


The presentation and the outcome of penetrating abdominal bullet injuries – Iraqi hospital based study

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Abstract

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Website: <https://djm.uodiyala.edu.iq/index.php/djm>

Received: 19 September 2021
Accepted: 6 November 2021
Published: 15 October 2022

Background: In Iraq penetrating injuries to the abdomen caused by firearm are more common than stab wounds with remarkable mortality and morbidity. Early recognition of the injuries and immediate treatment are mandatory in saving the lives of many of those patients.

Objective: To review the presentation and evaluate the early post-operative morbidity and mortality of abdominal bullet injuries in Baghdad teaching hospital.

Patients and Methods: This prospective study was conducted on 132 patients admitted to second surgical unit in Baghdad teaching hospital after sustaining bullet injury to the abdomen during the time period of one year from October 2013 to September 2014.

Results: The most vulnerable age group involved, between 21-30 years comprised 71.2% of total. Male to female ratio was 43:1 (male comprised 97.73%). It was observed that the majority of the injured patients were military personnel (83%), associated with high velocity missiles (81%). It was seen that 96.6% of patients had positive findings during laparotomy; small intestine was involved in the majority of the patients 42.6% followed by large intestine in 35.65%, then liver in 20.86%. Majority of the patients had involvement of two organs (42%), followed by one organ in (28%). The major postoperative complications were wound infection (28.6%), followed by chest infection in (24.4%). The major cause of death was septicemia in 80%.

Conclusion: Explorative laparotomy continues to be the most accurate method used to diagnose the presence of penetrating intra-abdominal injuries with a negative laparotomy rate of 3.4%. The mortality rate tended to be related to the number of intra-abdominal organs injuries; high rates of surgical site and chest infections were found and septicemia was the chief cause of death after 48 hours. Hospital stays in our study were prolonged in comparison to other developed countries.

Keywords: Penetrated abdominal injuries, abdominal bullet injury, postlaparotomy complications

Introduction

The incidence of firearm-related violence is on the rise globally [1]. Most nations may attribute their gunshot injuries (GSIs) to crime, suicide or accident [2].

Penetrating injuries to the abdomen caused by firearms are more common than stab wounds and cause more damage to different sites of the abdomen with higher mortality [3]. Approximately 85% of abdominal wall GSIs penetrate the abdominal cavity and 95% of them require a surgical procedure for correction [4].

Early recognition of the injuries and immediate treatment are mandatory in saving the lives of many of those patients. Abdominal wounds require urgent treatment [5]. The patient who has been wounded in the abdomen is almost certain to die unless he is operated upon, so every penetrating and violating injury to the abdominal wall musculature should be explored by laparotomy [6, 7].

To manage patients competently, it is not sufficient to understand only operative techniques; knowledge is required over a wider area, encompassing epidemiology, biophysics and pathophysiology. Failure to understand the underlying scientific basis of such injuries will lead to inappropriate management[7]. The aim of this study is to review the presentation and evaluate the early post-operative morbidity and mortality of abdominal bullet injuries in Baghdad teaching hospital.

Patients and Methods

This prospective study was done at the 2nd surgical unit -Baghdad Teaching Hospital-Medical City Complex-Iraq, from the 1st of October 2013 till the 30th of September 2014. One hundred thirty-two patients with

penetrating bullet injuries to the abdomen with or without other associated injuries who were admitted to the hospital were included. Patients under 12 years who were managed in the pediatric surgical unit and those with death on arrival were excluded from the study.

All the patients had primary surveys to identify any life-threatening conditions and were resuscitated depending on the condition of the patient, some patients with thoracic injury required emergency thoracotomy; others with limb fractures required back slabs.

During exploration, a midline incision was used for all patients; control of life-threatening bleeding was done immediately by packing; fecal contamination was minimized by controlling the lacerated viscous; then systematic assessment of all organs was done. Damage control procedures were performed on the severely injured patients.

Statistical Analysis

A standardized data collection form was completed for each patient, including demographic data, patients' presentation and duration, physical examination, results of imaging studies, line of management, operative findings, postoperative hospital stay and outcome.

