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Research Article

Assessment of the management and outcomes of penetrating abdominal shotgun injuries

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ABSTRACT

Background: Lately in Egypt, the incidence of abdominal shotgun injuries has greatly increased especially after the 25th of January 2012 revolution. There is a controversy that exists over whether patients with penetrating abdominal shotgun wounds should have selective or mandatory exploration. This work aims to put a clear management plan for patients with penetrating abdominal shotgun injuries and to determine the role and indications of exploratory laparotomy to avoid unnecessary explorations and their complications.
Methods: The study was conducted on 40 patients presented to Kasralainy medical school with penetrating abdominal shotgun injuries, who were randomly allocated into two groups, Group (1): the patients were treated conservatively for 72 hours and Group 2: the patients were explored.
Results: In group (2), it was found that most of the patients (13 out of 18 which is 72.2%) had negative or non-significant injuries and only 5 out of 18 patients (27.8%) showed significant injuries which demanded repair. So, they were explored with no benefit but on the contrary they had the chance of developing complications of abdominal explorations and this truely occurred because the complications in group 2 were significantly higher than group (1) regarding postoperative wound infection and paralytic ileus. Also, incisional hernia and burst abdomen occurred in group 2. While in group (1), only 3 patients (13.6%) out of 22 had deteriorated during the follow up. which is a low percent especially that these patients could be detected early and managed.
Conclusions: Conservative management for patients with intra-abdominal pellets who are vitally stable with no massive hemoperitonium or pneumoperitoniumon is feasible and safe with the ability of identification and management of patients who will require surgery by close follow up without increase in the major morbidities or mortalities. This strategy significantly reduces the rate of unnecessary laparotomies and related complications. Although the main drawback is the small number of the study group.

Keywords: Shotgun injuries, Laparotomy, Firearm injuries

INTRODUCTION

Lately in Egypt, the incidence of abdominal shotgun injuries has greatly increased especially after 25th January 2012 revolution. Yet, we do not have a clear plan for management of such patients.

Shotgun injuries present specific challenges to the surgeon. Multiple penetrating wounds frequently involve large anatomic areas with potential multi-system injury.[1] The spectrum of injuries resulting from abdominal shotgun wounds is vast and represents a particularly difficult challenge for the trauma surgeon. This diversity of injury, primarily caused by the unique ballistics of shotgun blasts, ranges from extensive, multi-organ, visceral destruction to superficial, widespread, soft-tissue damage with minimal associated intra-abdominal injury.[2]

Evaluation of the abdomen in a potentially injured patient remains one of the greatest challenges faced by surgeons. None of the current diagnostic modalities available to the trauma surgeon are completely accurate. All of the available techniques, including DPL, sonography, CT, and laparoscopy, have advantages and disadvantages.[3]

There is controversy that exists over whether patients with abdominal shotgun wounds should have selective or mandatory exploration. It has been proposed that exploratory laparotomy may be unnecessary and even overused in a subset of patients with abdominal shotgun wounds.[4]

Therefore, Sherman and Parrish recommended that exploratory laparotomy should be performed in all abdominal shotgun wound patients where intra-abdominal penetration cannot be ruled out, regardless of the type of injury. However, others have continued to suggest that normotensive abdominal shotgun wounds with a scatter pattern of pellets penetrating the peritoneum can be successfully observed expectantly, even in the advent of ongoing peritonitis.[5]

Still others had reported a more selective approach in the management of hemodynamically stable intra-abdominal shotgun wounds.[6]

METHODS

The study was a prospective case control study which was conducted on 40 patients presented with shotgun injuries the abdomen only or the abdomen and other parts of the body and admitted in the causality department at Kasr Al-Ainy hospital starting from May 2013 to May 2014.

Patients with shotgun injuries to the abdomen who attended ER department would follow ABCDE approach to ensure their safety where vitally unstable patients with evidence of shots penetrating the abdominal cavity were resuscitated and transferred to the operating room directly for exploratory laparotomy (excluded from the study).

