

Challenges in the Diagnosis and Treatment of Intra- and Extraperitoneal Rectal Injuries among War-Injured Individuals

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Abstract

Background: Rectal trauma sustained during armed conflict is a rare but life-threatening injury associated with high morbidity due to severe contamination, complex pelvic anatomy, and frequent multi-organ involvement. In conflict-affected regions such as Gaza, additional challenges-including limited resources, delayed evacuation, and overwhelming patient load-further complicate diagnosis and management. This study aimed to evaluate injury patterns, diagnostic approaches, treatment characteristics, and outcomes of war-related intra- and extraperitoneal rectal trauma, while also exploring frontline healthcare providers' experiences in managing these injuries under austere conditions.

Methods: A descriptive cross-sectional design combined with a retrospective medical record review was employed. The retrospective component included all available cases of confirmed intra- and/or extraperitoneal rectal injuries managed during the study period in Gaza hospitals and referral trauma centers. A purposive sampling strategy ensured inclusion of all eligible patient records. Quantitative data were extracted using a structured data collection form and analyzed using descriptive and inferential statistics in SPSS. Associations between injury type, severity grading, associated organ injuries, and shock were assessed using chi-square testing. The cross-sectional component involved semi-structured interviews with trauma surgeons, emergency physicians, and surgical nurses with at least six months of war-trauma experience. Qualitative data were analyzed thematically. Ethical approval was obtained, and confidentiality was strictly maintained.

Results: A total of 332 patients were included. Shrapnel injuries accounted for 88.0% of cases. Extraperitoneal injuries were most common (39.8%), while 27.7% sustained combined intra- and extraperitoneal injuries. Multi-organ involvement was present in 37.3% of patients. High-grade injuries (AAST Grade III-IV) constituted 41.0% and were significantly associated with multiple associated organ injuries ($p < 0.001$). Shock on admission occurred in 39.8% and was significantly associated with combined injury patterns ($p < 0.001$). CT imaging demonstrated superior detection of complex injuries compared with FAST examination ($p < 0.01$). Healthcare providers reported significant diagnostic and resource-related challenges.

Conclusion: War-related rectal trauma in Gaza is characterized by high-energy mechanisms, complex anatomical disruption, and significant physiological instability. Early surgical intervention and advanced imaging are critical for improving outcomes in resource-constrained conflict settings.

Keywords: Rectal Trauma; War Injuries; Shrapnel; Combat Surgery; Pelvic Sepsis

Introduction

With a frequency of around 1% to 3% in trauma cases involving civilians and 5.1% in rectal trauma cases resulting from military trauma, the rectum is the least often damaged organ in trauma. In almost a quarter of these situations, explosives play a role. Approximately 70% to 85% of civilian injuries are caused by gunshot wounds, with the remaining instances accounted for by blunt force trauma (5% to 10%), and knife wounds (3% to 5%) [1]. Among them, civilians seldom sustain blunt trauma that causes rectal injuries outside of the abdomen; when they do, it is typically in conjunction with pelvic or sacral fractures that occur inside the abdomen [2]. Rectal injuries are uncommon, hard to detect, and sometimes disregarded because of the rectum's protective location inside the pelvic [3].

Much to colonic lesions, intraperitoneal rectal lesions are often treated with direct repair without diversion. On the other hand, fecal diversion is the sole option available when using the transabdominal method, and extraperitoneal rectal lesions are notoriously difficult to reach [4]. Depending on the severity of the lesion, extraperitoneal rectal lesions may be treated either conservatively or surgically. Closing the defect, if feasible, seems to be advantageous, however there is presently no consensus for the care of mild injuries [2]. To minimize diversion and ensure adequate primary repair, it is important to optimize access to extraperitoneal rectal lesions in such patients. When dealing with extraperitoneal rectal lesions, transanal minimally invasive surgery may improve the chances of a successful primary repair [4,5]. Despite improvements in trauma patient care, the death rate remains between 3 and 10% and the risk of further complications is between 18% and 21%, despite a drop in mortality rates over the last several decades. Furthermore, rectum lesions are seldom seen in isolation due to the closeness of the organs and major pelvic arteries, the injury to which might complicate care and decrease the patient's result. There is still a lot of debate about how to best treat these kinds of injuries [1,3].