Results

This prospective study included 132 patients, 129 male (97.73%) and 3 female (2.27%), as shown in Table (1).

Table (1): The distribution of patients according to the gender

Gender	No. of patients	%
Male	129	97.73%
Female	3	2.27%
Total	132	100%

The age of the patients ranged from 18 to 65 years with an average of 28 years. The highest percentage of victims (71.2%) was found to be in the age group (21-30) years. Table (2) shows the distribution of the patients according to their age.

Table (2): The distribution of the patients according to the age

Age (years)	No. of patients	%
12-20	7	5.3%
21-30	94	71.2%
31-40	23	17.4%
41-50	6	4.6%
>50	2	1.5%
Total	132	100%

Of the 132 patients, (83%) were military and 22 patients (17%) were civilian, as shown in Figure (1).

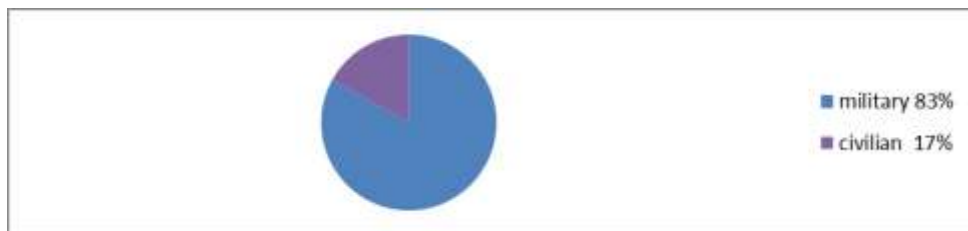


Figure (1): The distribution of patients according to the occupation

It was observed that the majority of injuries were with high velocity missile (HVM) in 107(81%) of patients, while in 25 patients (19%) the injury was by low velocity missile (LVM).Figure 2 shows the mechanism of injury in our patients.

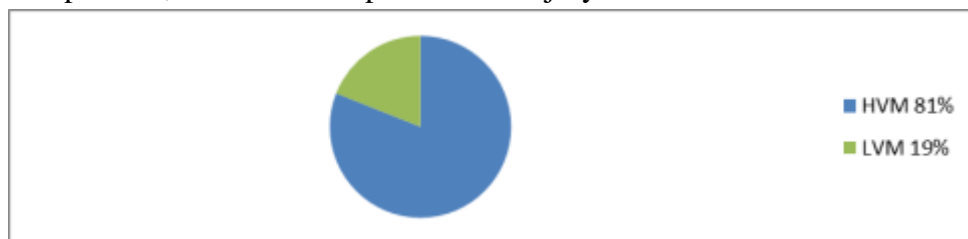


Figure (2): Mechanism of the injury

Hospital arrivals varied, but more than half of the patients 75 (56.8%) arrived 3-6 hours from insult, with the average time from injury to operation 5 hours. As shown in Table (3).

Table (3): Time from insult to hospital admission

Time (hours)	No. of patients	%
<1	2	1.5
1-<3	20	15.2
3-6	75	56.8
>6-10	16	12.1
>10	19	14.4
Total	132	100%

Depending on blood pressure at time of admission, the patients were divided into two categories, shocked with systolic blood pressure less than 90 mmHg comprised 30

patient (23%) and patients with stable vital signs (compensated) 102 patients (77%). As shown in Figure (3).

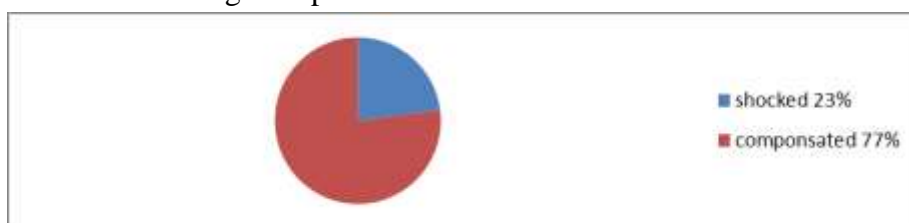


Figure (3): State of patients on admission (initial vital signs)

After resuscitation and survey including focused abdominal ultrasonography (FAST) and abdominal CT (when available), 8 patients were assigned to conservative management, one of them needed a

laparotomy later-on, local wound exploration (LWE) was done in 6 other patients. In 118 patients, laparotomy was done along with resuscitation Table (4).

