ORIGINAL ARTICLE

Management of abdominal gunshot injuries: Surgical intervention or conservative follow-up? A single-center experience

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ABSTRACT

BACKGROUND: This study aims to retrospectively evaluate treatment approaches and clinical outcomes in patients with penetrating abdominal trauma caused by gunshot injuries—one of the most complex and controversial areas in trauma surgery.

METHODS: A total of 101 patients diagnosed and treated for penetrating abdominal trauma due to gunshot injuries between 2015 and 2025 were included in the study. Demographic data (age and sex); vital signs at admission to the emergency department (blood pressure, pulse, respiratory rate, body temperature); level of consciousness (Glasgow Coma Scale); hemodynamic status (stability/instability, need for fluid or inotropic support); intra-abdominal (liver, spleen, small intestine, colon, etc.) and extra-abdominal (thorax, extremities, head, etc.) organ injuries; laboratory findings (hemoglobin, leukocyte count, creatinine, pH level); treatment modality (surgical intervention or conservative management); surgical techniques used; blood and blood product transfusions; and hospital length of stay were retrospectively analyzed. Patients were divided into two groups: those who underwent surgical treatment and those managed conservatively. Factors influencing treatment decisions and variables affecting mortality were evaluated statistically.

RESULTS: Of the patients, 83.2% were male, with a mean age of 28.3±10.5 years. Surgical treatment was performed in 81.2% of cases, while 18.8% received conservative management. No mortality occurred in the conservatively managed group, whereas the surgically treated group had a mortality rate of 15.9%. Mortality among female patients (29.4%) was significantly higher than among males (9.5%) (p=0.026). Hemodynamic instability, intra-abdominal organ injury, presence of free air in the abdomen, and the need for blood product transfusion were associated with both the decision for surgical intervention and higher mortality. Additionally, damage control surgery and multiple organ injuries were linked to increased mortality.

CONCLUSION: Management of abdominal trauma caused by gunshot injuries requires a multidisciplinary approach to ensure appropriate patient selection and treatment planning. In hemodynamically stable patients, selective non-operative management (SNOM) is a safe and effective option, whereas surgical intervention—particularly in cases requiring damage control surgery—is associated with higher mortality. The increased mortality rate among female patients underscores the need for closer monitoring of this subgroup and further investigation into potential additional risk factors. These findings align with current literature and provide practical guidance for clinical decision-making.

Keywords: Gunshot injury; selective non-operative management (SNOM); surgical intervention; mortality; hemodynamic instability; damage control surgery; abdominal trauma.

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INTRODUCTION

Penetrating abdominal trauma is one of the most complex and debated challenges in trauma surgery. In regions where gunshot and stab wounds are prevalent, such injuries continue to be a major cause of morbidity and mortality.[1] Even in the absence of death, gunshot injuries can lead to permanent disability, reduced quality of life, loss of employment, and high treatment costs.[2]

Despite advances in surgical techniques, imaging modalities, and intensive care, the management of abdominal trauma caused by gunshot injuries continues to vary depending on patient- and injury-specific characteristics.[3]

Traditionally, surgical exploration has been the mainstay of treatment for such injuries.[4] Damage control surgery remains the first-line approach for surgical exploration,[5,6] and physiological criteria can provide an objective basis for decision-making in this context.[7] However, diagnostic laparotomy for abdominal gunshot injuries has been reported to result in negative laparotomy rates as high as 53%.[8,9] Gunshot wounds to the abdomen represent the most challenging subgroup for decision-making among penetrating abdominal trauma cases. Although selective non-operative management (SNOM) remains difficult in these patients, it has been shown to be successful in carefully selected cases.[10,11,12]

In recent years, the outcomes of SNOM in hemodynamically stable patients have gained increasing acceptance and clinical application.[12] This approach offers several advantages, including the prevention of unnecessary laparotomies, shorter hospital stays, and lower complication rates. The literature emphasizes that with proper patient selection, SNOM is a safe and effective strategy; however, meticulous monitoring is essential.[1]

In this study, we retrospectively evaluated the clinical characteristics, treatment modalities, and outcomes of 101 patients treated for abdominal trauma caused by gunshot injuries. Our aim was to assess these findings in the context of existing literature, focusing on how treatment approaches in abdominal gunshot trauma vary depending on factors such as hemodynamic status, organ injury, presence of free intraperitoneal air, and the mechanism of injury.

