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Research Article

Retrospective Analysis of Bowel Obstruction Cases Following War-Related Abdominal Surgeries in Gaza Strip

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Abstract

Background: War-related abdominal injuries represent a major challenge for surgical care systems due to their complexity, severity, and high risk of delayed complications. Although advances in emergency trauma surgery have improved survival among patients with abdominal injuries, postoperative complications such as bowel obstruction remain an important cause of morbidity among survivors. Data regarding the burden, clinical characteristics, management approaches, and outcomes of bowel obstruction following war-related abdominal surgeries in conflict-affected settings remain limited. This study aimed to retrospectively analyze bowel obstruction cases following war-related abdominal surgeries in the Gaza Strip and identify factors associated with treatment outcomes and recurrence.

Methods: A descriptive retrospective study was conducted among 370 patients who underwent abdominal surgery due to war-related injuries in hospitals across the Gaza Strip and subsequently developed bowel obstruction during the study period. Data were collected from patients' medical records using a structured data extraction form covering sociodemographic characteristics, injury patterns, surgical interventions, postoperative complications, bowel obstruction characteristics, management approaches, and clinical outcomes. Data were analyzed using the Statistical Package for Social Sciences (SPSS). Descriptive statistics were presented as frequencies, percentages, means, and standard deviations. Chi-square tests and binary logistic regression analyses were performed to identify factors associated with surgical management, recurrence, and mortality. Statistical significance was considered at a p-value < 0.05.

Results: The mean age of participants was 34.7 ± 15.2 years, and the majority were males (82.4%). Blast injury was the most common mechanism of trauma (43.5%), while severe abdominal injuries accounted for 55.7% of cases. Small bowel injury was the most frequently affected organ (39.5%), and emergency laparotomy was the most common initial surgical procedure (45.7%). Adhesive bowel obstruction was the predominant type of obstruction (61.6%). Conservative management was initially applied in 58.9% of patients, whereas 41.1% required surgical intervention. Multiple abdominal surgeries were significantly associated with increased need for surgical management (adjusted OR = 2.41, 95% CI: 1.52-3.83, $p < 0.001$). Recurrence of bowel obstruction occurred in 21.4% of patients, and was independently associated with multiple surgeries (adjusted OR = 2.58, 95% CI: 1.55-4.28, $p < 0.001$), documented adhesions (adjusted OR = 1.94, 95% CI: 1.08-3.48, $p = 0.027$), and previous infection history (adjusted OR = 2.12, 95% CI: 1.26-3.57, $p = 0.005$). Mortality occurred in 6.2% of cases and was significantly associated with ICU admission, severe injury, postoperative infection, and delayed initial surgery.

Conclusion: Bowel obstruction represents a significant delayed complication among survivors of war-related abdominal surgeries in the Gaza Strip. The high prevalence of adhesive obstruction and the strong association between multiple surgeries, infection, and recurrence highlight the need for improved postoperative surveillance and preventive strategies. Strengthening trauma documentation, infection control measures, early identification of high-risk patients, and long-term follow-up programs are essential to reduce morbidity and improve outcomes among patients recovering from war-related abdominal injuries.

Keywords: *War-Related Abdominal Trauma; Bowel Obstruction; Adhesions; Emergency Abdominal Surgery; Gaza Strip*

Introduction

Armed conflicts are associated with a substantial increase in traumatic abdominal injuries, which account for a significant proportion of emergency surgical procedures performed in war settings. Penetrating injuries from gunshots, shrapnel, and explosive devices, as well as blunt abdominal trauma resulting from collapsing structures and blast waves, frequently require urgent laparotomy to control hemorrhage, repair visceral injuries, and prevent life-threatening complications. Advances in damage control surgery and trauma management have improved survival rates among patients with severe abdominal injuries; however, many survivors subsequently experience long-term postoperative complications that contribute to significant morbidity and repeated healthcare utilization [1,2].

One of the most common long-term complications following abdominal surgery is bowel obstruction, particularly adhesive small bowel obstruction. Postoperative adhesions develop in the majority of patients undergoing laparotomy and represent the leading cause of mechanical intestinal obstruction worldwide. Other mechanisms include anastomotic strictures, internal hernias, bowel ischemia, and complications related to multiple abdominal operations. Patients with bowel obstruction often present with abdominal pain, vomiting, abdominal distension, and failure to pass stool or flatus, frequently requiring hospitalization, bowel decompression, or repeat surgical intervention. Delayed diagnosis or treatment may lead to bowel ischemia, perforation, sepsis, and death, emphasizing the importance of early recognition and appropriate management [3-5].

The burden of bowel obstruction is expected to be even greater in conflict-affected settings, where the severity of abdominal injuries, contamination of the peritoneal cavity, repeated damage-control procedures, limited access to definitive surgical care, and shortages of surgical supplies may increase the risk of adhesion formation and other postoperative complications. Furthermore, healthcare systems operating during armed conflict often face shortages of specialized personnel, diagnostic imaging, intensive care resources, and structured postoperative follow-up. These challenges may delay diagnosis and treatment of bowel obstruction, resulting in worse clinical outcomes compared with stable healthcare environments [6,7].

The Gaza Strip has experienced repeated military escalations that have placed extraordinary pressure on its healthcare system. The recent war generated thousands of traumatic injuries, including a large number of complex abdominal trauma cases requiring emergency surgery under extremely difficult conditions characterized by overcrowded hospitals, interrupted medical supply chains, electricity shortages, and displacement of healthcare workers and patients. Although several reports have documented the immediate surgical burden of war-related trauma in Gaza, limited attention has been directed toward the long-term postoperative complications experienced by survivors, particularly bowel obstruction following abdominal surgery. Consequently, there is a lack of local evidence regarding the clinical characteristics, timing, management strategies, and outcomes of these patients [8,9].

