

Kashtalyan M. A., Tkachenko A. Ye., Kvasnevskiy Ye. A., Honcharuk V. S. Surgical care to the wounded with large bowel battle truma during the anti-terrorist operation. *Journal of Education, Health and Sport*. 2020;10(5):290-300. eISSN 2391-8306. DOI <http://dx.doi.org/10.12775/JEHS.2020.10.05.031>
<https://apcz.umk.pl/czasopisma/index.php/JEHS/article/view/JEHS.2020.10.05.031>
<https://zenodo.org/record/3936035>

The journal has had 5 points in Ministry of Science and Higher Education parametric evaluation. § 8. 2) and § 12. 1. 2) 22.02.2019.

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The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 04.05.2020. Revised: 16.05.2020. Accepted: 29.05.2020.

SURGICAL CARE TO THE WOUNDED WITH LARGE BOWEL BATTLE TRUMA DURING THE ANTI-TERRORIST OPERATION

M. A. Kashtalyan¹, A. Ye. Tkachenko², Ye. A. Kvasnevskiy¹, V. S. Honcharuk²

¹Odessa National Medical University, Odessa, Ukraine

**²Ukrainian Military Medical Academy of the Ministry of Defense of Ukraine, Kyiv,
Ukraine**

M. A. Kashtalyan, MD PhD, Professor, Chief of Department of General and Military Surgery, 2, Valikhovskiy lane, Odessa 65082, Ukraine; tel. (048) 723-42-49
e-mail: mkashtalian@gmail.com;

Tkachenko Andriy, PhD, Senior lecturer of the Department of Military Surgery, Ukrainian Military Medical Academy, 45/1, Moscow St., Kyiv 01015, Ukraine; tel: (044) 280-00-34, (044) 280-01-43;
e-mail: andrtkach@bigmir.net; ORCID: <https://orcid.org/0000-0002-3371-497X>

Ye. A. Kvasnevskiy, Adjunct of the Department of General and Military Surgery, Odessa National Medical University, 2, Valikhovskiy lane, Odessa 65082, Ukraine; tel. (048) 723-42-49,
e-mail: arztev@icloud.com;

Honcharuk Viktor, Adjunct of the Department of Military Surgery, Ukrainian Military Medical Academy, 45/1, Moscow St., Kyiv 01015, Ukraine; tel: (044) 280-00-34, (044) 280-01-43;
e-mail: goncharukviktor87@gmail.com; ORCID: <https://orcid.org/0000-0001-9803-7781>

Abstract

A study of surgical treatment at the stages of medical evacuation of 83 wounded with a battle trauma to the abdomen and damage to the large bowel, received during the anti-terrorist operation. The wounded patients were divided into two groups: the comparison group — 42 patients with a traditional surgical management, and the main group — 41 patients with a priority surgical management, which depended on the severity of the condition, the severity of

internal injuries and operational and tactical circumstances. At the second level of medical care, the surgical management and the extent of surgical interventions were determined: full, abbreviated or damage control surgery. At the III–IV levels of medical care, planned repeated operations “damage control surgery”, “second look”, as well as comprehensive treatment of the consequences and complications of gunshot wounds were performed.

A new approach to the choice of surgical management, as well as the standardization of the extent of surgical interventions have reduced the number of postoperative abdominal complications by 27% and mortality rate — by 16.4%.

Key words: gunshot wound; large bowel; “damage control surgery”; “second look”.

Introduction. A battle surgical trauma is the most actual problem of the military field surgery. The armed conflict has taken place at the eastern Ukraine since 2014 — the anti-terrorist operation, and later — the joint forces operation (ATO/JFO). As a result of the operation the number of the wounded — 29–31 thousand and the dead — 13–13.2 thousand people [1].

The specific gravity of the battle abdominal trauma in the structure of sanitary casualties of the surgical profile is relatively small and ranged from 4.0 to 7.3% [2, 3], but it is one of the most severe battle injuries. According to the ATO/JFO, large bowel injuries occur in 19–21% of the wounded patients with penetrating abdominal trauma, and the number of postoperative complications reaches 65%, and mortality is 12–31% [4, 5].

Surgical treatment of large bowel injuries is a difficult problem in providing surgical care to the wounded patients. At the same time, the classical methods of the colorectal surgery must be adapted to the morphological and functional features of gunshot wounds, taking into account their multiple and combined nature and the organization of surgical care at the war.

The purpose of the study: to increase the effectiveness of attending surgical care to the wounded with a battle trauma of the large bowel at the stage of medical evacuation (SME), by way improving approaches to assessing the severity of the condition, diagnosis and surgical treatment management.

