

# Abdominal Traumatic Injuries Patterns in Military Casualties

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## Research

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## Abstract

**Introduction:** Mortality and morbidity after abdominal trauma are important problems in military casualties. This study aimed to assess the patterns of abdominal traumatic injuries in military personals.

**Methods:** The cross-sectional study assessed the data of 111 cases. All military casualties that referred at hospital from May 2014 to June 2017 were included. The morbidity and mortality rate of patients was analyzed by SPSS-20 software.

**Results:** The most common damaged organ was the small intestine (43 cases of small bowel repair with AIS = 2) while the most severely damaged organ was the Spleen (4 cases of AIS = 6). The most damaged organ was the small intestine with ICD10 =S36.4 (64 cases) and the few damaged organ was bladder injury with ICD10 = S37.2 (8 cases). There was a statistically significant relationship between the trauma mechanism, injuries accompanying the abdominal trauma, and the final outcomes of the patients ( $P<0.05$ ).

**Conclusion:** The results showed that the most damages were associated with the small intestine in the umbilical region and most treatments were delivered as laparotomy surgery.

## Introduction

Mortality and morbidity after abdominal trauma are important problems in military casualties. In the human dimension, apart from the loss of life and disability people, the morbidity and mortality caused by injuries impose a financial burden on the individual and society (1). Knowledge about military casualties' patterns is very important from several perspectives including prioritizing injuries in order to monitor health and rehabilitation and designing appropriate war tools and equipment in order to eliminate weaknesses cause to mortality and morbidity (2). There are several differences between civilian trauma and military trauma cases for example in military casualties there are serious limitations in medical diagnostic procedures and the transfer of injured cases from the military area to safer hospitals (3). The most common wounds sustained in conflict due to explosive munitions. However, gunshot injuries are more frequently encountered during the early phases of conflicts, known as entry operations (4). Injuries caused by Gunshot or Explosion have different effects on each of the various anatomical organs and tissues of the body (5). The abdomen area is one of the most important parts of the body due to the crucial organs it contains, all of which can be exposed to penetrating traumas. Some abdominal visceral injuries can be dangerous and fatal in the first few minutes (6).

Penetrating wounds that occur on the battlefield are the result of projectiles hitting the fighter's body. Evidence shows that the lower extremity is the most common anatomical site of injury in the military casualties (3). These injuries can be caused by direct Gunshot or the impact of fragmentation from explosive munitions such as mines, grenades, mortars, and bombs. Abdominal traumas are one of the specific causes of increased mortality (7).

Due to the nature of traumas and the possibility of damage to various organs, rapid diagnosis and treatment of trauma can reduce mortality and increase the patient's chances of survival (9). Assessing the number of injuries and damage in military battles helps researchers to determine the needs of personnel and medical equipment based on the results obtained from different military situations (8). This study aimed to assess the patterns of abdominal traumatic injuries in military personals.

## Methods

The cross-sectional study assessed the data of 111 cases. All military casualties that referred at hospital from May 2014 to June 2017 were registered and assessed. Data of study were included patients' age, type of traumatic weapon, Abbreviated Injury Scale (AIS), type of diagnostic procedure performed based on the International Statistical Classification of Diseases (ICD-10) system, type of trauma, trauma location, severity and details of trauma, and outcome of treatment. The data were measured using a valid researcher-made checklist of trauma patients.

AIS is one of the trauma intensity scoring systems in which based on the severity of damage to each organ, a score between 0 (no damage) to 6 (complete organ failure) was allocated.

Data were analyzed by SPSS-20. Frequency (percent) and mean  $\pm$  SD were used for description of data. Chi 2 was used for assessing relationship between variables. P-value less than 0.05 were considered as statistical significantly.

## Results

Overall, 111 patients were included. The average age of all patients was  $27.38 \pm 7.23$  and mostly injured in 2016 (54 cases 48.6%). The results also showed that the most affected area was the umbilical cord area with 31 casualties, and most traumas were caused by penetration and explosion. Calculation of AIS of various organs of the body showed that the most severe damage was related to the spleen (4 cases of splenectomy AIS = 6), and the most abundant damaged organ was the small intestine (43 cases of repair of small intestine with 2 = AIS). Details on the demographic characteristics of patients, AIS of different organs, mechanism and location of trauma are provided in Table 1.

