

## Original Research Article

# Conservative management versus surgical intervention for penetrating abdominal shotgun injuries

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## ABSTRACT

**Background:** The objective of the study was to present our experience of selective conservative management of abdominal gunshot wounds in University hospital over three years.

**Methods:** This prospective study included 30 patients who presented with shotgun injuries to the abdomen. The study included only patients with bird shots (small pellets, number 6), who are vitally stable with evidence of penetration on CT scan, and with no hemoperitoneum, pneumoperitoneum, or collection. They were allocated to one of two groups according to the surgeon preference. Patients in the Operative Group were transferred for immediate exploratory laparotomy. Patients in the Conservative Group were closely observed for 48 hours, received nothing per oral with the administration of antibiotics and fluid and no analgesics. After 48 hours, if the patients were stable with no complications, they were discharged. Conservative management was terminated for vital instability, hemoglobin drop, rising white blood cells count, fever, abdominal symptoms, and signs of peritonitis.

**Results:** Exploration yielded a negative result in 9 out of 14 patients (64.3%) of the Operative Group. Four patients had significant injuries, and one had an insignificant injury. Postoperative complications occurred in 3 patients. Conservative management failed in one patient who developed high fever and abdominal symptoms.

**Conclusions:** In patients with penetrating abdominal shotgun injuries with no evidence of abdominal organ injuries, conservative management is a safe and successful option based on strict selection criteria including small shots in a hemodynamically stable patient with evidence of penetration on CT scan, and with no hemoperitoneum, pneumoperitoneum or collection.

**Keywords:** Shotgun, Conservative, Operative, Trauma

## INTRODUCTION

Penetrating abdominal trauma is caused by stab wounds and less commonly by firearm wounds. However, gunshot wounds are associated with a significantly higher mortality rate and are responsible for 90% of penetrating trauma deaths.<sup>1</sup> Gunshot wounds are characterized by vague courses, more tissue destruction, and deeper injury. In about 80% of cases, abdominal gunshot wounds enter the peritoneal cavity.<sup>2</sup> The most frequently affected

organs in abdominal gunshot wounds are small intestine, followed by the colon, and then the liver.<sup>1</sup>

Over the past decades, the non-operative management of abdominal blunt trauma and stab wounds has gained acceptance. In contrast, the standard of care for gunshot wounds to the abdomen in most centers encompasses mandatory surgical exploration.<sup>3</sup> Given the higher frequency of visceral and vascular injuries in abdominal gunshot wounds, the concept of non-operative

management is controversial among some surgeons.<sup>4,5</sup> Currently, some high-volume centers are adopting selective non-operative management (SNOM) of gunshot wounds to the abdomen.<sup>6</sup> There is also accumulating evidence of successful management of abdominal gunshot wounds over the last three decades.<sup>3</sup>

In the past few years, the number of shotgun trauma presenting to the emergency department (ED) at Kasr Al-Aini hospital has markedly increased. The purpose of the current study is to present our experience of selective conservative management of abdominal gunshot wounds in Kasr Al-Aini hospital over three years.

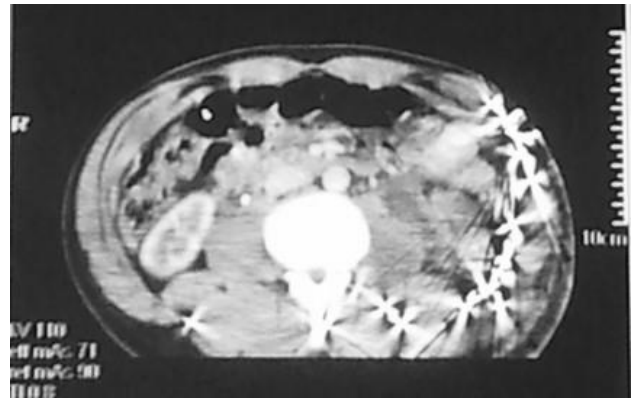
**METHODS**

This prospective study included 30 patients who presented to the Emergency Department of a University teaching hospital with shotgun injuries to the abdomen during the period from March 2013 to August 2013. During this period, the number of emergency room attendants was 116,761 (trauma and surgical emergencies). The total number of firearm injuries was 3242; 987 of them (30.4%) had shotgun injuries. The total number of abdominal shotgun injuries was 596 cases (60.4% of total shotgun injuries).

