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Evaluation of Penetrating Abdominal Trauma

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ABSTRACT

Background: Penetrating abdominal trauma (PAT), typically caused by stab wounds, blasts, or gunshots is a serious emergency with high global mortality, particularly among young males in conflict or low-resource settings. Mortality is commonly associated with shock, delayed hospital arrival, and multiple organ injuries. Management follows ATLS protocols, with urgent surgery for unstable patients. Diagnosis is guided by clinical assessment and imaging tools such as FAST, CT scans, or exploratory laparotomy. *Aim of study:* To identify key predictors of mortality in penetrating abdominal trauma.
Methods: A retrospective study was conducted on 90 patients with confirmed penetrating abdominal trauma admitted to Al-Nasiriya Teaching Hospital from May 2024 to May 2025. Inclusion required peritoneal violation due to gunshot, stab, or blast injuries, while patients with blunt trauma or incomplete data were excluded. Management followed ATLS protocols, including clinical evaluation, imaging, and surgery when indicated. Data were analysed using SPSS version 26, applying descriptive statistics and Pearson's test to identify mortality predictors. Ethical approval was obtained, and patient confidentiality was ensured.
Results: A total of 90 cases were analysed, with patients predominantly male (95.6%) and a mean age of 31.77 years. Stab wounds were the most frequent injury (51.1%), followed by gunshots (45.6%) and blasts (3.3%). The small bowel was the most commonly injured organ (48.9%), and extra-abdominal injuries were present in 17% of cases. The overall mortality rate was 10%, significantly associated with gunshot/blast injuries, delayed hospital arrival, hemodynamic instability, multiple intra-abdominal organ injuries, extra-abdominal involvement, and transfusion of ≥3 blood units. Age and injury location showed no significant correlation with mortality.
Conclusions: Mortality in penetrating abdominal trauma is closely associated with gunshot injuries, delayed arrival, hemodynamic instability, multiple organ injuries, extra-abdominal involvement, and high blood transfusion needs, emphasizing the importance of early identification and timely intervention.
Keywords: Penetrating abdominal trauma, gunshot injuries, hemodynamic instability, organ damage, blood transfusion requirements.

INTRODUCTION

Trauma can be defined as cellular disruption resulting from external energy that exceeds the body's tolerance, often compounded by ischemia/reperfusion injury. Globally, it remains the first cause of death among people aged 1 to 44 years (1). The incidence of trauma varies by region, related to socioeconomic conditions, violence, firearm accessibility, and military conflict. Penetrating

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abdominal trauma (PAT) typically happened due to stab wounds, blasts, or gunshots, represents a critical emergency contributing significantly to global trauma related mortality and morbidity (2). Risk factors associated with increased mortality include shock at presentation, colonic injury, and multiple intra-abdominal organ damage (2).

Each year, over 5 million deaths are linked to injuries, with penetrating trauma accounting for about 7% of trauma related deaths in the UK (3). The abdomen, due to its size, is affected in 10–15% of trauma cases. Males constitute the majority of PAT cases globally, comprising up to 90% of victims in certain regions. Gunshot wounds are responsible for nearly 90% of deaths from penetrating abdominal injuries, with high velocity bullets linked to eightfold higher mortality than stab wounds (4).

Anatomically, the abdomen is surrounded superiorly by the diaphragm and continues inferiorly into the pelvis. It is divided into four regions for trauma evaluation: anterior abdomen, thoracoabdominal area, flanks, and back. Organs are divided as intraperitoneal (e.g., stomach, small intestine, liver, spleen) or retroperitoneal (e.g., pancreas, kidneys, colon, aorta) based on their mobility and location (5).

The pathophysiology of penetrating trauma involves tissue destruction, haemorrhage, and systemic responses such as coagulopathy and hypothermia. High velocity injuries amplify damage through both shock waves and cavitation, increasing the risk of necrosis, bleeding, and even lead toxicity or embolism. Children are particularly vulnerable due to their thinner abdominal walls (6-8).

Initial trauma management follows the ATLS protocol, emphasizing rapid assessment and resuscitation (Airway, Breathing, Circulation), followed by a thorough secondary survey including AMPLE history and physical examination (1). The Revised Trauma Score (RTS), incorporating GCS, systolic blood pressure, and respiratory rate, aids in triage (9).