Stable patients with no symptoms and signs suggesting a surgical abdomen had a CT scan of the abdomen without contrast to check if any penetrating pellets and to check the type of shots. Only small pellets, number (6) were included in our study which is the most commonly found in shotgun cases in Egypt.

Inclusion criteria

Vitally stable patients presented with abdominal shotgun injuries with or without other injuries (but these injuries were not affecting the vitals and the stability of patients e.g. Chest tube inserted for pneumothorax or mild hemothorax or pellets in the extremities but not affecting the limb circulation).

Exclusion criteria

Non-penetrating pellets.

Abdominal ultrasound revealed massive intra-abdominal collection.

X-ray erect revealed air under diaphragm.

Other injuries that require urgent exploration e.g. vascular injuries.

Patients with large caliber shots (slugs or buck shots).

Other indication of surgery e.g.: (chest injury-neck injury).

Chronic psychiatric illness.

Procedure in details

The patients were randomly chosen according to inclusion and exclusion criteria. After proper history taking, examination and consenting where all patients were fully informed about the risks and benefits of the conservative and operative procedures and a consent was obtained. Full labs were done to assess the admission hemoglobin level, total leucocytic count and a routine FAST was also done.

After admission, C.T abdomen was done to assess the presence of intra-abdominal pellets (penetrating pellets). Non penetrating injuries were excluded.

In case of penetrating pellets, the patients were randomly allocated to one of the following groups:

Group 1: Conservative treatment with NPO, IV fluids, antibiotics and analgesia if needed for 72 hours.

Group 2: Exploration either open or laparoscopic.

For group 1

These patients had:

- Close follow up observation for the vital signs (every-2 hour).
- Abdominal examinations (every-6 h).
- Serial Complete blood picture (every 12 h).

If the first 48 hour hours passed smoothly with no symptoms or signs of deterioration, oral fluids were started and if tolerated, the patient was discharged after another day, and these were categorized as group 1A.

If any clinical or radiological evidence of peritonitis or intra-abdominal bleeding were found, the patient was explored. And these were categorized as group 1B**.**

Termination of the conservative management was done in the following cases:

- Deterioration of the patient (vital instability).
- Dropping of Hemoglobin (more than 2gm/dl over 24 hours) as in the management the blunt abdominal trauma.
- Rising of the white blood cells count with fever and abdominal symptoms.
- Development of symptoms and signs of peritonitis (Guarding and rigidity etc…).

For group 2

Injuries were classified as follows:

- Significant (injuries that demands surgical repair to heal) and these were categorized as group 2A or positive explorations.
- Non-significant (most probably will heal spontaneously with conservative management) or negative explorations and these were categorized as group 2B.

Non-significant injury criteria

For hollow organs

- No eversion of mucosa.
- No soiling.

For solid organ injury

No active bleeding (Grade I and II injuries), (Willis et al., 1935).

Postoperatively, the patient was discharged if found afebrile, with audible bowel sounds and was able to tolerate a liquid diet with follow up for the next 3 months, where the first visit was after two weeks of discharge, then after one month, and finally after three months for observation of any new symptoms and signs.

Outcomes to be assessed

1. The number of patients who had conservative management and passed smoothly without need for exploration and those who needed exploration and their ratio to the whole patients.
2. Patient's characteristics e.g. age and sex.
3. Site of injury (by abdominal quadrants).
4. Intraoperative findings for patients who needed exploration (type of injury).
5. Postoperative morbidity including wound infection, general complications of surgery, intra peritoneal collection, pain and postoperative hospital stay in both groups.
6. Time needed to return to work in patients who were explored and those who were treated only by conservative management.

Collected data were analyzed statistically and comparison of results was done using computer program SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

RESULTS

In the past few years, the number of shotgun cases that presented to the emergency department at Kasr Al-Ainy has increased. During the period from May 2013 to May 2014, the total number of firearm injuries was 5124 cases with 1315 shotgun injuries cases (26% of total number of firearm cases).