Materials and methods of research. The study of surgical treatment of 83 wounded with battle injuries of the large bowel, received at the area of ATO/ JFO at the period of years 2014–2018, at II, III and IV levels of medical care. For comparative analysis of treatment results, two clinical groups were formed: the comparison and the main group. The comparison group included 42 wounded patients who were treated from April 2014 to February 2015 (the

first and second periods of ATO/JFO [6]), who were used traditional surgical management. The main group included 41 wounded patients who were treated from March 2015 to 2018, which surgical treatment was differentiated and based on the application of a selective approach to the choice of surgical para-operative management at the second level of care, namely: determining the sequence and scope of surgery on various parts of the body according to the FAST protocol, assessment of the severity of the wounded according to the perfusion index (PI), the use of damage control surgery (DCS) in the wounded patients with extremely severe trauma. At the III–IV levels of medical care, a differential approach was used to perform the third phase operations of the DCS management, “second look” and treatment of postoperative complications.

Assessment of the severity of the condition was performed according to PI — “Method of assessing the severity of the condition, mortality prognosis and choice of surgical management for battle injuries” [Patent of Ukraine for utility model No 135133 of 10.06.2019, Bull. No11], anatomical injuries were performed by the PTS scale (Polytrauma schlussels) and AIS (Abbreviated Injury Scale). The study groups by age ($p=0.053$) and severity of injury ($p=0.98$) were comparable.

Analysis of the distribution of wounded patients with battle trauma by type of wound/injury revealed that the vast majority of them in both groups had missile wounds — 49 (59.1%). There were 30 (36.1%) patients with bullet wounds, and 4 (4.8%) with closed injuries.

The choice of surgical management and the extent of surgical interventions on damaged organs and structures took into account the results of experimental study of mechanical origin and pathomorphology of gunshot wounds of the large bowel, obtained in bench studies by modeling gunshot wounds on “Thoracoabdominal ballistic model” [Patent of Ukraine for utility model No 13090] which contained biological materials of animal origin.

Research results and their discussion. The wounded patients with battle trauma of the large bowel, in the flow of casualties, were admitted to the II level of medical care: at the local civilian hospitals on the basis of which military nursing brigades worked — front surgical augmentation groups (FSAG) — level II-a, or military mobile hospitals (MMH) — the level II medical care.

The comparison group performed: resuscitation measures, stabilization of the general condition, laboratory and radiological examinations, surgical interventions in full or reduced volume, intensive care was conducted and the wounded were prepared for evacuation. In the main group in the medical units of the second level there similar measures were performed,

but the assessment of the severity of the condition by PI and the FAST protocol results played the key role in determining further management, which reduced the preoperative period by 15 min. The wounded with a minor injury were immediately taken to the MMH, where they were provided with qualified surgical care. The wounded with a severe trauma were sent to the anti-shock ward or ICU, and with extremely severe trauma — to the operating room, where anti-shock measures were continued, invasive diagnostic tests were performed (with questionable FAST data): pleural puncture, diagnostic laparocentesis, revision of the gunshot wound as an element of its primary surgical treatment (PST). If there were signs of penetrating injury, internal bleeding, surgery was performed with a mandatory intraoperative revision of the abdominal cavity and, the retroperitoneal space according to the indications. Additional diagnostic measures were performed during surgery (X-ray examination) and at the postoperative period.

In all the wounded in the study groups, abdominal trauma was the leading and there was damage to the large bowel: the isolated nature was 6 (14.3%) cases in the comparison group and 3 (7.3%) in the main group, multiple and combined nature, correspondently — 36 (85.7%) and 38 (92.7%).

Surgical management of abdominal injuries in the main group was formed taking into account the following factors which are listed in the order of decision making: severity by PI, nature and severity of abdominal injuries, ballistic characteristics of the wounding projectile, the degree of damage to individual organs and structures. In the comparison group, the severity of the condition was assessed by clinical signs and blood pressure, and the ballistic characteristics of the missiles were not taken into account.

In the main group, 4 (9.8%) laparoscopies were performed, 3 of which were curative — the lesions of the large bowel were sutured laparoscopically, the access conversion to laparotomy was performed in 1 case. In all the cases when the operation was completed laparoscopically, we left “Laparoport” [Patent for utility model of Ukraine No134116 of 25.04.2019, Bull. No8] for dynamic monitoring of the suturing site.