Table 1  
Patients' characteristics and AIS score regarding various organs

Variable	Age	Year of referral			Mechanism of trauma			Trauma in the abdominal area				
		2015	2016	2017	Gunshot	Explosion	Quiver	RUQ	RLQ	LUQ	LLQ	Umbilical
<b>N or average (%)</b>	27.3	19 (17.1)	54 (48.6)	38 (34.2)	47 (42.3)	56 (50.5)	8 (7.3)	13 (11.7)	26 (23.4)	16 (14.4)	25 (22.5)	31 (27.9)
<b>AIS score</b>	0		1	2			3	4		5		6
<b>Organ</b>	n (%)		n (%)	n (%)			n (%)	n (%)		n (%)		n (%)
Liver	100 (90)		0	4 (3.6)			1 (.9)	6 (5.4)		0		0
Spleen	100 (90.1)		0	2 (1.8)			1 (.9)	3 (2.7)		1 (.9)		4 (3.6)
Kidney	102 (91.9)		0	2 (1.8)			4 (3.6)	3 (2.7)		0		0
Bile ducts	108 (97.3)		0	0			0	2 (1.8)		0		1 (.9)
Small intestine	47 (42.3)		1 (.9)	(38.7)43			(10.8)12	4 (3.6)		4 (3.6)		0
Colon	72 (64.9)		0	(6.3)7			(11.7)13	(13.5)15		4 (3.6)		0
Ureter	102 (91.9)		1 (.9)	(6.3)7			1 (.9)	0		0		0
Bladder	103 (92.8)		0	(4.5)5			3 (2.7)	0		0		0

The highest damage was to the small intestine with code ICD10 = S36.4 (64 cases (57.6%)) while the smallest one was bladder injury with code ICD10 = S37.2 (8 cases (7.2%)) (Table 2).

Table 2  
Distribution of patient regarding ICD10

Injured organ	Code ICD10	Frequency (%)
Spleen	S36.0	11 (9.9)
Liver and bile ducts	S36.1	13 (11.7)
small intestine	S36.4	64 (57.6)
Colon	S36.5	39 (35.1)
Kidney	S37.0	9 (8.1)
Ureter	S37.1	9 (8.1)
Bladder	S37.2	8 (7.2)

The most common diagnostic procedures for patients were a complete blood test (CBC) and a urine test (UA), Also Survey of the damaged organs showed that the most damage was to the small intestine (%57.6), and the bile ducts were the least damaged.

The results of the injuries associated with abdominal trauma patients showed the most common injury was quiver of the lower limb (%12.6), and smallest damage was related to jaw and face quiver (%3.5).

There were 10 partial recoveries (such as having osteoma and intestinal fistula). The mortality rate was 3 cases (2.7%), and all deaths were due to penetrating trauma with severe AIS = 2 damage (Table 3).

Table 3  
Frequency of diagnostic measure, injured organ, accompanying injuries and final outcomes

Diagnostic measure N (%)	Ct scan 60 (55.9)	Sonography 9 (8.1)	Simple graphy 78 (80.2)	Ua,CBC ex 102 (98.2)	Antibiogram culture 2 (2)	Diagnostic laparotomy 21 (18.9)		
Injured organs N (%)	Liver 11 (9.9)	Kidney 9 (8.1)	Spleen 11 (9.9)	Small intestine 64 (57.6)	Colon 37 (35.1)	Ureter 9 (8.1)	Blader 8 (7.2)	Bile duct 3 (2.7)
Accompanying Injuries N (%)	Pneumothorax 12 (10)	Paraplegia 8 (7.2)	Lower limb quiver 14 (12.6)	Upper limb quiver 8 (7.2)	Jaw and face quiver 4 (3.5)	Lower limb fracture 5 (3.8)	Upper limb fracture 5 (3.8)	Fracture of the vertebrae 8 (7.2)
Final outcome of patient N (%)	Full ricavery 98 (88.2)		Partial ricavery 10 (2.7)		mortality 3 (9)			

The data also showed that no foreign object was laced for the patients in the hospital and most treatments were conservative in nature (67 cases). A variety of treatment measures in the hospital is provided in Table 4.