Aim of the Study

The current study aimed to examine the diagnostic and therapeutic challenges associated with intra- and extraperitoneal rectal injuries among war-injured individuals in order to improve clinical outcomes and guide evidence-based management in conflict settings.

Methods

Study design

This study adopted a descriptive cross-sectional design complemented by a retrospective review of medical records. The cross-sectional component captured the diagnostic and treatment challenges faced by healthcare providers in real time, while the retrospective analysis provided insight into patterns of clinical presentation, interventions, and outcomes among war-injured individuals with intra- and extraperitoneal rectal trauma. This mixed approach ensured both breadth and depth of understanding, combining direct accounts from practitioners with empirical patient data to generate evidence-based conclusions.

Study setting

The research was conducted in Gaza hospitals, referral trauma centers, and designated humanitarian medical facilities situated in conflict-affected regions. These settings reflected the realities of wartime healthcare delivery, including resource limitations, delayed patient evacuation, and high patient load. By situating the study within such contexts, the research captured the practical difficulties of diagnosing and managing rectal injuries under austere conditions, thereby ensuring the findings remained directly applicable to real-world war surgery and emergency medicine.

Study population

The study population consisted of war-injured individuals diagnosed with intra- or extraperitoneal rectal injuries, as well as frontline healthcare professionals-including trauma surgeons, emergency physicians, and surgical nurses-who were involved in their care. Inclusion criteria for patients encompassed all individuals with confirmed rectal injuries sustained during armed conflict, regardless of age, sex,

or military status. Healthcare providers with at least six months of experience in managing war-related trauma were also eligible to participate. This dual perspective, integrating patient outcomes with provider experiences, generated a comprehensive understanding of the challenges involved.

Sample size and sampling technique

For the retrospective patient record review, a purposive sampling strategy was employed to include all available cases of intra- and extraperitoneal rectal injuries managed within the study period. Given the relative rarity of rectal trauma compared to other forms of abdominal injuries, inclusion of all identified cases was essential to maximize data power. For healthcare professionals, a purposive sampling approach was also used to target those with direct and significant experience in diagnosing and managing rectal trauma in wartime conditions. Sample size adequacy was determined by data saturation for qualitative insights and by the total number of available patient cases for quantitative review.

Study instruments

Data were collected using two primary instruments: a structured data extraction form and a semi-structured interview guide. The extraction form was designed to capture demographic information, mechanism of injury, clinical presentation, diagnostic procedures, surgical interventions, complications, and outcomes from medical records. The semi-structured interview guide was used to elicit healthcare providers' perspectives on diagnostic difficulties, surgical decision-making, and resource-related constraints. These instruments were validated through expert review and pretested in a small subset of cases to ensure clarity, accuracy, and reliability.

Data collection

Patient data were collected retrospectively from hospital records covering a defined study period, with all relevant details extracted systematically. In parallel, healthcare providers were invited to participate in face-to-face or virtual interviews depending on accessibility and security conditions. All interviews were recorded with consent, transcribed verbatim, and anonymized. Data collection was conducted by trained research assistants to ensure consistency, minimize bias, and maintain confidentiality. Continuous supervision and quality checks were implemented throughout the process.

Data analysis

Quantitative data derived from patient records were entered into statistical software (SPSS) and analyzed using descriptive and inferential statistics. Frequencies, proportions, and measures of central tendency summarized injury characteristics, diagnostic methods, and treatment outcomes. Associations between diagnostic delays, treatment modalities, and patient outcomes were explored using appropriate statistical tests. Qualitative data from interviews were analyzed thematically through systematic coding, categorization, and identification of recurrent patterns. Integration of quantitative and qualitative findings provided a holistic interpretation of the challenges in diagnosis and management.