Patients with abdominal shotgun injuries were primarily managed using the Airway, breathing, circulation, disability, exposure (ABCDE) approach to ensure their safety. The vitally unstable patients with evidence of shots penetrating the abdominal cavity were resuscitated and transferred to the operating room directly for exploratory laparotomy. Stable patients with no symptoms and signs suggesting a surgical abdomen had a CT scan of the abdomen without contrast to check if the shots penetrated the abdominal wall into the abdominal cavity, shots within the viscera, or penetrating the peritoneum, and to check the type of shots (Figures 1 and 2).



**Figure 1: CT scan of abdomen and pelvis showing small sized pellets (bird shots).**



**Figure 2: CT of the abdomen showing small sized pellets (bird shots) penetrating the abdomen.**

The study included only patients with bird shots (small pellets, number 6), who are vitally stable with evidence of penetration on CT scan, and with no hemoperitoneum, pneumoperitoneum, or collection. Patients with a clear indication of abdominal organ injury on CT scan or other indication of surgery, e.g., chest injury-neck injury or those affected by large caliber shots were excluded from the study. The included patients were allocated to one of two groups according to the surgeon preference.

Patients in the operative group were transferred to the operating room for immediate exploratory laparotomy under general anesthesia. Formal abdominal exploration was done searching for any injuries to manage. Patients in the Conservative Group were admitted to the ICU or a step-down unit for 48 hours. They received nothing per oral with the administration of antibiotics and fluid and no analgesics. They were subjected to close follow up of vital signs (every 1 hour), abdominal examination every-6 h, and serial complete blood picture every 12 h. After 48 hours, if the patients were stable with no complications, they were discharged. Conservative management was terminated should one of the following criteria was observed. Vital instability, hemoglobin drop by >2 gm/dl over 24 hours, rising white blood cells count with fever and abdominal symptoms or in the absence of extra-abdominal infection, and development of symptoms and signs of peritonitis.

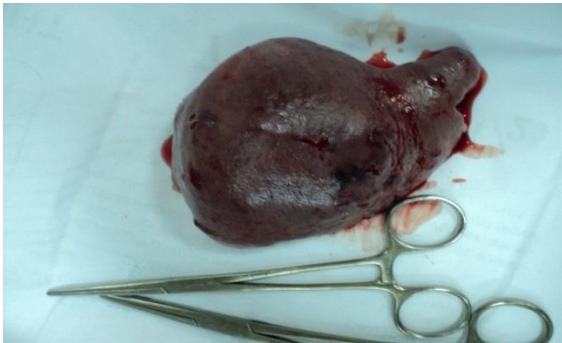
Injuries were classified as significant (if demanding surgical repair to heal) or non-significant (probably will heal spontaneously with conservative management). The criteria of non-significant injuries were a hollow organ with a wound <3 mm, no eversion of the mucosa, and no soiling, or a solid organ with no active bleeding (Figures 3-6).

All patients were subjected to history taking, physical examination, and lab investigations. The accident history included information about the type of weapon and time and distance of shooting. However, we couldn't depend only on history; thus, we took the surface area affected to estimate the shooting distance. As the distance increased,

the surface area of dispersion was increased, and therefore, the areas affected also increased. This is an imaginary circle drawn where the longest transverse and vertical diameters were taken then added and divided by 2 to get average then divided again by 2 to get the radius of the circle where the surface area of this circle can be calculated as,  $A=\pi r^2$ . The distance of shooting was classified as 1) <2 meters, 2 to 5 meters, and >5 meters. The affected area can include abdomen only, abdomen and thorax, or more than two areas.