Table (4): Lines of treatment

Line of treatment	No. of patients	%
Conservative	7	5.3
Local wounded explorations	6	4.55
Immediate laparotomy	118	89.39
Late laparotomy	1	0.76
Total	132	100%

During laparotomy, hemoperitoneum or retro- peritoneal hematoma with or without organic injuries was found in 115 (96.6%) of cases (positive laparotomy) while in 4 patients (3.4%) neither hematoma nor organ

injuries were found (negative laparotomy) (bullet in the abdominal wall). As shown in Figure (4). There were 87% intra-abdominal injuries encountered in the patients studied with bullet injury.



Figure (4): Findings during laparotomy

In patients with positive laparotomy, the small intestine was involved in 49 (42.6%) of cases followed by the large intestine in 41 patients (35.65%) and then the liver and diaphragm, in 24 patients (20.116%) and 22 patients (18.48%) respectively. Other injuries are shown in the Table(5).

Table (5): The incidence of various organs injured in 115 with positive laparotomy

Organ	HVM	LVM	Total no.	%
Small intestine	43	6	49	42.6
Large intestine	31	10	41	35.65
Liver	20	4	24	20.86
Spleen	11	3	14	12.17
Kidneys	11	2	13	11.3
Stomach	9	1	10	8.69
Diaphragm	17	5	22	19.13
Urinary bladder	3	2	5	4.34
Common bile duet	1	-	1	0.86
Pancreas	3	1	4	3.36
Major vessel	3	1	4	3.36

Depending on the number of organs involved, 37 (28%) of the patients in the study had one organ injury, 55 (42%) had two organs injury and 14 (10.6%) had three organs injuries.

Table (6): No. of organs involved in relation to type of missile

No. of organ involved	HVM	LVM	Total No.	%
1 organ	30	7	37	28
2 organs	44	11	55	42
3 organs	9	5	14	10.6
>=4 organs	6	0	6	4.4
Total	89	23	112	85%

79.6% of the small intestinal injuries were associated with other organs injury mainly the large intestine (33%).

Liver injury associated with other organs injury was found in 75% of the cases. Diaphragmatic injuries were associated with

other organs in 95.5% (most diaphragmatic injury associated with liver injury 31% and next was stomach injury 23%), while isolated diaphragmatic injury was noted in one case. Stomach injuries were never isolated . as shown in Table (7).

Table (7): Organ injury in relation to other organ

Organ	Injured alone	Injured with other-viscera
Small intestine	10 (20.4%)	39 (79.6%)
Large intestine	15 (36.6%)	26 (63.4%)
Liver	6 (25%)	18 (75%)
Diaphragm	1 (4.5%)	21 (95.5%)
Stomach	Nil	10 (100%)
Spleen	1 (7.1%)	13 (92.9)
Kidneys	1 (7.7%)	12 (92.3%)
Pancreas	Nil	4 (100%)

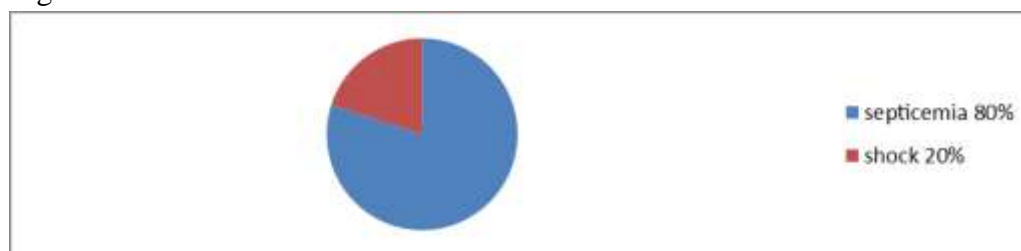
For the patients who survived, hospital stay ranged between 5-17 days with an average of 10 days Table (8).