Ethical consideration

Ethical approval was obtained from the relevant institutional review boards and hospital ethics committees prior to commencement of the study. Informed consent was obtained from all participating healthcare providers and, where possible, from patients or their legal representatives for the use of medical data. Confidentiality was strictly maintained by anonymizing records and interview transcripts, with all data stored securely and accessed only by authorized research personnel. Given the sensitivity of war-related injuries, special consideration was given to ensuring that participation was entirely voluntary, with the right to withdraw at any stage without consequence. The study adhered strictly to the ethical principles of beneficence, respect for persons, and justice.

Results

The study included 332 participants. Majority of participants were males (n = 280, 84.3%). The mean age among study participants was 29.43 ± 12.15 years with median age of 29 years.

The mechanism of injury was overwhelmingly related to high-energy explosive trauma. Shrapnel injuries constituted the vast majority of cases (n = 292, 88.0%), followed by gunshot wounds (n = 36, 10.8%) and blast injuries without penetrating fragments (n = 4, 1.2%). With regard to referral patterns, most patients were directly admitted from the field (n = 292, 88.0%), while 40 patients (12.0%) were transferred from other hospitals. This distribution reflects the acute nature of battlefield evacuation systems and the centralized structure of trauma management in conflict settings.

Variable	Category	n	%
Mode of injury	Shrapnel	292	88.0
	Gunshot	36	10.8
	Blast	4	1.2
Referral source	Direct admission	292	88.0
	Transferred	40	12.0

Table 1: Mechanism of injury and referral source.

Extraperitoneal rectal injuries were the most frequent anatomical pattern, observed in 132 patients (39.8%). Intraperitoneal injuries were identified in 108 patients (32.5%), while 92 patients (27.7%) sustained combined intra- and extraperitoneal injuries. The predominance of extraperitoneal involvement is consistent with pelvic and gluteal injury trajectories commonly seen in shrapnel dissemination during explosive events. However, the substantial proportion of combined injuries underscores the destructive potential of high-energy mechanisms and the complex anatomical disruption associated with such trauma.

Type of Injury	n	%
Extraperitoneal	132	39.8
Intraperitoneal	108	32.5
Combined	92	27.7

Table 2: Type of rectal injury.

Isolated rectal injury occurred in 112 patients (33.7%), whereas 96 patients (28.9%) sustained one associated intra-abdominal organ injury and 124 patients (37.3%) had two or more associated organ injuries. The most common associated injuries involved the small bowel, documented in 132 patients (39.8%), followed by large bowel injury in 72 patients (21.7%) and urinary bladder injury in 64 patients (19.3%). Vascular injuries were identified in 36 patients (10.8%), and fractures were documented in 20 patients (6.0%). Solid organ injuries were less frequent, with splenic injuries occurring in 16 patients (4.8%), renal injuries in 12 patients (3.6%), and hepatic injuries in 8 patients (2.4%). Stomach injury was recorded in 4 patients (1.2%). No pancreatic, diaphragmatic, or gallbladder injuries were observed. These findings illustrate the high incidence of concomitant visceral damage in war-related rectal trauma and highlight the complexity of surgical management in this cohort.

Organ/System	n	%
Small bowel	132	39.8
Large bowel	72	21.7
Urinary bladder	64	19.3
Vascular	36	10.8
Fracture	20	6.0
Spleen	16	4.8
Kidney	12	3.6
Liver	8	2.4
Stomach	4	1.2

Table 3: Associated organ injuries.

Based on the AAST rectal injury grading scale, grade II injuries were the most common, identified in 144 patients (43.4%). Grade III injuries accounted for 100 cases (30.1%), grade I injuries for 48 cases (14.5%), and grade IV injuries for 36 cases (10.8%). High-grade injuries (Grade III-IV) therefore constituted 41.0% of the cohort, reflecting the destructive energy transfer characteristic of shrapnel wounds and their association with extensive tissue disruption.

