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Laparoscopy for combat-related abdominal trauma: a single center experience during the Ukrainian War of Independence

I. A. Lurin[1,2,A,F], **K. V. Gumeniuk**[3,A,F], **Iu. O. Mikheiev**[4,5,A-F], **R. M. Kuziv**[5,A,F], **Ya. V. Tielushko**[4,5,D,E,F], **I. V. Rusanov**[4,5,D,E,F], **D. S. Mialkovskyi**[5,D,E,F], **S. M. Machuskyi**[5,D,E,F]

[1]National Academy of Medical Sciences, Ukraine, [2]State Institution of Science "Center of Innovative Healthcare Technologies" State Administrative Department, Kyiv, Ukraine, [3]Command of the Medical Forces of the Armed Forces of Ukraine, [4]Zaporizhzhia State Medical and Pharmaceutical University, Ukraine, [5]Zaporizhzhia Military Hospital, Ukraine

A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation; D – writing the article; E – critical revision of the article; F – final approval of the article

Aim. To evaluate the feasibility, indications, and outcomes of laparoscopic surgery in hemodynamically stable combat casualties with abdominal trauma during the Ukrainian War of Independence.

Material and methods. A retrospective observational study included 238 hemodynamically stable patients with combat-related abdominal trauma treated at the Zaporizhzhia Military Hospital between 2022 and 2025. Medical records, operative protocols, imaging examinations (e-FAST, computed tomography), and intraoperative documentation were analyzed.

Results. Laparoscopic procedures performed included diagnostic laparoscopy (n = 78), foreign body removal (n = 60), hemostasis (n = 23), diaphragmatic repair (n = 19), hollow viscus suturing (n = 15), splenectomy (n = 5), and colectomy / colostomy (n = 12). Conversion to laparotomy was required in 28 cases (11.8 %), while secondary laparotomy was needed in 5 patients due to missed bowel injuries, intra-abdominal abscess, ileus, or bleeding. The best outcomes were achieved in American Association for the Surgery of Trauma (AAST) grade I–II injuries. Advanced bowel resections were technically complex requiring further validation for routine use. Barbed suture-based closure improved safety and efficiency in diaphragmatic and hollow viscus repair.

Conclusions. Laparoscopy appears to be a safe and effective option for selected hemodynamically stable patients with abdominal combat trauma. It reduces rates of unnecessary laparotomies, postoperative complications, and recovery time, facilitating faster return of soldiers to duty. Complex bowel resections require further validation before routine implementation in military trauma surgery.

Keywords: laparoscopy, abdominal injuries, combat casualties, hemodynamically stable patients, military medicine, surgery.

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Лапароскопія при травмах живота, пов'язаних з бойовими діями: досвід одного центру у війні за Незалежність України

І. А. Лурін, К. В. Гуменюк, Ю. О. Міхеєв, Р. М. Кузів, Я. В. Тєлушко, І. В. Русанов, Д. С. Мялковський, С. М. Мачуський

Мета роботи – оцінити можливості, показання та результати лапароскопічних втручань у гемодинамічно стабільних поранених з абдомінальною травмою в умовах війни за Незалежність України.

Матеріали і методи. До ретроспективного обсерваційного дослідження залучено 238 гемодинамічно стабільних пацієнтів з абдомінальною бойовою травмою, які перебували на лікуванні у Запорізькому військовому госпіталі впродовж 2022–2025 рр. Проаналізовано медичну документацію, операційні протоколи, результати візуалізаційних досліджень (e-FAST, комп'ютерна томографія) та інтраопераційні матеріали.

Результати. Пацієнтам виконано діагностичну лапароскопію (n = 78), видалення сторонніх тіл (n = 60), гемостаз (n = 23), ушивання діафрагми (n = 19), ушивання порожнистих органів (n = 15), спленектомію (n = 5), колектомію / колостомію (n = 12). Конверсія до лапаротомії необхідна була у 28 (11,8 %) випадках, вторинна лапаротомія – у 5 пацієнтів (пропущені ушкодження кишечника, абсцес, кишкова непрохідність, кровотеча). Найкращі результати визначено при ушкодженнях I–II ступенів за AAST. Використання шовного матеріалу з насічками підвищувало ефективність ушивання діафрагми та порожнистих органів.

Висновки. Лапароскопія є безпечним і ефективним методом у певної когорти гемодинамічно стабільних пацієнтів з абдомінальною бойовою травмою. Вона зменшує частоту необґрунтованих лапаротомій, післяопераційних ускладнень і прискорює відновлення, сприяючи швидшому поверненню військовослужбовців у стрій. Розширені резекції кишечника залишаються дискусійними та потребують подальшого вивчення перед рутинним застосуванням.

Ключові слова: лапароскопія, абдомінальна травма, бойові поранені, гемодинамічно стабільні пацієнти, військова медицина, хірургія.

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In February 2022, Russia launched a full-scale invasion of Ukraine, resulting in significant morbidity and mortality among civilians and military personnel of the Armed Forces of Ukraine. This conflict is unprecedented in modern history, characterized by the widespread use of drones, including first-person view kamikaze drones, which have created new challenges for contemporary military surgery [1].

