UDC 616.34-001.4-089.843
DOI https://doi.org/10.32782/2226-2008-2025-4-7

O. S. Herasymenko[1,2] https://orcid.org/0000-0002-0039-5757
M. A. Kashtalian[1,2] https://orcid.org/0000-0002-2945-2161
Ya. I. Haida[2] https://orcid.org/0009-0008-2213-3767
A. V. Okolets[2] https://orcid.org/0009-0007-7896-4837
Ie. A. Kvasnevskyi[1] https://orcid.org/0000-0002-0753-7666

PECULIARITIES OF THE FORMATION OF INTER-INTESTINAL ANASTOMOSES IN THE USE OF DAMAGE CONTROL SURGERY TACTICS

[1]Odesa National Medical University, Odesa, Ukraine
[2]Military Medical Clinical Center of the Southern Region, Odesa, Ukraine

O. S. Herasymenko[1, 2], M. A. Kashtalian[1, 2], Ya. I. Haida[2], A. V. Okolets[2], Ie. A. Kvasnevskyi[1]
PECULIARITIES OF THE FORMATION OF INTER-INTESTINAL ANASTOMOSES IN THE USE OF DAMAGE CONTROL SURGERY TACTICS
[1] Odesa National Medical University, Odesa, Ukraine
[2] Military Medical Clinical Center of the Southern Region, Odesa, Ukraine

Introduction. The incidence of small intestine injuries from gunshot wounds in the wars of the last century, as well as during the full-scale war in Ukraine, ranges from 21.1 to 42.1%, and the incidence of large intestine injuries – from 15.3 to 41.6%.

Objective of the study is to improve the results of treatment of wounded with small and large intestine injuries by improving surgical techniques for the formation of intestinal anastomoses.

A study of surgical treatment at the stages of medical evacuation of 148 wounded with combat abdominal trauma and damage to the small and large intestine was conducted. The wounded were divided into two groups: the main group (80) consisted of wounded who underwent restoration of intestinal integrity by forming a manual anastomosis. The second group, the control group (68), included wounded who underwent anastomosis formation by hardware, using the GIA TriStapler with DST Series Technology 60 mm.

At the third stage of DCS IV level of medical care, after stabilization of the wounded within 24–72 hours, an operation was performed to restore the integrity of the intestine by forming an anastomosis (in case of small intestine injuries). In case of colon injuries, preference was given to forming a terminal or preventive colostomy.

In the postoperative period, anastomotic failure in the control group occurred in 4.4%, compared to the main group – 2.5 %, which amounted to 3.4 % of the total.

Conclusions. In the formation of interintestinal anastomoses during the implementation of phase III of the DCS tactics, preference should be given to manual methods.

Keywords: combat abdominal trauma, intestinal anastomoses, “damage control surgery”.

О. С. Герасименко[1,2], М. А. Каштальян[1,2], Я. І. Гайда[2], А. В. Околець[2], Є. А. Квасневський[1]
ОСОБЛИВОСТІ ФОРМУВАННЯ МІЖКИШКОВИХ АНАСТОМОЗІВ ПРИ ЗАСТОСУВАННІ ТАКТИКИ DAMAGE CONTROL SURGERY
[1]Одеський національний медичний університет, Одеса, Україна
[2]Військово-медичний клінічний центр Південного регіону, Одеса, Україна

Досліджено хірургічне лікування на етапах медичної евакуації 148 поранених з бойовою травмою живота, ушкодженням тонкої та товстої кишки. Поранені були поділені на дві групи: основна (80) – поранені, яким виконувалося відновлення цілісності кишки шляхом формування ручного анастомозу. До другої групи – контрольної (68) – увійшли поранені, яким здійснювалося формування анастомозу апаратним шляхом, для цього використовувався апарат GIA TriStapler with DST Series Technology 60 mm.