MATERIALS AND METHODS

This study involved a retrospective evaluation of 101 patients who presented to our hospital and were treated for abdominal trauma caused by gunshot injuries between 2015 and 2025. Ethical approval was obtained from the institutional review board of the hospital (Ethics Committee Approval No: 2025/01-37). The research was conducted in accordance with the principles of the Declaration of Helsinki.

Inclusion and Exclusion Criteria

Patients aged 15-64 years with a diagnosis of abdominal trauma caused by gunshot injuries and complete medical records were included in the study. Exclusion criteria were incomplete medical records, stab wounds, non-penetrating (blunt) abdominal trauma.

Data Collection

Patient data were retrieved from medical files and the hospital information management system. Collected variables included demographic characteristics (age, sex), clinical findings at admission, treatment modality (surgical or conservative), type of surgery (definitive or damage control), hemodynamic status, level of consciousness, presence of abdominal penetration, intraperitoneal free air, intra-abdominal and extra-abdominal organ injuries, laboratory parameters, need for blood product transfusion, and lengths of stay in the intensive care unit and inpatient wards.

Treatment Groups

Patients were classified into two groups based on treatment modality: surgical and conservative. For the surgically treated group, detailed data were recorded on the type of surgery, hemodynamic and neurologic status, intra-abdominal and extra-abdominal injuries, laboratory findings, and clinical outcomes. For the conservatively managed group, clinical and laboratory data, as well as treatment outcomes, were analyzed.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics, version 28 (IBM Corp., Armonk, NY, USA). Categorical variables were expressed as frequencies and percentages, and continuous variables as mean ± standard deviation or median (minimum-maximum), depending on distribution. Differences between categorical variables were analyzed using the chi-square test, and differences between continuous variables were assessed using the independent samples t-test or the Mann-Whitney U test, as appropriate. A p-value <0.05 was considered statistically significant.

RESULTS

The study population consisted of 101 patients, including 17 females (25.41±12.88 years, range: 15-64 years) and 84 males (28.88±9.93 years, range: 16-56 years), with a mean age of 28.30±10.49 years (range: 15-64 years).

The mortality rate was higher among patients who underwent surgical treatment (15.9%) compared to those managed conservatively, in whom no mortality was observed. This finding suggests that surgically treated patients presented with more severe and higher-risk clinical profiles. Regarding sex, the mortality rate among female patients (29.4%) was significantly higher than that among males (9.5%) (p=0.026),

possibly reflecting more severe presentations or additional risk factors in female patients. By type of surgery, no mortality occurred among patients who underwent definitive surgery, whereas the mortality rate was 33.3% in those who underwent damage control surgery (Table 1).

Hemodynamically stable patients were less likely to undergo surgery and had lower mortality rates. Similarly, patients with preserved consciousness had lower mortality (Table 2), indicating that the patient's overall condition at presentation directly influenced treatment decisions and outcomes.

