominal trauma is to improve the methods of diagnosis and surgical treatment, which would reduce complications and promote rapid return of the wounded to resume their duties. These issues have become especially important as a result of the anti-terrorist operation in the eastern region of Ukraine.

A combat abdominal trauma takes a high proportion in the structure of modern combat traumas. The amount of abdominal injuries in peacetime is 4–5%, while in modern military conflicts it makes 4–10%. The mortality rate in modern armed conflicts with isolated and combined abdominal injuries does not decrease and makes on the average 4–14%, which is comparable to the structure of sanitary losses in the area of the anti-terrorist operation in the east of Ukraine [1,3].

The specificity of gunshot wounds to the abdomen is in the peculiarities of wound ballistics and the course of gunshot peritonitis, which causes progressive multi-organ affection and significant development of complications [2,4,9].

Traditional methods of assessing the severity of the condition, anatomical injuries and surgical tactics using laparotomy in the wounded with the combat abdominal trauma do not improve treatment outcomes. Therefore, it is of importance to find new methods of diagnosis and surgical treatment of the wounded with the combat trauma to the abdomen. A promising direction in improving the results of diagnosis and treatment of the combat abdominal trauma is the application of noninvasive technologies [5,6,7,8,10].

Materials and methods. A comparative analysis of the treatment results of 157 wounded persons from the area of the anti-terrorist operation in the eastern Ukraine is presented. They were admitted to hospital in

the period from 2014 to 2018 at the 2nd-4th levels of medical aid and had isolated and combined combat traumas (closed combat trauma, nonpenetrating and penetrating injuries to the abdomen, trunk, and limbs). All injured were males, the age of the wounded ranged from 18 to 56 years (mean 34.2 ± 1.7 years).

Depending on the method of the treatment used, the wounded were divided into two groups: the first group (a comparison group) consisted of 81 persons with the combat trauma to the abdomen who were treated in the period of 2014-2015 according to the traditional tactics using laparocentesis and laparotomy.

The second group (a main group) consisted of 76 wounded who received a comprehensive method of diagnosis that included pulse oximetry, FAST protocol, laparocentesis, and surgical treatment was performed using endovideosurgery in the period of 2016-2018.

The study groups were comparable and were compared by the age, duration of the period between injury and hospitalization, the nature of the injury, the number and location of wounds ($p > 0.05$).

The terms of transportation from the moment of injury to the stage of qualified aid varied depending on the operational and tactical situation from 24 minutes to 1.5 hours and made on the average 48.4 ± 9.2 minutes in the main and comparative groups. Delayed evacuation from the front line was due to intense enemy shelling in all cases, which did not allow for a safe evacuation.

The nature of the combat injuries to the abdomen was dominated by cases of gunshot wounds - 136 (86.6%). At the same time, penetrating abdominal injuries were more often detected - 80 (50.9%) cases, including 37 (48.7%) wounded of the main group and 43 (53.1%) patients of the comparison group ($\chi^2 = 0.30$; $p > 0.05$) Non-penetrating abdominal injuries occurred in 56 (35.7%) wounded. Closed combat abdominal trauma was observed in 21 (13.4%) wounded (Table 1).

In the wounded of both groups, blunt abdominal injuries were most frequently observed - 111 (70.7%), including 56 (69.1%) cases in the comparison group and 55 (72.4%) - in the main one ($\chi^2 = 0.20$; $p > 0.05$ be-

tween groups). Through - and - through wounds occurred in 16 (19.8%) and 9 (11.8%) wounded, respectively, by clinical groups ($\chi^2 = 1.83$; $p > 0.05$). The size of the entrance and exit wounds ranged from 0.3 to 4.6 cm

Table 1

Characteristics of gunshot wounds in the study groups, abs. (%)

Character of the wound	Comparison group n=81	Main group n=76	Total n=157
Penetrating wounds to the abdomen	43 (53.1 %)	37 (48.7 %)	80 (50.9 %)
Nonpenetrating wounds to the abdomen	29 (35.8 %)	27 (35.5 %)	56 (35.7 %)
Blast injury, closed injury to the abdomen	9 (11.1 %)	12 (15.8 %)	21 (13.4 %)

Note. The differences between the indices of the comparison and the main groups are not statistically significant ($p > 0.05$).

According to the type of injury in the patients of both study groups shrapnel wounds dominated - 55 (67.9%) cases in the comparison group and 51 (67.1%) in the main one. The diameter of the fragments varied from 0.5 to 4 cm (on an average - 2.3 ± 0.8 cm) with irregular cut shapes. Bullet wounds were observed in 30 (19.1%) cases, and blast injuries - in 21 (13.4%) cases. The type of injuries described reflects the nature of the hostility of warfare and the weapons used.

