

Presentation and Intraoperative Findings of Penetrating Abdominal Injuries in a Battle Field Hospital, Yemen 2018 – 2019

Ayman Fadul Ebad Adam, Mohamed El Makki Ahmed

Corresponding Author: Ayman Fadul Ebad Adam

Abstract :

Background Abdominal war wounds have the strange history of all injuries suffered in times of armed conflict. Of all major life threatening injuries, wounds in the abdomen are ----the most amenable to surgical intervention likely to produce good results and the return of the patient to a productive life. Most patients with blunt and penetrating trauma were treated conservatively and surgically respectively. The cure rate is higher in surgical than in conservative management.

Objective this study aimed to describe the presentation and intraoperative findings in penetrating abdominal injury in battle field hospital, Yemen War, 2018 – 2019

Methods An Observational, descriptive, hospital based cross sectional study was conducted in Field Hospital in Yemen within the period from September 2018 to March 2019. Data entered, cleaned and analyzed using SPSS version 25.0.

Results This study covered 80 study participants. The majority of them were classified as military personnel (91.2%).. The majority of them were males with male: female ratio of 19: 1 with ages ranging from 10 to 53 years and a mean \pm SD of 31.7 ± 9.9 . Our study found that two thirds of the patients had gun shots (66.3%), blast injury (16.3%), explosive injury (15%) and sharpness among only (8.8%). The average time from injury to laparotomy was less than one hour in more than three quarters of the study participants (80%). Concerning the presentation of the study participants, half of them (51.3%) were shocked, (21.3%) evisceration, and (61.4%) reported peritonism presentation. Nearly two thirds of the patients showed inlet only (65%), while (22.5%) presented with both inlet and outlet and only (12.5%) lost part of their abdominal wall. More than half

of the study participants received Medical help outside the battle field hospital (53.8%), such as blood transfusion (53.5%) and intravenous fluids for the majority of them. Regarding the intraoperative findings, the majority of the patients (95%) had operated, on average, for five hours or less. Nearly half of them had been injured in 1 – 3 organs (45%) while (7.5%) of them was injured in more than six organs. The most affected organs were Jejunum (75.6%), Ileum (73.1%), and large colon (43.6%), while the liver and splenic injuries were (32.1%) and (17.9%) respectively . Furthermore, cardiac arrest occurred only among a small proportion (2.5%) of the study patients. Only (1.3%) mortality reported. Only (1.3%) had reactionary bleeding as an early post-operative complication among our study patients. Finally, our study realized that most of the patients (83.7) were evacuated within 6 to 12 hours.

Conclusion and recommendation The majority of patients with abdominal gunshot wounds are best served by laparotomy; however, select patients may be managed expectantly. All cases of such injuries should have exploratory laparotomy as soon as possible with a short time interval between the injury and the operation to prevent morbidity and mortality.

Introduction:

From traditional face to face combat using bare fists, sticks and stones, knives, weapons that struck at a distance came into being: the sling-shot, javelin and propagation of gunpowder triggered off a revolution in warfare with the development of weapons that act at even greater distance: explosive devices and the rifle. ⁽¹⁾

After three years of civil war the ongoing conflict in Yemen provides a valuable source of scientific data to explore the nature of battlefield injuries in both military and civilian personnel, as this war zone witnessed the use of both conventional and advanced weapons.

Abdominal war wounds have the strange history of all injuries suffered in times of armed 2 conflict. leaving behind the long held belief and fatalistic approach that all such wounds were inevitably lethal and that operative intervention was fruitless, surgeons have moved on to a modern aggressive approach of damage control and staged multiple operative surgery. ⁽²⁾ Of all major life threatening injuries, wounds in the abdomen are the most amenable to surgical intervention

likely to produce good results and the return of the patient to a productive life.^(2,3) Mortality has gone from near 100% down to around 10% in one century, probably the greatest improvement in the surgical care of the war wounded. Penetrating abdominal trauma is seen in many situations.⁽⁴⁾ The most common cause is a stab or gunshot. The most common organs injured are the small bowel (50%), large bowel (40%), liver (30%), and intra-abdominal vasculature (25%). When the injury is close range, there is more kinetic energy than those injuries sustained from a distance.⁽⁴⁾