Patients who underwent surgery had significantly longer intensive care unit (ICU) and ward stays, reflecting their more severe clinical status and greater demand for hospital resources. In terms of laboratory parameters, pH and he-

Table 1. Clinical and demographic characteristics and outcomes

Variable	Category	No Mortality	Mortality	Total	p-value
Treatment approach	Surgical	69 (84.1%)	13 (15.9%)	82	0.063
	Conservative	19 (100%)	0 (0%)	19	
Sex	Male	76 (90.5%)	8 (9.5%)	84	0.026
	Female	12 (70.6%)	5 (29.4%)	17	
Type of surgery	Definitive	43 (100%)	0 (0%)	43	<0.001
	Damage control	26 (66.7%)	13 (33.3%)	39	

Table 2. Association between treatment approach, level of consciousness, and hemodynamic stability

Treatment Approach	Hemodynamically Stable (n, %)	Hemodynamically Unstable (n, %)	Conscious (n, %)	Unconscious (n, %)	Total	p-value
Surgical	31 (37.8%)	51 (62.2%)	54 (65.9%)	28 (34.1%)	82	<0.001 (stability)
Conservative	19 (100%)	0 (0%)	19 (100%)	0 (0%)	19	
Total	50	51	73	28	101	0.003 (consciousness)

Table 3. Laboratory and clinical parameters

Parameter	Surgical (n=82)	Conservative (n=19)	p-value
ICU stay duration (days)	6 [1-300]	1 [0-4]	<0.001
Ward stay duration (days)	4 [0-12]	2 [1-5]	0.007
pH	7.31 [6.80-7.52]	7.40 [7.35-7.42]	<0.001
INR	1.26 [0.91-3.93]	1.07 [0.97-1.86]	<0.001
WBC	12.78 [1.86-27.90]	14 [9.77-6]	0.332
Hemoglobin (Hb)	12.90 [4.80-17.58]	15 [13-18.6]	<0.001
ALT	40.50 [8-974]	27 [9-108]	0.023
AST	48 [12-714]	27 [17-127]	0.001
Creatinine	0.85 [0.32-4.22]	0.80 [0.66-1.09]	0.266
Abdominal penetration (yes/no)	81/1	11/8	<0.001
Presence of free air in abdomen (yes/no)	79/3	11/8	<0.001
Blood product transfusion (yes/no)	49/33	0/19	<0.001

pH: Blood acidity level; INR: International Normalized Ratio; WBC: White blood cell count; Hb: Hemoglobin; ALT: Alanine aminotransferase; AST: Aspartate aminotransferase.

Table 4. Injury characteristics and firearm type

Variable	Category	Surgical (n=82)	Conservative (n=19)	Total (n=101)	p-value
Injury region	Right upper	35 (42.7%)	7 (36.8%)	42 (41.6%)	0.098
	Left upper	12 (14.6%)	1 (5.3%)	13 (12.9%)	
	Right lower	11 (13.4%)	7 (36.8%)	18 (17.8%)	
	Left lower	24 (29.3%)	4 (21.1%)	28 (27.7%)	
Firearm type	Rifled	70 (85.4%)	8 (42.1%)	78	<0.001
	Smoothbore	12 (14.6%)	11 (57.9%)	23	
Blood product transfusion	Yes	49 (59.8%)	0 (0%)	49	<0.001
	No	33 (40.2%)	19 (100%)	52	
Time to surgery	Immediate	64 (63.4%)	-	-	-
	12-48 hours later	18	-	-	-

moglobin (Hb) levels were significantly lower in the surgical group, suggesting impaired tissue perfusion and more extensive blood loss. Conversely, international normalized ratio (INR), alanine aminotransferase (ALT), and aspartate aminotransferase (AST) levels were higher in the surgical group, indicating more pronounced coagulopathy and liver injury. The presence of intra-abdominal injury and free air was markedly more common in the surgical group, supporting the preference for surgical intervention in cases of visceral organ injury. Blood product transfusion was significantly more frequent in the surgical group, whereas no transfusions were required in the conservatively managed patients (Table 3).