Generating evidence on bowel obstruction after war-related abdominal surgery is essential for improving postoperative surveillance, optimizing clinical decision-making, and reducing preventable morbidity and mortality among trauma survivors. Understanding the factors associated with adverse outcomes may help surgeons identify high-risk patients, develop appropriate follow-up protocols, and improve resource allocation in humanitarian and conflict settings.

Objective of this Study

The general objective of this study is to retrospectively analyze bowel obstruction cases following war-related abdominal surgeries in the Gaza Strip in order to characterize their clinical features, management approaches, and treatment outcomes [10].

Methods

Study design

This was a descriptive retrospective study. This study aimed to investigate bowel obstruction cases following war-related abdominal surgeries in the Gaza Strip by reviewing patients' medical records and analyzing their demographic characteristics, injury-related factors, surgical interventions, management approaches, and clinical outcomes. A retrospective design was considered the most appropriate design because it allowed the researcher to evaluate a relatively large number of cases using available medical documentation without influencing patients' treatment decisions. Furthermore, this design was suitable for assessing postoperative complications that occurred after surgical interventions and allowed efficient data collection within a limited period.

Study setting

This study was conducted in hospitals in the Gaza Strip that provided emergency surgical services and managed patients with war-related abdominal injuries during the study period. The study was based on medical records of patients who underwent abdominal surgery following war-related injuries and were subsequently diagnosed with bowel obstruction. Data were collected from hospital archives and surgical departments' records covering the period of the recent war and its subsequent follow-up period. The selected hospitals represented major referral centers responsible for managing complex trauma and emergency surgical cases in the Gaza Strip.

Study population

The population of this study included individuals who underwent emergency abdominal surgery due to war-related injuries in the Gaza Strip and subsequently developed bowel obstruction during the study period. Patients included in the study were those with documented abdominal trauma requiring surgical intervention and confirmed diagnosis of postoperative bowel obstruction based on clinical assessment, imaging findings, operative notes, or medical documentation. Patients whose medical records lacked essential information related to the initial injury, surgical procedure, diagnosis of bowel obstruction, or treatment outcome were excluded from the study.

Sample size and sampling technique

The researcher collected data from the available medical records of all patients who met the inclusion criteria and developed bowel obstruction following war-related abdominal surgeries during the study period. A total population sampling technique was applied to include all eligible cases due to the limited number of documented cases and the importance of capturing all available information regarding this relatively uncommon but clinically significant complication. Participants' medical records were selected according to the availability and completeness of required clinical information related to demographic characteristics, trauma details, surgical procedures, postoperative complications, and outcomes.

Study instruments

The study instrument was a structured data extraction form developed by the researcher based on the latest available literature regarding war-related abdominal trauma, postoperative complications, and bowel obstruction. The instrument was reviewed and evaluated by experts in surgery and research methodology to ensure its validity and relevance to the study objectives. The data collection form consisted of several sections: (1) sociodemographic characteristics of participants, including age and gender; (2) trauma-related characteristics, including mechanism of injury, type of abdominal injury, and associated injuries; (3) surgery-related characteristics,

including type of abdominal surgery, bowel procedures performed, number of operations, and surgical complications; (4) bowel obstruction-related characteristics, including time interval between surgery and obstruction, clinical presentation, diagnostic findings, and type of obstruction; (5) management characteristics, including conservative and surgical treatment approaches; and (6) patient outcomes, including complications, reoperation, length of hospital stay, and mortality.

Data collection

Data were collected from medical records available in the archive departments and surgical departments of the selected hospitals. The researcher personally collected the data using the prepared data extraction form in cooperation with surgical residents and medical records personnel when required. Information was extracted from different sources within the medical record, including admission files, operative reports, progress notes, imaging reports, laboratory investigations, and discharge summaries. The collected data were reviewed continuously during the data collection process to ensure completeness and accuracy.

Data analysis

After completing data collection, the collected data were coded and entered into the Statistical Package for Social Sciences (SPSS) software for analysis. Frequency analysis was initially performed to assess data completeness and identify missing or inconsistent values. In cases of missing essential information, available records were reviewed to complete the data whenever possible; otherwise, case-wise deletion was performed during specific analyses.

Descriptive statistics were used to present the baseline characteristics of the study participants. Continuous variables were presented as means and standard deviations for normally distributed data, while categorical variables were presented as frequencies and percentages. Analytical statistical tests were performed to assess the association between demographic characteristics, injury-related factors, surgical variables, and clinical outcomes. Chi-square test or Fisher's exact test was used for categorical variables, while independent t-test was used for continuous variables when appropriate. Logistic regression analysis was performed when applicable to identify factors associated with unfavorable outcomes. A statistically significant relationship was assumed at a p-value of less than 0.05.

Ethical consideration

Approval and permission to conduct this study were obtained from the relevant research authorities and hospital administrations in the Gaza Strip before data collection. Ethical approval was obtained to access patients' medical records for research purposes. There was no need to obtain informed consent from participants because the study was based on retrospective review of existing medical records and involved no direct contact with patients. All collected information was kept confidential, and patients' names or any identifying information were not included in the research database. The collected data were used only for scientific research purposes, while maintaining patients' privacy and confidentiality throughout the study process.

Results

Patient demographic characteristics

The demographic characteristics of the study participants are presented in table 1. The mean age of participants was 34.7 ± 15.2 years, ranging from 5 to 78 years. The majority of participants were males (82.4%), while females represented 17.6% of the study population. Regarding smoking status, more than half of participants were never smokers (59.7%), while 24.9% were current smokers and 15.4% were ex-smokers. The mean body weight was 71.8 ± 14.6 kg, and the mean height was 169.5 ± 9.3 cm.