Urgent laparotomy is indicated in cases of peritonitis, hemodynamic instability, evisceration, or gastrointestinal bleeding (10). Abdominal distension may signal severe internal bleeding, although its absence does not exclude serious injury, particularly in retroperitoneal trauma (9).

Diagnostic evaluation includes local wound exploration, CT scanning, FAST ultrasound, diagnostic peritoneal lavage, laparoscopy, and laparotomy depending on the patient's stability and injury severity (1).

PATIENTS AND METHODS

This retrospective study was conducted at Al-Nasiriya Teaching Hospital and involved 90 patients admitted to the Emergency Department (ED) with penetrating abdominal trauma due to gunshot wounds, stab injuries, or blast related injuries. Only patients with confirmed peritoneal penetration, with or without associated injuries, were included. Cases were excluded if there was no peritoneal breach, if the trauma was blunt in nature, if patients were dead on arrival or unresponsive to resuscitation, if they left against medical advice and were lost to follow-up, or if injuries involved regions outside the abdomen.

Upon presentation, all patients underwent a primary trauma survey and resuscitation following Advanced Trauma Life Support (ATLS) protocols. Once stabilized, each patient received a full physical examination and relevant investigations, including complete blood count, random blood sugar, urinalysis, viral serology, and blood grouping with cross-match. Imaging studies such as erect chest and abdominal X-rays, abdominal FAST, and CT scans (in hemo-dynamically stable patients) were conducted based on the clinical scenario. While most diagnoses were evident, injuries to the lower chest or back with subtle signs of peritonitis posed diagnostic challenges.

Patients with abdominal gunshot wounds and those with stab injuries showing signs of peritonitis, instability, evisceration, persistent pain, or radiological evidence of organ injury underwent surgery. All surgical candidates received prophylactic antibiotics, and their treatment details were documented in standardized admission forms.

Exploratory laparotomies were performed via midline incisions. Surgical priorities included haemorrhage control, management of hollow viscus injuries, and full inspection of abdominal organs. Damage control surgery was applied in severe cases. Multidisciplinary teams were involved as needed.

Statistical Analysis

Data were analysed using SPSS version 26. Descriptive statistics summarized patient demographics and injury characteristics. Associations between mortality and clinical variables were assessed using Pearson's Chi-square test, with a p-value < 0.05 considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the hospital's ethics committee, and patient confidentiality was strictly maintained.

RESULTS

A total of 90 patients with penetrating abdominal trauma were included in this study. The mean age of patients was 31.77 years, ranging from 4 to 67 years. The majority were male (86 patients; 95.6%) and only 4 were female (4.4%) (*table 1*).

Regarding the mechanism of injury, 46 patients (51.1%) sustained stab wounds, 41 (45.6%) had gunshot injuries, and 3 (3.3%) suffered blast injuries. Extra-abdominal injuries were recorded in 15 patients (16.7%). Most patients (72; 80%) presented within 2 hours of trauma, and 36 patients (40%) were hemodynamically unstable on arrival (*table 2*).

In terms of intra-abdominal organ injury, the most commonly affected organs were the small bowel (44 patients; 48.9%), large bowel (33; 36.7%), liver (18; 20%), stomach (13; 14.4%), spleen (8; 8.9%), and kidneys (10; 11.1%). Less frequently involved structures included the diaphragm (15; 16.7%), pancreas (5; 5.6%), bladder (5; 5.6%), ureter (2; 2.2%), gallbladder (1; 1.1%), and great vessels (4; 4.4%). While the extra-abdominal injuries included the chest (8 patients; 8.9%), lower limbs (3; 3.3%), upper limbs (3; 3.3%), neck (3; 3.3%), and spinal cord (1; 1.1%) (*table 3*).

The overall mortality rate was 10% (9 patients). Mortality was significantly higher among those with gunshot or blast injuries (8 deaths among 44 patients; 18.2%) compared to stab wounds (1 death among 46 patients; 2.2%) ($p = 0.01$). Patients presenting after 2 hours had higher mortality (5 deaths among 18; 27.8%) versus those presenting earlier (4 deaths among 72; 5.6%) ($p = 0.004$). All 54 hemodynamically stable patients (60%) survived, while 9 of 36 unstable patients (25%) died ($p < 0.001$).