На III етапі DCS IV рівні медичного забезпечення після стабілізації стану пораненого протягом 24–72 годин виконувалася операція з відновлення цілісності тонкої кишки шляхом формування анастомозу. У разі поранень товстої кишки перевага віддавалася формуванню кінцевої або превентивної колостоми.

В післяопераційному періоді неспроможність анастомозу у контрольній групі виникла у 4,4% випадків, в основній – у 2,5%.

Ключові слова: бойова травма живота, міжкишкові анастомози, «damage control surgery».

Introduction

In the structure of modern combat trauma, the proportion of abdominal injuries is increasing, accompanied by the development of purulent-septic complications, multiple organ failure, and high mortality [1; 2].

During the period of modern hostilities, the percentage of abdominal injuries in the overall structure of injuries is 6.6–9%, according to the ATO – 7% [3]. The close relationship between the results of treatment of this category of wounded and the quality of surgical care creates organizational difficulties, especially in case of mass admissions [4]. Specific features of gunshot wounds of the abdomen determine the severity of functional disorders, more frequent development of complications (54–81%) and, as a result, a higher mortality rate (12–31%), which does not tend to decrease [5].

According to the literature, the frequency of small intestine injuries from gunshot wounds in the wars of the last century, as well as during the full-scale war in Ukraine, ranges from 21.1 to 42.1%, and 15.3 to 41.6% for the colon [6].

© O. S. Herasymenko, M. A. Kashtalian et al., 2025

Стаття поширюється на умовах ліцензії

At the advanced levels of medical support (LMS), the provision of surgical care to wounded with combat abdominal trauma (CAT) in severe and extremely severe condition is based on the use of Damage Control Surgery (DCS) tactics, which involves the division of surgical care into three phases, can take place both in one medical facility and after medical evacuation to higher LMS [7].

During the implementation of phase III of DCS tactics, the continuity of the small (or large) intestine is restored by forming interintestinal anastomoses (entero- and colostomy). The incidence of failure of small-small intestinal anastomoses in CAT is 9.3–14.7%, and of colon-colon anastomoses – 12.9–27.4% [8]. The development of such complications depends on the nature and type of injury, the general condition of the patient, the severity of microcirculatory disorders in the edges of the damaged intestine, as well as the technical features of anastomosis formation. Improvement of surgical tactics in combat wounds with small (or large) intestine injuries is an urgent issue of military surgery and contributes to the improvement of the results of multistage treatment of such injuries.

The aim of the study – to improve the results of treatment of wounded with small and large intestine injuries by improving surgical techniques for the formation of intestinal anastomoses.

Materials and methods

We analyzed the surgical treatment of 148 wounded with CAT and small and large intestine injuries, aged 18 to 51 years. After being wounded, the combatants were admitted to the second LMS near the contact line, where they were treated in the scope of Phase I of DCS tactics, namely: stopping intra-abdominal bleeding, preventing contamination of the abdominal cavity with intestinal contents by clipping the edges of the damaged intestine, temporary abdominal closure, anti-shock measures and evacuation to the third- and fourth LMS.

All the wounded were divided into 2 groups.

The first group (n=80) consisted of wounded who underwent restoration of intestinal integrity by forming a manual anastomosis (main group).

The second group (n=68) included wounded who underwent anastomosis formation by stapler, for which our clinic used the GIA TriStapler with DST Series Technology 60 mm (control group). The duration of reconstructive surgery was 24–72 hours.

The study was approved by Odesa National Medical University (ONMedU) Biomedical Ethics Committee (Protocol No. 2 of 03.02.2025) and was conducted in accordance with the written consent of the participants and in accordance with the principles of bioethics set forth in the Helsinki Declaration of Ethical Principles for Medical Research Involving Human Subjects and the Universal Declaration of Bioethics and Human Rights (UNESCO).

A written agreement was signed with patients who agreed to participate in the study. The work was performed within the framework of the initiative research project "Treatment of acute surgical diseases, abdominal and soft tissue injuries" (No. 0121U109029) for 2021–2025.