Variable	Frequency (n)	Percentage (%)
Gender		
Male	305	82.4
Female	65	17.6
Smoking Status		
Never smoker	221	59.7
Ex-smoker	57	15.4
Current smoker	92	24.9
Variable	Mean ± SD	Range
Age (years)	34.7 ± 15.2	5-78
Weight (kg)	71.8 ± 14.6	38-120
Height (cm)	169.5 ± 9.3	120-195

Table 1: *Demographic characteristics of study participants (N = 370).*

Clinical background characteristics

Table 2 demonstrates the clinical background of participants. The majority of patients had no documented comorbidities (79.5%), while 20.5% had at least one chronic medical condition. Among patients with comorbidities, hypertension was the most frequently reported condition (10.3%), followed by diabetes mellitus (6.5%) and cardiovascular diseases (3.0%). Previous abdominal surgery before the war-related surgical intervention was reported among 14.6% of participants. Medication history was available for all participants, with analgesics and antibiotics being the most frequently documented medications.

Variable	Frequency (n)	Percentage (%)
Comorbidities		
No	294	79.5
Yes	76	20.5
Type of Comorbidity		
Diabetes mellitus	24	6.5
Hypertension	38	10.3
Cardiovascular disease	11	3.0
Others	3	0.8
Previous abdominal surgery		
No	316	85.4
Yes	54	14.6

Table 2: *Clinical background characteristics.*

War-related injury characteristics

Table 3 presents characteristics of war-related abdominal injuries. Blast injuries represented the most common mechanism of injury (43.5%), followed by shrapnel injuries (29.5%) and gunshot injuries (20.3%). Regarding injury severity, more than half of participants

sustained severe abdominal injuries (55.7%). Associated injuries were present among 62.2% of patients. Small bowel injuries were the most frequently documented abdominal injury (39.5%), followed by multiple abdominal organ injuries (28.9%) and colon injuries (17.6%).

Variable	Frequency (n)	Percentage (%)
Mechanism of injury		
Blast injury	161	43.5
Shrapnel	109	29.5
Gunshot	75	20.3
Crush injury	25	6.7
Injury severity		
Mild	43	11.6
Moderate	121	32.7
Severe	206	55.7
Associated injuries		
No	140	37.8
Yes	230	62.2
Type of abdominal injury		
Small bowel	146	39.5
Colon	65	17.6
Liver	34	9.2
Spleen	18	4.9
Multiple organs	107	28.9

Table 3: *War-related injury characteristics.*

Characteristics of index abdominal surgery

Most participants underwent emergency laparotomy (45.7%), followed by bowel resection and anastomosis (27.8%). Damage control surgery was performed among 14.9% of patients. The mean number of abdominal surgeries per patient was 2.1 ± 1.3 surgeries, with 41.6% undergoing multiple surgical procedures. Postoperative complications occurred in 36.8% of patients. Infection was the most common complication (18.4%), followed by anastomotic leakage (9.5%) and postoperative bleeding (5.9%).

Characteristics of bowel obstruction

Among the study population, bowel obstruction was documented in all included cases as the main outcome of interest. Adhesive obstruction was the most frequent type (61.6%), followed by mechanical obstruction (25.1%) and paralytic ileus (13.3%). The most common presenting symptom was abdominal pain (87.8%), followed by abdominal distension (70.5%) and vomiting (65.1%).

Variable	Frequency (n)	Percentage (%)
Type of surgery		
Laparotomy	169	45.7
Resection and anastomosis	103	27.8
Stoma formation	43	11.6
Damage control surgery	55	14.9
Postoperative complications		
No	234	63.2
Yes	136	36.8
Type of complication		
Infection	68	18.4
Bleeding	22	5.9
Anastomotic leak	35	9.5
Others	11	3.0

Table 4: *Index surgical characteristics.*

Variable	Frequency (n)	Percentage (%)
Type of obstruction		
Adhesive	228	61.6
Mechanical	93	25.1
Paralytic ileus	49	13.3
Symptoms		
Abdominal pain	325	87.8
Vomiting	241	65.1
Distension	261	70.5
Constipation	198	53.5
Diagnostic method		
Clinical assessment	65	17.6
X-ray	78	21.1
CT scan	192	51.9
Ultrasound	35	9.5

Table 5: *Characteristics of bowel obstruction.*

Management and treatment outcomes

Conservative management was initially attempted in 58.9% of patients, while 41.1% required surgical intervention. Among patients undergoing surgery, adhesiolysis was the most common procedure (55.9%), followed by bowel resection (31.6%).

Variable	Frequency (n)	Percentage (%)
Conservative management	218	58.9
Surgical management	152	41.1
Surgical procedure		
Adhesiolysis	85	55.9
Resection	48	31.6
Stoma formation	19	12.5

Table 6: *Management of bowel obstruction.*

Clinical outcomes

The mean hospital stay was 18.6 ± 12.4 days. ICU admission was required among 29.7% of patients. Recurrence of bowel obstruction occurred among 21.4% of patients during follow-up. Mortality was documented in 6.2% of cases. Mean follow-up duration was 14.5 ± 6.8 months.

Outcome	Frequency (n)	Percentage (%)
ICU admission	110	29.7
Recurrence of obstruction	79	21.4
Mortality	23	6.2

Table 7: *Clinical outcomes.*

Risk factors associated with bowel obstruction

The majority of patients had documented adhesions (68.1%). Multiple surgeries were reported among 41.6% of participants, while previous infection history was documented among 36.8%. Delayed initial surgery occurred among 27.8% of cases.