Mortality increased with the number of injured intra-abdominal organs: 0 deaths among patients with 0–1 injured organs, 1 death among 26 patients with 2 organs injured (3.8%), 3 deaths among 12 patients with 3 organs (25%), and 5 deaths among 9 patients with ≥4 organs (55.6%) ($p < 0.001$). Patients with extra-abdominal injuries had significantly higher mortality (8 deaths among 15 patients; 53.3%) compared to those without (1 death among 75; 1.3%) ($p < 0.001$). Transfusion volume was also associated with outcome: mortality occurred in 7 of 26 patients (26.9%) who received ≥3 blood units, while no deaths were observed among the 39 patients who received 0-1 unit ($p = 0.002$) (*table 4*).

Pearson's test confirmed significant correlations between mortality and the following parameters: injury mechanism ($p = 0.01$), arrival time ($p = 0.004$), hemodynamic status ($p < 0.001$), number of injured organs ($p < 0.001$), extra-abdominal injury ($p<0.001$), and number of transfused blood units ($p<0.001$).

Table 1 - Demographic characteristics of the study population

Variables		Patients (n=90)
Age (years)	Mean(range)	31.77(4-67)
Sex; n (%)	Male	86(95.55%)
	Female	4(4.45%)

Table 2 - Trauma characteristics and presentation data of patients

Variables	No=90	%
Mechanism of trauma		
Stab wound	46	51.0%
Gunshot	41	46.0%
Blast injury	3	3.0%
Associated extra-abdominal organ injury		
Yes	15	17.0%
No	75	83.0%
Time of the presentation		
≤ 2 hours	72	80.0%
> 2 hours	18	20.0%
Hemodynamic status of the patient		
Stable	54	60.0%
Unstable	36	40.0%

Table 3 - Distribution of injuries among patients.

Variables No=90	%	
Intra-abdominal organ injuries		
Small bowel	44	49
Large bowel	33	37
Liver	18	20
Pancreas	5	6
Spleen	8	9
Stomach	13	14
Kidney	10	11
Gall bladder	1	1.1
Bladder	5	6
Diaphragm	15	17
Ureter	2	2.2
Great vessels	4	4.4
Extra-abdominal injuries		
Chest	8	9
Lower limbs	3	3.3
Upper limbs	3	3.3
Neck	3	3.3
Spinal cord	1	1.1

Table 4 - Factors Associated with Mortality in Patients with Penetrating Abdominal Trauma.

Variables	Total (n;%)	Survival (n;%)	Mortality (n;%)	P-value
Injury mechanism				
Gunshot & blast injury	44(49)	36(40%)	8(9%)	0.01
Stab wound	46(51)	45(50%)	1(1%)	
Arrival time				
≤ 2 hours	72(80%)	68(76%)	4(4%)	0.004
> 2 hours	18(20%)	13(14%)	5(6%)	
Hemodynamic status				
Stable	54(60%)	54(60%)	0	< 0.001
Instable	36(40%)	27(30%)	9(10%)	
Number of injured organs				
0	7(8%)	7(8%)	0	< 0.001
1	36(40%)	36(40%)	0	
2	26(29%)	25(28%)	1(1%)	
3	12(13%)	9(10%)	3(3%)	
≥ 3	9(10%)	4(4%)	5(6%)	
Extra-abdominal organ injury				
Yes	15(17%)	7(8%)	8(9%)	< 0.001
No	75(83%)	74(82%)	1(1%)	
Number of transfused blood units				
0	12(13%)	12(13%)	0	0.002
1	27(30%)	27(30%)	0	
2	25(28%)	23(26%)	2(2%)	
≥ 3	26(29%)	19(21%)	7(8%)	

Table 5 - Correlation between mortality and clinical parameters using Pearson's test.

Parameter	P-value
Age	0.66
Injury mechanism	0.01
Injury location	0.14
Arrival time	0.004
Hemodynamic status	<0.001
Number of injured organs	<0.001
Extra-abdominal injury	<0.001
Number of transfused Blood units	<0.001

There was no significant correlation with age (p= 0.66) or injury location (p = 0.14) (*table 5*).