The most commonly affected anatomical region was the right upper quadrant (41.6%). There was no significant association between the site of injury and the treatment approach, suggesting that treatment decisions were more strongly influenced by the patient's overall condition and organ injury rather than the location of trauma. Analysis by firearm type revealed that the majority of surgically treated patients were injured by rifled firearms (85.4%), whereas injuries from smoothbore firearms were more often managed conservatively. This finding supports the notion that rifled firearms tend to cause deeper and more severe injuries, thereby increasing the likelihood of surgical intervention. Blood product transfusion was significantly more common in the surgical group, further indicating a higher incidence of hemorrhage and shock in these patients. Among the surgically treated group, 63.4% underwent immediate surgery, while the remaining patients were operated on within 12-48 hours (Table 4).

DISCUSSION

According to the literature, mortality rates in abdominal trauma caused by gunshot injuries range between 10-20%, with factors such as multiple organ injury, hemodynamic instability, and advanced age being associated with higher mortality.[13] In our study, the overall mortality rate was 12.9%, and the factors associated with mortality were analyzed in detail (Tables 1 and 2).

Gunshot injuries are more frequently observed in males and tend to occur more often in young adults.[14,15] Similarly, in our study, 84 of the 101 patients were male, with a mean age of 28 years.

Surgical treatment was performed in the majority of patients (81.2%), while conservative management was applied in 18.8%. Notably, no mortality occurred in the conservatively managed group, whereas the mortality rate among surgically treated patients was 15.9%. These findings align with previous studies reporting mortality rates of 10-20% in surgically treated gunshot-related abdominal trauma cases.[4] For instance, Demetriades reported a 13.5% mortality rate in surgically treated patients with abdominal gunshot injuries.[11]

The significantly higher mortality rate in female patients compared to males (29.4% vs. 9.5%, p=0.026) raises the question of whether sex plays a prognostic role in abdominal gunshot trauma. Although data on sex-related differences in mortality are limited, some studies have suggested that mortality may indeed be higher among female patients.[1] In our study, the higher mortality in women was not associated with surgical type, hemodynamic or neurological status, intra-abdominal involvement, presence of free air, injury location, firearm type, or blood transfusion (Table 3). This suggests the potential presence of non-standard risk factors in female patients. Further multicenter studies with larger cohorts are needed to better evaluate the effect of sex on mortality (Table 1).

In many studies, the small intestine has been reported as the most frequently injured organ in abdominal gunshot trauma. Adesanya and Feliciano reported small bowel injuries in 52.4% and 60% of their patients, respectively.[16,17] However, other studies have found colon injuries to be more common.[15] In our study, colon injuries were more frequent than small bowel injuries, although the latter were also common. Among the patients who underwent surgery, 45 had colon injuries

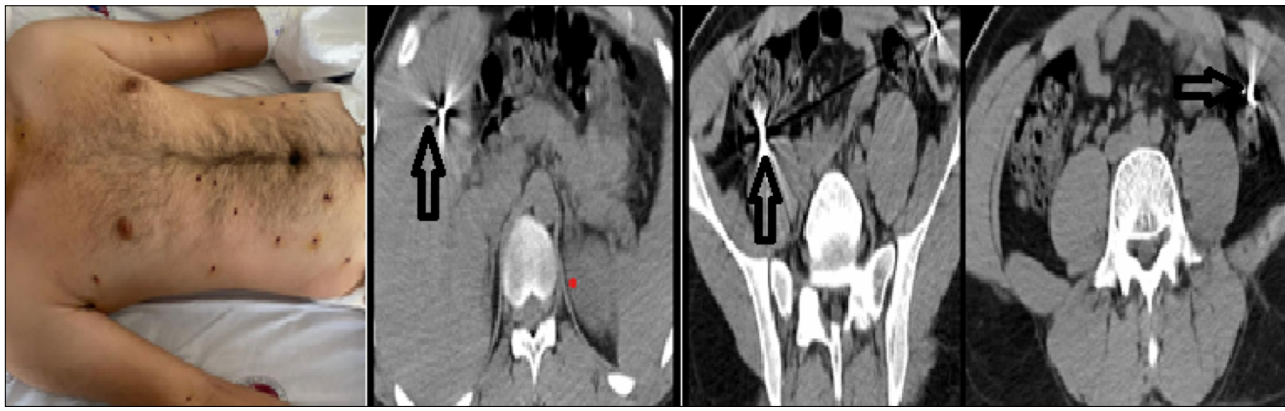

Figure 1. A 17-year-old male patient admitted with a firearm injury involving multiple injury sites in the abdominal region. Foreign body densities are visible in the liver parenchyma, sigmoid colon, and cecal lumen (black arrows). The patient was managed non-operatively and discharged after treatment.