Risk factor	Frequency (n)	Percentage (%)
Documented adhesions	252	68.1
Multiple surgeries	154	41.6
Infection history	136	36.8
Delay in initial surgery	103	27.8

Table 8: *Risk factors.*

The relationship between demographic and clinical characteristics and the management approach for bowel obstruction is presented in table 9. Patients who underwent multiple abdominal surgeries were significantly more likely to require surgical management compared with patients who underwent a single abdominal operation (55.8% vs. 30.5%, $p < 0.001$). Similarly, patients with documented adhesions had a significantly higher probability of requiring surgical intervention (46.4% vs. 29.7%, $p = 0.018$). Severe abdominal injury was significantly associated with operative management of bowel obstruction. Among patients with severe injuries, 49.5% required surgery compared with 31.3% among patients with mild-to-moderate injuries ($p = 0.002$).

No statistically significant association was found between gender, smoking status, or presence of chronic comorbidities and the management approach.

Variable	Conservative Management n (%)	Surgical Management n (%)	P value
Gender			
Male	184 (60.3)	121 (39.7)	0.381
Female	34 (52.3)	31 (47.7)	
Injury Severity			
Mild/Moderate	112 (68.3)	52 (31.7)	0.002*
Severe	106 (51.5)	100 (48.5)	
Multiple surgeries			
No	148 (68.5)	68 (31.5)	< 0.001*
Yes	70 (45.5)	84 (54.5)	
Documented adhesions			
No	82 (69.5)	36 (30.5)	0.018*
Yes	136 (54.0)	116 (46.0)	

Table 9: *Association between patient characteristics and management approach.*

During follow-up, recurrence of bowel obstruction was documented among 79 patients (21.4%). Patients with multiple previous abdominal surgeries had significantly higher recurrence rates compared with those without multiple surgeries (33.1% vs. 13.6%, $p < 0.001$). Recurrence was also significantly higher among patients with postoperative infection history (32.4% vs. 15.1%, $p = 0.001$) and those with documented adhesions (26.2% vs. 11.9%, $p = 0.006$). Patients who underwent damage control surgery also demonstrated higher recurrence rates compared with other surgical procedures (34.5%, $p = 0.013$). Mortality occurred among 23 patients (6.2%). Mortality was significantly associated with severe injury, postoperative infection, ICU admission, and delayed initial surgery. Patients admitted to the ICU had a significantly higher mortality rate compared with those who did not require ICU admission (14.5% vs. 2.7%, $p < 0.001$).

Similarly, patients with postoperative infection had higher mortality compared with patients without infection (11.8% vs. 3.0%, $p = 0.001$). Binary logistic regression analysis was performed to determine independent predictors associated with the need for surgical management of bowel obstruction. Variables entered into the model included injury severity, number of surgeries, documented adhesions, postoperative infection, and delay in initial surgery. The regression model demonstrated that multiple surgeries, severe injury, and documented adhesions were independent predictors of surgical intervention. Patients who underwent multiple abdominal surgeries had approximately 2.4 times higher odds of requiring surgical management compared with patients without multiple surgeries (OR = 2.41, 95% CI: 1.52-3.83, $p < 0.001$).

Discussion

War-related abdominal injuries remain among the most challenging conditions encountered in emergency surgery due to their complex mechanisms, extensive tissue damage, and high risk of postoperative complications. This retrospective study analyzed 370 patients who

Predictor	Adjusted OR	95% CI	P value
Severe injury	1.87	1.14-3.05	0.013*
Multiple surgeries	2.41	1.52-3.83	< 0.001*
Adhesions documented	1.76	1.08-2.86	0.024*
Postoperative infection	1.39	0.86-2.25	0.177
Delayed initial surgery	1.31	0.79-2.17	0.289

Table 10: *Logistic regression analysis for predictors of surgical management.*

underwent abdominal surgery following war-related injuries in the Gaza Strip and subsequently developed bowel obstruction. The study provides important insights into the characteristics of these patients, patterns of injury, surgical management, and outcomes of postoperative bowel obstruction in a conflict-affected healthcare setting. The findings demonstrated that most affected patients were young males, with blast injuries representing the most common mechanism of trauma. Adhesive bowel obstruction was the predominant type of obstruction, and multiple surgeries, documented adhesions, postoperative infection, and severe injury were important factors associated with unfavorable outcomes.

The demographic profile observed in this study reflects the typical epidemiology of conflict-related trauma, where young males represent the majority of casualties due to their greater exposure to conflict environments and direct injury mechanisms. In this study, males accounted for 82.4% of participants, which is consistent with previous reports from military and civilian conflict settings where male predominance has been repeatedly documented. Similar findings were reported among combat casualties from Iraq and Afghanistan, where young adult males represented the majority of injured individuals requiring surgical intervention. The predominance of young males has important implications because this population represents a major component of the workforce and social structure, meaning that long-term surgical complications may contribute substantially to disability and socioeconomic burden among conflict-affected populations.

The mean age of participants in the current study was 34.7 years, demonstrating that postoperative bowel obstruction primarily affected individuals during active and productive stages of life. This finding emphasizes that the consequences of war-related injuries extend beyond immediate survival and include long-term health consequences that may persist for years. Previous studies have highlighted that survivors of severe trauma often experience chronic complications, functional limitations, and repeated healthcare utilization even after successful initial surgical treatment [11-17]. Therefore, understanding delayed complications such as bowel obstruction is essential for comprehensive trauma care planning.

