



Original Research

Civilian Gunshot Injuries of the Abdomen at Hajjah Governorate in Yemen

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Abstract

Background: Civilian gunshot injuries of the abdomen become a global problem and constitute enormous emotional, physical, financial and social burden. The true magnitude of this problem in Yemen is not explored yet.

Aim: The purpose of this study is to identify the pattern of civilian abdominal gunshot injuries and evaluate outcome of the management.

Methods: All patients operated for penetrating gunshot of the abdomen in Saudi hospital at Hajjah governorate from June 2013 to September 2016 were included. Data of patients were prospectively recorded and analyzed to identify the pattern of abdominal gunshot injuries and evaluate the management outcome. Patients assigned to observation were excluded.

Results: Eighty-five patients were enrolled. They were 71 men and 14 women with age ranging from 10 to 60 years. Small bowel was the most common affected organ, 52 patients (61.1%) followed by the colon in 24 patients (28.2%), then diaphragm in 19 patients (22.3%) and then comes liver in 15 patients (17.8%). Spleen, kidneys, great vessels and rectum were at 11.7%, 9.4%, 8.2% and 5.9% respectively. Duodenum, pancreas and urinary bladder were the least affected organs, 2 cases for each. Forty patients (47%) had bullets' entrance through anterior abdominal wall. Personal conflicts and tribal clashes were the leading events of abdominal gunshot, 48 cases (56.5 %) followed by mishandling with handguns, 11 cases (12.9%). The commonest surgical procedures performed were resection and anastomosis for small bowel, resection and colostomy for the colon and primary repair for diaphragmatic injury. Splenectomy was performed in 6 patients, partial gastrectomy in 5 patients, and nephrectomy in one patient. Chest tubes were inserted in 44 patients. Postoperative complications were recorded in 35 patients (41.1%). The death rate was at 8.2%. Wound infection was recorded in 16 patients.

Conclusion: Small bowel was the most common organ involved by gunshot, followed by colon, diaphragm and liver respectively. Duodenum, pancreas and urinary bladder were the least. The majority of patients were injured during personal conflicts or tribal clashes. Lack of sufficient laws governing the firearms possession and easy access to weapons without restriction is the primary cause of the problem. Therefore, serious regulations of the use of firearms to settle disputes and strict enforcement of laws to combat this trend are extremely important and needed.

Keywords: Civilian abdominal gunshot, Pattern, Management outcomes

1. Introduction

Firearm injuries are increasingly seen in many developing countries which have been attributed to spates of

communal and ethnic clashes, political violence and armed robberies [1]. The use of guns in assaults, homicide and suicide becomes dominant because of their easy availability and lack of laws governing the possession of the firearms [2,3]. Firearm injuries are

associated with substantial emotional, physical and financial burden that cause an enormous human toll and imposing huge costs on the society with outcomes that could be lethal [4]. This is associated with long term physical and psychological disability for individuals, families, communities and societies [5]. The socioeconomic cost of civilian gunshot trauma is enormous, especially in developing nations. Civilian gunshot injuries become a significant cause of serious morbidity and mortality [6]. Endless wars, tribal armed clashes and political violence within and around Yemen encourage easy access to different types of weapons. This leads to a high incidence of gunshot injuries even in peace times. It is believed that more than 50 million legal and illegal weapons in circulation in Yemen. However; true magnitude of this problem in Yemen has not been studied and explored yet. The purpose of this prospective study is to identify the pattern of abdominal gunshot wounds among civilian and to evaluate the outcome of the management at Hajjah governorate in Yemen over period from June 2013 to September 2016.