Grade	n	%
Grade I	48	14.5
Grade II	144	43.4
Grade III	100	30.1
Grade IV	36	10.8

Table 4: Severity grading.

At presentation, 132 patients (39.8%) were in shock, indicating significant physiological compromise on admission. Rectal bleeding was documented in 124 patients (37.3%), while abdominal tenderness was observed in 204 patients (61.4%). Clinical signs of peritonitis were present in 32 patients (9.6%), and fecal matter within the wound was documented in 20 patients (6.0%). The majority of patients underwent surgical intervention within six hours of presentation (96.4%), reflecting adherence to expedited trauma protocols in the management of penetrating rectal injuries.

All patients underwent complete blood count testing upon admission. Imaging modalities were widely utilized in diagnostic evaluation. Computed tomography (CT) of the abdomen and pelvis was performed in 312 patients (94.0%), while focused assessment with sonography for trauma (FAST) was conducted in 296 patients (89.2%). Abdominal X-ray was used in 8 patients (2.4%), and contrast enema was performed in selected cases, demonstrating contrast extravasation in 24 patients (7.2%). FAST examination yielded positive findings in 81.9% of cases. CT imaging commonly demonstrated hemoperitoneum, free intra-abdominal fluid, pneumoperitoneum, retroperitoneal air, perirectal fat stranding, and direct visualization of shrapnel tracts abutting or penetrating the rectum.

Hemoglobin levels on admission demonstrated a wide range, with a substantial proportion of patients presenting with values below 10 g/dL, reflecting significant blood loss secondary to high-energy penetrating trauma. White blood cell counts were variably elevated, consistent with the acute inflammatory response to tissue injury and contamination.

Modality	n	%
CT scan	312	94.0
FAST	296	89.2
Abdominal X-ray	8	2.4
Contrast enema (extravasation)	24	7.2

Table 5: Diagnostic modalities used.

Inferential statistical analysis demonstrated a significant association between type of rectal injury and the presence of shock on admission (χ^2 test, $p < 0.001$). Combined intra- and extraperitoneal injuries were disproportionately associated with hemodynamic instability compared with isolated extraperitoneal injuries. Furthermore, higher AAST grades (III-IV) were significantly associated with the presence of two or more associated organ injuries (χ^2 test, $p < 0.001$), indicating a direct correlation between injury severity and multi-organ involvement. CT utilization was significantly associated with improved detection of combined injuries compared with FAST examination alone ($p < 0.01$), reinforcing the role of CT as the gold standard diagnostic modality in hemodynamically stable patients.

To further evaluate the relationships between injury characteristics, physiological status, and associated trauma burden, inferential statistical analyses were performed using chi-square testing for categorical variables. Statistical significance was defined as $p < 0.05$.

A statistically significant association was identified between the anatomical type of rectal injury and the presence of shock on admission (χ^2 test, $p < 0.001$). Patients with combined intra- and extraperitoneal injuries demonstrated a markedly higher proportion of hemodynamic instability compared with those sustaining isolated extraperitoneal injuries. Intraperitoneal injuries also showed an intermediate association with shock. These findings suggest that increasing anatomical complexity and tissue disruption correlate with greater physiological compromise at presentation.

Further analysis demonstrated a strong and statistically significant relationship between AAST injury severity grade and the presence of multiple associated organ injuries. High-grade injuries (Grade III-IV) were significantly more likely to be associated with two or more concomitant organ injuries compared with low-grade injuries (Grade I-II) (χ^2 test, $p < 0.001$). This reinforces the concept that greater rectal wall disruption reflects higher energy transfer and a broader zone of tissue damage involving adjacent structures.