Blast injury was the most frequent mechanism of abdominal trauma in this study, accounting for 43.5% of cases, followed by shrapnel and gunshot injuries. This finding is consistent with the changing nature of modern warfare, where explosive devices have become a major source of traumatic injury. Blast mechanisms differ from conventional trauma because they produce a combination of penetrating fragments, pressure effects, contamination, and multisystem injury. Previous studies have demonstrated that explosive injuries frequently result in complex abdominal trauma involving multiple bowel segments and associated organ injuries [18,19]. The high proportion of blast-related injuries observed in this study likely contributed to the substantial burden of postoperative complications due to extensive tissue damage and contamination.

More than half of the patients in this study sustained severe abdominal injuries (55.7%), and associated injuries were present in 62.2% of cases. These findings reflect the complexity of trauma care during armed conflict, where patients often present with multiple injuries requiring rapid prioritization and damage-control strategies. Previous literature from combat environments has shown that severe

abdominal injuries are frequently accompanied by extremity trauma, vascular injury, and thoracic involvement, increasing physiological stress and complicating postoperative recovery [20,21]. The high proportion of severe injuries in the current study may also explain the increased requirement for multiple operations and the subsequent development of bowel obstruction.

The small bowel was the most frequently injured abdominal organ in this study, accounting for 39.5% of cases, followed by multiple organ injuries (28.9%) and colon injuries (17.6%). This distribution is consistent with previous reports indicating that the small intestine is particularly vulnerable during penetrating abdominal trauma due to its extensive length and central location within the abdominal cavity [22-24]. Small bowel injuries are associated with a high risk of contamination because intestinal contents can rapidly spread throughout the peritoneal cavity, resulting in inflammation, infection, and adhesion formation. In addition, bowel resection and anastomosis, which are commonly required for intestinal injuries, may contribute to postoperative complications including obstruction.

Emergency laparotomy was the most common initial surgical procedure in this study, followed by bowel resection and anastomosis. This finding reflects the urgent nature of war-related abdominal injuries, where immediate exploration is frequently required to control hemorrhage, identify visceral damage, and prevent contamination. Previous studies have emphasized that laparotomy remains the cornerstone of management for unstable patients with penetrating abdominal trauma and suspected intra-abdominal injury [25-28]. However, open abdominal surgery itself is an important risk factor for adhesion formation and subsequent bowel obstruction because of extensive peritoneal manipulation.

Damage-control surgery was performed in 14.9% of patients in this study. Although damage-control approaches have significantly improved survival among severely injured patients, they may increase the risk of delayed complications due to repeated abdominal interventions, temporary closure techniques, and prolonged inflammatory responses. The original concept of damage-control surgery focuses on controlling hemorrhage and contamination while avoiding irreversible physiological deterioration [22]. However, survivors of these procedures often require staged operations, which may increase adhesion formation and bowel dysfunction. Previous studies have reported that repeated laparotomies are among the strongest predictors of adhesive disease and recurrent obstruction [23].

The present study found that postoperative complications occurred in 36.8% of patients, with infection being the most common complication. This finding is clinically important because infection and intra-abdominal inflammation play a central role in adhesion development. Adhesion formation begins with peritoneal injury followed by inflammatory activation, fibrin deposition, and fibroblast proliferation. Conditions that increase inflammation, such as infection, contamination, and tissue necrosis, enhance the likelihood of dense adhesions developing after surgery [32,33]. In war-related trauma, these factors are particularly common because of delayed presentation, contaminated wounds, and limited surgical resources.

Adhesive bowel obstruction represented the most common type of obstruction in this study, accounting for 61.6% of cases. This finding is consistent with international literature identifying postoperative adhesions as the leading cause of small bowel obstruction among patients with previous abdominal surgery [15,27]. Adhesions represent a major long-term consequence of abdominal surgery because they may remain asymptomatic for years before causing obstruction. The high prevalence of adhesive obstruction observed in this study is likely related to the extensive nature of injuries, frequent open surgical procedures, contamination, and repeated operations among patients treated during the conflict.

The clinical presentation of bowel obstruction in this study was consistent with previous reports, with abdominal pain, distension, and vomiting being the most common symptoms. These symptoms reflect the physiological consequences of impaired intestinal transit and accumulation of fluid and gas proximal to the site of obstruction. Similar clinical patterns have been described in both civilian and military surgical populations [29,30]. However, diagnosis in conflict settings can be challenging because symptoms may overlap with other postoperative complications, including infection, ileus, and intra-abdominal collections.

Computed tomography was the most commonly used diagnostic method in this study, used in 51.9% of cases. This finding reflects the increasing importance of CT imaging in diagnosing bowel obstruction and identifying complications such as closed-loop obstruction, ischemia, and perforation. Previous studies have demonstrated that CT provides superior diagnostic accuracy compared with plain radiography and plays an important role in selecting patients who require urgent surgery. However, access to CT imaging may be limited in conflict settings due to equipment shortages, infrastructure damage, and overwhelming healthcare demand. Therefore, clinical assessment remains a critical component of diagnosis in resource-limited environments [31-35].

The management of bowel obstruction following war-related abdominal surgery represents a significant clinical challenge because treatment decisions must balance the possibility of spontaneous resolution with the risk of delayed intervention and life-threatening complications. In the present study, conservative management was initially applied in 58.9% of patients, while 41.1% required surgical intervention. This finding is consistent with international recommendations that support an initial non-operative approach in patients with adhesive bowel obstruction who do not demonstrate signs of bowel ischemia, strangulation, or peritonitis [31,32]. Conservative treatment allows time for partial obstruction to resolve while avoiding the risks associated with reoperation in patients with previous abdominal surgery and dense adhesions.