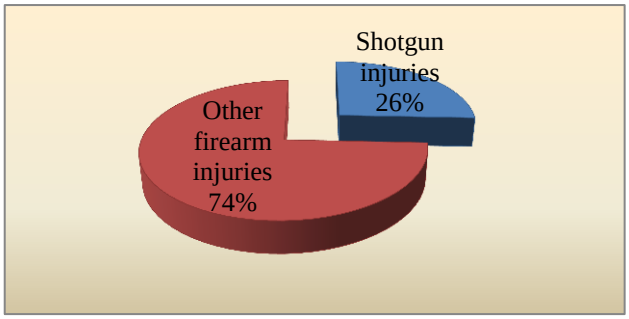

Figure 1: Ratio of shotgun injuries to all firearm injuries.

The total number of shotgun abdominal injuries was 873 cases (66 % of total shotgun injury cases).

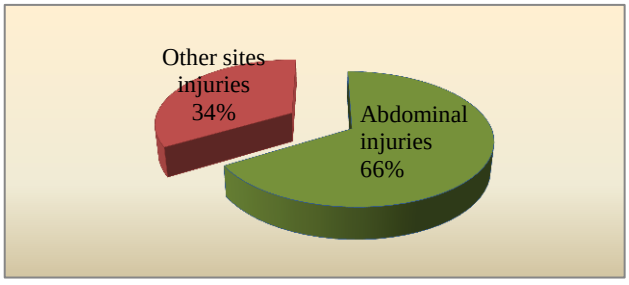

Figure 2: Ratio of abdominal shotgun to all shotgun injuries.

This study was conducted on 40 patients presented with either isolated abdominal shotgun injuries or abdominal with other parts of the body and were admitted in the casuality department at Kasr Al-Ainy hospital starting from May 2013 to May 2014.

The study included the following groups and subgroups:

Table 1: Distribution of patients.

Group (1): conservative (22 patients)		Group (2) :operative (18 patients)	
Group 1A	**Group 1B**	**Group 2A**	**Group 2B**
19	3	5	13

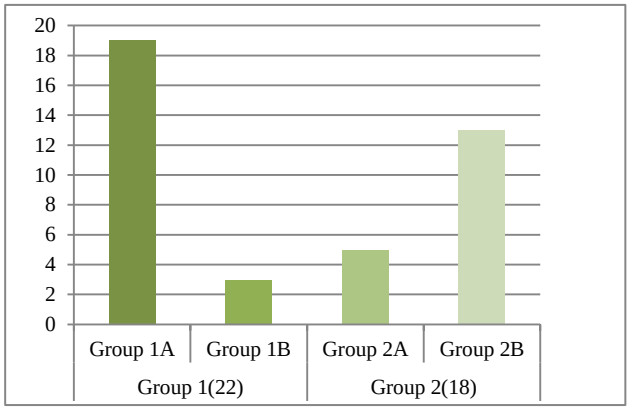

Figure 3: Distribution inside the 2 main groups (4 subgroups).

Demographics

Age ranged between 18-41 years with mean age 28.3 ± 6 years, the mean age for group 1 was 27.1 ± 5.8 years, while the mean age for group 2 was 29.8 ± 6.1 years. PV was 0.2 (non-significant).

Total number of males 29 and total number of females 11, in Group (1): 17 males (77.3%) and 5 females (22.7%). While Group (2): 12 males (66.7%) and 6 (33.3) females. P value was insignificant (0.5).

Main affected quadrant

Table 2: Distribution of main affected quadrant in all patients.

Main affected quadrant		
Umbilical	10	25.0
Epigastrium	8	20.0
Left hypochondrium	6	15.0
Right hypochondrium	5	12.5
Left iliac	5	12.5
Right iliac	2	5.0
Right lumbar	2	5.0
Left lumbar	1	2.5
Hypogastrium	1	2.5

Investigations

HG and TLC count on admission

The TLC levels were significantly higher in the operative group while the HG levels were significantly lower also in the operative group.