Laparotomy in the wounded patients in the study groups was the main type of surgical access to the abdominal cavity. When massive bleeding was detected, temporary hemostasis of the identified sources was performed: temporary tamponade of parenchymal organs, gunshot defects of the abdominal wall and retroperitoneal space (16 cases), application of clamps to non-great vessels, control of vascular pedicles (9 cases). We performed an intraoperative inspection to identify all injuries and assess them by two categories: minor injuries 1–2 degree AIS — “minor problems” or complex injuries 3–5 degree AIS — “major

problems”. When “major problems” were identified, surgical management was reconsidered to reduce or minimize the volume of surgical interventions. However, we distinguished between the concept of reducing the volume of surgical manipulation — bleeding arrest and contamination from an organ or anatomical structure by the fastest and technically simplest surgical procedure, and DCS management — all medical and surgical measures in a particular wounded patients, aimed at minimizing negative pathogenetic effects of the operation itself on the state of the organism by dividing surgical interventions and intensive care measures into phases of DCS management (Table 1).

Table 1

Abdominal surgery procedures by extent

Organ, organ complex/extent of intervention	Minimum	Abbreviated	Full
Liver	Tamponing	Suturing, hepatopexy (as a temporary method)	Suturing, hepatopexy (as a final method), resection
Spleen	Splenectomy		Recovery with minor injuries, splenectomy with severe injuries
Kidney	Nephrectomy		Recovery with minor injuries, nephrectomy with severe injuries
Stomach	Stitching		Suturing, resection
Pancreas	Hemostasis, drainage		Resection, reconstruction
Small bowel	Suturing (with indications to resection), obstructive resection		Suturing, resection with application of anastomosis
Large bowel	Suturing (with indications to resection), obstructive resection	Resection with stoma exteriorization	Resection with application of anastomosis

Some abbreviated surgical procedures, such as splenectomy, nephrectomy, resection of the bowel with removal of the stoma, had a complete functional nature — that is did not require re-operation in the near future.

The main indications for DCS were: extremely severe trauma on admission; combination of damage to hollow organs with parenchymal and large vessels; severe, life-threatening injuries; massive admission of the wounded and injured; with intraoperative development of hypothermia and clinical signs of coagulopathy.

Operations on damaged organs and structures were performed in full extent in 29 (69.0%) patients of the comparison group and 14 (34.1%) of the main group ($p=0.002$; χ^2 — Pearson=10.1); in abbreviated or minimal in 13 (31.0%) and 27 (65.9%) patients, correspondently, and DCS management was initiated in 12 (29.3%) patients of the main group.

Surgery of the large bowel injuries was based on the classical principles of the colorectal surgery with modifications according to the peculiarities of battle gunshot wounds and the accepted rules of differentiation of surgical treatment depending on the severity of the wound and the organization of surgical aid. The morphological and functional features of large bowel injuries depending on the ballistic characteristics of the wounding projectile was also taken into account in the main group.

With minor injuries to all parts of the large bowel with low-energy shells, the wound was mostly sutured with a 2-row suture after excision of its edges: 17 (40.5%) patients in the comparison group and 12 (29.3%) in the main group.

With severe injuries of the cecum and ascending colon by high-energy shells the obstructive resection with attenuation of the proximal and distal end of the intestine was performed: 2 (4.9%) in the main group; 1 (2.4%) ascendostomy and 2 (4.8%) right hemicolectomy with primary anastomosis in the comparison group.

With similar injuries of the transverse colon, the segmental resection with ostomy — 3 (7.1%) in the comparison group, the primary anastomosis — 5 (11.9%) in the comparison group and 3 (7.3%) in the main group; obstructive resection — 3 (7.3%) in the main group was performed.

Severe injuries of the descending colon in 1 (2.4%) patients in the main group ended in obstructive resection; 2 (4.8%) patients of the comparison group were performed resection of the damaged area with the final transversostoma exteriorization.

With injuries of the sigmoid colon: 2 (4.9%) — obstructive resections in the main group; resection with stoma — 2 (2.8%) in the comparison group, 3 (7.3%) in the main group; with application of anastomosis — 3 (7.1%) in the comparison group, 7 (17.1%) in the main group.

With severe rectal injuries, suturing/resection of the defect was performed with sigmoidostoma exteriorization: 5 (11.9%) in the comparison group, 7 (17.1%) in the main group, and 1 (2.4%) — obstructive resection in the main group (Fig. 1).