**Figure 3: A specimen showing a terminal loop of ileum, cecum, and part of the ascending colon. The terminal ileum shows multiple holes close to each other, indicating a close range of shooting (2:5 meters).**



**Figure 4: Spleen showing shotgun injuries (grade IV) from a near distance (<2 meters).**



**Figure 5: Small bowel showing small hole at the antimesenteric border (non-significant) single, <3 mm, no everted mucosa and no soiling.**



**Figure 6: Extracted cartridge from a shotgun wound from a near distance (<2 meters).**

**Follow up**

Follow up visits were arranged after discharge on two weeks, one month, three months, and six months for observation of any new symptoms. Abdominal ultrasound was done after one month. CT scan of abdomen and pelvis with contrast were done if needed.

**Statistical methods**

Statistical analysis was done using IBM® SPSS® Statistics version 22 (IBM® Corp., Armonk, NY, USA). Numerical data were expressed as mean and standard deviation. Qualitative data were expressed as frequency and percentage. Chi-square test (Fisher’s exact test) was used to examine the relation between qualitative variables. For quantitative data, comparison between two groups was made using independent sample t-test or Mann-Whitney test. A p<0.05 was considered significant.

**RESULTS**

The operative group (n=14) included 13 males and one female with a mean age of 28.3±9.2 years. The conservative group (n=16) were males with a mean age of 28.1±8.7 years. They were comparable regarding age (p=0.983). The two groups were comparable in the characteristics of shotgun injuries (Table 2) and admission criteria (Table 3) except for the distance of shooting.

**The outcome of the operative group**

In 9 out of 14 patients (64.3%), exploration yielded a negative result. In the remaining five patients, 4 had significant injuries that demand surgical repair. The small bowel was affected in all of the five patients, while two patients had large bowel injury and one had spleen injury.

**Description of injuries in individual patients**

**Patient #1**

A 38 years old male shot from 2 to 5 meters. Exploration through a mid-line incision showed multiple ileal holes 150 cm from duodenojejunal junction affecting 10 cm of



ileum. Multiple pellets affected the hilum of the spleen with hematoma but no bleeding. Resection-anastomosis and splenectomy were done. The patient was discharged

on the 5<sup>th</sup> day of admission with no postoperative complications.

**Table 1: Characteristics of the shotgun injuries in the two studied groups.**

	Operative group (n=14)	Conservative group (n=16)	P value
	N (%)	N (%)	
<b>Distance of shooting</b>			
<2 meters	3 (21.4)	2 (12.5)	0.025
2 to 5 meters	2 (14.3)	10 (62.5)	
>5 meters	9 (64.3)	4 (25.0)	
<b>Areas affected</b>			
Abdomen only	7 (50.0)	3 (18.8)	0.170
Abdomen and thorax	4 (28.6)	9 (56.3)	
More than 2 areas	3 (21.4)	4 (25.0)	
Surface area (cm <sup>2</sup> )	970±635	1,216±658	0.347

**Table 2: Admission criteria of the two studied groups.**

	Operative group (n=14)	Conservative group (n=16)	P value
<b>Time since injury (hours)</b>	1.8±0.8	1.6±0.9	0.567
<b>Hemoglobin (gm/dl)</b>	13.2±1.3	13.3±1.3	0.754
<b>TLC (×10<sup>3</sup>/mm<sup>3</sup>)</b>	14.1± 5.9	12.5±5.9	0.868

Data are presented as mean±SD, TLC: Total leukocytic count.

#### Patient #2

A 23 years old male shot from <2 meters. An intercostal chest tube was inserted at the resuscitation room due to the presence of hemothorax. Exploration showed 15 cm of the transverse colon with multiple perforations and soiling. Transverse colectomy was done with colostomy and mucous fistula. Wound infection occurred on the 3<sup>rd</sup> day managed by systemic antibiotic and drainage with good improvement. The patient was discharged on the 6<sup>th</sup> day of admission. Colostomy was closed after three months.