The statistical processing of the study results was performed using the methods of statistical analysis generally accepted in biomedical research using Microsoft Excel 5.0 and Statistica 10. Statistica-Release Notes and Guides [9].

Results and discussion

DCS tactics and its impact on anastomosis formation involves three key stages:

1. Emergency intervention. Stop bleeding, control contamination of the abdominal cavity and minimize surgical intervention (Fig. 1).
2. Resuscitation. Stabilization of hemodynamics, correction of coagulopathy, hypothermia and acidosis.
3. Delayed reconstruction. Final formation of anastomoses and restoration of organ integrity after stabilization of the patient's condition.

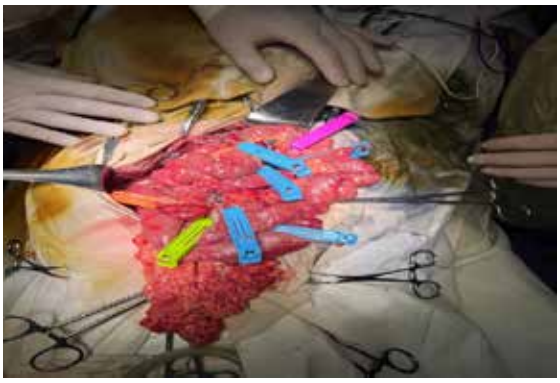


Fig. 1. Stages of Damage control surgery tactics (intestinal clips on the resected areas of the small intestine)

Indications and approaches to the formation of intestinal anastomoses in DCS depends on the following factors:

– Hemodynamic status. In patients with unstable hemodynamics, the risk of anastomotic failure increases significantly. In such cases, it is better to avoid the formation of anastomoses.

– Tissue condition. If the intestinal tissues show signs of ischemia or edema, the anastomosis is postponed until the patient's condition stabilizes.

– The level of contamination of the abdominal cavity. In conditions of spilled peritonitis, the primary anastomosis is associated with a high risk of complications.

– The possibility of repeated intervention. When developing temporary solutions, it is important to provide easy access for further reconstruction.

We conducted a comparative analysis of manual and stapler anastomoses (Table 1).

All wounded in the first phase of DCS underwent obstructive resection of the damaged area of the intestine with the application of intestinal clips at the ends of the intestine [8]. In the absence of the risk of active bleeding or unrepaired retroperitoneal hematomas, most operations were completed with the application of an abdominal VAC system with a constant negative pressure level of -50 mm Hg (Fig. 2).

At the III stage of DCS IV LMS, after stabilization of the wounded within 24–72 hours, surgery was performed to restore the integrity of the intestine by forming an anastomosis (in case of small intestine injuries). In case of colon injuries, preference was given to the formation of a terminal or preventive colostomy (Fig. 3).

Table 1

Comparative characteristics of intestinal anastomoses

Parameter	Manual anastomoses	Stapler anastomoses
Duration	15.7–3.2 min	7.9–2.7 min
The level of training of the surgeon	High level	Medium level
Risk of complications	Depends on the experience and skills of the surgeon	May be due to mechanical mistakes
Cost	Cheap, does not require special equipment	Much more expensive due to special equipment
Availability	Availability in all clinics	Special equipment is required

Fig. 2 Final view of abdominal NPWT system

To determine the viability of the resected intestine, we used a pulse oximeter with a Clarke sensor, which was placed at the end of the damaged intestine and assessed the degree of microcirculatory disorders and the extent of resection (Fig. 4).

The following complications were observed in the postoperative period in the wounded of both groups: anastomotic failure, stenosis, anastomositis, acute ulcers with bleeding, postoperative adhesive obstruction (Table 2).

In the postoperative period, anastomotic failure occurred in 4.4% of cases in the control group, 2.5% in the main group, which amounted to 3.4% of the total.