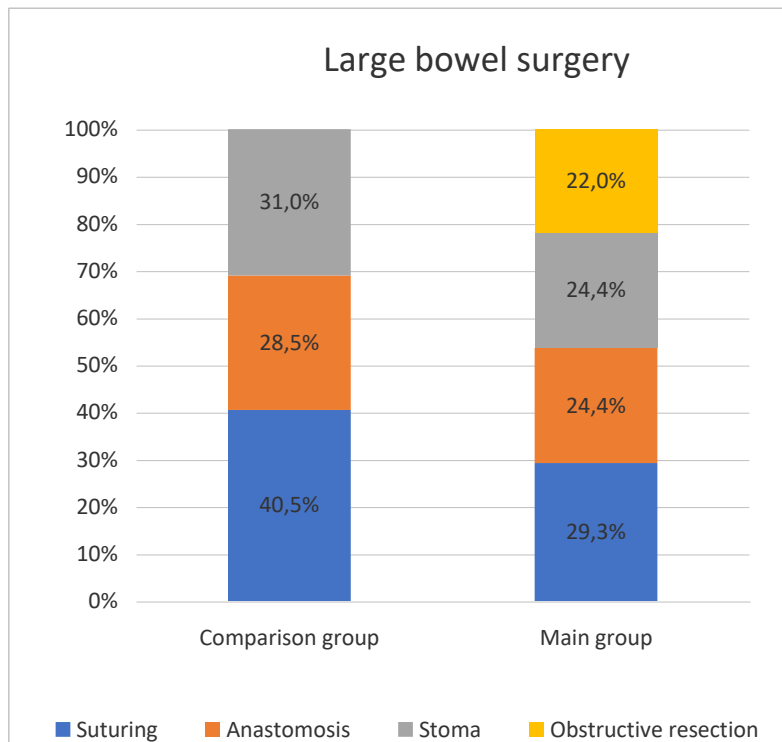


Fig. 1. The large bowel surgery in the wounded patients with battle abdominal trauma

The most of the minor damage was repaired by suturing. In 16 (19.3% of cases) extraperitonization of the bowel segment with sutures was additionally performed.

Obstructive resection (minimum extent of intervention) — 9 (10.8%) was more often performed when the mesoperitoneally located parts of the large bowel (ascending, descending) were damaged. This is due to the anatomical features of these departments — their mobilization to stoma exteriorization or application of anastomosis required additional time, blood loss of the patient and the skills of the surgeon. While the parts of the colon with the mesentery are mobile, they are well supplied with blood and are more suitable for application stoma or primary anastomosis.

When resecting a segment of the large bowel adjacent to the wound defect, we retreated from 5 to 20 cm in both directions, depending on the extent of macroscopically visible areas of paravulnar contusion injury.

As part of the DCS management, phase I was completed by a temporary closure of the abdominal cavity due to skin sutures — 8 patients in the main group, or the formation of a laparostoma — 2 patients in the main group. Laparostomas were formed using sterile films from intravenous infusion bags that were sutured to the skin or used a plastic protector to suture the aponeurosis with ligatures that were tied in the middle of the laparotomy wound like parachute slings.

The injured with large bowel damage had concomitant injuries of other anatomical areas: 28 (66.6%) in the comparison group and 30 (73.2%) in the main group, which also required surgery at the second level of medical care.

Thoracocentesis with pleural drainage was the first surgical operation (before laparotomy) with penetrating wounds or chest injuries accompanied by hemopneumothorax: 12 (28.6%) in the comparison group and 18 (43.9%) in the main group. Pleural drainage preceded the other surgical interventions to eliminate respiratory failure and prevent the occurrence of intense pneumothorax during mechanical ventilation with general anesthesia.

An urgent thoracotomy was performed in 2 (4.8%) patients in the comparison group because of penetrating chest injuries and lung damage. A retrospective analysis of these cases revealed that the lung injury was peripheral and the intrapleural hemorrhage was limited to 1000 ml — indications to thoracotomy were incorrect.

Surgical treatment of gunshot fractures of the thigh and unstable pelvic fractures was the content of damage control orthopedic management — a component of DCS. Immobilization of the anterior parts of the pelvic ring, hip fractures or implantation of the "pelvis — thigh" with an external fixator in 2 (4.8%) patients in the comparison group and 5 (12.2%) patients in the main group.

PST of the body and extremities wounds was performed in all patients at the end of the main intervention — 83 (100%) (PST of inlet/outlet openings of gunshot wounds in the abdominal wall) or at the same time, if it was possible to organize a convenient spatial placement of "patient — surgical teams" one team performed laparotomy, the other one performed PST of extremities wounds).

The reduction in the extent of surgical procedures during abdominal surgery in the wounded patients allowed to reduce its duration from (126.5±10.6) min in the comparison group up to (98.2±6.0) min in the main group ($p < 0.05$; Student's criterion = 4.9).

After providing surgical care to the wounded at the II level, removal from the state of shock, they were evacuated to the stage of medical evacuation of the III level, and in 11 cases (13.3%) to the IV level of medical care for the 1st–2nd day after the injury.