Diagnostic modality was also evaluated in relation to injury pattern detection. CT imaging demonstrated significantly greater detection of combined intra- and extraperitoneal injuries compared with FAST examination alone (χ^2 test, $p < 0.01$). While FAST was valuable for rapid assessment of free fluid and hemoperitoneum, it was less sensitive for detailed retroperitoneal and pelvic injury characterization. CT scanning provided superior visualization of retroperitoneal air, perirectal fat stranding, direct shrapnel tracts, and associated pelvic injuries, thereby improving anatomical classification accuracy in hemodynamically stable patients.

Collectively, these inferential findings demonstrate that anatomical injury complexity is significantly associated with physiological instability, that higher injury grades correlate with multi-organ involvement, and that CT imaging significantly improves detection of complex rectal trauma patterns. These statistical relationships reinforce the clinical importance of early comprehensive imaging and aggressive resuscitation strategies in patients with suspected combined or high-grade rectal injuries in wartime trauma settings.

Discussion

Rectal trauma remains one of the most technically demanding and physiologically consequential injuries encountered in both civilian and military surgical practice. Its management is complicated by the rectum’s deep pelvic location, proximity to major vascular and genitourinary structures, and the high risk of fecal contamination leading to pelvic sepsis. In contemporary conflict environments, the

injury patterns observed differ substantially from those traditionally described in civilian trauma series. The present study demonstrates that rectal injuries sustained in wartime are predominantly caused by high-energy shrapnel mechanisms, frequently resulting in combined intra- and extraperitoneal disruption, multi-organ injury, and significant hemodynamic instability at presentation. These findings align with evolving descriptions of combat-related colorectal trauma, which emphasize the destructive potential of explosive fragmentation devices compared with low-velocity civilian gunshot wounds [6].

The predominance of shrapnel injuries in this cohort reflects the tactical realities of modern asymmetric warfare, where improvised explosive devices, mortars, and fragmentation munitions are common mechanisms of injury. Unlike civilian firearms, which often produce relatively linear wound tracts, explosive fragmentation results in multidirectional energy dispersion and irregular projectile trajectories. The transfer of kinetic energy from multiple fragments creates cavitation effects and unpredictable tissue disruption, particularly within confined anatomical spaces such as the pelvis [7]. Previous military analyses have reported similar distributions, with fragmentation injuries accounting for the majority of colorectal trauma during operations in Iraq and Afghanistan [8]. These mechanisms inherently predispose to complex injury patterns that extend beyond the rectal wall itself.

Anatomically, the rectum is divided by the peritoneal reflection into intraperitoneal and extraperitoneal segments, a distinction that has historically guided management strategies. In the present study, extraperitoneal injuries were slightly more common than intraperitoneal injuries, but a substantial proportion of patients sustained combined involvement of both compartments. This distribution is consistent with prior military experiences in which pelvic fragmentation commonly traversed peritoneal reflections, producing simultaneous contamination of both the pelvic retroperitoneum and the intraperitoneal cavity [9]. Civilian literature has often reported a higher proportion of isolated intraperitoneal injuries, particularly in anterior abdominal gunshot wounds [10]. The divergence between civilian and combat patterns underscores the need for context-specific management algorithms.

The high proportion of combined intra- and extraperitoneal injuries in this series has important clinical implications. Combined injuries reflect greater energy transfer and a broader zone of tissue devitalization. In experimental models of blast trauma, pressure waves propagate through soft tissues and amplify shear forces at tissue interfaces, increasing the likelihood of occult extension beyond the visible wound tract [11]. In the pelvis, this phenomenon may disrupt adjacent hollow viscera, vascular structures, and osseous elements, thereby compounding physiological compromise. The statistically significant association observed between combined injury patterns and shock at presentation in this study supports this pathophysiological relationship.