One of the promising areas for the introduction of modern technologies into military surgery is laparoscopy for combat-related abdominal trauma. Ukrainian military surgeons were pioneers in implementing laparoscopy in military surgery, with initial reports describing laparoscopic nephrectomy in combat-related kidney injury, minimally invasive approaches to thoracoabdominal gunshot wounds, and laparoscopic colon resections at a Role 3 facility [2,3,4]. Notwithstanding these foundational efforts, the role and feasibility of laparoscopic surgery in combat-related penetrating abdominal trauma remain understudied.

The global literature on laparoscopy in this context is still relatively scarce [5,6]. Debate continues regarding the optimal role of laparoscopy in trauma, although it can offer advantages over traditional exploratory laparotomy. Laparoscopy has been applied as a diagnostic and therapeutic tool in abdominal trauma [7].

Some general principles have emerged: laparoscopy should be reserved for hemodynamically stable patients, is most useful for grade I–II injuries of abdominal organs according to the American Association for the Surgery of Trauma (AAST) scale and has demonstrated particular benefit in the evaluation and repair of diaphragmatic injuries [7,8].

To address the current gap in the literature, this study reports the single-center experience of Zaporizhzhia Military Hospital in implementing laparoscopy for combat-related abdominal trauma under wartime conditions.

Aim

To evaluate the feasibility, indications, and clinical outcomes of laparoscopic surgery in hemodynamically stable combat casualties with abdominal trauma during the Ukrainian War of Independence.

Materials and methods

This was a retrospective observational study performed at the Zaporizhzhia Military Hospital from November 2022 to July 2025. All 238 hemodynamically stable patients with combat-related abdominal trauma who underwent laparoscopic management were included. Patients had wounds to the anterior abdominal wall, flank, back, or thoracoabdominal junction. All patients were hemodynamically stable without or negligible intra-abdominal fluid on CT and/or metallic fragments in the abdomen in cases of penetrating trauma. The patients with hemodynamic instability, gunshot wounds with suspected multiple bowel injuries, massive hemoperitoneum, previous surgery (Role 2) with any type of damage control surgery, or in cases of general contraindications to pneumoperitoneum were excluded.

The initial examination of patients was performed according to the Advanced Trauma Life Support protocol. A thorough medical history, encompassing the details of injuries, was obtained from all patients included in the study. A comprehensive clinical examination of the patients was performed, including an Injury Severity Score.

The Bioethics Committee of Zaporizhzhia State Medical and Pharmaceutical University reviewed the materials presented in the article. The study was confirmed to be in full compliance with ethical standards, including the ICH/GCP guidelines, the Declaration of Helsinki (1964, as amended), the Council of Europe Convention on Human Rights and Biomedicine, the Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine, other relevant documents regulating research involving human participants, as well as the current legislation of Ukraine (Protocol No. 9, August 29, 2025). All participants provided written informed consent for the laparoscopic procedure.

Patients underwent standard diagnostic tests including laboratory and radiological examinations such as extended Focused Assessment with Sonography for Trauma (e-FAST), and CT scans (in most cases non-contrast CT scans). The median time from injuries to admission to the hospital emergency unit (Role 3) was 12 hours (range: 2–28 hours), whereas the median time from admission to the emergency unit to the initiation of laparoscopic surgery was 2 hours (range: 1–8 hours). By etiology of combat-related abdominal injuries, blunt trauma was identified in 25 patients, whereas penetrating trauma was observed in 214 cases, including 3 caused by bullets and 211 resulting from shrapnel.

All enrolled patients initially underwent diagnostic laparoscopy to assess abdominal and intra-abdominal injuries. Based on the intraoperative findings, cases were subsequently classified into four categories: negative laparoscopy (absence of injury), non-therapeutic laparoscopy, therapeutic laparoscopy, and conversion to laparotomy. Patients were stratified into four groups based on laparoscopic findings and subsequent management. The negative laparoscopy group included individuals with no intra-abdominal injuries. The non-therapeutic laparoscopy group included patients with injuries that did not necessitate surgical intervention. The therapeutic laparoscopy group, representing the majority of cases, encompassed patients with injuries successfully managed laparoscopically. The conversion to laparotomy group consisted of patients requiring open surgical exploration for the repair of severe injuries. Injury characteristics, applied treatment strategies, and perioperative outcomes were systematically analyzed.

Results

A total of 238 hemodynamically stable combat casualties with abdominal injuries underwent laparoscopic interventions at the Role 3 Military Hospital during the study period. The spectrum of procedures was extensive, including both diagnostic and therapeutic applications of minimally invasive surgery in battlefield settings *(Table 1)*.

Diagnostic laparoscopy was the most frequently performed procedure (n = 78), serving as a key modality for clarifying the extent of injury, excluding hollow viscus perforation, and reducing the rate of non-therapeutic laparotomies. In most cases, it was sufficient to rule out

Table 1. Spectrum of laparoscopic procedures performed in hemodynamically stable battlefield casualties with abdominal trauma (n = 238)