As a projectile pass through tissue, it decelerates and transfers kinetic energy to the tissue. Increased velocity causes more damage than mass. Kinetic energy increases with the square of the velocity.⁽⁵⁾

Penetrating abdominal trauma is due to stabbing, ballistic injuries, and industrial accidents. These injuries may be life-threatening because the abdominal organs bleed profusely.⁽⁵⁾ If the pancreas is injured, further injury occurs from auto digestion. Injuries of the liver often present in shock because the liver tissue has a large blood supply. The intestines are at risk of perforation with concomitant fecal matter complicating penetration.⁽⁵⁾

Penetrating abdominal trauma may cause hypovolemic shock and peritonitis. Penetration may diminish bowel sounds due to bleeding, infection, and irritation, and injuries to arteries may cause bruits. Percussion reveals hyper resonance or dullness suggesting blood. The abdomen may be distended or tender, indicating surgery is needed.⁽⁵⁾

The standard management of penetrating abdominal trauma is a laparotomy. A greater understanding of mechanisms of injury and improved imaging has resulted in conservative operative strategies in some cases.⁽⁴⁻⁵⁾

The patient is treated with intravenous fluids and/or blood. Surgery is often required; impaled objects are secured in place so that they do not move and they should only be removed in an operating room.⁽⁶⁾

Foreign bodies such as bullets may be removed, but if there is a possibility that they may cause more damage, they should be left in place. Wounds are debrided to remove tissue that cannot survive and will lead to infection.⁽⁶⁾ The prognosis of patients with penetrating abdominal trauma is variable and depends on the extent of injury and time of presentation to the emergency department.⁽⁷⁾ In the presence of massive abdominal contamination from a perforated viscus, hemorrhage, multi-organ injury, associated head injury, or coagulopathy, the mortality rates are high.

In patients who are promptly resuscitated and explored, the mortality rates remain low. Stab wounds to the abdomen, usually have a much better prognosis than gunshot wounds ⁽⁷⁾.

Throughout this context, this study is aimed to describe the presentation and intraoperative findings in penetrating abdominal injury in battle field hospital, Yemen War, 2018 – 2019.

Materials and Methods:

An observational, descriptive, hospital based cross sectional study was conducted in Field hospital in Yemen within the period from September 2018 to March 2019 and included all 3 patients who are diagnosed with penetrating abdominal injury and recruited from the study area within the time period and accepted to participate in the study.

Total coverage method was applied. All cases who fulfilled the study population criteria and recruited within the study area and time period.

The data were collected through comprehensive structural close ended questionnaire. It covered all personal, clinical presentation and intraoperative findings for all study participants recruited under the study area. Data was entered, cleaned, and analyzed using SPSS version 25.0. Descriptive statistics in term of frequency tables with percentages and graphs. Means and standard deviations were presented with relevant graphical representation for quantitative data.

Bi-variable analysis to determine the associations between the outcome variables and the other relevant influencing factors with Chi square test (for categorical variables) and t- test (quantitative variables) statistical tests. The relation between quantitative variable was assessed by Pearson correlation coefficients. P value of 0.05 or less is considered statistically significant.

Written ethical clearance and approval for conducting this research was obtained from Sudan Medical Specialization Board Ethical Committee. Also, written permission was obtained from the Administrative authority of the field hospital, Yemen and study data/information was used for the research purposes only. The privacy issues were considered.

Results:

This study covered 80 patients. The majority of them were classified as military personnel (91.2%) as presented in figure 1.