and 39 had small bowel injuries. Given the broad spectrum of organ involvement, gunshot wounds to the abdomen are often associated with multiple injuries. The thoracic region is the most commonly affected extra-abdominal site.[18] In our series, 15 patients had lung injuries and six had diaphragm injuries (Table 3).

Mortality was significantly higher in patients who underwent damage control surgery compared to those who underwent definitive procedures (p<0.001). This likely reflects the fact that damage control surgery is typically performed in critically ill, hemodynamically unstable patients with multiple injuries. Rotondo emphasized that while damage control surgery can be life-saving in patients with severe physiological derangements and multiple injuries, it is also associated with high mortality rates.[19]

When dividing the abdomen into four quadrants—right upper, right lower, left upper, and left lower—the literature commonly identifies the right upper quadrant as the most frequently injured area.[20] Our findings were consistent with this pattern. However, no significant correlation was found between injury location and mortality (p=0.154) (Table 4).

Other variables influencing treatment decisions and prognosis included intra-abdominal organ injury, presence of free intraperitoneal air, and the need for blood product transfusion. Intra-abdominal injury was present in 98.8% of surgically treated patients compared to 57.9% in the conservative group. Similarly, free air was observed in 96.3% of the surgical group. Mortality was significantly higher among patients who received blood transfusions (p<0.001). Consistent with previous reports, these findings indicate that injury severity and associated organ damage are key prognostic factors. Leppäniemi reported that multiple organ injuries and massive hemorrhage are major determinants of mortality.[21]

A notable case in our series involved a patient with a left lower quadrant entry wound and an exit wound near the umbilicus who developed signs of acute abdomen and underwent surgery. Despite the absence of a clear intra-abdominal trajectory, the patient was found to have a sigmoid colon perforation. This case highlights the unpredictable clinical presentations of gunshot injuries and the importance of clinical judgment in determining the appropriate treatment modality (Fig. 1).

In our study, all patients managed conservatively were hemodynamically stable, and none experienced mortality. These findings support the view that SNOM is a safe and effective approach in appropriately selected patients. The 2010 Guidelines for Selective Nonoperative Management of Penetrating Abdominal Trauma also state that SNOM is a safe strategy in hemodynamically stable patients and helps reduce unnecessary laparotomies.[1] Leppäniemi further reported that the success rate of SNOM exceeds 90% in stable patients. Moreover, hospital and ICU stays were significantly shorter in the conservatively treated group, underscoring the benefits of SNOM in terms of patient comfort and resource utilization.[21,22]

This study has several limitations. Its retrospective and single-center design and limited sample size restrict the generalizability of the findings. Additionally, the relatively small number of female patients necessitates caution when interpreting sex-related results.

CONCLUSION

This study demonstrates that treatment approaches and clinical outcomes in patients with abdominal trauma caused by gunshot injuries are influenced by multiple factors. Our findings indicate that SNOM is a safe and effective treatment option in hemodynamically stable patients.

The management of abdominal gunshot trauma requires a multidisciplinary approach to ensure appropriate patient selection and treatment planning. Hemodynamically stable patients should be primarily considered for SNOM, whereas those requiring surgical intervention should be closely moni-

tored in an intensive care setting.

Ethics Committee Approval: This study was approved by the Van Yüzüncü Yıl University Ethics Committee (Date: 04.02.2025, Decision No: 2025/01-37).