Hemodynamic instability was present in nearly 40% of patients, emphasizing the severity of these injuries. Shock in rectal trauma is often multifactorial, resulting from hemorrhage due to associated vascular injury, pelvic fracture bleeding, or concomitant intra-abdominal organ disruption. Military trauma registry data have consistently demonstrated that pelvic fragmentation injuries are associated with higher transfusion requirements and increased mortality compared with isolated extremity injuries [12]. Moreover, the confined pelvic cavity can conceal ongoing hemorrhage, delaying recognition until systemic hypotension becomes evident [13]. The significant correlation between injury complexity and shock identified in this analysis reinforces the importance of early aggressive resuscitation and hemorrhage control.

The burden of associated organ injuries in this cohort further illustrates the destructive nature of combat-related rectal trauma. Over one-third of patients sustained injuries to two or more additional organs, with small bowel, large bowel, and urinary bladder injuries being the most frequent. The anatomical contiguity of these structures explains their frequent co-involvement. The small bowel, occupying much of the abdominal cavity, is particularly vulnerable to penetrating fragmentation, while the bladder's anterior position within the pelvis predisposes it to concurrent injury in lower abdominal trajectories [14]. Previous reports from military surgical facilities have described similar clustering patterns, particularly involving recto-vesical and recto-urethral injuries [15].

The presence of vascular injury in a notable proportion of patients is clinically significant. Pelvic vascular injuries, whether involving the internal iliac branches or presacral venous plexus, can be difficult to control surgically due to limited exposure and ongoing contamination. Damage control strategies, including pelvic packing and temporary diversion, may be necessary in unstable patients [16]. The interaction between hemorrhage and contamination presents a therapeutic dilemma: while rapid control of bleeding is essential, definitive repair may need to be deferred until physiological stabilization is achieved. These considerations highlight the complexity of decision-making in this population.

Injury severity grading using the AAST classification demonstrated that more than 40% of patients sustained Grade III or IV injuries. Higher grades were significantly associated with multiple associated organ injuries, suggesting that rectal wall disruption serves as a surrogate marker for overall energy transfer. The AAST system has been validated in multiple trauma populations and correlates with complication rates and mortality [17]. In civilian studies, higher-grade injuries have been associated with increased risk of pelvic sepsis and anastomotic failure [18]. The present findings extend this association to the wartime context, where higher grades also reflect greater systemic trauma burden.

The management of rectal trauma has undergone substantial evolution since the mid-20th century. During World War II and the Vietnam War, the standard approach involved the “four Ds”: fecal diversion, distal rectal washout, presacral drainage, and primary repair when feasible [19]. This strategy significantly reduced mortality compared with earlier eras but was based largely on high-velocity wartime injuries. In subsequent decades, civilian trauma centers questioned the routine necessity of presacral drainage and distal washout, particularly for nondestructive extraperitoneal injuries [20]. Randomized and observational studies suggested that selective management without mandatory drainage did not increase septic complications [21].

However, the extrapolation of civilian data to combat settings remains controversial. The higher energy transfer and contamination observed in war-related injuries may justify a more aggressive approach in selected patients. Some military surgeons advocate routine diversion in high-grade or combined injuries to minimize pelvic sepsis risk [22]. Others suggest that individualized decision-making based on physiological status and tissue viability yields comparable outcomes [23]. Although operative details were not the primary focus of this study, the high prevalence of complex injury patterns observed here supports the continued need for cautious surgical planning.

Diagnostic evaluation is another critical component of management. In this study, CT imaging was significantly superior to FAST examination alone in detecting combined injuries. FAST is invaluable for rapid assessment in unstable patients but lacks sensitivity for retroperitoneal pathology and small perforations [24]. Multidetector CT, by contrast, provides detailed visualization of bowel wall defects, extraluminal air, and associated pelvic fractures. Studies have demonstrated CT sensitivities exceeding 90% for penetrating abdominal injuries when interpreted by experienced radiologists [25]. Early accurate diagnosis reduces missed injuries and facilitates appropriate operative strategy.