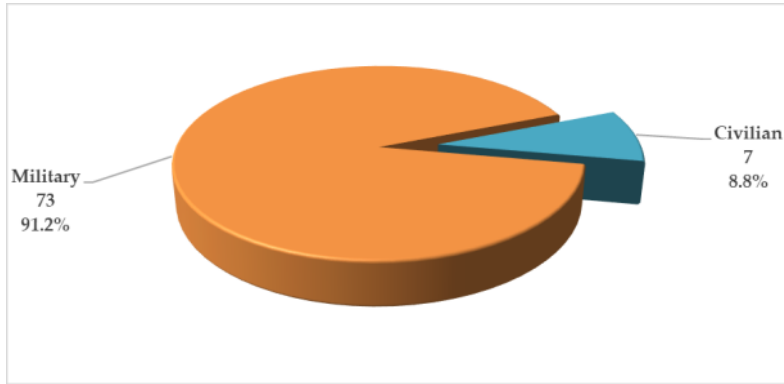


Figure (1): The distribution of the patients according to their type

The majority of them were males with male: female ratio of 19: 1, with ages ranged from 10 to 53 years and a mean \pm SD of 31.7 ± 9.9 .

This study found that two thirds of the study participants had gun shots (66.3%), blast injury (16.3%), explosive injury (15%) and sharpness among only (8.8%) as presented in figure 2.

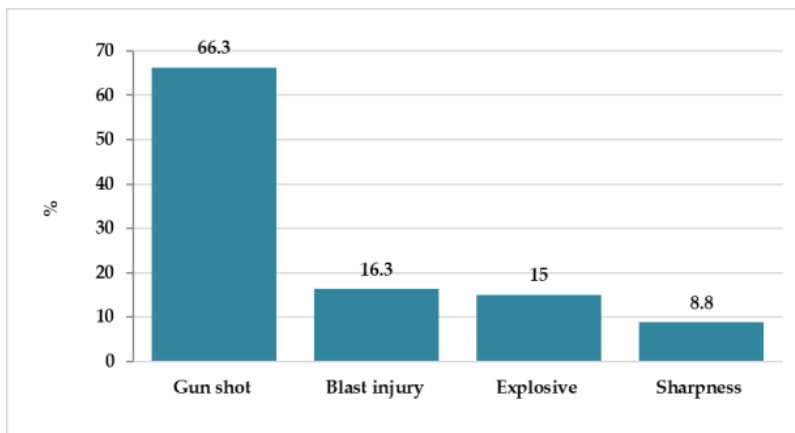


Figure (2): Abdominal injury types

The average time from injury to laparotomy was less than one hour in more than three quarters of the study participants (80%).

Concerning the presentation of the study participants, our study found that half of them (18.8%) were shocked, (8.8%) evisceration, and (33.8%) reported peritonism presentation.

Nearly two thirds of the patients showed inlet only (65%), while (22.5%) presented with both inlet and outlet and only (12.5%) lost part of their abdominal wall. 4

The study found that (38.8%) of the patients had reported some additional injuries, such as chest injuries (35.3%), arm injury/fractures (6.5%), face (6.5%) head injury (7.5%) and finger amputation/ fracture among only (3.2%). More than half of the patients received Medical help outside the battle field (53.8%), such as blood transfusion (53.5%) and intravenous fluids for the majority of them.

Regarding the intraoperative findings, our study found that the majority of the study participants (95%) had operation, on average, for 5 hours or less.

Nearly half of them had been injured in 1 – 3 organs (45%) while (7.5%) of them was injured in more than six organs. The study found that the most affected organs were shown in table 1 below.

Table (1): The most affected organs

| Type of injured organs | Frequency | Percent |
|-----------------------------------|-----------|---------|
| Jejunum | 59 | 75.6 |
| Ileum | 57 | 73.1 |
| Large colon | 34 | 43.6 |
| Stomach | 25 | 32.1 |
| Liver | 25 | 32.1 |
| Spleen | 14 | 17.9 |
| Diaphragm | 11 | 14.1 |
| Pancreases | 7 | 9 |
| Kidney | 7 | 9 |
| Gall bladder | 4 | 5.1 |
| Bladder | 3 | 3.8 |
| Rectum | 1 | 1.3 |
| Ureter | 1 | 1.3 |
| Duodenum | 1 | 1.3 |
| Uterus | 1 | 1.3 |
| Extra biliary tree | 0 | 0.0 |
| Other (Retroperitoneal haematoma) | 1 | 1.3 |

Our study found that nearly two thirds (66.3%) of the study participants had been transfused with 1 – 3 units of blood. Furthermore, cardiac arrest occurred only among small proportion (2.5%) of the study patients. Only (1.3%) mortality reported. Only (1.3%) had reactional bleeding as an early post-operative complication among our study participants as detailed in table 2 below.