Procedure type	Number of cases (n)	% of the total	Notes
Diagnostic laparoscopy	78	32.8 %	Exclusion of major injuries, including negative and non-therapeutic patient groups
Foreign body removal	60	25.2 %	Metallic fragments, splinters; magnetic devices used in selected cases
Laparoscopic hemostasis	23	9.9 %	Mainly minor liver and splenic injuries
Diaphragmatic repair	19	8.0 %	Thoracoabdominal trauma, intracorporeal suturing, chest tube before laparoscopy
Gastric suturing	7	2.8 %	Primary repair of penetrating gastric injuries
Small bowel suturing	8	3.4 %	Include 1 extracorporeal repair
Colonic suturing	24	10.1 %	Majority involved left colon injuries
Small bowel resection + anastomosis	1	0.4 %	Extracorporeal anastomosis
Colostomy	7	2.9 %	For destructive colonic injuries
Right hemicolectomy	3	1.2 %	1 extracorporeal, 2 intracorporeal anastomoses
Transverse colon resection	1	0.4 %	Intracorporeal anastomosis
Left hemicolectomy + colostomy	1	0.4 %	High-grade colonic injury
Hartmann's procedure	1	0.4 %	Severe destructive colonic trauma
Splenectomy	5	2.1 %	High-grade splenic trauma

major intra-abdominal injuries and guide further management, thereby minimizing surgical trauma in already compromised patients. Of these 78 patients, 42 % (n = 33) had negative laparoscopy with no intra-abdominal injuries detected. The remaining 58 % (n = 45) constituted the non-therapeutic laparoscopy group, in which no organ repair was required; however, adjunctive procedures such as peritoneal lavage or evacuation of minimal hemoperitoneum were performed. Although certain patients could have been considered candidates for non-operative management, laparoscopy was utilized to reliably exclude occult injuries and thereby minimize the risk of missed pathology in the combat setting.

In 60 cases, foreign bodies were surgically removed. The extracted materials included metallic fragments, shell splinters, and other retained objects. In selected instances, specially adapted magnetic devices were employed to enhance localization and facilitate retrieval. These procedures were important for preventing delayed infectious complications and reducing long-term morbidity related to retained foreign bodies. In about 30 % of cases (n = 18), the fragments were biologically inert and, in theory, could have been left in situ without immediate clinical consequences. However, given the context of combat-related trauma and the potential risk of undetected visceral injuries or secondary complications, surgical removal was performed. This proactive approach illustrates the pragmatic balance in military surgery between minimizing unnecessary interventions and reducing the likelihood of missed injuries in complex battlefield environments.

Laparoscopic hemostasis was achieved in 23 cases, primarily involving parenchymal organs such as the liver and spleen (AAST grade I). These procedures demonstrated the feasibility of bleeding control without conversion to open surgery in carefully selected patients. This approach is especially justified in patients with a high degree of anatomical damage to the parenchymal organs of the abdominal cavity according to the AAST. In cases of superficial liver and splenic injuries, laparoscopic hemostasis was predominantly achieved using monopolar coagulation.

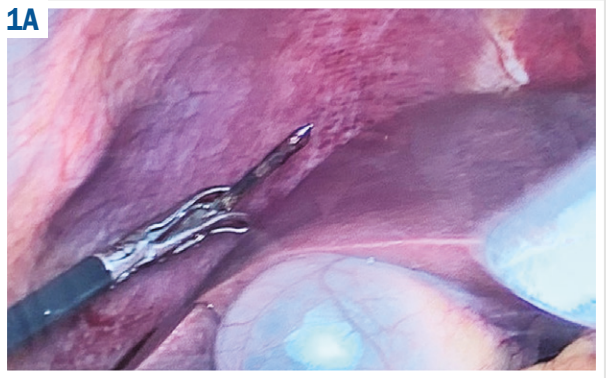
Repairs of diaphragmatic injuries were performed in 19 patients, including 15 involving the left hemidiaphragm and 4 involving the right hemidiaphragm, predominantly resulting from penetrating thoracoabdominal trauma. Laparoscopic suturing ensured reliable closure while reducing the incidence of postoperative pulmonary complications compared to conventional open repair. In this patient population, preoperative chest tube thoracostomy is essential, as insufflation of carbon dioxide into the abdominal cavity may markedly exacerbate the condition of individuals with an undrained pleural space. Injuries were closed in all cases using 3-0 V-Loc barbed sutures.

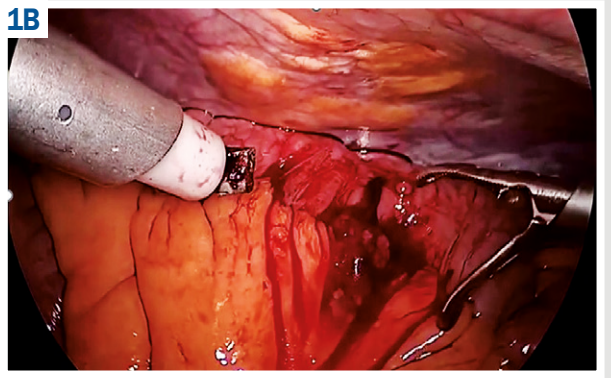
Hollow viscus repair was performed in 39 cases, including gastric suturing (n = 7), small bowel suturing (n = 8, with one extracorporeal repair), and colonic suturing (n = 24). In one patient, laparoscopic resection of the small intestine with extracorporeal anastomosis was performed.