Among 157 injured included in the study, isolated abdominal injuries occurred in 50 (31.8%) cases, and

combined injuries to different anatomical and functional areas were found in 86 (54.8%). Combined abdominal injuries were observed in 48 (63.2%) wounded of 76 military servicemen of the main group, isolated (including closed abdominal injuries) - in 28 (36.8%) cases. In the comparison group, isolated combat abdominal trauma was observed in 43 (53.1%) cases, of which 9 (11.1%) were blast injuries, 38 (46.9%) servicemen had combined injuries of different anatomical and functional areas. It should be noted that combined injuries were significantly more common in the main group - 63.2% vs. 46.9% ($\chi^2 = 4.18$; $p < 0.05$), and isolated gunshot wounds to the abdomen - in the comparison group - made 42.0% vs. 21.0% ($\chi^2 = 7.91$; $p < 0.01$) (Fig. 1).

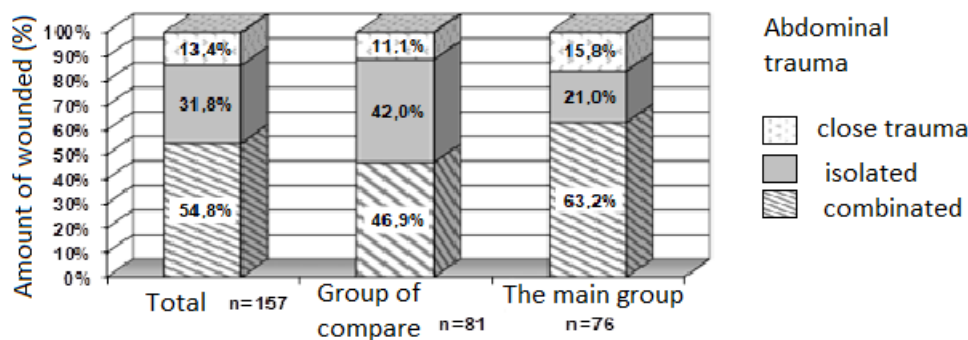


Fig. 1. The structure of the combat abdominal injuries.

The most common combination of gunshot wounds to the abdomen with injuries to other anatomical and functional areas in the wounded of both groups were limbs - 69 (43.9%) cases, of which 38 (50.0%) was in the wounded of the main group and 31 (38.3%)

cases - in the comparison group. In every fifth case, there were chest injuries - 15 (19.7%) and 17 (21.0%) cases in the main and comparison groups, respectively; pelvic injuries were in 12 (15.8%) and 7 (8.6%) injured (Fig. 2).

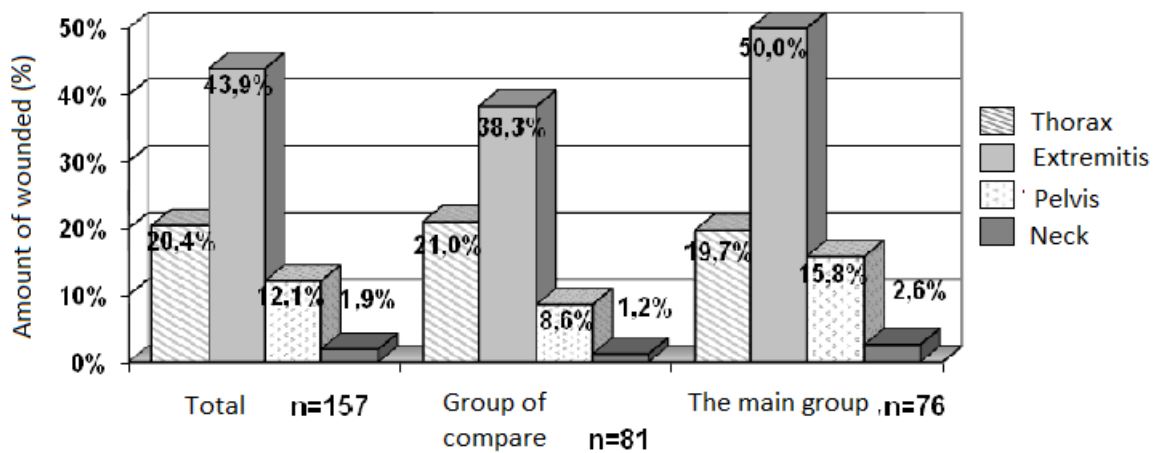


Fig. 2. Frequency of combinations of gunshot abdominal wounds with injuries to other anatomical and functional areas.