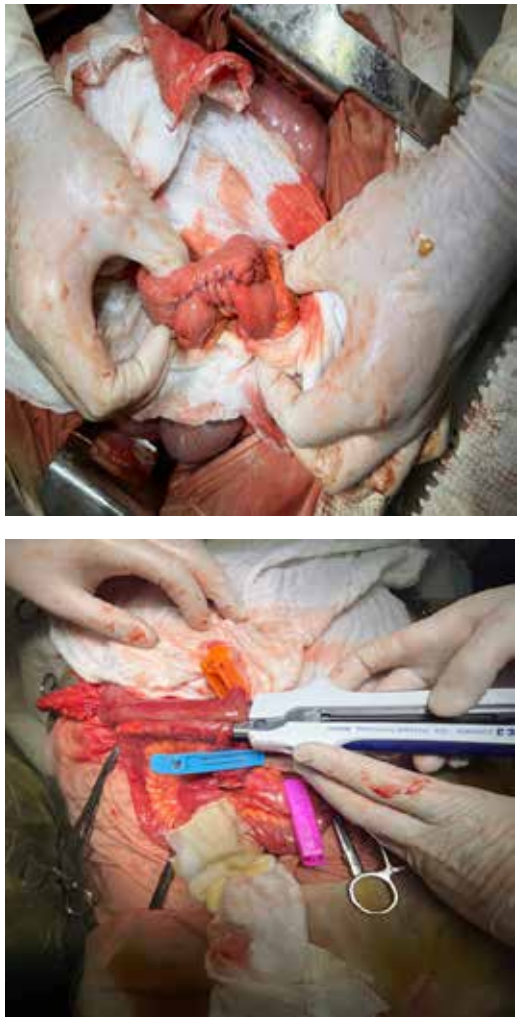
An acute ulcer with perforation occurred in 1 patient in the control group (1.5%), with bleeding – 2 (2.9%), in the main group no such complications were noted.

The incidence of early adhesive obstruction was 2.5% in the main group and 4.4% in the control group. Late adhesive obstruction occurred in 1 patient (1.3%) in the main group and in 2 patients (2.9%) in the control group.

Comparative characteristics of complications in both groups are shown in the table 2.

When restoring the integrity of the intestine in phase III of DCS, in conditions of a relatively “clean abdomen”, the manual anastomosis is formed with a two-row suture (1 row with a wraparound suture, 2 rows with separate knot sutures). If there was a risk of failure and other complications, we formed two-row small-intestinal anastomoses with separate knotted sutures.

In the treatment of the control group, the restoration of intestinal integrity was performed mainly by forming stapler anastomosis, while in the main group, a manual anastomosis was used. After a comparative analysis of the frequency and nature of complications, it was decided to form intestinal anastomoses manually, and to use staplers



A

B

Fig. 3. Methods of forming intestinal anastomoses: A – manual, B – stapler

to seal the edges of the resected intestine with subsequent peritonization of the suture line.

Conclusions

1. In the formation of stapler intestinal anastomoses, the frequency of their failure is 4.4%, manual – 2.5%.
2. If there is a risk of complications, namely, a decrease in SpO2<85% in the edges of the damaged intestine, small intestinal (as well as all colon) double-row anastomoses should be formed with separate nodal sutures.
3. Staplers techniques can be used to seal the edges of the resected intestine with mandatory subsequent peritonization, or during reconstructive interventions to

Fig. 4. Determination of the boundary of intestinal resection using a pulse oximeter: *A* – small intestine, *B* – sigmoid

Table 2

Comparative characteristics of complications

Types of complications	Comparison groups		Total n=148
	Main group (n=80)	Control group (n=68)	
Failure of anastomosis	2 (2.5%)	3 (4.4%)	5 (3.4%)
Acute ulcer with perforation	–	1 (1.5%)	1 (0.7%)
Acute ulcer with bleeding	–	2 (2.9%)	2 (1.4%)
Early adhesive postoperative obstruction	2 (2.5%)	3 (4.4%)	5 (3.4%)
Late adhesive postoperative obstruction	1 (1.3%)	2 (2.9%)	3 (2.0%)
Total	5 (6.3%)	11 (16.1%)	16 (10.8%)

restore continuity after 6 months or more (especially during endo-video surgery).