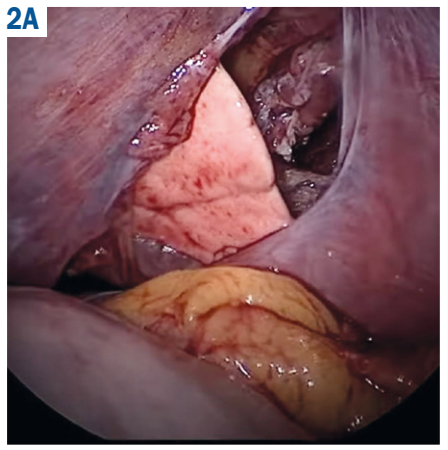
Colorectal procedures demonstrated the greatest variability. These included laparoscopic colostomy (n = 7), right hemicolectomy (n = 3), transverse colon resection with intracorporeal anastomosis (n = 1), left hemicolectomy with colostomy (n = 1), and laparoscopic Hartmann's procedure (n = 1).

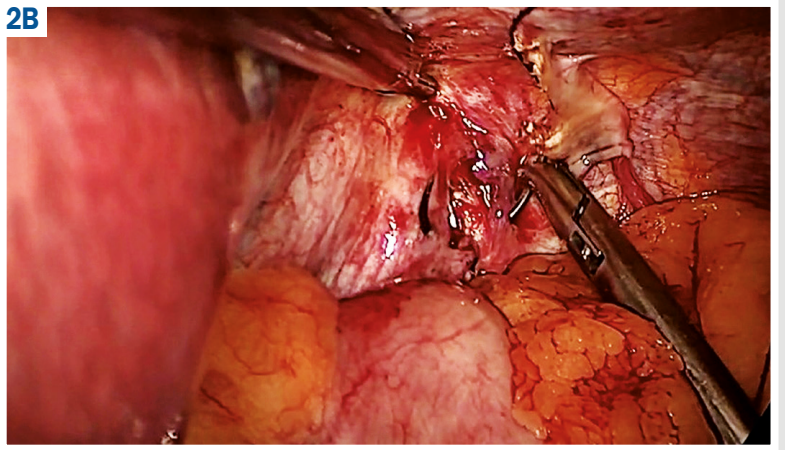
High-degree splenic injuries were managed laparoscopically in 5 patients, where splenectomy was required due to the severity of parenchymal disruption. Despite the technical complexity, these procedures demonstrated that laparoscopic approaches are feasible even in operations traditionally performed via open surgery. In selected patients with severe splenic trauma, laparoscopic splenectomy may provide a viable alternative to open surgery, offering potential benefits such as diminished postoperative pain, reduced length of hospital stay, and accelerated recovery. Nevertheless, this technique requires a high level of surgical proficiency and rigorous intraoperative hemostatic management due to the spleen's rich vascular supply.

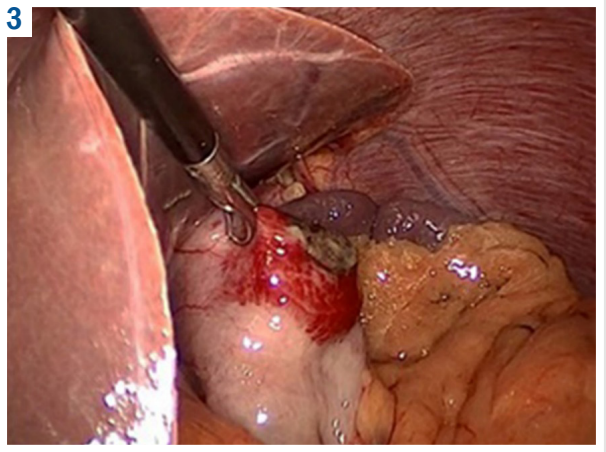
Within the study cohort, laparoscopic procedures necessitated conversion to open laparotomy in 28 (11.7 %) cases. In most instances, the decision for conversion was made within the first 15 minutes of surgery, prompted by intraoperative conditions precluding safe laparoscopic management, such as uncontrolled hemorrhage, extensive peritoneal contamination, or inadequate visualization. Furthermore, secondary laparotomy was performed in 5 patients during the postoperative period due to missed small bowel injuries (n = 2), intra-abdominal abscess formation (n = 1), refractory paralytic ileus (n = 1), and delayed intra-abdominal hemorrhage (n = 1).

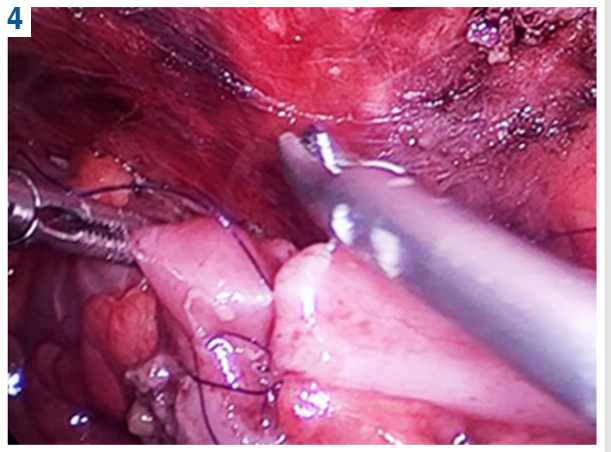












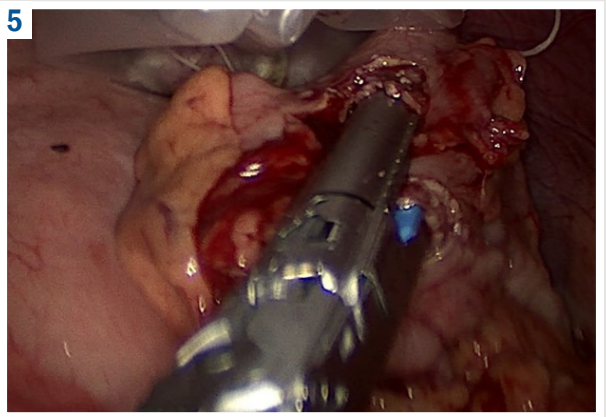


Fig. 1. A: a facet removed from the liver surface using a laparoscopic technique. **B:** depicts a metallic fragment removed from the mesenteric root using a laparoscopic magnet.