Comprehensive examination of the wounded at the hospital stage using instrumental and laboratory methods was performed in the first minutes after admission. All the wounded underwent drug therapy aimed at compensating for the identified disturbances of the general condition caused by the injury. Antibacterial therapy was used in all wounded.

The initial severity assessment in the study groups was performed according to the ABCDE algorithm. In the comparison group, the ABCDE algorithm was supplemented by the Algover index of severity assessment and traumatic shock characteristics.

Assessment of the severity condition of the wounded in the main group was determined using pulse oximetry with a certain perfusion index. The value of the perfusion index, which in the normal range corresponds to 4–5% allows to determine the shock pattern.

The study sample consisted of the data of 24 wounded with the combat trauma to the abdomen that

required surgery. All wounded were assessed for the severity of injuries by the PTS scale (Politrauma score, Hannover), as well as determined the perfusion index, SpO₂ and heart rate using pulse oximeters "CX 130" with a range of the perfusion index from 0.3 to 10% (normal range - 4–5%). The above-mentioned examinations were made on admission, on the 1st–3rd day from the moment of the injury, which corresponded to the terms of being at the II level of medical aid.

According to the correlation analysis, a probable association between the anatomical and functional assessment of the severity of injuries by the PTS scale and the value of the perfusion index in the wounded has been established at the time of hospitalization (Spearman correlation coefficient $r = -0.62$, $p = 0.001$) (Fig. 1) and in the first 1–3 days after injury ($r = -0.74$, $p < 0.001$) (Table 2).

Table 2

Comparative characteristics of the prognostic value of determining the probability of death between the PTS scale (1997) and the perfusion index

Degree of severity by the PTS scale Hannover	Total points by the PTS scale (1997)	Indices of perfusion index, %	Mortality, %
Mild	<11	>4,0	<10
Moderate-severe, severe, without life threatening	12–30	2,0–4,0	<25
Severe, life threatening	31–49	0,6–2	<50
Very severe with small chance for survival	≥49	<0.6	>75

Thus, based on the study, the priority of anti-shock and the choice of surgical measures, the order of evacuation was determined based on a certain value of the perfusion index under the following condition:

PI > 4.0 - mild injuries (mortality <10), surgery is performed in the full scope and simultaneously;

PI 2.0–4.0 - moderate and severe injuries, but not life-threatening in the acute period of traumatic illness (mortality <25), full surgical interventions or urgent surgical interventions are performed in the reduced scope after anti-shock measures and complete stabilization of hemodynamic indices;

PI 0.6–2.0 - severe injuries, life-threatening in the acute period of traumatic illness (mortality <50), resuscitation surgery is performed in the reduced scope;

PI <0.6 - extremely severe injuries, with a small chance for survival (mortality > 75), resuscitation surgery is performed in the minimum scope by the damage control tactics.

Therefore, the value of the perfusion index was considered the optimal criterion for determining differentiated surgical tactics, which correlated with the severity of the patient's condition and its informative value is not inferior to the PTS scale.

The FAST protocol was performed on 56 wounded (35.7%), laparocentesis - 83 (52.9%), video-laparoscopy - 76 (48.4%) in the total study array (n = 157).

Results and discussion. While comparing the diagnostic significance of the FAST protocol and laparocentesis in the detection of free fluid in the abdominal cavity of the wounded, their high informative value in penetrating wounds and closed combat trauma to the abdomen should be noted. At the same time, in non-penetrating gunshot wounds, the informative value of laparocentesis is significantly lower - 88.9% (16 of 18 cases) of positive results according to the FAST-protocol versus 44.7% (17 of 38 cases) of laparocentesis data at $p = 0.003$ according to Fisher's exact criterion.

A surgical approach - laparotomy was used for surgical treatment in the comparison group (n = 81). The patients with mild and moderately severe wounds were performed operations in the "full" scope. In case of a severe combat injury with a severe form of shock, the operations were performed in the "reduced" scope according to the damage control tactics.

During the first hour from the moment of admission, 43 (53.1%) operations were started; all patients had wounds of moderate and severe degree of severity. All the wounded underwent a series of medical and diagnostic measures under the conditions of the anti-shock ward of the admission department or operating room. Within 2 hours of admission, surgery was initiated in 38 (46.9%) patients with mild and moderate degree of severity.

43 (53.1%) persons were observed to have penetrating gunshot wounds of 81 wounded of the comparison group with combat abdominal traumas, nonpenetrating wounds were found in 29 (35.8%) wounded, and 9 (11.1%) persons had blast traumas, closed abdominal trauma due to blowing up of the armored vehicles by mines. The damage control surgery tactics was applied in 11 (13.6%) wounded of the comparison group.