Table (8): Post operative hospital stay

Days	No. of patients	%
<=7	46	36
8-14	66	52
>=15	15	12
Total	127	100%

Mortality rate was 3.78%, and the major cause of death was septicaemia 80% (depending on clinical data not on forensic

medicine report). Figure (5) shows the causes of mortality in our study.



Figure(5): Causes of death

All of the deceased were males who underwent early laparotomy, and they were injured by HVM. 4/5(80%) arrived within 3-6 hr after injury. 3/5(60%) were in shock state at presentation.

For those who survive, the most common postoperative complication was wound infection

28.6%, followed by chest infection 24.4%, burst abdomen recorded in 6 cases (5.1%), liver abscess developed in 2 cases (1.7%) and both associated with liver injury, entero-cutaneous fistula developed in 3 cases (2.5%), 2 in small intestine and one from the site of ileotransverse anastomose.

Table (9): Common early postoperative complications

Complication	No. of patients	%
Wound infection	34	28.6%
Chest infection	29	24.4%
Burst abdomen	6	5.1%
Enter cutaneous fistula	3	2.5%
Inter abdominal abscess	2	1.7%
DVT	2	1.7%

Re-exploration was indicated in 13 patients (11%) and the major cause of re-exploration was burst abdomen in 6 cases (5.1%); damage control procedure done in 5 cases (4.2%) who needed a second look operation within 72 hours and missed large intestinal injury (splenic flexure) was found in 2 cases (1.7%) Table (10).

Table (10): Causes of re-exploration

Causes	No. of patients	%
Burst abdomen	6	5.1%
Damage control procedure	5	4.2%
Missed injury	2	1.7%
Total	13	11%

Table (11): Injured organs in different studies

Study	No. of patient	Small intestine	Large intestine	Liver
Current study	132	42.6%	35.6%	20.8%
Adesanya A.A. et al ⁽¹³⁾	-----	56.1%	38.6%	22.8%
Feliciano D.V. et al ⁽¹⁴⁾	-----	60%	41.6%	29.3%
Mudher S. Borhan ⁽¹⁵⁾	274	42.3%	36.9%	21.5%

Table (12): Incidence of stomach injury in different studies

Study	No. of cases	Isolated stomach injury	Stomach inj. With other organ	Total no. and percentage
Current study	132	Nil	10	10(8.69%)
Ali Abbas ⁽¹⁸⁾	148	Nil	12	12(8%)
Mudher S. ⁽¹⁵⁾	274	3	9	12(9.23%)
EAST ⁽⁵⁾	2632	-----	-----	4.3%

Table (13): Mortality rate in different studies

Current study	Pinedo-Onofre JA ⁽⁸⁾	Gutierrez de Ceballos ⁽⁵⁾	Brismar ⁽²²⁾	Ali Abbas ⁽¹⁸⁾
3.78%	3.9%	5.3%	6.4%	12.1%

Table (14): Incidence of the most common early postoperative complication in different studies

Complication	Current study	Gutierrez de Ceballos ⁽²¹⁾	Brismar ⁽²²⁾	Teixeira PG ⁽²³⁾	Ali Abbas ⁽¹⁸⁾
Wound infection	28.6%	51.6%	47.6%	----	20.6%
Chest infection	24.4%	----	14%	----	----
Burst abdomen	5.1%	----	6.8%	----	3.1%
Enterocutaneous fistula	2.5%	-----	----	1.5%	4.8%
DVT	1.7%	2%	2.3%	----	----

Discussion

In our study, there were 87% intra-abdominal injuries encountered in the patients studied with bullet injury. That is comparable to the 85% injuries stated by James E *et al* [7] and Laren P [8].

In the present study, it was observed that the majority of the patients were in the age group 21-30 years (71.2%). This observation agrees with Bergvist D *et al* [9], who reported that the most common age group was between 20-30 years.

In our series, males dominated females in a ratio of 7.5:1 among civilian patients, while 43:1 among the total number of patients (97.73%). This dominance of male injuries was in agreement with Bergvist *et al* [9], Zuhir Bodalal *et al* [6] was reported 22:1 (96.7%) was male and Pinedo-Onofre *et al* [4] (93.67% was male).

The majority of patients were military 83% due to the events that occurred in our country during the period of the study, and also this explains the male predominance.