#### Patient #3

A 42 years old male shot from <2 meters. Exploration showed multiple tears at terminal ileum (about 10 cm) and cecum with soiling. Right hemicolectomy was done with ileotransverse anastomosis (hand sewn). The patient was discharged in the 6<sup>th</sup> day with no postoperative complications.

#### Patient #4

A 29 years old male shot <2 meters. Multiple ileal tears were found of length 15 cm and about 30 cm proximal to the ileocecal valve with everted mucosa and soiling. Resection and primary anastomosis were done. On 5<sup>th</sup> day postoperative, he developed a burst abdomen without evisceration. The abdomen was closed in layers with good improvement. The patient discharged on 6<sup>th</sup> day postoperative.

#### Patient #5

A 32 years old male shot from >5 meters. Multiple holes (3 pellets holes in jejunum separated from each other by 5 cm and each hole was <3 mm with no eversion of mucosa and no soiling) were found 20 cm from the duodenojejunal junction in length about 40 cm. Resection and anastomosis were done. The patient discharged on the 4<sup>th</sup> day postoperative with no complications. Collectively, postoperative complications occurred in 3 patients, two wound infections, and one burst abdomen.

#### The outcome of the conservative group

Five patients (31.3%) developed a fever during the conservative period; 4 of them had a temperature <38.5°C. They had X-ray erect and abdominal ultrasonography to exclude pneumoperitoneum and collections. Fever was due to chest infection in all but one who had urinary tract infection. They responded well to medical treatment and discharged. Temperature was >40°C in the fifth patient with a tender abdomen on examination. He was shot from <2 meters in his left flank with no hematuria or signs of peritonitis. He was admitted to a step-down ward for close observation. The condition continued for 12 hours. The decision was to explore where an intra-abdominal abscess was found containing a mass of pellets, debris, hairs, clothes and wad with no organ injury at left iliac fossa. Peritoneal lavage with evacuation of the abscess was done with an improvement of the patient with no postoperative complications. This was the only patient who failed conservative management; therefore, conservative management had a 93.8% success rate.

Five injuries were classified as significant; 4 in the operative group and one in the conservative group. It was observed that 4 of the five significant injuries (80%) had a short shooting distance (<2 m) compared to 2 (8%) of

the non-significant injuries ( $p=0.001$ ). The surface area affected was significantly smaller in insignificant injuries (Table 3).

**Table 3: Comparison between significant and non-significant injuries in the whole studied group (n=30).**

	Significant injuries (n=5) N (%)	Non-significant injuries (n=25) N (%)	P value
<b>Distance of shooting</b>			
<2 meters	4 (80)	2 (8)	0.001
2 to 5 meters	1 (20)	12 (48)	
>5 meters	0 (0)	11 (44)	
<b>Surface area (cm<sup>2</sup>)</b>	705±310	1,087±586	0.035
<b>Hemoglobin (gm/dl)</b>	13.3±1.9	13.1±1.0	0.695
<b>TLC (×10<sup>3</sup>/mm<sup>3</sup>)</b>	14.6±5.5	13.3±6.3	0.674
<b>Postoperative complications</b>	2 (40)	1 (4)	0.634

Data are presented as mean±SD, or number (%); TLC: Total leukocytic count.

### Follow up

Hospital stay was significantly longer ( $p=0.004$ ) in the operative group ( $5.1±1.3$  days) compared to the conservative group ( $2.8±1.1$  days). In the operative group; two patients with wound infection were followed. They healed well with removal of sutures. The patient with a burst abdomen had completely healed midline incision without an incisional hernia. Apart from previous patients, no long-term complications or mortalities occurred in the two groups.