Table (2): Early post-operative complications

| Early post-operative complications | Frequency | Percent |
|---|------------------|----------------|
| Reactional bleeding | 1 | 1.3 |
| None | 79 | 98.8 |
| Total | 80 | 100.0 |

Finally, our study realized that most of the study patients (83.7) were evacuated with 6 to 12 hours as detailed in table 3.

Table (3): Average time for evacuation - hours

| Average time for evacuation - hours | Frequency | Percent |
|--|------------------|----------------|
| < 6 | 5 | 6.3 |
| 6 - 12 | 67 | 83.7 |
| 13 - 24 | 2 | 2.5 |
| None | 6 | 7.5 |
| Total | 80 | 100.0 |

Discussion:

This study reported that the majority of the study patients were classified as military personnel (91.2%) while the remaining were civilian. In similar context, Wilson H, et al explained that possibly because large numbers of patients with penetrating wounds of the abdomen are in general not common in civilian practice, the tendency to consider military wounds and their management as standards for civilian patients is quite relevant. ⁽⁸⁾ Other additional concern elucidated by A. Ramasamy et al from Iraq, who claimed with the current global threat of terrorist bombings, both military and civilian surgeons should be aware of the spectrum and emergent management of the injuries caused by these weapons. ⁽⁹⁾

We found that The male: female ratio 19: 1 with ages ranged from 10 to 53 years and a mean \pm SD of 31.7 ± 9.9 . Similarly, in Libya, Hend Abdalla, et al stated that the ages ranged from 6 to 56 years. ⁽¹⁰⁾ In Ugandan experience, Opvang, et al found that the patients' ages ranged from 2 to 50 years with a mean of 27 years. ⁽¹¹⁾

Our study found that the majority of them were males with male: female ratio of 19: 1. Similar findings were obtained by Ahmed BA, et al, who stated that males constitute the great majority of patients with penetrating trauma injuries across the world. In some areas, approximately 90% of patients with penetrating trauma are male. Injuries are the leading cause of death in patients aged 1-44 years. ⁽¹²⁾ Similarly, in Libya, Hend Abdalla, et al found that ninety-seven percent were males, Betül Kocamer, et al 93.2% were males in Syria ⁽¹³⁾ In Ugandan experience, Opvang, et al found that the male to female sex ratio was 7.5: 1. ⁽¹¹⁾

Two thirds of the study patients had gun shots (66.3%), blast injury (16.3%), explosive injury (15%) and sharpness among only (8.8%). Correspondingly, in Libya, Hend Abdalla, et al found that gunshot injuries were reported in 76% of the patients, while 24% were due to explosive injuries. ⁽¹⁰⁾ In Iraq, A. Ramasamy, et al reported that a quarter of the cases (24.4%) sustained gunshot wounds, (75.6%) suffered injuries from fragmentation weapons. ⁽⁹⁾ Correspondingly, In Ugandan experience, Opvang, et al found that the gunshot wounds accounted for 58 (85.3%) of the cases while the remaining ten (14.7%) had injuries caused by bomb blast fragments. ⁽¹¹⁾

The average time from injury to laparotomy was less than one hour in more than three quarters of the study participants (80%). In the same way, in Pakistan, Kisat M, stated that the time between injury and operation was 152 minutes. ⁽¹⁴⁾

Concerning the presentation of the study participants, our study found that half of them (18.8%) were shocked, (8.8%) evisceration, and (33.8%) reported peritonism presentation. Liebenberg ND, et al stated that (96%) had a peritoneal violation among the cases of intra-abdominal injuries (17 %) of the patients with intraperitoneal trauma had unimpressive physical signs on admission. These findings support a policy of routine exploration for gunshot wounds violating the peritoneum. ⁽¹⁵⁾