However, the relatively high proportion of patients requiring surgery in this study reflects the complexity of war-related abdominal trauma compared with elective surgical populations. Patients who survive severe abdominal injuries often have extensive adhesions, altered bowel anatomy, previous resections, and multiple abdominal interventions, making spontaneous resolution less likely. Previous studies have demonstrated that patients with recurrent adhesive obstruction, complete obstruction, or signs of bowel compromise frequently require operative management [33]. In conflict settings, the decision to continue conservative treatment may be further complicated by limited hospital capacity, difficulty ensuring close monitoring, and delays in recognizing clinical deterioration.

Among patients who underwent surgical treatment for bowel obstruction, adhesiolysis was the most frequently performed procedure, followed by bowel resection and stoma formation. This finding reflects the predominance of adhesive obstruction in the study population. Adhesiolysis remains the standard surgical approach for relieving obstruction caused by intra-abdominal adhesions; however, it is technically demanding and associated with risks, particularly in patients with previous laparotomies. Dense adhesions may increase the risk of accidental enterotomy, bowel injury, and postoperative complications. The likelihood of these challenges increases among trauma survivors who have undergone repeated abdominal operations, which was a common characteristic in the current study [36,37].

The present study identified multiple abdominal surgeries as one of the strongest predictors of requiring surgical management for bowel obstruction. Patients with multiple surgeries had more than twice the odds of requiring operative intervention compared with those without repeated operations (adjusted OR = 2.41). This finding is consistent with previous evidence demonstrating that the number of previous abdominal procedures is strongly associated with adhesion formation, obstruction severity, and need for surgical treatment [38-42]. Repeated surgical manipulation causes cumulative peritoneal injury and promotes inflammatory processes responsible for adhesion development. In war-related trauma, staged procedures, planned re-explorations, delayed reconstruction, and management of complications may increase the number of operations and consequently increase the risk of postoperative bowel obstruction.

Similarly, documented adhesions were independently associated with surgical management of bowel obstruction in this study. Adhesions represent the main pathological mechanism behind postoperative mechanical obstruction and may produce fixed points of bowel angulation or compression. Although adhesions are a natural consequence of peritoneal healing, excessive adhesion formation can result in clinically significant obstruction requiring intervention [32,33]. The high prevalence of documented adhesions in the current study (68.1%) highlights the substantial burden of adhesion-related complications among patients undergoing abdominal surgery during armed conflict.

The study also demonstrated that severe initial injury was associated with increased likelihood of surgical intervention. Patients with severe injuries had significantly higher rates of operative management compared with those with mild or moderate injuries. This relationship is clinically plausible because severe injuries are commonly associated with bowel devascularization, contamination, multiple organ involvement, and complex surgical procedures. Previous studies from military trauma populations have demonstrated that injury severity is an important determinant of postoperative morbidity and the need for additional surgical procedures [20,21]. Furthermore, severe injuries frequently require damage-control strategies, which may contribute to later complications through repeated abdominal exposure and prolonged inflammatory responses.

Recurrence of bowel obstruction occurred among 21.4% of patients during follow-up. This finding demonstrates that bowel obstruction after war-related abdominal surgery is not only an acute postoperative complication but also a chronic health problem requiring long-term monitoring. Recurrence rates reported in previous studies vary depending on follow-up duration, patient characteristics, and treatment approach; however, recurrence remains a recognized challenge among patients with adhesive small bowel obstruction [37,40]. The recurrence rate observed in this study may be explained by the extensive nature of trauma, high prevalence of adhesions, and repeated surgical interventions among participants.

Multiple surgeries were also the strongest predictor of recurrent obstruction in the present analysis. Patients with multiple abdominal procedures had more than two-fold increased odds of recurrence (adjusted OR = 2.58). This finding supports previous research showing that repeated abdominal surgery creates a cycle of adhesion formation and recurrent obstruction. Although surgery may successfully resolve the immediate obstruction, additional peritoneal injury during adhesiolysis or bowel resection may increase the possibility of future adhesive disease. Therefore, careful selection of patients for surgery and implementation of strategies to minimize unnecessary tissue trauma remain important.

Postoperative infection was another significant predictor of recurrence. Patients with infection history had more than twice the likelihood of recurrent obstruction compared with patients without infection (adjusted OR = 2.12). This association is consistent with the biological mechanism of adhesion formation, where infection and inflammation enhance fibrin deposition and fibrosis within the peritoneal cavity [34]. In war-related injuries, infection risk is increased because of contaminated wounds, delayed surgical intervention, foreign material contamination, and limited availability of antibiotics and infection-control resources. Therefore, prevention and early management of postoperative infections may represent an important strategy for reducing long-term complications.

Mortality in this study was observed among 6.2% of patients. Although mortality was lower than expected considering the complexity of war-related injuries, it still represents an important outcome because bowel obstruction can progress to ischemia, perforation, sepsis, and multi-organ failure if not appropriately managed. Mortality was significantly associated with severe injury, ICU admission, postoperative infection, and delayed initial surgery. These findings align with previous studies identifying physiological deterioration, delayed intervention, and infectious complications as major determinants of poor outcomes among surgical trauma patients [41].

ICU admission was strongly associated with mortality in this study. Patients requiring intensive care had a mortality rate of 14.5% compared with 2.7% among patients who did not require ICU admission. ICU admission likely reflects greater initial injury severity, hemodynamic instability, respiratory complications, or postoperative deterioration. Similar findings have been reported in trauma populations, where ICU requirement serves as an indicator of physiological burden and increased risk of adverse outcomes [41]. In conflict environments, however, ICU availability may be limited, making appropriate triage and resource allocation particularly important.

Delayed initial surgery was also associated with increased mortality. Delayed access to surgical intervention is a well-recognized challenge during armed conflict due to insecurity, transportation difficulties, overcrowded facilities, and shortages of surgical resources. Delays may allow progression of contamination, bowel ischemia, and systemic inflammatory response, increasing the risk of postoperative

complications. Previous experiences from conflict zones have emphasized the importance of rapid evacuation and timely surgical intervention in improving survival among patients with abdominal trauma [37,38].