### DISCUSSION

This study demonstrated a 93.8% success rate of conservative management of penetrating abdominal shotgun injuries in the absence of immediate evidence of abdominal organ injuries. Urgent exploratory laparotomy of these patients yielded a 64.3% negative result. Short shooting distance (<2 m) and large affected surface area were associated with significant injuries. Postoperative complications occurred in 3 out of 5 operated patients (60%).

Worldwide and likewise, in our center, mandatory laparotomy is designated as the standard of care for patients with abdominal gunshot wounds (GSWs). This approach is known to be associated with numerous unnecessary and negative laparotomies, in addition to the relatively high risk of postoperative complications in 22–41% of cases and more lengthy hospital stay.<sup>3,7,8</sup> Unnecessary laparotomy rate in the current study was 64.3%, with significantly more extended hospital stay compared to conservative management.

The selection criteria to be used and the predictors of failure of conservative or SNOM are not clearly defined. In the current study, only patients with small shots were included if they were vitally stable with evidence of penetration on CT scan, and with no hemoperitoneum, pneumoperitoneum, or collection. Many investigators

found that non-operative management can be considered for patients with hemodynamically stable vital signs, absence of peritonitis, and a reliable physical exam.<sup>9–11</sup> CT scans have been a useful adjunct for practicing SNOM over the past two decades.<sup>12–14</sup> Advocates of CT proposed a better characterization of the bullet trajectory with a sensitivity and specificity exceeding 90% for detection of injuries.<sup>13</sup> However, other investigators argue its false negative and positive results and inaccurate detection of intestinal and diaphragmatic injuries.<sup>6</sup>

In fact, abdominal CT has radically changed the way of trauma management. It allows accurate 3D determination of missile course in and its proximity to vital structures.<sup>10</sup> CT also can identify specific intra-abdominal injuries with a sensitivity and specificity of 90.5% and 96%, respectively.

In the current study, we adopted the system of ICU or dedicated, monitored observation area during the first 48 hours. This practice was followed in previous studies to ensure close observation with repeated physical examination and lab investigations.<sup>10,14</sup> A decrease in hemoglobin, hemodynamic instability, or development of abdominal tenderness were the known indications to terminate SNOM.<sup>6,15,16</sup> Other reasons included development of peritonitis, fever, new tachycardia, or rising WBC counts.<sup>17–20</sup> The only patient who failed conservative treatment in the current study developed high fever and abdominal tenderness; laparotomy was positive in this patient and passed with no complications.

In a large study including 787 patients with a GSW, 636 patients were conservatively managed with a failure rate of 4.6%.<sup>21</sup> With the use of CT, as the current study, other investigators reported failure rates between 3.5% and 8.8%.<sup>15,21,22</sup> In the present study, the failure rate was about 6%.

In view of the high non-therapeutic or negative laparotomy (64.3%), and the advantages of conservative

management; high success rate (93.8%), safety (uncomplicated delayed laparotomy), shorter hospital stay, and lower cost, conservative management appears to be a safe alternative to immediate laparotomy in selected cases of GSW to the abdomen. In the CT era, patient selection became more efficient and reliable.

The selection criteria in the current study appeared optimum for the achievement of good results. It seems logical to encourage conservative management, especially in tertiary high-volume centers like ours, with a high degree of expertise and readily available surgical facilities. The close observation period in the current study, i.e., 48 hours appeared enough to assure safe discharge when passed uneventfully. Several studies, actually, recommend a 24-hour period.<sup>15,23</sup>

### Limitation

The main limitation of the current study was the small number of cases, which is mainly attributed to the high-conservative attitude of the institutional review board for patients' safety. We believe that the current results may inspire modification of the local protocol of management to endorse non-operative management of GSW to the abdomen under precise selective criteria.

### CONCLUSION

We can conclude that in patients with penetrating abdominal shotgun injuries with no evidence of abdominal organ injuries, conservative management is a safe and successful option based on strict selection criteria. These include small shots in a hemodynamically stable patient with evidence of penetration on CT scan, and with no hemoperitoneum, pneumoperitoneum or collection.

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