DISCUSSION

This study evaluated patients with penetrating abdominal trauma to determine the mortality rate and its associated risk factors. The mean age for the patients in this study was 31.77 years, consistent with previous findings by Hamdawi et al., who reported a mean age of 33.78 years among 523 patients with penetrating abdominal injuries (11), and Abdullah et al., who found a similar mean age of 28 years in an Iraqi cohort (12). This age range reflects the predominance of trauma among young, active individuals, likely due to increased outdoor and occupational exposure.

A pronounced male predominance (95.6%) was observed, aligning with earlier studies that consistently reported similar trends in trauma demographics (11,13). This gender disparity may be attributed to higher exposure of males to risk environments such as conflict zones, or violence prone activities.

In the present study, stab wounds were the most frequent mechanism of injury (51.1%), followed by gunshot wounds (45.6%) and blast injuries (3.3%). These findings go on with the study done by Babar et al., who reported 51.7% stab wounds and 40.8% gunshot injuries among 147 trauma patients (14). In contrast, Hamdawi et al. reported a predominance of high energy mechanisms, including gunshots and shrapnel injuries (96.2%), with stab wounds accounting for only 3.6% (11). Such variation may reflect geographical, socio-political, or urban-rural differences in trauma ethology.

The small bowel was the most frequently injured organ (48.9%), followed by the large bowel (36.7%) and liver (20%). This pattern is consistent with multiple previous studies (11,15,16), where the small bowel was consistently the most commonly affected organ in penetrating abdominal trauma. Its fixed mesenteric attachment and anatomical positioning render it more susceptible to direct injury (17).

Extra-abdominal injuries were recorded in 17% of patients, a proportion similar to the 17.4% reported by Olaogun et al. (18), though lower than the 27.3%

mentioned by Hamdawi et al. (11). This difference may result from variations in trauma severity, mechanism, or hospital referral patterns.

Most patients (80%) presented within two hours of injury. Early presentation is critical, as delays are associated with worse outcomes. While Hamdawi et al. reported that 75% of their patients presented within or shortly after the first hour (11), Abdullah et al. observed longer delays, with most patients arriving after three hours (12).

The overall mortality rate in our study was 10%, falling within the range reported in the literature (3.78–17%) (19-21). Higher mortality was associated with gunshot or blast injuries, delayed hospital arrival, hemodynamic instability, multiple intra-abdominal organ injuries, extra-abdominal involvement, and the need for multiple blood transfusions - all statistically significant findings. These associations have been supported by several other studies (11,19,22).

Gunshot wounds, in particular, were linked to elevated mortality rates, as also reported by Olaogun et al., due to the high kinetic energy transfer and extensive tissue damage they inflict (18). Time to presentation has likewise been demonstrated to impact survival significantly; Gad et al. and Abdullah et al. both found that delayed presentation worsens outcomes in penetrating abdominal trauma (22,23).

Hemodynamic instability was strongly associated with mortality in our series, consistent with Dr. Hussein et al., who reported hypovolemic shock as the leading cause of death in 68.4% of their patients (22). Furthermore, patients with multiple injured organs or extra-abdominal trauma were more likely to die, as confirmed in studies by Dr. Qasim et al. and Oosthuizen et al. (19,21).

Finally, the number of transfused blood units was a significant mortality predictor, as supported by evidence indicating that extensive transfusion requirements often reflect greater injury severity and physiological compromise (6).

However, this study had multiple limitations, including a small sample size, the inability to exclude the contribution of other confounding factors to mortality, being a single center study, and the involvement of multiple surgeons in performing the procedures.

CONCLUSIONS

This study concluded that mortality in patients with penetrating abdominal injuries is significantly associated with several clinical and trauma-related factors. Specifically, gunshot injuries, delayed hospital presentation, hemodynamic instability at admission, the presence of multiple intra-abdominal organ injuries, the need for multiple blood transfusions, and associated extra-abdominal injuries were all strongly correlated with increased risk of death. These findings highlight the importance of rapid assessment, early intervention, and prioritization of care for high-risk patients. Identifying these predictors can help guide clinical decision making and resource allocation to improve outcomes in this vulnerable population.

Conflict of Interest

The author(s) reported no conflicts of interests.

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