It was observed that most of our patient insults were due to HVM injury (81%).

In our management plan, 118 patients (89.39%) required early laparotomy after resuscitation and survey including focused abdominal ultrasonography (FAST) and abdominal CT (when available). According to Shah R *et al* this approach have been explained by 4 reasons: (a) There is a high incidence of intra-abdominal organ injury, which approaches 90%; (b) Many centers have limited experience with gunshot wounds; (c) Negative laparotomy is not particularly morbid; (d) Physical examination is unreliable [10].

The overall negative exploration rate was 3.36% a finding that is consistent with the experience of Biancolini CA [11] and Mustafa Dhia [12] that reported the percentage of negative laparotomy (3.5%) in patients had penetrating injuries.

The commonly injured organs were the small intestine in 49 patients (42.6%); large intestine in 41 patients (35.65%) and liver in 24 patients (20.86%), respectively and these results were close to other studies Table (11). These findings may be explained that these organs are large organs, occupy a good proportion of the surface area of the peritoneal cavity, and are unprotected by bone[16]. Two large bowel missed injuries were found that required re-exploration and this resulted in increase morbidity in our study and an associated increment in hospital stay.

The majority of liver injuries required no surgical , only packing or needed simple mattress suturing. Leppaniemi *et al* [17] reported (97%) of liver injury requiring no surgical intervention or just simple mattress suturing.

Stomach injuries were reported in 10 cases (8.69%) all of the injuries were associated with other organs mostly the diaphragm, liver and spleen. These results agree with other studies Table [12].

In splenic injuries, only 5 cases were suitable for splenorrhaphy and the other 9 cases were managed by splenectomy.

Missiles may pass through both the thorax and abdomen via the diaphragm [19]. The diaphragm was injured in 22 cases (19.13%); one case was isolated and 13/14 cases were being associated with liver, stomach, spleen, small intestine and large intestine.

Pancreas was injured in 4 cases (3.47%); 2 cases were managed by direct suturing and 2 cases by distal pancreatectomy. Close drain was used in all cases. This low incidence of pancreatic injury can be explained by its deep and well-protected anatomical position. Similar findings have also been reported by Ivatury *et al* [20].

In our study 119 patients underwent explorative laparotomy, 99 patients (84.2%) had a hemoperitoneum, Mudher S. Borhan *et al* [15] reported 84.97% with hemoperitoneum. In our study the overall mortality rate was 3.78%, all the deceased patients presented with more than 2 organs injury, mortality is directly related to the number of organs injured and this finding coincides with other studies as shown in Table (13).

The most common early postoperative complication of those underwent laparotomy was wound infection 28.6% ,this is probably because GSWs are contaminated by bacteria, clothing and debris which are sucked into the cavity, large intestinal injuries and nosocomial infection. This tends to be lower than the results of other studies as shown in Table[4]. Followed by chest infection 24.4%. Burst abdomen occurred in 5.1% and enterocutaneous fistula developed in 2.5% of patients.

The average of hospitalization time in general surgical wards was 10 days, which appears longer in comparison with the study of Kobi Peleg (4 days) [24], and similar to that of Ali Abbas who reported 10 days average of hospital stay [18].

Conclusions

Explorative laparotomy continues to be the most accurate method used to diagnose the

presence of penetrating intra-abdominal injuries, particularly for those with unreliability of physical signs and false negative results of FAST or abdominal CT.

The mortality rate tended to be related to the number of intra-abdominal organs injuries. High rates of surgical site and chest infections were found and septicaemia was the chief cause of death after 48 hours.

Hospital stay in our study as well as in a previous study at our hospital is prolonged in comparison to other studies in developed countries.

Recommendations

Establishing a special trauma centers and military hospitals to deal with trauma patients as there is a good number of penetrating injuries as it has been found that specialized centers have a better outcome.

Patients who sustained penetrating intra-abdominal bullet injuries should be dealt with by early exploration and re-exploration when needed to improve outcome and to avoid the course of multi organ dysfunction syndrome and septic shock.

A more liberal use of the damage control approach for severely injured patients is recommended.