All the wounded patients underwent a profound clinical and laboratory examination, as well as multispiral computed tomography of chest, abdomen, pelvis with intravenous contrast according to the protocol "polytrauma". The purpose of the study was to establish the clinical course of the wound after medical care on the previous stages of medical evacuation, completeness and adequacy of this care, the functional state of the wounded patients

organism, early complications, as well as the selection of a group of the wounded patients who need the “second look” operations.

The decision on the “Second look” operation was made on the basis of the following recommendations:

— Indication in the protocol of the operation of the second level of medical care the need for the “second look” operation.

— The presence of severe abdominal injuries with high-velocity shells.

— The presence of multiple abdominal injuries with two or more shells.

— Pathological or "doubtful" discharge along the drainage from the abdominal cavity.

— Detection of hidden injuries or foreign bodies of the abdomen on KT, which required surgery, severe diffuse infiltration of organs and tissues of the abdominal cavity, ischemic or necrotic changes.

The “second look” operations were performed in 9 (23.1%) patients of the main group and in 8 (19%) patients of the comparison group. At the same time, a thorough examination of the abdominal cavity and retroperitoneal space was performed, attention was paid to the areas of contusion damage to internal organs, signs of ischemia, an ability of sutures and anastomoses, anatomical and functional adequacy of the previous operation, drainage. After the operation with revision, laparoports for visual monitoring were installed in 4 patients of the main group.

Monitoring video laparoscopy was performed on the 2nd day after the last operation, other — on clinical suspicion of the development of abdominal contractions. The diagnostic tasks of such laparoscopy did not differ from the tasks of repeated examination. The laparoport in the wounded patients was up to 4–6 days postoperatively.

According to the results of the “second look” operation in 6 cases the line of anastomosis sutures was strengthened; resection of a segment of the intestine with an ascendostomy and application of an ileostomy was performed in 1 case; in 1 case — omentohepatopexy, cholecystectomy with external drainage of the choledochus according to Pikovsky; in 5 cases — removed hidden foreign bodies. At signs of serous or serous-fibrinous peritonitis, nasogastrintestinal intubation was carried out, in addition drainages were established — 10 cases.

The postponed and planned surgical interventions included: internal osteosynthesis of pelvic and limb fractures. These operations were performed in the third–fourth period of the traumatic disease, after compensation of functional systems of the body and healing of gunshot wounds in 5 (6.0%) patients of both groups.

As a result of the introduction of clinical and organizational measures, the number of patients with postoperative abdominal complications in the main group — 19 (48.7%), decreased as compared to the comparison group — 28 (75.7%) — ($p=0.0156$; χ^2 — Pearson)=5.85), which we associate with re-revision, additional surgical procedures aimed at improving the operative result during the second operation with the DCS and “second look” management.

Mortality in the study groups was 11 (26.2%) cases in the comparison group and 4 (9.8%) in the main group ($p<0.049$; F-test).

The main causes of death of the wounded patients with large bowel injuries were traumatic shock and blood loss (1st–2nd day): 5 (11.9%) in the comparison group and 3 (7.3%) in the main; septic complications: 6 (14.3%) in the comparison group; pulmonary embolism — 1 (2.4%) in the main group. A significant difference in the causes of death in the study groups was found in the category of septic complications ($p=0.012$; χ^2 — Pearson=6.31).

So, when analyzing the application of priority diagnostic and treatment management for the patients with large bowel injuries, we can note a decrease in the proportion of postoperative abdominal complications, a decrease in total mortality and mortality from purulent-septic complications in the main group.

Conclusions

1. Introduction of differential surgical treatment in the wounded patients with large bowel injuries with the distribution of the extent of surgical interventions depending on the severity of the injury on full — in mild injury, shortened and minimal — with severe and extremely severe injury, reduced the time of operations with 126.5 ± 10.6 min in the comparison group to 98.2 ± 6.0 min in the main group. And in the wounded patients with the reduced and minimum extent operations without final functional nature, the damage control surgery management with a duration of 58.5 ± 6.0 min was used.

2. The introduction of repeated surgical examination of the abdomen during operations of phase 3 the damage control surgery and the “second look” operations allowed to diagnose and eliminate hidden injuries, progressive signs of gunshot wounds, organ ischemia, surgical defects of the previous operations, which generally led to reduction of postoperative abdominal complications from 28 (75.5%) in the comparison group to 19 (48.7%) in the main group.

3. Differential diagnostic and treatment management in the wounded patients with large bowel injuries depending on the severity of the condition, the nature of the wound, the

ballistic characteristics of the wounding projectile, and the organization of staged treatment in the ATO/JFO reduced mortality from 26.2% to 9.8% .

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