4. When performing surgical interventions using DCS tactics, an individually differentiated approach to the choice of surgical tactics should be applied, taking into account the severity of the wounded.

5. The use of manual methods of forming intestinal anastomoses in combat abdominal trauma can reduce the total number of complications from 16.1% to 6.3%.

Funding. The work was performed within the framework of the initiative research project "Treatment of acute surgical diseases, injuries of the abdominal cavity and soft tissues" (No. 0121U109029) for 2021–2025. The study has no external sources of funding.

Conflict of interest. The authors declare no conflict of interest.

BIBLIOGRAPHY

1. Humeniuk KV, Khomenko IP, Lurin IA, et al. Likuvalnia poranenykh z boiovymy ushkodzhenniamy zhyvota (za dosvidom ATO/OOS) [Treatment of the wounded with combat abdominal injuries (based on ATO/OUF) experience)]. Kherson; 2022. P. 11–12 (in Ukrainian).
2. Kazmirchuk A, Yarmoliuk Y, Lurin I, et al. Ukraine's experience with management of combat casualties using NATO's four-tier changing as needed healthcare system. *World J Surg*.2022 Dec;46(12):2858–2862. doi: 10.1007/s00268-022-06718-3.
3. Bilyi VYa, Zarutskyi YaL, Sobko IV et al. Vakuumni pov'yazky v likuvanni ran m'akykh tkanyn pry boiovii khirurhichnii travmi: metodychni rekomendatsii [Vacuum dressings in the treatment of soft tissue wounds in combat surgical trauma: guidelines]. Kyiv: Liudmyla Publishing; 2023. P. 88–89 (in Ukrainian).
4. Gumeniuk K, Lurin IA, Tsema I, Malynovska L, Gorobeiko M, Dinets A. Gunshot injury to the colon by expanding bullets in combat patients wounded in hybrid period of the Russian-Ukrainian war during 2014–2020. *BMC Surg*. 2023;23(1):23. https://doi.org/10.1186/s12893-023-01919-6.

5. Humeniuk KV, Bilyi AYa, Korol SO, Zarutskyi YaL, Gybalo RV, Aslanyan SA, et al. Khirurhichna taktyka pry vohnepalnykh poranenniakh porozhnystykh orhaniv zhyvota: metodychni rekomendatsii [Surgical tactics in gunshot wounds of hollow abdominal organs: guidelines]. Kyiv: Liudmyla Publishing; 2023. P. 25–26, 33–34 (in Ukrainian).
6. Trutiak I, Pivnyk V, Prokhorenko H, Kalynovych N. The role and place of damage control surgery in military medical evacuation doctrine during hostilities in modern war. *Proc Shevchenko Sci Soc Med Sci* [Internet]. 2021;65(2):130–40. doi: 10.25040/ntsh2021.02.12. Available from: https://mspsss.org.ua/index.php/journal/article/view/383.
7. Johnson JW, Gracias VH, Schwab CW, et al. Evolution in damage control for exsanguinating penetrating abdominal injury. *J Trauma*. 2020;51:261–9. doi: 10.1097/00005373-200108000-00007.
8. Lurin I, Vorovskiy O, Makarov V, et al. Management of thoracoabdominal gunshot injuries by using minimally invasive surgery at role 2 deployed field hospitals in Ukraine. *BMC Surg*. 2024;24:183. doi: 10.1186/s12893-024-02475-3
9. Peacock JL, Peacock PL. Oxford Handbook of Medical Statistics. 2nd ed. Oxford: Oxford University Press; 2020. 640 p. doi: 10.1093/med/9780198743583.001.0001

Надійшла до редакції 04.06.2025 р.
Прийнята до друку 01.09.2025 р.
Електронна адреса для листування arztev@icloud.com