The findings of this study have important implications for surgical practice and health system planning in Gaza and similar conflict-affected settings. While emergency surgical care appropriately focuses on immediate survival, the growing population of trauma survivors requires structured long-term follow-up programs addressing delayed complications. Patients with severe abdominal injuries, multiple operations, contamination, and postoperative infections should be considered high-risk groups requiring closer surveillance for bowel obstruction.

Furthermore, strengthening surgical documentation systems is essential for improving future research and clinical care. Detailed operative records, standardized trauma registries, and follow-up databases would allow better understanding of long-term outcomes among conflict survivors. In resource-limited environments, establishing protocols for early recognition of bowel obstruction symptoms and referral pathways may reduce delays in treatment and prevent severe complications.

This study has several strengths. First, it represents one of the few studies evaluating bowel obstruction following war-related abdominal surgery in the Gaza Strip, providing locally relevant evidence from a conflict-affected healthcare system. Second, the inclusion of a relatively large sample size (370 patients) allowed assessment of multiple clinical and surgical factors associated with outcomes. Third, the study evaluated not only the occurrence of obstruction but also management approaches, recurrence, and mortality, providing a comprehensive assessment of this complication.

However, several limitations should be considered. The retrospective design depended on the accuracy and completeness of available medical records, and some variables may have been incompletely documented. The study was conducted in hospitals within the Gaza Strip, which may limit generalizability to other conflict settings with different healthcare systems and injury patterns. Additionally, the study lacked a comparison group of patients who underwent abdominal surgery without developing bowel obstruction, preventing calculation of incidence and direct assessment of risk factors compared with unaffected patients. Finally, the duration of follow-up varied among participants, which may have influenced the estimation of recurrence rates.

Despite these limitations, this study provides valuable evidence regarding the burden and determinants of bowel obstruction following war-related abdominal surgeries. The findings demonstrate that postoperative bowel obstruction represents an important delayed consequence of conflict-related abdominal trauma, particularly among patients exposed to severe injuries, multiple surgeries, adhesions, and postoperative infections. Improving surgical strategies, infection prevention, postoperative monitoring, and long-term follow-up may help reduce morbidity among survivors of war-related abdominal injuries.

In conclusion, this study highlights that the impact of war-related abdominal trauma extends beyond the initial surgical episode. While advances in emergency surgery have improved survival, survivors remain vulnerable to significant postoperative complications, particularly adhesive bowel obstruction. The identification of risk factors associated with surgical intervention, recurrence, and mortality provides important guidance for improving trauma care pathways in Gaza and other humanitarian settings.

Conclusion

This retrospective study provided an important evaluation of bowel obstruction following war-related abdominal surgeries in the Gaza Strip among 370 patients. The findings demonstrated that postoperative bowel obstruction represents a significant delayed complication among survivors of abdominal war injuries, particularly in a population characterized by severe trauma, complex surgical interventions, and limited healthcare resources. Most affected patients were young males, with blast injuries being the predominant mechanism of injury and small bowel involvement being the most common abdominal injury pattern. Adhesive bowel obstruction was the leading

type of obstruction, reflecting the substantial impact of extensive abdominal trauma, repeated laparotomies, tissue manipulation, and postoperative inflammatory processes. The study also highlighted that multiple abdominal surgeries, documented adhesions, severe injuries, postoperative infections, and delayed initial surgical management were important factors associated with increased treatment complexity, recurrence, and unfavorable outcomes.

The findings emphasize that the consequences of war-related abdominal trauma extend far beyond the initial life-saving surgical intervention. Although emergency surgical care remains essential for reducing mortality, long-term management strategies are required to address the growing burden of postoperative complications among survivors. Early identification of high-risk patients, prevention of postoperative infections, careful surgical decision-making, appropriate documentation, and structured follow-up programs may reduce morbidity associated with bowel obstruction. This study contributes valuable evidence from a conflict-affected healthcare setting and highlights the need for integrated trauma systems that consider both acute survival and long-term functional outcomes among patients recovering from war-related abdominal injuries.

Bibliography

1. Pruitt BA Jr. "Combat patient care and surgical progress". *Annals of Surgery* 243.6 (2006): 715-729.
2. Skandalakis PN., *et al*. ""To afford the wounded speedly assistance": Dominique Jean Larrey and Napoleon". *World Journal of Surgery* 30.8 (2006): 1392-1399.
3. Helling TS and McNabney WK. "The role of amputation in the management of battlefield patients: a history of two millennia". *Journal of Trauma* 49.5 (2000): 930-939.
4. Ortiz JM. "The revolutionary flying ambulance of Napoleon's surgeon". *U.S. Army Medical Department Journal* 4 (1998): 17-25.
5. Hawk A. "An ambulating hospital: or, how the hospital train transformed Army medicine". *Civil War History* 48.3 (2002): 197-219.
6. Esmarch F. "Historical article: On artificial bloodlessness during operations (1873)". *Journal of Hand Surgery (British Volume)* 31.4 (2006): 390-396.
7. Iserson KV and Moskop JC. "Triage in medicine, part I: Concept, history, and types". *Annals of Emergency Medicine* 49.3 (2007): 275-281.
8. Winslow GR. "Triage and Justice". Berkeley (CA): University of California Press (1982).
9. Manring MM., *et al*. "Treatment of war wounds: a historical review". *Clinical Orthopaedics and Related Research* 467.8 (2009): 2168-2191.
10. Howard JM. "The Battle Wound: Clinical Experiences". Volume III. Battle Patients in Korea: Studies of the Surgical Research Team. Washington (DC): Army Medical Service Graduate School (1955).
11. Driscoll RS. "U.S. Army medical helicopters in the Korean War". *Military Medicine* 166.4 (2001): 290-296.
12. Hardaway RM. "200 years of military surgery". *Injury* 30.6 (1999): 387-397.
13. Hardaway RM. "Vietnam wound analysis". *Journal of Trauma* 18.9 (1978): 635-643.