Fig. 2. A: a case of extensive injury of the left diaphragmatic dome. **B:** a case of laparoscopic repair employing intracorporeal diaphragmatic suturing.

Fig. 3. Gastric wall injury associated with an embedded metallic fragment.

Fig. 4. Laparoscopic suturing of a colonic defect following combat-related injury with 3-0 V-Loc barbed sutures.

Fig. 5. Colon resection followed by side-to-side anastomosis using a linear stapler.

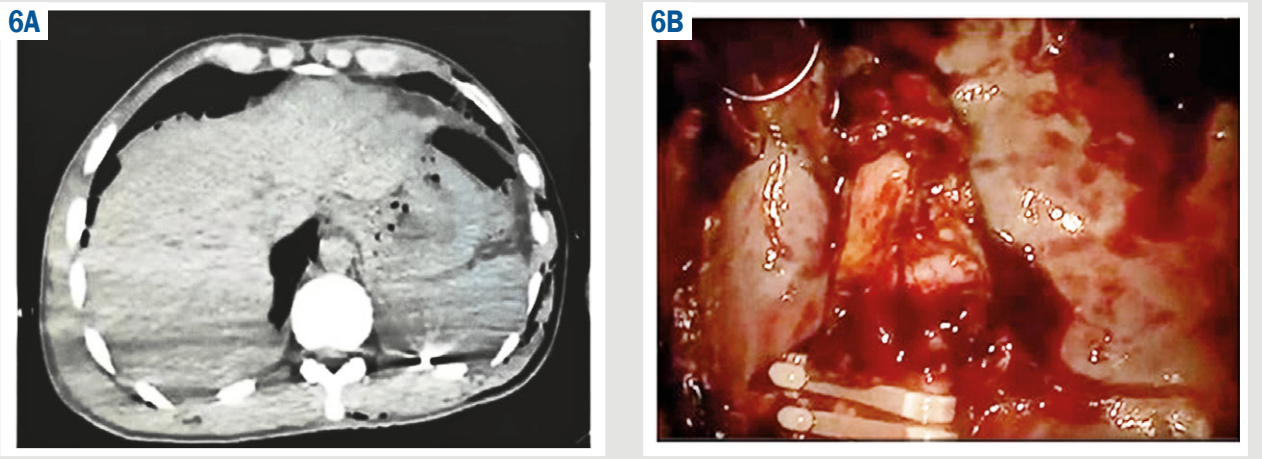


Fig. 6. A: CT scan of AAST grade 4 splenic penetrating injury in a hemodynamically stable patient. **B:** Laparoscopic splenectomy in a patient with high-grade splenic trauma.

Table 2. Complications, conversions, and negative outcomes of laparoscopic interventions (n = 33)

Negative outcomes	Number of cases (n)	% of the total	Notes
Conversions to laparotomy	28	11.7 %	Decision made within first 15 minutes due to uncontrolled bleeding, contamination, or inadequate visualization
Secondary laparotomy (postoperative), n = 5 (2.1 % of the total)			
Missed small bowel injuries	2	0.9 %	Diagnosed during postoperative course
Intra-abdominal abscess	1	0.4 %	Managed by surgical drainage
Paralytic ileus	1	0.4 %	Resistant to conservative treatment
Delayed intra-abdominal bleeding	1	0.4 %	Required re-laparotomy for hemostasis

Discussion

Based on the authors' experience at the Zaporizhzhia Military Hospital, the use of laparoscopy in the management of abdominal trauma in military settings has proven both feasible and beneficial when strict selection criteria are applied. The essential conditions ensuring the safe application of laparoscopic interventions comprised a relatively limited influx of casualties, the presence of a highly trained surgical team with laparoscopic proficiency, the availability of appropriate instrumentation, and patient hemodynamic stability. Additional prerequisites included routine preoperative CT imaging and meticulous patient selection, taking into account the characteristics of entry and exit wounds, fragment trajectory, and the exclusion of cases with extensive hemoperitoneum or fecal contamination. These criteria are consistent with international consensus, which underscores that laparoscopy should be restricted to carefully selected hemodynamically stable trauma patients [9,10]. Within our clinical context, the primary benefits of laparoscopy were accelerated recovery, earlier mobilization, and expedited return of soldiers to active duty – an outcome of particular relevance under wartime conditions.

