

Diagonal Thoraco-abdominal Arrow and Gunshot Injuries as Seen at Juba Teaching Hospital, South Sudan.

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Background: *Civil wars and inner city violence in Africa and worldwide are associated with multiple severe injuries to various anatomical sites or combined. The thoraco-abdominal variety tends to cause high mortality or significant morbidity and they warrant an auditing study to guide practice and reduce mortality.*

Methods: *At Juba Teaching Hospital, South Sudan we receive numerous victims of gunshot or arrow shot injuries to most parts, head, neck, chest abdomen, pelvis, and limbs or combined. Between Dec.2012-Jan.2014, we managed a significant number of casualties, and out of this number we selected to study prospectively the outcome of management of patients with thoraco-abdominal arrow and gunshot injuries.*

Results: *We managed 23 patients. 22 adult males and one female child aged 7years, mean age (29) and range 7-59years. 11 patients (47.8%) survived and discharged and 12/23 died (52.2%).*

**Two patients died on table before operative intervention.*

Conclusion: *Diagonal thoraco-abdominal gunshot and arrowshot injuries are associated with high mortality in African setting with limited resources that do not include specialist and intensive therapies units.*

Introduction:

Civil wars and inner city violence in Africa are associated with severe multiple injuries. Gunshot injuries are the most dominant, and cause most anatomical damage. They are anatomically classified according to sites, eg. Head, neck, chest, pelvis, limbs or combined as in open combats. The combined injuries tend to cause multi-organ damage leading to high morbidity and mortality¹. We tend to receive and manage a significantly high number of victims of violence with multiple gunshot and arrowshot injuries to various anatomical regions and specific organs. The thoraco-abdominal injuries are associated with most damage and severer impact on the victims and this is shown by high rates of morbidity and mortality². Violence using firearms and injurious weapons is a socio-economic significant issue that is on the rise world-wide and costly needs a holistic approach to prevent^{3,4}.

Patients and Methods:

Our study was carried out at Juba Teaching Hospital in Juba City, the capital of South Sudan, which is a post-war new country. Between December 2012 and Jan.2014 we selected to follow prospectively patients with a particular pattern of combined injuries, the diagonal thoraco-abdominal injuries. During this period we recorded 23 patients. These patients were identified on admission and put on the study if they had sustained combined chest and abdominal gunshot or arrowshot injuries. The pattern and extent of damage caused by the shots were finally described after Laparotomy and chest drain. The presentation was noted on a designed Performa for every patient, recording demographic data, mode of transport to hospital (ambulance or public/private vehicle). Evidence of an effective clinical assessment by an appropriately trained surgeon was shown. The duration from the scene of accident to the hospital, the mode of injury; gunshot or arrow shot, the anatomical site; left chest to abdomen

or diagonally right chest to abdomen were documented. Clinical signs of severity of injury were recorded as; external signs of bleeding at both entry and exit wounds. Vital signs were documented on the Performa sheet as respiratory rate (RR), pulse (P), blood pressure BP, Oxygen saturation and urine output on catheterisation. Essential trauma investigations done and resuscitation therapies given were recorded. Emergency surgical interventions performed were documented in each case. The findings on chest drain or laparotomy were finally described and noted (Tables 1 and 2). Outcomes of surgical intervention were documented as mortality or survival on discharge.

Results

During the study period we recorded 23 patients who sustained thoraco-abdominal injuries; 19 were males and one was a female child. With the mean age of 29 and range 7-59 years. All the patients were brought to the hospital by public or private transport and no accredited ambulance delivery to the hospital. The causes of injury were thoraco-abdominal gunshot in 19 and arrow shot in 4 of the 23 cases. All the patients were triaged urgently at the Accident & Emergency Department (A&E) and main operating theatres by a senior surgeon within 15 minutes of arrival. All the 23 patients were haemodynamically unstable, with abnormal vital signs; 5 patients had signs of active external bleeding while 18/20 showed trace signs of bleeding at the entry and exit wounds with abdominal tenderness.