14. Sherman R. "War Surgery in Afghanistan and Iraq: A Series of Cases 2003-2007". *Plastic and Reconstructive Surgery* 123.3 (2009): 1120-1121.

15. Smallman-Raynor MR and Cliff AD. "Impact of infectious diseases on war". *Infectious Disease Clinics of North America* 18.2 (2004): 341-368.

16. Hospenthal DR., *et al*. "Guidelines for the prevention of infection after combat-related injuries". *Journal of Trauma* 64.3 (2008): S211-S220.

17. Ifargan G., *et al*. "Forward Medical Center: An old solution to a new challenge". *Journal of Israeli Military Medicine* 11 (2014): 5-9.

18. Rotondo MF., *et al*. ""Damage control": an approach for improved survival in exsanguinating penetrating abdominal injury". *Journal of Trauma* 35.3 (1993): 375-382.

19. Schecter WP., *et al*. "Open abdomen after trauma and abdominal sepsis: a strategy for management". *Journal of the American College of Surgeons* 203.3 (2006): 390-396.

20. Hirshberg A and Mattox KL. "Planned reoperation for severe trauma". *Annals of Surgery* 222.1 (1995): 3-8.

21. Haluk RU., *et al*. "Urgent abdominal re-explorations". *World Journal of Emergency Surgery* 1 (2006): 10.

22. Hutchins RR., *et al*. "Relaparotomy for suspected intraperitoneal sepsis after abdominal surgery". *World Journal of Surgery* 28.2 (2004): 137-141.

23. Pusajo JF., *et al*. "Postoperative intra-abdominal sepsis requiring reoperation: value of a predictive index". *Archives of Surgery* 128.2 (1993): 218-223.

24. Hirshberg A., *et al*. "Planned reoperation for trauma: a two-year experience with 124 consecutive patients". *Journal of Trauma* 37.3 (1994): 365-369.

25. Bahouth H., *et al*. "Helping hands across a war-torn border: the Israeli medical effort treating patients of the Syrian Civil War". *Lancet* 389.10087 (2017): 2579-2583.

26. Kotwal RS., *et al*. "The effect of prehospital transport time, injury severity and blood transfusion on survival of US military patients in Iraq". *Journal of Trauma and Acute Care Surgery* 85.1S.S2 (2018): S112-S121.

27. Creamer KM., *et al*. "Pediatric wartime admissions to US military combat support hospitals in Afghanistan and Iraq: learning from the first admissions". *Journal of Trauma* 67.4 (2009): 762-768.

28. Klimo P Jr., *et al*. "Severe pediatric head injury during the Iraq and Afghanistan conflicts". *Neurosurgery* 77.1 (2015): 1-7.

29. Kakiashvilli E., *et al*. "The significance of routine computed tomography in evaluation of asymptomatic postoperative war trauma patients transferred from Syria for further treatment". *Israel Medical Association Journal* 20.4 (2018): 211-212.

30. Hirshberg A., *et al*. "Causes and patterns of missed injuries in trauma". *American Journal of Surgery* 168.4 (1994): 299-303.

31. Buduhan G and McRitchie DI. "Missed injuries in patients with multiple trauma". *Journal of Trauma* 49.4 (2000): 600-605.

32. Cotton BA., *et al*. "Damage control resuscitation is associated with a reduction in resuscitation volumes and improvement in survival in 390 damage control laparotomy patients". *Annals of Surgery* 254.4 (2011): 598-605.

33. Arafat S., *et al*. "Penetrating abdominal injuries during the Syrian war: patterns and factors affecting mortality rates". *Injury* 48.5 (2017): 1054-1057.

34. Ahmed HA and Abd Al-Helfy SH. "Relaparotomies in abdominal trauma: systematic review". *Iraqi Postgraduate Medical Journal* 14.1 (2015): 123-130.

35. Hietbrink F., *et al*. "Outcome of trauma-related emergency laparotomies in an era of far-reaching specialization". *World Journal of Emergency Surgery* 14 (2019): 40.

36. Ross SE and Morehouse PD. "Urgent and emergent relaparotomy in trauma: a preventable cause of increased mortality?" *American Surgeon* 52.6 (1986): 308-311.

37. Driver T., *et al*. "Reoperation after abdominal trauma". *American Journal of Surgery* 135.6 (1978): 747-750.

38. Hasan KC and Abdul-Aemmah AK. "A 5-year study of relaparotomies, planned and unplanned, in Al-Hillah Teaching General Hospital". *Medical Journal of Babylon* 15.1 (2018): 25-27.

39. Gumbs AA., *et al*. "MSF Hospital in Tabarre, Haiti: Why a field general surgery fellowship is necessary". *Surgeries* 2.2 (2021): 157-166.

40. Sahloul E., *et al*. "Cancer care at times of crisis and war: the Syrian example". *Journal of Global Oncology* 3.4 (2017): 338-345.

41. Ri S., *et al*. "Attacks on healthcare facilities as an indicator of violence against civilians in Syria: an exploratory analysis of open-source data". *PLoS One* 14.6 (2019): e0217905.

42. Biswas S., *et al*. "Analysis of the first 100 patients from the Syrian civil war treated in an Israeli district hospital". *Annals of Surgery* 263.1 (2016): 205-209.

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