Diaphragmatic repair constitutes a well-established indication for laparoscopic intervention in cases of penetrating thoracoabdominal trauma. In the present cohort, barbed sutures (3-0 V-Loc) were employed, demonstrating safety and reliability while contributing to a significant reduction in operative time. The insertion of a chest tube prior to the creation of pneumoperitoneum was considered essential, since insufflation of carbon dioxide in the presence of an undrained pleural cavity may lead to respiratory compromise. These findings are consistent with evidence from international centers, which indicate that laparoscopic repair of diaphragmatic injuries ensures both high diagnostic accuracy and therapeutic efficacy, while being associated with lower morbidity compared to conventional open procedures [11,12].

In cases of parenchymal organ injury, laparoscopic hemostasis of the liver and spleen employing bipolar cautery or advanced energy devices enabled avoidance of laparotomy in selected hemodynamically stable patients with limited hemoperitoneum. In our cohort, the majority of injuries were classified as AAST grade I–II, with a smaller subset of carefully selected grade III–IV cases. This prudent strategy is consistent with current evidence, which supports the use of laparoscopy for low-grade solid organ injuries, whereas its role in higher-grade injuries remains controversial and necessitates individualized clinical decision-making [9,13].

Laparoscopic splenectomy was undertaken exclusively in hemodynamically stable patients presenting with penetrating trauma and substantial anatomical disruption (AAST grade 2 and higher). Despite its technical feasibility, the clinical applicability of this approach remains constrained, as hemodynamic instability in splenic trauma constitutes an absolute indication for laparotomy. Consistent with this, international guidelines recommend laparoscopic splenectomy only in exceptional circumstances [14].

Hollow viscus injuries constituted a significant indication for minimally invasive intervention. In the present cohort, laparoscopic repair of gastric and small bowel perforations proved feasible, with the application of barbed sutures notably facilitating and expediting the procedure. These

repairs were restricted to lesions of AAST grade I–II severity, typically involving partial-thickness defects of less than 50 % of the bowel circumference, without substantial devascularization or full-thickness disruption. In a single case, small bowel resection with extracorporeal anastomosis was undertaken; however, the applicability of intracorporeal anastomosis in the trauma setting remains to be determined. Current evidence supports laparoscopic repair in carefully selected cases of hollow viscus injury, although the potential for missed injuries remains a major limitation [5]. For low-grade lesions, this approach confers distinct advantages, including technical simplicity, shorter operative time, and reduced invasiveness compared to open surgery.

Based on our clinical observations, the application of barbed sutures offers distinct advantages in laparoscopic repair of both diaphragmatic and hollow organ injuries, primarily by facilitating intracorporeal suturing and reducing operative time. These results align with the findings of N. R. Muensterer et al., who demonstrated the feasibility and safety of barbed sutures in congenital diaphragmatic hernia repair, noting enhanced handling characteristics and secure closure without the necessity of knot tying [15].

Moreover, the accumulated evidence in gastrointestinal surgery further supports these outcomes. In their systematic review and meta-analysis, N. Velotti et al. reported that barbed sutures not only shorten operative duration but also yield complication, leakage, and recurrence rates comparable to those of conventional sutures [16]. Collectively, both our experience and the expanding international literature provide robust evidence for the routine implementation of barbed sutures in minimally invasive surgery.

In our series, colorectal trauma accounted for the greatest diversity of laparoscopic interventions, encompassing primary suturing, segmental resections, colostomies, hemicolectomies, and Hartmann's procedure. Compared with open surgery, laparoscopy demonstrated clear benefits, notably in reducing wound-related complications and accelerating postoperative recovery. These observations align with the worldwide trend toward broader implementation of minimally invasive techniques in colorectal trauma, largely supported by accumulated experience in elective colorectal surgery [9,17]. However, the current body of evidence in trauma remains insufficient, underscoring the need for large-scale multicenter investigations to formulate more definitive clinical guidelines.

The issue of negative and non-therapeutic laparoscopies, as well as the management of retained foreign bodies, remains a matter of ongoing debate in trauma surgery. Several systematic reviews have highlighted that negative laparoscopy is not uncommon, ranging from 20–40 % of cases in both civilian and military settings, reflecting the priority of avoiding missed injuries rather than strictly minimizing surgical exposure [5,7].

While some authors argue that unnecessary laparoscopic interventions could be avoided through careful observation protocols in hemodynamically stable patients [6], others emphasize that in high-energy combat trauma the threshold for operative exploration should remain low given the frequency of occult injuries and the catastrophic consequences of delayed diagnosis [8].

A similar controversy exists regarding the management of metallic fragments and splinters: although a proportion of these foreign bodies may be biologically inert and could theoretically be left in situ, most trauma surgeons advocate for their removal when feasible, to reduce the risk of sepsis, migration, or late complications [4]. Thus, in the combat environment, the decision to proceed with laparoscopy or foreign body extraction should be understood as a trade-off between minimizing unnecessary intervention and safeguarding against potentially life-threatening missed injuries.

Conversion to laparotomy occurred in 11.7 % of our cases, typically within 15 minutes of initiating laparoscopy when the procedure was deemed unsafe or non-beneficial. Post-laparoscopy complications requiring delayed laparotomy developed in five patients, including two missed small bowel injuries, one intra-abdominal abscess, one paralytic ileus, and one delayed intra-abdominal bleeding. The findings highlight the dual nature of laparoscopy, emphasizing its advantages as a minimally invasive diagnostic and therapeutic modality, while also underscoring the necessity for vigilance, readiness to convert to open surgery, and recognition of the potential for missed injuries. International data report comparable rates of conversion and complication profiles [9,10].