Nearly two thirds of the patients showed inlet only (65%), while (22.5%) presented with both inlet and outlet and only (12.5%) lost part of their abdominal wall. Within the similar context they reported that ninety-five patients had omentum protruding through the wound. ⁽¹⁵⁾

The study found that (38.8%) of the patients had reported some additional injuries, such as chest injuries (35.3%), arm injury/fractures (6.5%), face (6.5%) head injury (7.5%) and finger amputation/ fracture among only (3.2%). Also, in Syria, Betül Kocamer, et al reported that additional head-neck, chest-abdomen, and multiple body injuries were the most widely seen among civilians brought in because of gunshot injuries sustained during the Civil War. ⁽¹³⁾

More than half of the study patients received Medical help outside the battle field hospital (53.8%), such as blood transfusion (53.5%) and intravenous fluids for the majority of them. In Libya, Hend Abdalla, et al reported that a few cases (3.4%) received conservative managements in the field such as single broad-spectrum antibiotics administered in 53% of the cases, while combined antibiotics were administrated in 47% of the cases. ⁽¹⁰⁾ in Syria, Betül Kocamer, et al stated that the number of blood products used for surviving patients was fewer relative to that used for non-surviving patients. ⁽¹³⁾

Regarding the intraoperative findings, our study found that the majority of the study patients (95%) had been operated, on average, for 5 hours or less. The impact of this time interval was explained in Nigerian study by Adesanya AA, et al who claimed that prolonged injury to arrival and surgical intervention time were contributing factors to the high incidence of sepsis (63.2%) and mortality (22.8%) after laparotomy. ⁽¹⁶⁾

Nearly half of them had been injured in 1 – 3 organs (45%) while (7.5%) of them was injured in more than six organs and only (2.5%) had a negative laparotomy. While Nino Sikic, et al reported that the overall average number of injured intra-abdominal organs was 2.0. ⁽¹⁷⁾ In Nigerian study by Adesanya AA, et al found that only (1%) required delayed laparotomy which was negative. ⁽¹⁶⁾ a higher proportion was reported by Liebenberg ND, et al, who found that The overall unnecessary laparotomy rate was 21%. ⁽¹⁵⁾

The study found that the most affected organs were Jejunum (75.6%), Ileum (73.1%), and large colon (43.6%). To some extent, the findings were similar to Hend Abdalla, et al from Libya, who stated that the penetrating abdominal injuries were: isolated small intestinal injuries (22.8%), small intestine and right-sided colon injuries (8.5%), isolated left-side colon (7.6%), small intestine and left-sided colon injuries (5.7%), isolated right-side colon injury (4.7%) and isolated rectal injuries (2.8%).

The other abdominal injuries included: splenic injuries (12.4%), hepatic injuries (12.4%), and the vascular injuries reported in 5.4% of the cases. Another study by Nino Sikic, et al found that the most frequently injured organs have been the small and large bowels. ⁽¹⁰⁾

In Uganda, Opvang, et al found that the organs most commonly injured were the small bowel, colon and liver. ⁽¹¹⁾ while in Nigeria, Adesanya AA, et al stated that the commonly injured organs were the small bowel (56.1%), colon (38.6%), liver (22.8%) and stomach (19.3%). ⁽¹⁶⁾

Furthermore, cardiac arrest occurred only among small proportion (2.5%) of the study patients. Mortality reported and only (1.3%) while (1.3%) had reactionary bleeding as an early post-operative complication among our patients. The mortality can be explained by Hend Abdalla, et al in Libyan study, who claimed that the low death rate was reflecting best practice of the inexperienced surgeons in the military trauma. ⁽¹⁰⁾ Furthermore, they reported that the early complications were reported in 17.6% of the cases, while 15% of the cases reported late complications over 2 years of the follow up. About 79% of the cases were discharged in a good condition, 10.3% of them left against medical advice. ⁽¹⁰⁾