The choice of endovideosurgery as a method of surgical treatment of the wounded of the main group (n = 76) depended on the type of injury, the nature of anatomical injuries and the severity of the condition.

137 surgical interventions were performed in 76 wounded of the main group with the obligatory diagnosis of a dominant, competing and concomitant injury, which determined the scope and sequence of surgical interventions.

Taking into account the peculiarities of the course of the traumatic disease, we proposed dynamic endovideosurgery based on the second look tactics, which enabled to reveal surgical complications within a short time without increasing surgical trauma and performing timely medical correction.

37 penetrating laparoscopies were performed in penetrating abdominal gunshot wounds after stabilization of the condition. Of these, 26 had sanative laparoscopy, and 11 had conversion to laparotomy after the diagnostic stage. In this group there were 18 moderately severe wounds (the perfusion index was 2–4%), 19 persons were with severe wounds (the perfusion index was $\leq 2\%$).

In case of non-penetrating injuries, 27 diagnostic laparoscopies were performed, thanks to which it was possible to reveal the non-penetrating nature of the injury and to ensure the absence or presence of damage to the abdominal organs. Of these, 20 were mildly injured (the perfusion index was 4–5%) and 7 were moderately injured (the perfusion index was $< 4\%$).

Endovideosurgery for the closed combat abdominal trauma was performed on 12 wounded of the main group. Of these, 10 wounded were of mild degree of severity (the perfusion index was 4–5%), 2 wounded were of moderate degree of severity (the perfusion index was $< 4\%$). In 2 cases, damage to the internal organs was revealed, resulting in a conversion to laparotomy. Damage to the abdominal cavity was not detected in 9 cases, and laparoscopy was completed at the diagnostic stage. (Table 3).

Table 3.

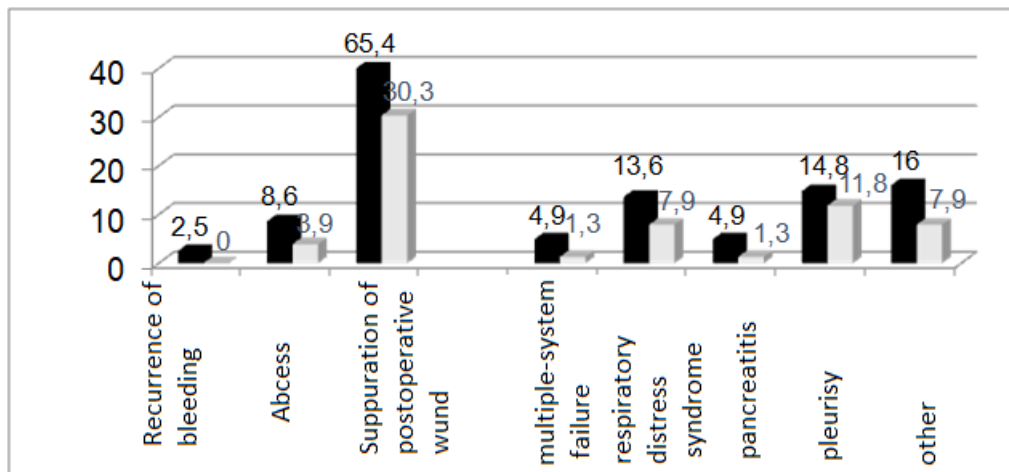
The results of videolaparoscopy in the main group with combat abdominal wounds and closed combat abdominal injury (n = 76)

Result	Penetrating (n=37)		Nonpenetrating (n=27)		CCAT DACO (n=3)		CCAT Without DACO (n=9)	
	Abs.	%	Abs.	%	Abs.	%	Abs.	%
	Total LS/LT, of them	37	100	27	100	3	100	9
- explorative LS	37	100	27	100	3	100	9	100
- sanative LS	26	70.3	–	–	–	–	–	–
- conversion to LT	11	29.7	–	–	2	66.7	–	–

Note: CCAT - closed combat abdominal trauma to the abdomen, DACO- damage to the abdominal cavity organs, LS - laparoscopy, LT - laparotomy.

The use of endovideosurgery allowed to exclude injuries of the abdominal organs in 36 (47.3%) wounded of the main group. At the same time, 10 (12.3%) diagnostic laparotomies were performed in the comparison group, during which no injuries of the abdominal organs were detected.

Complications were observed in 63 (77.8%) wounded of the comparison group, in 42 (55.3%) ($\chi^2 = 8.97$; $p < 0.01$) of the main group. That is, complications in the wounded of the main group were observed 1.4 times less frequently than in the comparison group. The postoperative complications were noted in 53 (65.4%) and 19 (25.0%) wounded, respectively, by groups ($\chi^2 = 25.8$; $p < 0.001$); clinical complications were found in 31 (38.3%) and 16 (21.1%) wounded ($\chi^2 = 5.54$; $p < 0.05$). (Fig. 3).