The patients were unstable and because our setting lacks diagnostic scans, no scans (CT or US) were done. The clinical decisions to intervene were taken in all cases by the attending consultants. The intravenous (IV) fluids resuscitation (Crystalloids and blood transfusion of 4 units or more), analgesia, IV antibiotics and monitoring were administered actively with surgical intervention. The duration spent from the scene of the injury to the hospital was recorded as given by the accompanying individuals to be; between 2 hours to 48 hours (Table 3).

Table 1. Chest intervention

Intervention	Yes	No
*No chest drain	-	2/23
Chest drain < 500ml of blood	16/20	-
Chest drain > 500ml of blood	5/20	-

Table 2. Intra-abdominal Injuries at laparotomy and outcomes

	No	Survival	Mortality
Bowel(SB/LB +Liver +spleen)	1	0	1
Extensive bowel Injury(SB/LB)	4	0	4
Bowel SM/LB Moderate +Liver Laceration	6	4	2
Bowel SB/LB +Splenic injury	1	0	1
Viscera other(Stomach, Bladder, Mesentery Kidneys, blood vessels and spleen alone)	9	7	2

Table 3. Vital Signs records

Vital signs	Normal	High	Low
Resp. rate	0	22/23	1/20
Tachypnoea		22/23	
Tachycardia		23/23	
Normal pulse	0		
Normal BP			
Hypotension	0	0	23/23
Normal Temperature	0	21/23	2/23
Pyrexial		21/23	
Normal urine out put			
Low urine output			23/23
PO ₂ Concentration			23/23

Table 4. Glasgow Coma Scale (GCS)

Score	15	11-14	<10
No.	10	8	5
Group Survival	9	2	0
Mortality	1	6	5

Table 5. Duration from Accident Scene to Arrival at the Facility (Hospital) and Mortality

Duration	1 hr	2 hrs	4 hrs	>6 -24 hrs	>24- 48 hrs	> 48 hrs	Total
No.	0	6	7	6	4	0	23
Mortality	0	4	6	2	0	0	12
Survival	0	2	1	4	1	0	8

No patient was reported to have reached within one hour, the golden hour, 13/20 reached the hospital between 2-4 hours and most of mortality cases were among this group, 10/20. Those reaching the hospital over 6 hours, but less than 24 hours were 6/20, two of these patients died. Only a single victim was reported to have reached the hospital in about 48 hours and underwent surgical intervention and survived.

The anatomy of the injury was a combined chest and abdominal injury by a gunshot or an arrowshot. Four patients sustained arrowshot and 19 sustained gunshots. We noted the portal of entry to be either left chest to abdomen 10/23 or right chest to abdomen 13/23 diagonally as demonstrated by entry wounds and exits or embedded and no exit in the case of an arrow. The mortality according to the anatomical passage of the bullet or the arrow is 7/13 of the right-sided and 5/10 of the left-sided traversing shots.

The operative intervention was apparently dictated by the haemodynamic conditions of the patients. 21/23 had operations, 2/23 died on table in operating theatres (OT) just before surgery. The two procedures performed were chest drainage (thoracotomy) and a laparotomy. The multiplicity and the degree of severity of the injuries were finally described intraoperative during the surgical interventions by chest drains and laparotomies (Tables 1 and 2)

Thoracic Injuries

The chest injuries were measured intra-operatively by how much blood is drained from the pleural cavity.

The intra-abdominal Injuries

The passage of the shots (bullets or arrows) through the abdominal cavity caused significant organ damage from upper quadrant to lower abdomen, right to left or left to right diagonally. Injuries of solid organs (spleen and liver) associated with bowel damage did result in most cases of mortality (Table 4 and 5), the arrows passage was less damaging and all 4 patients with arrow shots survived.