2. Methods

All patients admitted and operated for penetrating gunshot injuries of the abdomen in Saudi hospital at Hajjah governorate between June 2013 and September 2016 were included in this prospective hospital-based study. Data pertaining patients' demographics, assault events, symptoms and signs, general condition at the presentation, entry and exit wounds, operative procedures and findings, postoperative complications, length of hospitalization were prospectively recorded on proforma sheets. Preoperative investigations including laboratory, chest and abdominal radiography and ultrasound were performed before shifting patients to the operation room. Indications for abdominal exploration

were all gunshot wounds penetrating the abdominal wall with or without chest co-injury. These indications were based on positive signs of peritoneal irritation, presence of free air under diaphragm and free fluid collection in the peritoneal cavity proved by ultrasound. Hemoglobin level was evaluated as co-factor than independent factor. The penetration is understood as when the bullet penetrates the entire thickness of abdominal wall from the skin to the peritoneum. Gunshot wounds confined to the abdominal wall were not regarded as penetrating and were excluded from the study. The exclusion criteria were: 1) Patients that were subjected to conservative management because of the absence of signs of peritonitis and absence of free air under diaphragm or absence of free fluid collection within peritoneal cavity during serial abdominal examinations. 2) Patients with deep coma at the time of presentation that didn't response to resuscitative measures. 3) Gunshot wounds that were confined to abdominal wall- the peritoneum is intact.

The abdominal area is anatomically delineated superiorly by nipples line to the symphysis pubis

inferiorly. On the back, from the line joining scapular angles superiorly to gluteofemoral crease inferiorly.

Patients indicated to laparotomy were taken directly from emergency room into operation room after stabilization of patient general condition. Analgesics, antibiotics, intravenous fluid and antitetanus toxoids were given. Blood transfusions were given when hemoglobin is <100g/l. The approach to the abdominal cavity was always through midline incision. The collected data was analyzed using IBM statistics SPSS version 22.

3. Results

The total number of patients, who were admitted and operated in Saudi hospital at Hajjah governorate for abdominal gunshot over period from June 2013 to September 2016, was 85 patients. They were 71 men and 14 women with age ranging from 10 to 60 years. The majority of injured were between 11-40 years (Figure 1).

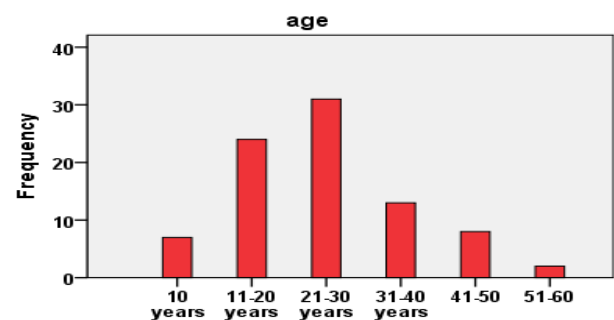


Figure 1: Frequency of abdominal gunshot according to age

All performed laparotomies for gunshot wounds of the abdomen were positive. Of 85 patients, 43 patients (50.58%) had moderate to huge hemoperitoneum, the remnant had slight to mild hemoperitoneum in association with the injury of intra-abdominal organs. Forty-four patients (51.76%) had concomitant hemopneumothorax requiring insertion of chest tube. Thirty-two patients (37.64%) were shocked (systolic pressure less than 100 and pulse rate more than 100 per min) at the time of presentation. Interpersonal civil conflicts and tribal clashes were the most common reasons of civil gunshot of the abdomen, 48 cases (56.5%) (Table 1).

Table 1: Events leading to gunshot injuries

Injuries' events	n (%)
Tribal clashes and interpersonal conflicts	48 (56.5)
Mishandling	11 (12.9)
Festival celebrations	9 (10.6)
Family disputes	6 (7.0)
Accidental discharge	5 (5.9)
Stray bullets	4 (4.7)
Road hijacking	2 (2.4)

Unfortunately, stray bullets, tribe clashes and use of weapons during marriage and birth celebrations comprises considerable rate of abdominal gunshot. Unlike others there was no suicidal trial recorded. Sixty-seven

patients (78.8%) had single entrance, while 18 patients (21.1%) had multiple wound entrances. Out of 85 patients, 14 patients (16.5%) had retained bullets, while through and through wound were recorded in 71 patients (83.5%) (Figures 2 and 3).