Laparoscopic approaches demonstrate considerable advantages in the management and subsequent rehabilitation of patients with combat-related abdominal trauma. The technique is associated with minimized surgical trauma, earlier mobilization, and reduced postoperative pain, which collectively contribute to shorter intensive care unit and overall hospital stays. These outcomes facilitate more rapid functional recovery and reintegration into military rehabilitation programs.

Our clinical experience underscores the expanding role of laparoscopy in the treatment of abdominal trauma within the military setting. Despite the well-recognized benefits such as reduced morbidity, accelerated recovery, and earlier return to duty, its implementation necessitates rigorous patient selection, highly experienced surgical teams, and adequate institutional resources.

Conclusions

1. Laparoscopic interventions for abdominal combat trauma have been shown to be feasible under conditions of hemodynamic stability, routine preoperative CT imaging, availability of appropriate equipment, and careful patient selection. The spectrum of safe procedures ranges from diagnostic laparoscopy and foreign body removal to hemostasis of parenchymal organ injuries and repair of hollow viscus lesions up to AAST grade II. These approaches have significantly reduced non-therapeutic laparotomies and postoperative morbidity while accelerating recovery and return to duty.

2. More complex interventions, such as laparoscopic resections of the small and large bowel, remain technically demanding and should currently be reserved for highly selected cases. Wider adoption in military trauma surgery requires further evidence, prospective multicenter studies, and long-term follow-up to refine selection criteria and standardize protocols.

Prospects for further research. Future research should focus on expanding the evidence base for advanced laparoscopic interventions in combat-related trauma. Particular attention is needed for the role of extended bowel resections with intracorporeal anastomosis, which remain poorly stud-

ied in the trauma setting. Further studies are also warranted to evaluate the safety and long-term outcomes of barbed sutures in emergency abdominal surgery, as well as to address other current gaps in evidence regarding minimally invasive approaches in wartime abdominal injuries.

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Information about the authors:
Lurin I. A., MD, PhD, DSc, National Academy of Medical Sciences of Ukraine, Kyiv; State Institution of Science "Center of Innovative Healthcare Technologies" State Administrative Department, Kyiv, Ukraine.
ORCID ID: 0000-0001-6280-1725
Gumeniuk K. V., MD, PhD, Associate Professor, Command of the Medical Forces of the Armed Forces of Ukraine, Colonel of the Medical Service, Chief Surgeon of the Armed Forces of Ukraine.
ORCID ID: 0000-0001-8892-4061
Mikheiev Iu. O., MD, PhD, DSc, Associate Professor, Professor of the Department of Disaster Medicine and Military Medicine, Zaporizhzhia State Medical and Pharmaceutical University; Major of the Medical Service, Leading Surgeon, Zaporizhzhia Military Hospital, Military Unit A3309, Ukraine.
ORCID ID: 0000-0002-0305-1570
Kuziv R. M., MD, Commander of Zaporizhzhia Military Hospital, Ukraine.
ORCID ID: 0009-0001-4462-9922
Tielushko Ya. V., MD, PhD, Associate Professor of the Department of Disaster Medicine and Military Medicine, Zaporizhzhia State Medical and Pharmaceutical University; Head of the Department of Thoracic Surgery, Zaporizhzhia Military Hospital, Ukraine.
ORCID ID: 0000-0002-0745-6698
Rusanov I. V., MD, PhD, Associate Professor of the Department of Hospital Surgery, Zaporizhzhia State Medical and Pharmaceutical University; Head of the Department of Vascular Surgery, Zaporizhzhia Military Hospital, Ukraine.
ORCID ID: 0000-0002-4363-1158
Mialkovskyi D. S., MD, PhD, Senior Vascular Surgeon, Zaporizhzhia Military Hospital, Ukraine.
ORCID ID: 0000-0001-5565-0850
Machuskyi S. M., MD, Vascular Surgeon, Zaporizhzhia Military Hospital, Ukraine.
ORCID ID: 0000-0002-0985-223X

Відомості про авторів:
Лурін І. А., д-р мед. наук, професор, Національна академія медичних наук України, м. Київ; Державна наукова установа «Центр інноваційних технологій охорони здоров'я» Державного управління справами, м. Київ, Україна.
Гуменюк К. В., канд. мед. наук, доцент, полковник медичної служби, головний хірург Збройних Сил України, Командування Медичних сил Збройних Сил України.
Міхеєв Ю. О., д-р мед. наук, доцент, професор каф. медицини катастроф та військової медицини, Запорізький державний медико-фармацевтичний університет; майор медичної служби, провідний хірург, Запорізький військовий госпіталь, військова частина А3309, Україна.
Кузів Р. М., начальник Запорізького військового госпіталю, Україна.
Тєлушко Я. В., канд. мед. наук, доцент каф. медицини катастроф та військової медицини, Запорізький державний медико-фармацевтичний університет; зав. відділення торакальної хірургії, Запорізький військовий госпіталь, Україна.
Русанов І. В., канд. мед. наук, доцент каф. госпітальної хірургії, Запорізький державний медико-фармацевтичний університет; зав. відділення судинної хірургії, Запорізький військовий госпіталь, Україна.
Мялковський Д. С., PhD, старший судинний хірург, Запорізький військовий госпіталь, Україна.
Мачуський С. М., судинний хірург, Запорізький військовий госпіталь, Україна.