Table 3: Comparison of initial labs between the 2 groups.

	Conservative	Operative	P value
HG (gm/dl)			
Mean ± SD	11.9 ± 0.8	11.0 ± 1.5	0.02 S
Median	12.0	11.0	
TLC (wbcs/dl)			
Mean ± SD	9.4 ± 2.1	11.7 ± 2.1	0.002 S
Median	9.0	12.0	

Abdominal collection (mild or moderate amount) or not by CT scan

88.8% of the patients in group (2) had collections (mild to moderate) and 81.8% of the patients in group (1) had no collection.

Table 4: Comparison of evaluation of collection by CT between the 2 groups.

	Conservative (n=22)		Operative (n=18)		P value
	N	**%**	**N**	**%**	
Collection by CT					
Yes	4	18.1	16	88.8	0.001 S
No	18	81.8	2	11.1	

Exploration results in Group (2)

18 patients were explored, 5 (2A) had significant injuries as shown in Table 5.

While 13 patients (2B) had negative exploration or had non-significant injuries in the form of scattered intra-peritoneal pellets in 5 patients, inactive liver bleeding or hematomas in 3 patients and serosal tears in 5 patients.

Table 5: Results of overall explorations.

Exploration result (n=18)	Number	Ratio (%)
2 perforations in transverse colon	1	5.6
Stomach tear	1	5.6
3 cecal tears	1	5.6
Splenic tear & 2 ileal perforations	1	5.6
4 jujenal perforations	1	5.6
Negative or non-significant injuries (2B)	13	72.2

Failure rate of conservative management (Group 1B): 3 patients

In this study there were 3 patients who deteriorated under conservative management and all developed peritonitis (2 cases after one day and one case after two days).

These patients had abdominal symptoms and signs of peritonitis (tenderness, rebound tenderness and guarding or rigidity).

In their serial investigations, they showed elevated TLC and 2 patients out of 3 developed air under diaphragm by X-ray. On exploration 2 had ileal perforations and 1 had jujunal perforation.

Post-operative complications

Wound infection occurred in 12 patients (10 patients in the operative group and 2 in the conservative group) P value = 0.002, 1 patient had burst abdomen and 3 patients developed incisional hernias within the first 3 months of follow up.

Patients who had routine unnecessary explorations (2B) suffered from many complications which included wound infection (53.8%), ileus (15.4%), incisional hernia (23%) and burst abdomen (7.6%).

Morbidity of delayed explorations

Delay in exploration did not cause major morbidities. 2 cases had wound infection and one case had postoperative ileus.

Other parameters

Table 6: Comparison of other parameters between the 2 groups.

	Conservative	Operative	P value
Length of hospital stay (days)			
Mean ± SD	3.6 ± 1.4	6.3 ± 3.4	0.003 S
Median	3.0	5.5	
Time needed to return to work (days)			
Mean ± SD	4.9 ± 2.3	9.3 ± 6.1	<0.001 S
Median	4.0	7.0	

Table 7: Comparison between number of patients who were indicated for intervention in each group.

	Conservative (n=22)		Operative (n=18)		P value
	N	%	N	%	
Sequence					
Indicated for intervention	3	13.6	5	27.8	0.4
Not indicated	19	86.7	13	72.2	NS

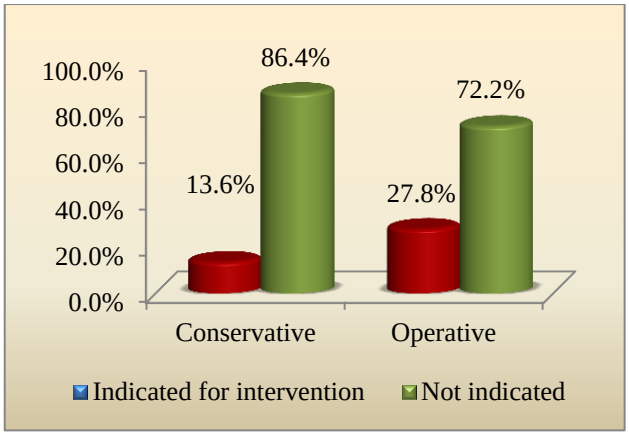

Figure 4: Comparison between number of patients who was indicated for intervention in each group.