Figure 2: Through and through gunshot through anterior abdominal wall and exit at right flank



Figure 3: Gunshot entrée at left flank of retained bullet

Small bowel was found to be the most common organ involved followed by the colon and then diaphragm (Table 2 and Figure 4). Duodenum, urinary bladder, perineum and pancreas were the least injured. The distribution of gunshot wounds to the body is very variable. Forty patients (47%) had inlet wounds at anterior abdominal wall, of which 24 were at left side and 16 were at right side.

Table 2: Distribution and frequency of organs' injury

Organ injured	n (%)
Small bowel	52 (61.1)
Colon	24 (28.2)
Diaphragm	19 (22.3)
Stomach	16 (18.8)
Liver	15 (17.6)
Spleen	10 (11.7)
Kidney	8 (9.4)
Major vessels	7 (8.2)
Rectum	5 (5.9)
Pancreas	4 (4.7)
Perineum	3 (3.5)
Urinary bladder	2 (2.4)
Duodenum	2 (2.4)

The remnant entrance wounds were in the chest wall in 23 patients (27%), posterior trunk in 17 patients (20%), at the perineum in 3 patients (3.5%) and 2 patients (2.3%) in right gluteal region. Complications were recorded in 35 patients (41.1%) (Table 3).

Table 3: Types of complications

Complications	n= 35	%= 41.1
Wound infection	16	18.8
Chest infection	3	3.5
Enterocutaneous fistula	2	2.3
Peritonitis including Intra-abdominal	7	8.2
Abscess.	7	8.2
Death	7	8.2
Total	35	100.0

Of these, 7 patients (8.2%) died due to either peritonitis complicated by septicemia or pulmonary embolisms. One patient died early postoperatively due to severe preoperative hemorrhage from inferior vena cava. The time interval between injury and arrival to the hospital ranged from 1 to 24 hours, most of them arrived too late. Different types of conventional surgical procedures were performed as it is shown in (Table 4). Regarding hospitalization stay, it ranged from 1 to 6 weeks with the majority between 1-2 weeks (Table 5).

Table 4: Surgical procedures performed

Organ	Procedure	n
Small bowel		52
	Resection and repair	32
	Debridement and repair	20
Colon		28
	Resection with colostomy	16
	Debridement and repair	7
	Resection and repair +Ileostomy	5
Diaphragm repair		19
Stomach		16
	Debridement and repair	11
	Partial gastrectomy	5
Liver		15
	Primary repair	7
	Segmentectomy	3
	No intervention	5
Spleen		10
	Splenectomy	6
	Splenoraphy	4
Chest tube		44
Great vessels ligations		3
Nephrectomy		1
Appendectomy		61

Table 5: Duration of hospitalization(n=85)

Number of weeks	n (%)
One week	35 (41.1)
Two weeks	30 (35.2)
Three weeks	12 (14.1)
Four weeks	4 (4.7)
Five weeks	3 (3.5)
Six weeks	1 (1.1)

4. Discussion

Worldwide gun-related violence is increasing and the use of guns becomes dominant [3,7]. The easy availability and unrestricted purchase of firearms and lack of laws

governing the firearms possession constitute the primary reason for violence, homicide, and suicide [3,8]. Consequently, socioeconomic cost of civilian gunshot trauma is enormous, especially in developing nations [6]. Our country (Yemen) is deeply suffering from illegal possession and distribution of different types of light and moderate weapons, which are used during tribal clashes, political conflicts and even during personal and communal disputes. There is also a tradition of celebrating the marriage ceremonies or the birth of a male child by way of opening fires on such occasions especially in the tribal areas [9].