Table 4  
Distribution of treatments at Hospital

Type of treatment	N (%)
Conservative and patient management	67 (60.3)
Laparotomy	
Repair	
Spleen	1 (1)
Secondary fascia closure	6 (5.9)
Liver	1 (1)
Ureter and Double j implementation	2 (2)
Rectum	3 (2.7)
Infection control	
Abdominal abscess drainage	12 (11.6)
Debridement and irrigation of infectious abdominal wall ulcers	8 (7.7)
Irrigation of peritoneal Space	2 (2)
Implementation Drain in the abdominal space	5 (4.8)
Hartman ostomy	2 (2)
Remove part of body	
Partial hepatectomy	1 (1)
Colectomy	1 (1)
Appendectomy	2 (2)
Hemostasis of Organ	
Liver	1 (1)

There was a statistically significant relationship between the trauma mechanism, injuries accompanying the abdominal trauma and the outcome of the patient (P < 0.05). Also, the prevalence of abdominal trauma area in patients showed that most injuries were in the

umbilical region (31 patients). There was no a significant relationship between the severity of the trauma, trauma area and the final outcome of the patient ( $P > 0.05$ ) (Table 5).

Table 5  
The relationship between related factors and outcomes of the patients

Outcome		Full recovery	Partial recovery	Death	P-value
<b>Related factors</b>					
<b>Related injury</b>	Pneumothorax	10	2	0	P = 0.002*
	Paraplegia	6	2	0	
	Lower limb quiver	8	5	1	
	Upper limb quiver	7	1	0	
	Jaw and face quiver	3	0	1	
	Lower limb fracture	4	0	0	
	Upper limb fracture	4	0	0	
	Fracture of the vertebrae	7	0	1	
<b>Trauma area</b>	RUQ	12	1	0	P > 0.05
	LUQ	14	2	0	
	RLQ	21	2	3	
	LLQ	24	1	0	
	Umbilical	27	4	0	
<b>Trauma severity (AIS)</b>	1	1	0	0	P > 0.05
	2	78	6	3	
	3	15	4	0	
	4	4	0	0	
<b>Trauma mechanism</b>	Penetrating	91	10	3	P = 0.007*
	Non Penetrating	7	0	0	
*Significant difference.					

## Discussion

In the current study, all patients before including in this research had the experience of pre-hospital setting, with proper alertness and with fluid and drug treatment. The most affected area was the umbilical region and the causes of mortality were traumas to the right lower quadrant of the abdomen caused by explosions. Most diagnostic procedures for patients included a complete blood count and urine analysis test.

The most severe damage was related to the spleen and the most common organ damaged was the small intestine. The ICD10 code indicated that the most damage was done to the small intestine and the least damage was to the bladder. The most therapeutic treatment in the hospital was conservative and no foreign body was placed for any of the traumatic patients. There were three deaths and all deaths were due to penetrating trauma with severe AIS = 2 damage to the small intestine, and the most related injury with abdominal trauma was lower limb quiver.

The results of this study showed that the most frequent intervention was the laparotomy. Mohebbi et al. (2008), assessed the frequency of gunshot and quiver injuries during the imposed war, stated that laparotomy was one of the main diagnostic measures (8). Saghafinia et al. (2010), performed to determine the frequency of surgeries performed during the 8 years of the Iran-Iraq war, it was noted that laparotomy was the most frequent surgery (11).

The high number of laparotomy surgery is similar to the results of the present study. The rational justification for a high number of laparotomy procedures can be due to severe traumas caused by the blast around the abdominal area, gunshot, and secondary laparotomy due to primary laparotomy complications (such as bleeding, fistula, peritonitis, abscess, etc.). On the other hand, the results of this study showed that most abdominal traumas were caused by explosions Penn-Barwell et al. (2015) showed that the most therapeutic interventions for penetrating trauma included the conservative ones and patient follow-up (4). This finding is consistent with the results of the present study. On the other hand, the results of this study showed that most abdominal traumas were caused by penetration and explosion. Some studies mentioned that the most frequent type of trauma was the penetrative type (12, 13). Despite the similarity of the results of the mentioned studies in terms of the type of penetrating trauma, the environment and the cause of trauma were different from the present study as traumas occurred in those studies in the city and the causes of trauma were traffic accidents and stabbings. However, in the present study, the damage was caused by close and ground battles due to suicide attacks, mortars, grenades and surface-to-surface missiles.