The comparison group ■ (n = 81) The main group ▒ (n = 76)

Fig. 3.

Characteristics of postoperative complications and complications of the clinical course in the study groups.

We proposed dynamic endovideosurgery according to the tactics of the second look in the wounded with the combat trauma to the abdomen, which allowed dynamic postoperative monitoring in 21 (27.6%) wounded of the main group (n = 76) and revealing postoperative complications in 9 (11.8%) wounded, which were promptly eliminated. In 12 (15.7%) wounded it was possible to make certain that there were no postoperative complications. The application of the second look tactics is found to have a preventive effect, as it prevents the risk of late detection of postoperative complications, does not require laparotomy, which leads to the exclusion of surgical wound complications, eliminates the necessity for topical pharmacological agents and additional work of the medical staff.

One of the advantages of endovideosurgery is the reduction of treatment time and rapid recovery. The duration of inpatient treatment in the main group is significantly shorter in the mild and severe combat traumas to the abdomen (p <0.001), which is associated with less traumatic access, fewer early and late complications, early activation of the wounded and faster rehabilitation.

CONCLUSIONS

1. The improved system of diagnostic measures using pulse oximetry and FAST-protocol enables to optimize surgical tactics. The perfusion index in the range of 2 - ≥5% is the optimal index for the use of endovideosurgical technologies in the wounded with the combat abdominal trauma and the implemented FAST-protocol helps reduce invasive study methods by 35.7%.

2. The developed method of dynamic endovideosurgery according to the tactics of the "second look" using 5 or 10 mm allowed detecting early postoperative complications in 11.8% of the wounded within a short time and performing timely medical correction without increasing surgical trauma, and making sure of absence of complications in 15.7% of the wounded.

3. The proposed tactics of diagnosis and treatment of the wounded with the combat abdominal trauma using pulse oximetry, FAST-protocol and endovideosurgical technologies made it possible to reduce significantly the incidence of complications by 1.4 times, and

the duration of inpatient treatment in the main group was reduced significantly by 1.6 times.

REFERENCES:

1. Alisov P.G. Gunshot wounds to the abdomen. Features, diagnosis and treatment at the stages of medical evacuation under modern conditions: dis. for the degree of doctor of med. science. St. Petersburg, 2016. 300 p.
2. Bely V. Ya., Zarutsky Ya. L., Zhovtonozhko A.I., Aslanyan S.A. Essays on surgery of combat abdominal trauma. K.: "MP Lesya", 2016. 212 p.
3. Verba A.V., Khomenko I.P., Khoroshun E.M., Characteristics of combat surgical trauma, disadvantages and achievements in the treatment of the wounded and injured in anti-terrorist operations. "Science and Practice" Interagency Medical Journal. 2016. №1-2. p. 27-34.
4. Kashtalyan M.A., Gerasimenko O.S., Yenin R.V., Tertishny S.V., Dhauadi F. New directions in the treatment of gunshot wounds. Military health problems. 2017. Issue. 48. p. 360-366.
5. Kashtalyan M.A., Shapovalov V.Yu., Gerasimenko O.S., Khoroshun E. N., Yenin R.V., Gaida Ya. I. The role and place of endovideosurgical technologies in the treatment of the wounded at the advanced stages. Science and practice. 2016. № 1-2 (7-8). p. 39-43.
6. Kashtalyan M.A., Shapovalov V. Yu., Gerasimenko O.S., Yenin R.V., Khoroshun E. N. Application of video laparoscopy in a field military hospital. Clinical surgery. 2016. №5. p. 26-28.
7. Kyoung H. L., Bong S. C. Laparoscopic surgery in abdominal trauma, a single center review: of a 7-year experience. World Journal of Emergency Surgery. 2015. Vol. 10. P. 16.
8. Mazurac S. M., Pearceab A., Alfred S. The F.A.S.T.E.R. trial: Focused assessment by sonography in trauma during emergency retrieval: A feasibility study. Injury. 2008. Vol. 39. №5. P. 512-518.
9. Shen-Gunther, J. Operation enduring Freedom: trends in combat casualty care by forward surgical teams deployed to Afghanistan. Mil. Med. 2011. Vol. 176. N 1. P. 67-78.
10. Smith I. M. Scanning and war utility of FAST and CT in the assessment of battlefield abdominal trauma. Ann. Surg. 2015. Aug; 262(2).- P.389-396.