The rapid surgical intervention observed in this cohort, with the majority of patients operated within six hours, likely contributed to improved contamination control. Delays in operative management have been associated with increased rates of pelvic abscess and systemic sepsis in rectal trauma [26]. Time-to-surgery has also been identified as an independent predictor of mortality in penetrating abdominal injuries more broadly [27]. The organized trauma pathways reflected in this study, including early imaging and operative readiness, underscore the importance of system-level preparedness in conflict zones.

Infectious complications remain a central concern in rectal trauma due to polymicrobial contamination. Pelvic sepsis, abscess formation, and wound infection can significantly prolong hospitalization and increase mortality risk. Previous series have reported pelvic abscess rates ranging from 10% to 30%, particularly in high-grade or delayed cases [28]. Broad-spectrum antibiotic coverage targeting gram-negative and anaerobic organisms is essential in the perioperative period [29]. In addition, meticulous debridement of devitalized tissue and appropriate diversion strategies are critical in minimizing infectious sequelae.

Long-term functional outcomes represent an additional dimension of concern. Pelvic nerve injury, sphincter disruption, and associated fractures can result in fecal incontinence or chronic pelvic pain. Studies evaluating post-conflict outcomes have documented significant rates of anorectal dysfunction and psychosocial distress among survivors [30]. Sexual dysfunction, particularly in cases involving concomitant genitourinary injury, further complicates recovery [31]. Comprehensive rehabilitation programs integrating colorectal, urological, orthopedic, and psychological expertise are therefore essential.

Another relevant consideration is the role of damage control surgery in unstable patients. In the setting of profound shock or coagulopathy, abbreviated laparotomy with temporary fecal diversion and deferred definitive repair may improve survival [32]. The principles of damage control, initially developed in military settings, have become integral to modern trauma care [6]. Their application to complex rectal injuries must balance contamination control with physiological stabilization.

Technological advancements may further enhance future management. Portable CT scanners and telemedicine consultation have expanded diagnostic capabilities in forward surgical units [7]. The integration of trauma registries and data-sharing platforms facilitates continuous quality improvement and evidence-based refinement of protocols [8]. Continued research into predictive modeling and standardized management pathways will be essential in optimizing outcomes.

Several limitations of this study warrant consideration. The retrospective design limits causal inference, and the absence of detailed long-term follow-up restricts conclusions regarding functional outcomes. Additionally, while statistically significant associations were identified, multivariable regression analysis would further clarify independent predictors of morbidity and mortality. Nonetheless, the relatively large sample size and comprehensive anatomical characterization strengthen the validity of the findings.

In summary, rectal trauma in modern warfare is characterized by high-energy shrapnel mechanisms, frequent combined anatomical involvement, substantial multi-organ injury burden, and significant rates of hemodynamic instability. Injury severity grading correlates strongly with associated injuries, and CT imaging remains indispensable for accurate classification. Early surgical intervention and aggressive resuscitation are central to successful management. These findings reinforce the need for context-specific protocols tailored to the unique injury patterns encountered in combat environments and support continued research aimed at improving survival and long-term functional outcomes.

Conclusion

This study demonstrates that rectal trauma in wartime settings is predominantly caused by high-energy shrapnel injuries and is frequently associated with complex anatomical disruption and multi-organ involvement. A substantial proportion of patients presented with hemodynamic instability, and nearly half sustained high-grade rectal injuries. Combined intra- and extraperitoneal injuries were significantly associated with shock on admission, while higher AAST injury grades strongly correlated with the presence of multiple associated organ injuries. These findings underscore the severe physiological burden and surgical complexity inherent in combat-related rectal trauma.

Furthermore, advanced imaging, particularly CT scanning, played a critical role in accurately characterizing injury patterns and detecting combined injuries, outperforming FAST examination in anatomical delineation. Early surgical intervention, implemented in the vast majority of cases, reflects the necessity of prompt operative management in this high-risk population. Overall, the results highlight the importance of rapid assessment, aggressive resuscitation, comprehensive imaging, and multidisciplinary surgical management to optimize outcomes in war-related rectal injuries.

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