Need for 24 availability of contrast-enhanced CT scans to assess the injury in suitable patients for the study and improve the process of decision making.

Use of diagnostic laparoscopy for those with equivocal finding.

Source of funding: The current study was funded by our charges with no any other funding sources elsewhere.

Ethical clearance: Ethical approval was obtained from the College of Medicine /

University of Diyala ethical committee for this study.

Conflict of interest: Nil

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مراجعة التقديم و النتائج لإصابات الطلق الناري النافذ في البطن في مستشفى بغداد التعليمي

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الملخص

خلفية الدراسة: في العراق إصابات البطن النافذة بسبب الطلقات النارية أكثر شيوعاً من الإصابات البطن الأخرى مع معدل اعتلال و وفيات عالية. التشخيص السريع و التداخل الجراحي المبكر ضروري في مثل هذه الحالات لتجنب المضاعفات و الوفيات المحتملة.

اهداف الدراسة: مراجعة التقديم و تقييم معدلات الاعتلال المبكرة ما بعد العملية و الوفيات الناتجة عن إصابات الطلق الناري في البطن في مستشفى بغداد التعليمي.

المرضى والطرائق: دراسة مستقبلية أجريت على ١٣٢ مريضاً أدخلوا إلى الوحدة الجراحية الثانية في مستشفى بغداد التعليمي بعد إصابتهم بغير ناري في البطن خلال فترة زمنية لمدة سنة واحدة اعتباراً من تشرين الأول ٢٠١٣ إلى أيلول ٢٠١٤.

النتائج: من تحليل النتائج وجد إن العمر الأكثر إصابة كان بين ٢١-٣٠ عاماً مشكلاً نسبة ٧١,٢٪ من المجموع الكلي. و كان نسبة الذكور إلى الإناث ٤٣: ١ (الذكور تشكل نسبة ٩٧,٧٣٪). ولوحظ أن الغالبية العظمى من المرضى المصابين هم من العسكريين (٨٣٪)، و إن الإصابات كانت بسبب الاطلاقات ذات السرعة العالية (٨١٪)، وكانت طريقة النقل إلى المستشفى بواسطة الطائرة مع سيارة الإسعاف هي الأكثر استخداماً (٥٩٪). و قد لوحظ أن ٩٦,٦٪ من المرضى كانت نتيجة فتح البطن إيجابية، الأمعاء الدقيقة كانت الأكثر إصابة بنسبة ٤٢,٦٪، تلتها الأمعاء الغليظة بنسبة ٣٥,٦٥٪، ثم الكبد بنسبة ٢٠,٨٦٪. معظم المرضى كانوا مصابين بعضوين من أعضاء البطن بنسبة (٤٢٪)، تليها إصابة عضو واحد بنسبة (٢٨٪). و كان التهاب الجروح هي الأكثر شيوعاً بين المضاعفات التي قد تحدث بعد العملية بنسبة (٢٨,٦٪)، يليها التهاب الجهاز التنفسي بنسبة (٢٤,٤٪). وكان السبب الرئيسي للوفاة و تسمم الدم الجرثومي بنسبة ٨٠٪.

الاستنتاجات: ما تزال عملية فتح البطن الاستكشافي أكثر دقة في تشخيص إصابات البطن النافذة مع نسبة ٣,٤٪ من الحالات السالبة أما معدل الوفيات ما بعد العملية فترتبط بعدد الأعضاء المصابة و ما زالت التهابات الجروح و الالتهابات التنفسية من أكثر المضاعفات بعد العملية أما أكثر الوفيات بعد العملية فبسبب تسمم الدم الجرثومي. أما فترة الرقود ما بعد العملية في المستشفى فهي أطول من مثيلاتها في الدول الأخرى.

الكلمات المفتاحية: إصابات البطن النافذة ، الطلق الناري ، مضاعفات مع بعد العملية

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تاريخ استلام البحث: ١٩ أيلول ٢٠٢١

تاريخ قبول البحث: ٦ تشرين الثاني ٢٠٢١

٢٠٢١ اختصاصي الجراحة العامة و الجراحة المنظارية – مستشفى بعقوبة التعليمي – ديالى – العراق