P value between the number of patients indicated for surgery in both groups was 0.4 (non-significant) and it denotes that, intervention in group (2) was not statistically different from conservative management in group (1). Bearing in mind the morbidities that occurred in unnecessary explorations, so conservative management is considered the better choice unless there is a clear indication for surgery.

Figure 5: Shotgun injury (Group 2A).

Figure 6: Non significant injury to the antimesenteric border to the small bowel, less than 3 mm, non everted mucosa and no soiling.

Figure 7: Pattern of spread of pellets of group 1A.

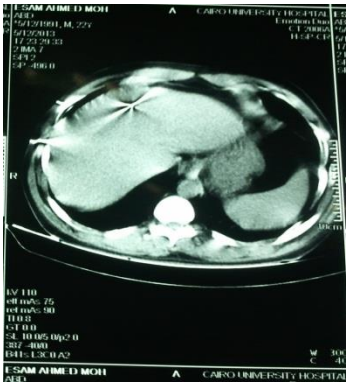

Figure 8: Pellets in the liver (Group 1A).

DISCUSSION

Numerous patients are admitted to hospitals worldwide with various types of firearm injuries, it is important for the surgeon who will be faced with the management of these wounds to be familiar with the peculiarities of the various weapons involved and the nature of the inflicted wound.

One group of injuries which is distinct in its characteristics is the shotgun injuries. In close range, these injuries most closely resemble the war wounds resultant from grenade and fragmentation devices, with large body wall defects and massive tissue destruction. At other times, they produce only a few scattered small wounds of minimal significance to the patient. Between these two extremes is a spectrum of injuries requiring careful evaluation and management.

The No. 6 shot is the most common shot load used worldwide and also in Egypt so our study was conducted on this type of shotgun.

It is designed for use on most medium-sized fowl and, when used in 12-gauge weapons, is an excellent all-around shell. Therefore, because the No. 6 shot shell used in a 12-gauge weapon is the most popular combination, it is the one most commonly involved in shotgun wounds. The No. 6 pellet is 0.11 inches in diameter and each shell contains hundreds of pellets. At close range, therefore, the concentration of pellets within the target pattern is extensive.[5]

Non-operative management of shotgun injuries is attractive because it avoids the morbidity and potential mortality of unnecessary laparotomy. Unnecessary operations include negative laparotomy or minor injuries that do not need surgical repair, such as a non-bleeding liver laceration (nontherapeutic laparotomy for non-significant injury).

This study tried to apply the conservative approach for patients who had no clear indication for exploration depending mainly on serial clinical examination. This concept of conservation had been adopted by many authors who were convinced by its value. This approach was adopted by Bolton in 1901, Bunch in 1928, Willis in 1935,[7] Drye and Schuster in 1953[8] and Bruce 1995.[4]

On the contrary, Sherman and Parrish recommended that exploratory laparotomy should be performed in all abdominal shotgun wound patients where intra-abdominal penetration cannot be ruled out regardless the type of injury. Martin in 1971, stated that "peritonitis due to the immediate soiling of the peritoneum may occur, but will subside with appropriate therapy and require no surgery".[9]

In 1984, Flint et al. suggested that the presence of four or more intra-abdominal pellets was as an indicator for the need for exploratory laparotomy and they emphasized that the presence of peritonitis and clinical judgment were the most important indicators for surgery.[1] In this study the number of intra-abdominal pellets had no impact on the prognosis as there were many pellets (more than 4) in many cases that had negative or non-significant injuries.