In another way, in Syria, Betül Kocamer, et al reported different findings, that the mortality rate of all patients followed up in the ICU after emergency surgery was 45%, ⁽¹³⁾ A higher mortality and complication rates reported by Nino Sikic, et al,

who found that a total of 10.8% of wounded patients died and 25.8% developed complications. ⁽¹⁷⁾

While in Iraq A. Ramasamy, et al found that a small proportion of cases subsequently died of wounds (3.7%). ⁽⁹⁾ On the contrary, in Uganda, Opvang, et al found that the morbidity rate was 36.8% all of whom had intestinal injuries. The overall mortality rate in this study was 14.5%, mostly as a result of haemorrhage and septicaemia. The high mortality rate associated with abdominal war injuries can be reduced if patients present early to hospital for prompt and appropriate treatment. ⁽¹¹⁾

In a similar study in Sudanese context, by Sawsan Mustafa, et al, they found that the death rate among patients underwent surgical management was 6.3% while it was 3.6% among patients underwent conservative management. Moreover, they stated that Cure rate was higher in surgical than in conservative management ⁽¹⁸⁾

On Nigerian experience, Adesanya AA, et al reported that (3.8%) patients died before laparotomy. ⁽¹⁶⁾ in the United States, D V Feliciano, et al found that there was an excellent survival rate, especially if vascular injuries are not present. ⁽¹⁹⁾ In the same way, Liebenberg ND, et al reported with a morbidity of 5.7% ⁽¹⁵⁾

Finally, our study realized that most of the study participants (83.7) were evacuated with 6 to 12 hours. While other studies such as Hend Abdalla, et al Libyan study, they found that the duration of hospitalization ranged from 1 to 32 days. ⁽¹⁰⁾

While in Syria, Betül Kocamer, et al found that average hospitalization duration in the ICU was 4.67 ± 1.32 days ⁽¹³⁾ in the United states, D V Feliciano, e tal found that the most common postoperative complication in survivors and patients who died later in the study was an intra-abdominal abscess (3.0%). ⁽¹⁹⁾

The study had some limitations. The relatively limited number of study patients (80 cases only) may affect negatively the probability of finding significant relationships between different factors and characteristics, and outcomes between both of them.

So many variables influence case fatality rate in abdominal wounds, analysis of large numbers of cases becomes a necessity for valid conclusions.

Another limitation, follow up. Some outcomes such as the long term outcome or the presence of complication - may need to be followed over time for a longer period.

Therefore, a long term prospective cohort follow-up design may be useful for more detailed description for the practices towards patients with abdominal penetrating injuries.

Conclusion:

This study aimed to describe the presentation and intraoperative findings in penetrating abdominal injury in battle field hospital, Yemen War, 2018 – 2019 and covered 80 study participants.

The majority of them were classified as military personnel . The majority of them were males with ages ranged from 10 to 53 years and a mean \pm SD of 31.7 ± 9.9 . Our study found that two thirds of the study participants had gun shots (66.3%), blast injury (16.3%), explosive injury (15%) and sharpness among only (8.8%).

Concerning the presentation of the study patients, our study found that half of them (18.8%) were shocked, (8.8%) had evisceration, and (33.8%) reported peritonism presentation.

Regarding the intraoperative findings, the majority of the study participants (95%) had operated on average, for 5 hours or less. Nearly half of them had been injured in 1 – 3 organs (45%) while (7.5%) of them was injured in more than six organs.

The most affected organs were Jejunum (75.6%), Ileum (73.1%), and large colon (43.6%). Furthermore, cardiac arrest occurred only among small proportion (2.5%) of the study patientst and (1.3%) mortality reported.

References:

1. Giannou C, Baldan M. War Surgery, vol 11. Annals of the Royal College of Surgeons of England. March 2013; 92(2):179-180.
2. El Bcheraoui C, Jumaan AO, Collison ML, Daoud F, Mokdad AH. Health in Yemen: losing ground in war time. Globalization and Health. 2018;14:42.
3. Bhimji SS, Daley BJ. Trauma, Abdomen, Penetrating. [Updated 2017 Oct 22]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2018 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK459123/>
4. Biffi WL, Leppaniemi A. Management guidelines for penetrating abdominal trauma. World J Surg. 2015 Jun;39(6):1373-80.