It is believed that more than 50 million legal and illegal handguns in circulation in Yemen. This causes for Yemeni society enormous emotional, physical, social and financial burden as the violence involves the most active and productive population of society-between 11-40 years (80.1%). This is also reported by other similar studies [8, 10-12].

In our study, male patients predominated (83.5%). This finding is well compared with similar other studies [3, 8, 11, 12] Chamisa [3] reported (87.1%), Feliciano et al [8] reported (85.3%) while Musau et al [11] reported (95%) male predominance. This male predominance might be explained that men are more engaged in violence and military clashes and weapons handling and using than women.

Our finding conformed that small bowel was the most common affected organ by gunshots. It accounts for (61.1%). This high rate might be explained because the majority of bullets' entrances were through anterior abdominal wall (47%) where the thickness of the muscles and interposed bony structures are less than posterior aspect of the trunk. This deprived intra-abdominal organs considerable protection [13]. Another explanation is because of face to face mechanism of clashes. The colon came in the second place with rate at 28.2% and then diaphragm 22.3%. Stomach and liver came in 4th and 5th places (18.8% and 17.6%) respectively. This finding is consistent with other studies [3, 8, 12].

Clashes between clans and tribes and personal conflicts were the most common events that led to gunshot injuries in current study. They comprised up to 56.5% (48 patients) followed by mishandling and playing with handguns, 11 cases (12.9%). Festival occasions such as marriage and birth celebrations came in 3rd place, 9 cases (10.6%). This is expected in poor society with high illiteracy and unemployment among young. Ibrahim et al [10] and Ogunlusi et al [14] reported armed robberies as the leading events causing gunshot injuries (65.5% and 50% respectively). Elach et al [15] reported rate as high as (29%). Despite poverty and political instability in Yemen, the armed robberies were not found to be leading event to gunshot injuries. The absence of suicidal gunshot and low rate of armed robberies (2.3%) in this study might reflect the positive impact of religion among people in Yemeni society. Instead of this, interpersonal conflicts and assaults and clashes between the tribes are the predominating events. For limiting these harms, it needs discouragement of gunshots in the midst of crowds

during celebrations, avoidance of the use of live bullets if it must be done at all and ensuring that such gunshots are well directed away from the gathering [16].

The management of gunshot injuries of the abdomen varies from center to center [8] Those centers supplied with modern and sensitive imaging facilities such as modern ultrasound, CT with contrast, MRI and laparoscopy could afford beside emergency mandatory laparotomy, the so called selective conservative management (SCM) [3]. The so called "selective conservatism" is based on careful initial and subsequent serial clinical examinations [3]. The proponents of selective conservative management claim that the policy of this approach has been re-appraised by many authors and advocated by a number of trauma centers [17-21]. According to these studies, SCM is safe and shortens the length of hospital stay, minimizes the hospital expenses and it is associated with minimal morbidity and mortality. They claim also that the mandatory exploration of gunshot wounds of the abdomen has negative laparotomy rate as high as 27% [21] and complications rate at 41% [17]. However; the conditions in our hospital are different. Despite the lack of modern diagnostic facilities such as CT, MRI, angiography or laparoscopy we didn't have negative laparotomy at all. The indication to laparotomy was based mainly on the finding of the physical examination of the abdomen and the results of abdominal ultrasound and plain x-ray investigations.

The presence of guarding and rigidity of anterior abdominal wall associated with penetrating gunshot wounds was regarded as strong criteria for mandatory laparotomy. The presence of free air under diaphragm was confirmed by plain x-ray of the abdomen, while free fluid collection within peritoneal cavity was confirmed by abdominal ultrasound. The level of hemoglobin was evaluated in conjugation with other criteria. Therefore, we were necessitated to perform the emergency laparotomy based on above mentioned criteria with zero negative laparotomy. All performed laparotomies were positive in 100%. This is may be attributed to clear inclusion criteria for the emergency laparotomy and surgical team that is familiar with gunshot injuries of the abdomen. The penetrating gunshot wound of the abdomen is understood as when bullet or shrapnel penetrates the entire thickness of the abdominal wall from the skin to the peritoneum. With this definition of penetrating gunshot wound of the abdomen, it is very rare to have negative laparotomy.