According to the mechanism of weapons, parts and explosive debris spread in different directions and cover a larger area, which can be overwhelming. Evidence showed the most important causes of civilian trauma included traffic accidents, fall from heights, and winning objects (14, 15). In the present study; most of the traumas were infiltrated and caused by explosions and bullets, which is different from the results of the mentioned research. Perhaps the main reason for this difference is the difference in the research community, in the present study, the research community included patients with abdominal trauma- sustained during the war and in war conditions. The high incidence of small intestine trauma could be due to inadequate use of bulletproof vests, lack of taking a trench, and greater distribution of small intestine in the abdominal space than other organs.

Raja'i et al. (2012), showed that the peritoneum and mesentery were the most injured organs in patients with abdominal trauma (10). Also, the results of the study of Moti'e et al, which was performed to survey patients with severe trauma showed that the spleen was the most damaged organ and the most common type of trauma was blunt (18). The reason for the difference between the results of these studies and the present study can be explained by the differences between the environments of trauma as trauma occurred in those mentioned studies in the city and the cause of trauma was mostly traffic accidents and stabbing, but in this study the trauma occurred in the war zones and was caused by firearms and explosives. In the current study there was a statistically significant relationship between the trauma mechanism, injuries accompanying the abdominal trauma and outcome of the patient. However, the study by Mobaleghi, et al. (2004) showed there was no statistically significant relationship between the pattern of trauma and the patient's outcomes (19).

The results of current study showed that the rate of wound infection was %30, whereas in the Störmann et al. (2016) showed the rate of wound infection was %7.8 (20). The reason for this discrepancy may be related to the nature and differences between civilian and military trauma conditions. After a bullet strikes the body, explosive waves enter the bullet's path and travel at the speed of sound, creating a vacuum within the body that passes through the body, causing the foreign bodies adjacent to the wound, such as soil, clothing, wood, iron. Parts of the thermos easily penetrate deep into the wound and cause localized neurovascular damage due to the vacuum that is responsible for the wound infection.

The mortality rate in the current study was about %2.9. Saghfinia et al. (2009) investigated the prevalence of abdominal injuries in warfare victims and reported a low incidence of mortality (3). Nourian et al. (2010) showed that the mortality rate of patients was %2.9 on patients undergoing treatment for penetrating chest trauma (21). This result is consistent with the findings of the current study. The similarity of these results could be due to early diagnosis, accurate follow-up, management and quality of health care and exact triage in two studies.

## Conclusion

The results showed the most damages were associated with the small intestine in the umbilical region and most treatments were delivered as laparotomy surgery.

## Declarations

- Ethical Approval and Consent to participate

The protocol was approved by ethical committee of Baqiyatallah university of medical sciences.

**- Consent for publication**

Not applicable

**- Availability of data and materials**

Through a contact to corresponding author' email address, researchers can obtain more information about data and materials of the study.

**- Competing interests**

We declare that there are not any Competing interests in this study

**- Funding**

There is not any funding for this study.

**- Authors' contributions**

Study concept and design: Hadi Khoshmohabat, Hamid Reza Rasouli

Acquisition of data: Hadi Khoshmohabat, Sohrab Nosrati, Hamid Reza Rasouli

Analysis and interpretation of data: Hadi Khoshmohabat, Sohrab Nosrati, Hamid Reza Rasouli Drafting of the manuscript: Hadi Khoshmohabat, Sohrab Nosrati, Hamid Reza Rasouli

Statistical analysis: Hadi Khoshmohabat, Sohrab Nosrati, Hamid Reza Rasouli

Administrative, technical, and material support: Hadi Khoshmohabat, Sohrab Nosrati, Hamid Reza Rasouli

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