Iurii Mikheiev (Юрій Міхеєв)
mikheev.u.a@gmail.com

References

1. Limaye Y. The terrifying new weapon changing the war in Ukraine. BBC [Internet]. 2025 May 28 [cited 2025 Aug 15]; Available from: https://www.bbc.com/news/articles/ckgn47e5qyno
2. Gumeniuk K, Lurin I, Savytskyi O, Nehoduiko V, Makarov V, Smolianyk K. Surgical tactics in fire kidney injury and the first experience in performing laparoscopic nephrectomy at the II level of medical support (role II) in combat conditions: Case report. Int J Surg Case Rep. 2023;106:108046. doi: 10.1016/j.ijscr.2023.108046
3. Lurin I, Vorovskiy O, Makarov V, Khoroshun E, Nehoduiko V, Ryzhenko A, et al. Management of thoracoabdominal gunshot injuries by using minimally invasive surgery at role 2 deployed field hospitals in Ukraine. BMC Surg. 2024;24(1):183. doi: 10.1186/s12893-024-02475-3
4. Mikheiev IO, Gumeniuk KV, Tielushko YV, Mialkovskyi DS, Savchenko SI. First experience of laparoscopic colon resection with primary anastomosis for combat-related thoracoabdominal trauma with through-and-through colon injury. Modern Medical Technology. 2025;17(1):73-8. doi: 10.14739/mmt.2025.1.320424
5. Pau L, Navez J, Cawich SO, Dapri G. Laparoscopic management of blunt and penetrating abdominal trauma: A single-center experience and review of the literature. J Laparoendosc Adv Surg Tech. 2021;31(11):1262-8. doi: 10.1089/lap.2020.0552
6. Beltzer C, Bachmann R, Strohäker J, Axt S, Schmidt R, Küper M, et al. Wertigkeit der Laparoskopie beim penetrierenden und stumpfen Abdominaltrauma – ein systematisches Review. Chirurg. 2020;91(7):567-75. doi: 10.1007/s00104-020-01158-y
7. O'Malley E, Boyle E, O'Callaghan A, Coffey JC, Walsh SR. Role of laparoscopy in penetrating abdominal trauma: A systematic review. World J Surg. 2013;37(1):113-22. doi: 10.1007/s00268-012-1790-y
8. Awad S, Dawoud I, Negm A, Althobaiti W, Alfaran S, Alghamdi S, et al. Impact of laparoscopy on the perioperative outcomes of penetrating abdominal trauma. Asian J Surg. 2022;45(1):461-7. doi: 10.1016/j.asjsur.2021.07.070
9. Di Saverio S, Birindelli A, Podda M, Segalini E, Piccinini A, Coniglio C, et al. Trauma laparoscopy and the six W's: Why, where, who, when, what, and how? J Trauma Acute Care Surg. 2019;86(2):344-56. doi: 10.1097/TA.0000000000002100
10. Zafar SN, Onwugbufor MT, Hughes K, Greene WR, Cornwell EE, Fullum TM, et al. Laparoscopic surgery for trauma: A meta-analysis. J Trauma Acute Care Surg. 2015;78(4):621-30. doi: 10.1097/TA.0000000000000560
11. Matthews BD, Bui H, Harold KL, Kercher KW, Adrales G, Park A, et al. Laparoscopic repair of traumatic diaphragmatic injuries. Surg Endosc. 2003;17(2):254-8. doi: 10.1007/s00464-002-8831-9
12. Koto MZ, Matsevych OY, Mosai F, Balabyeki M, Aldous C. Laparoscopic management of retroperitoneal injuries from penetrating abdominal trauma in haemodynamically stable patients. J Minim Access Surg. 2019;15(1):25-30. doi: 10.4103/jmas.JMAS_199_17
13. Coccolini F, Montori G, Catena F, Kluger Y, Biffl W, Moore EE, et al. Splenic trauma: WSES classification and guidelines for adult and pediatric patients. World J Emerg Surg. 2017;12:40. doi: 10.1186/s13017-017-0151-4
14. Coccolini F, Montori G, Catena F, Kluger Y, Biffl W, Moore EE, et al. Splenic trauma: WSES classification and guidelines for adult and pediatric patients. World J Emerg Surg. 2017;12:40. doi: 10.1186/s13017-017-0151-4
15. Muensterer NR, Weigl E, Holler AS, Zeller C, Häberle B, Muensterer OJ. Use of Barbed Sutures for Congenital Diaphragmatic Hernia Repair. Children (Basel). 2023 Dec 28;11(1):35. doi: 10.3390/children11010035
16. Velotti N, Manigrasso M, Di Lauro K, Vertaldi S, Anoldo P, Vitiello A, et al. Barbed suture in gastro-intestinal surgery: a review with a meta-analysis. Surgeon. 2022;20(2):115-22. doi: 10.1016/j.surge.2021.02.011
17. Abraha I, Binda GA, Montedori A, Arezzo A, Cirocchi R. Laparoscopic versus open resection for sigmoid diverticulitis. Cochrane Database Syst Rev. 2017;11(11):CD009277. doi: 10.1002/14651858.CD009277.pub2