Table 6. Intra-abdominal Injuries identified and outcomes

Bowel(SB/LB)	No	Survival	Mortality
Liver +Spleen	1	0	1
<i>Bowel Extensive Injury SB/LB</i>	4	0	4
<i>Bowel SM/LB Moderate +Liver Laceration</i>	6	4	2
<i>Bowel SB/LB +Splenic injury</i>	1	0	1
<i>Viscera other(Stomach,Bladder, Mesentry Kidneys,blood vessels and spleen alone)</i>	9	4	2



Figure 1. Evisceration at the exit wounds (Courtesy of M Achiek, FRCS)

Discussion

In our series despite the rather small number and only one year's experience chosen from a large pool of patients with gunshot injuries to various parts, we are showing effectively the extent of damage caused by bullets or arrows that traverse the thoracic and abdominal cavities at the same time. The victims of these injuries reach health facilities unstable clinically with a double impact of haemorrhagic and septic shock and attempts are made to conduct resuscitative operations (Thoracotomy and laparotomy) as shown in our study, even some larger series over 5 years do have comparable numbers⁵. Patients who do not reach hospitals within the golden hour and no pre-hospital rescue attempts by trained professionals have less survival opportunity^{5,6,7}, as in our series all the patients were brought to the hospital by untrained good Samaritans or private public transport. The teaching hospital our patients were brought to is modest and developing with very limited resources, both material and human.

Management by a multidisciplinary team of specialists in trauma centres supported by intensive therapy units (ITU) may improve survival significantly⁸. The outcome of combined thoracic and abdominal injuries may take long to improve in relation to the poor African inner city terrorist violence or the civil wars battlefields⁹. The mortality of (52.2%) in our series is relatively higher than what is quoted by others^{2,10} because none of our patients was treated on an ITU as we lack critical care facilities that could have supported these severely injured younger patients we managed. The pattern of injuries also has a role, as most patients had visceral injuries, affecting the bowel 11/23, With associated bowel perforating injuries, these patients on presentation had already developed septicaemia from peritonitis and this added to the effect of blood loss from the chest and the abdomen, this is a doubly-hit shocked patient who easily slips into multi-organ dysfunction^{1,8,11}. There could be at times assessment and diagnostic scans (US/CT) prioritization difficulties in managing critically ill multiple trauma patients⁹. However, in our series the patients had never have imaging investigations (x-Rays, US & CT scans, as they were all unstable barely reaching the operating theatres moribund, and we have to adhere to the ATLS principles and tried desperately life-saving¹².

We have chosen a subset of patients from a larger pool of victims of multiple trauma. In clinical practice in the areas of high violence prevalence whether military or civilian, the morbidity and mortality associated with these injuries is high^{10,13,14,15}, specially gunshots and blasts. Traditional weapons like arrows could equally cause significant damage when traversing cavities as in our series and may compare implement like knives and spears, but there is an element of velocity with an arrowshot.

Mortality and morbidity associated with thoraco-abdominal injuries will continue to be high as long as patients in developing nations are not benefiting from well developed prehospital systems and managed on tertiary centres with specialist multidisciplinary teams⁶. This auditing study is a painful lesson in our national healthcare planning strategy. Although the circumstances were far from ideal and very much similar to situation on the battle fields of the African civil wars, we are making a point of reflection on what could have been done differently at different points of patients contact, from trauma scene retrieval to the A&E triage and emergency surgical intervention.

Conclusion

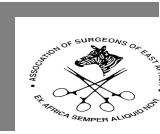
A trauma patient who is doubly-hit by the impact of haemorrhage from injury and septic from a viscus penetration has minimal chances of survival. These patients are in a doubled

shock, both haemorrhagic and septic and therefore, slip quickly into multi-organ dysfunction, critically ill and this sequence of events is associated with high mortality. They should be ideally managed on an ITU in a designated trauma centre.

Patients with thoraco-abdominal shot injuries will remain challenging to manage even to the best facilitated. In Africa if the healthcare authorities at least establish cardiothoracic surgical units HDUs/ITUs, the high mortality may be improved to some point.

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