The reported rate of negative laparotomy by others might reflect gap in experience of the staff dealing with gunshot injuries of the abdomen. Nineteen cases (22.35%) with injury of diaphragm were managed by primary repair (phrenoraphy) and chest tubes. The injured colon was managed preferably by resection and colostomy. Only stable patients with minimal contamination of peritoneal cavity were managed by debridement and primary repair. Of this group, 2 patients developed enterocutaneous fistula that required reconstruction of ileostomy. Sometimes more than one procedure in one organ was performed; for example: colon resection + colostomy in

one segment and debridement and repair of another segment of the colon. Resection and anastomosis of small bowel was carried out for multiple lacerations confined to short segment, otherwise debridement and primary repair was the choice. Injuries of the stomach were managed often by debridement and repair, only view cases required partial gastrectomy. Hemopneumothorax was diagnosed in 44 patients (51.7%) and required insertion of chest tubes at the presentation. Of these, one case needed endotracheal intubation and bilateral chest tubes for enormous bilateral surgical emphysema due to multiple ribs' fractures on both sides. Damage control surgery was applied in one case with burst retroperitoneal hematoma from injured inferior vena cava. This patient unfortunately died 12 hours postoperatively. Injury of the pancreas was managed conservatively just by drainage, nasogastric tubes and parenteral feeding, antibiotics and administration of somatostatin with good result. Unfortunately, the patient with duodenal injury has died due to retroperitoneal abscess and septicemia. Injuries of the rectum and perineum required temporary colostomy (Hartmann's procedure) that were closed after 4 months. Splenectomy in our study was performed only in 6 of 85 patients (7%). However; Adejumo et al [22] reported splenectomy as the most common procedure performed (29.0%), followed by colostomy (15.0%).

The complications in this study were recorded in 35 patients (41.1%). Of these, 16 patients (18.8%) had wound infections, which are lower than reported by other similar studies [10,22]. Mortality rate was at (8.2%). Comparing with poor diagnostic facilities in our hospital, this rate of mortality is acceptable. Same mortality rate was reported by others [9, 22]. However, Ibrahim et al [10] reported a mortality rate as low as 3.3%. In contrast to other continents where the average delay from injury to hospital admission is about 30 min. [23], patients in our country suffer a prolonged delay before medical care is reached. It was longer than 24 hours in some cases that came from rural mountain areas. This is because of poor information communication, primitive transport systems and roads and inadequate pre hospital trauma care. This may explain the deaths at or before presentation. Therefore, a pre hospital trauma care system has been emphasized by world health organization [24, 25]. An adequate pre hospital care would have prevented complications such as hemorrhage, shock, sepsis and renal failure, thereby improving final outcome [26].

4. Conclusion

In conclusion, small bowel was the most common abdominal organ sustained civilian gunshot injury, followed by colon, diaphragm and liver respectively. Duodenum, pancreas and urinary bladder were the least. Personal conflicts and tribal clashes were the most common cause of abdominal gunshot among civilians. Lack of sufficient laws governing the possession of

firearms, easy access to and purchase of weapons without restriction is among others the primary cause of the problem. Therefore, serious regulations of the use of firearms and strict enforcement of laws to combat this trend are extremely important and needed. Good governance, poverty alleviation, education, and gun control policy by governments are essential in reducing the danger. Efforts should be made to address the root causes of terrorism globally. Children need to be prevented from handling, using and carrying guns. The guns should be always kept away from their reach. Since it is difficult to obtain the true magnitude of the problem, a national database to which all gunshot wounds should have been reported is urgently required in order to clarify and assess the magnitude of the problem.

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Conflicts of interest

There are no conflicts of interest.

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