In this study, age range was 18-41 years with P value insignificant between both groups (P value 0.2). Also, sex distribution was not statistically different between the 2 groups with P value 0.5. This confirms random allocation to each group. Most of the patients in this study were males (29 male patients and 11 female patients). These results are comparable to results of martin in 1971 as the patients' ages ranged from 22 to 85 years, the average being 31.2 years. Also in Martin`s study 50 patients were male, 8 were female.[9] Also in a study done by Bruce et al. the average patient age was 30 years, and men out-numbered women nearly nine to one.[4] The similarity in age and sex could be explained as this is the age group susceptible to violence and males are more vulnerable than female to be a victim of shotgun injuries.

The range of HG was 7-13 gm/dl and the range of TLC was 6-17 wbcs/dl. The TLC levels were significantly higher in the operative group while the HG levels were significantly lower also in the operative group. This was

one of the causes that helped the surgeon to make up his mind to explore the patients but eventually this factor turned out to be a wrong parameter to depend upon.

Half of the patients in this study had collection by C.T scan while the other half did not. Nevertheless, the distribution inside the 2 groups was different because most of the patients (88.8%) in the operative group had collection (mild to moderate) and most of the patients (81.8%) in the conservative group had no collection. This was one of the causes that helped the surgeon to make his mind to explore the patients but eventually this turned out to be another wrong parameter to depend upon. This is comparable with the work done by Demetrios et al., who depended mainly on the suspicion of hollow viscus injury findings in CT scan not the presence of abdominal collection which may be misleading in the decision of exploration.[10] So, we can conclude that the suspicion of hollow viscus injury is much more important than the presence of abdominal collection in CT.

The morbidity of unnecessary laparotomy which has been reported by Renz and Feliciano was as high as 41.3% when problems such as atelectasis, prolonged ileus, and urinary tract infections are included to as low as 2.5% when only major complications such as subsequent small bowel obstruction are considered. In addition, unnecessary laparotomy increases the hospital length of stay and significantly increases the cost of care.[11]

Also, Demetriades et al. concluded that Mandatory exploration irrespective of clinical signs carries a high rate of negative laparotomy. Consequences of this include incisional hernia, adhesive small bowel obstruction and sometimes death.[12]

Several studies suggest that, in fact, there is no significant increase in complications resulting from a delayed operative procedure in patients who initially lacked positive clinical signs, which assumes that a change in the physical examination is identified within a reasonable period (<24 hours). Thus, if no immediate indication for operation exists, patients can be safely observed for the development of physical findings that may warrant surgical exploration.[13] These results are comparable to the results of this study as there were only 3 patients out of 22 who had deteriorated during the follow up (first 3 days), and they were explored to find that they all had hollow viscus injury. No major morbidities or mortalities occurred.

In this study we successfully conserved on 19 patients (47.5% of the whole patients) and there were only 3 patients who required delayed laparotomy. This comparable to the work done by George et al in 2001 as he had 38% of his patients were managed successfully without intervention and only 4% required delayed laparotomy.[14]

In the study done by Bruce et al., there were 37 out of 88 patients (42.1%), who required operations predominantly for hollow viscus injuries, 18.2% (16/88) required operations for solid organ injuries, and 32.9% (29/88) required procedures for both.[4] The similarity between results suggests that, the main cause for exploration in abdominal shotgun injuries is hollow viscus injury.

Also, the length of hospital stay and time needed to return to work were significantly lower in the conservative group. These results are comparable with the work done by George et al., in 2001[14] and Renz and Feliciano in 1995.[11]

CONCLUSION

From the previous results, we can assume that conservative management for patients with intra-abdominal pellets who are vitally stable with no massive hemoperitonium or pneumoperitoniumon is feasible and safe. Even with this strategy of conservative management, the chance is present for early identification and management of patients who will ultimately require surgery by close follow up without increase in the major morbidities or mortalities. This strategy significantly reduces the rate of unnecessary laparotomies and related complications. Although the main drawback is the small number of the study group.

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Ethical approval: The study was approved by the institutional ethics committee

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