5. Henneman PL. Penetrating abdominal trauma. *Emerg Med Clin North Am.* Aug;7(3):647-66.
6. Nance FC, Wennar MH, Johnson LW, Ingram JC, Cohn I. Surgical judgment in the management of penetrating wounds of the abdomen: experience with 2212 patients. *Annals of Surgery.*;179(5):639-646.
7. Franke A, Bieler D, Friemert B, Schwab R, Kollig E, GÜsgen C. The First Aid and Hospital Treatment of Gunshot and Blast Injuries. *Deutsches Ärzteblatt International.* 2017;114(14):237-243.
8. WILSON H, SHERMAN R. Civilian penetrating wounds of the abdomen. I. Factors in mortality and differences from military wounds in 494 cases. *Ann Surg.*;153(5):639-49
9. Ramasamy A, Harrison S, Stewart M, Midwinter M. Penetrating Missile Injuries During the Iraqi Insurgency. *Annals of The Royal College of Surgeons of England.* 2009;91(7):551-558.
10. Ibrahim Sharif, Hend Abdalla. A Perspective Study of Chest and Abdomen Gun-shot and Blast Injuries During the First 3 Months of Libyan Liberation War in Benghazi. *University of Benghazi J.* 2016: 1 - 2
11. DM Opvang. Penetrating abdominal war injuries among the war victims at Lacor Hospital in Gulu, Northern Uganda. *East and Central African Journal of Surgery* 2001.6(2) 12-3
12. Ahmed BA, Matheny ME, Rice PL, Clarke JR, Ogunyemi OI. A Comparison of Methods for Assessing Penetrating Trauma on Retrospective Multi-Center Data. *Journal of biomedical informatics.* 2009;42(2):308-316
13. Kocamer Şimşek B, Dokur M, Uysal E, Çaliker N, Gökçe ON, Deniz İK, Uğur M, Geyik M, Kaya M, Dağlı G. Characteristics of the injuries of Syrian refugees sustained during the civil war. *Ulus Travma Acil Cerrahi Derg.* 2017 May;23(3):199-206.
14. Kisat M, Zafar SN, Hashmi ZG, et al. Experience of damage control trauma laparotomy in a limited resource healthcare setting: A retrospective Cohort Study. *Int J Surg.* 2016;28:71-6.
15. Liebenberg ND, Maasch AJ. Penetrating abdominal wounds--a prospective trial of conservative treatment based on physical signs. *S Afr Med J.* Sep 3;74(5):231-3.
16. Adesanya AA, Afolabi IR, da Rocha-Afodu JT. Civilian abdominal gunshot wounds in Lagos. *J R Coll Surg Edinb.* Aug;43(4):230-4.
17. Sikić N, Korać Z, Krajacić I, Zunić J. War abdominal trauma: usefulness of Penetrating Abdominal Trauma Index, Injury Severity Score, and number of injured abdominal organs as predictive factors. *Mil Med.* 2001 Mar;166(3):226-30
18. Mustafa Abdalla, Sawsan & Eldirdiri, Sami & Mohamed, Elsadig & Ahmed A/Gadir Elimam, Mohamed A., Humida & Medani, Khalid. Abdominal trauma among patients attended a Sudanese state public hospital. 2015; 2. 57-64.

19. Feliciano DV, Burch JM, Spjut-Patrinely V, Mattox KL, Jordan GL. Abdominal gunshot wounds. An urban trauma center's experience with 300 consecutive patients. *Annals of Surgery.*;208(3):362-370.

Khalid. Abdominal trauma among patients attended a Sudanese state public hospital. 2015; 2. 57-64.

19. Feliciano DV, Burch JM, Spjut-Patrinely V, Mattox KL, Jordan GL. Abdominal gunshot wounds. An urban trauma center's experience with 300 consecutive patients. *Annals of Surgery.*;208(3):362-370.