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ORİJİNAL ÇALIŞMA - *ÖZ*

Abdominal ateşli silah yaralanmalarının yönetimi: Cerrahi müdahale mi yoksa konservatif takip mi? Tek merkez deneyimi

AMAÇ: Bu çalışma, travma cerrahisi alanında en karmaşık ve tartışmalı konulardan biri olan, abdominal bölgeyi penetran olarak etkileyen ateşli silah yaralanmalarında uygulanan tedavi yöntemleri ve klinik sonuçları geriye dönük olarak değerlendirmeyi amaçlamaktadır.

GEREÇ VE YÖNTEM: 2015-2025 yılları arasında ateşli silah yaralanması nedeniyle penetran abdominal travma tanısı konulan ve tedavi edilen toplam 101 hasta çalışmaya dahil edildi. Hastaların yaş, cinsiyet, acil servise başvuru anındaki vital bulguları (kan basıncı, nabız, solunum sayısı, vücut sıcaklığı), bilinç durumu (Glasgow Koma Skalası), hemodinamik durumu (stabil/instabil, sıvı ve/veya inotrop desteği ihtiyacı), intra-abdominal (karaciğer, dalak, ince bağırsak, kolon vb.) ve ekstra-abdominal (toraks, ekstremite, kafa vb.) organ yaralanmaları, laboratuvar bulguları (hemoglobin, lökosit sayısı, kreatinin, pH seviyesi), uygulanan tedavi yöntemleri (cerrahi müdahale veya konservatif takip), cerrahi teknikler, kan ve kan ürünü transfüzyonları ile hastanede kalış süreleri geriye dönük olarak analiz edilmiştir. Hastalar cerrahi tedavi uygulanan grup ve konservatif yönetilen grup olmak üzere ikiye ayrılmış, tedavi kararlarını etkileyen faktörler ve mortaliteye etki eden değişkenler istatistiksel olarak değerlendirilmiştir.

BULGULAR: Hastaların %83.2'si erkek olup, ortalama yaş 28.3±10.5 yıl olarak bulunmuştur. Hastaların %81.2'sine cerrahi tedavi uygulanırken, %18.8'ine konservatif tedavi verilmiştir. Konservatif tedavi uygulanan grupta mortalite gözlenmezken, cerrahi tedavi görenlerde mortalite oranı %15.9 olarak kaydedilmiştir. Kadın hastalarda mortalite oranı (%29.4) erkeklere (%9.5) göre anlamlı derecede yüksek bulunmuştur (p=0.026). Hemodinamik instabilite, intra-abdominal organ yaralanması, karın içinde serbest hava varlığı ve kan ürünü transfüzyonu ihtiyacı hem cerrahi tedavi kararını hem de mortaliteyi artıran faktörler arasında yer almıştır. Ayrıca, hasar kontrol cerrahisi ve çoklu organ yaralanmaları da mortalite ile ilişkilendirilmiştir.

SONUÇ: Ateşli silah yaralanmasına bağlı abdominal travmanın yönetimi, uygun hasta seçimi ve tedavi stratejisi için multidisipliner bir yaklaşım gerektirmektedir. Hemodinamik olarak stabil hastalarda seçici non-operatif yönetim (SNOY) güvenli ve etkili bir seçenektir. Cerrahi müdahale, özellikle hasar kontrol cerrahisi gerektiren vakalarda mortalite ile ilişkilidir. Kadın hastalarda gözlenen yüksek mortalite oranı, bu hasta grubunun daha yakından izlenmesi ve ek risk faktörlerinin araştırılması gerekliliğini ortaya koymaktadır. Elde edilen bulgular mevcut literatürle uyumludur ve klinik uygulamalara rehberlik etmektedir.

Anahtar sözcükler: Abdominal travma; ateşli silah yaralanması; cerrahi müdahale; hemodinamik instabilite; hasar kontrol cerrahisi; mortalite; SNOY.

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