

Assessment and outcome of 496 penetrating gastrointestinal warfare injuries

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Abstract

Aim: The abdominal viscera are among the most vulnerable organs of the body to penetrating trauma. Proper management of such trauma in war victims at the first-line hospital where these victims are first seen is of paramount importance. We reviewed medical records of war victims suffering small bowel and colorectal injuries treated at first, second and third-line hospitals during the Iraq-Iran War (1980-88) to assess surgical outcomes.

Methods: The medical records of 496 Iranian war victims suffering penetrating gastrointestinal (GI) injuries treated at first, second and third-line (tertiary) hospitals, a total of 19 centres, were reviewed. Laparotomy had been performed at the 1st line hospitals for all patients who had an acute abdomen, whose wounds violated the peritoneum or whose abdominal radiographs showed air or shrapnel in the abdominal cavity. Stable patients were transferred from first-line to second-line or from second line to tertiary hospitals postoperatively. The treatments, complications and patient outcomes were documented and analyzed.

Results: There were 496 patients; 145, 220 and 131 victims underwent laparotomy for GI injuries at first, second and third-line hospitals respectively. The small intestine and colon respectively were the most prevalent abdominal organs damaged. Those first treated for GI injuries at front-line hospitals (145 victims) had more serious conditions and could not be transferred prior to surgery and presented a higher prevalence of complications and mortality. Overall mortality from GI surgery was 3.6% (18 patients). Eleven patients (7.5%) whose first GI operation was performed at frontline hospitals and 7 patients (3.2%) who underwent their first surgical operation at second-line hospitals died. The most common reason for these deaths was complications relating to the gastrointestinal operation such as anastomotic leak. Six missed injuries were seen at the frontline and one at second line hospitals. There were no deaths at the 3rd line hospitals.

Conclusion: Penetrating abdominal injuries were common in Iranian victims of war often causing multiple organ injuries. The colon and small intestine were the more commonly injured organs and carried the most postoperative complications. Mortality at 1st line hospitals was more than double that of 2nd line hospitals; the complication rate was also greater as was the number of missed injuries. Adherence to the standard surgical protocols, prompt evaluation, proper triage and management are factors which may lower patient morbidity and complications.

Introduction

Penetrating injuries to the abdominal viscera from projectiles can cause immediate or delayed disability or death. The abdominal viscera, particularly the intestines, are vulnerable to penetrating injuries making management of penetrating colorectal injuries among the most important issues in traumatology. Both high and low velocity projectiles interacting with the body can cause penetrating abdominal organ injuries, either directly by fragmentation, or indirectly via blast waves from explosive devices [1-5]. Abdominal organ injury requires proper evaluation to define the correct triage and treatment priorities [1-7]. This is especially true for war injuries as there are marked differences in diagnosis, treatment, prognosis and outcome when compared to civilian injuries. The traditional approach to abdominal war wounds consists of triage, echeloned care, and immediate laparotomy (at

the field hospital) for penetrating injuries transgressing the peritoneum. This remains valid in modern-day management of warfare injuries. Management of abdominal casualties can be hampered under difficult circumstances via a high influx of patients during attacks, exhaustion of the available resources and continuous bombardment of the field hospital [1]. Evacuation of the patient from the frontline to a safer hospital behind the lines is a priority in non-emergency cases because of the less stressful conditions of operating outside a war zone and the better standards of care that can be rendered at second and third-line hospitals [2]. However, victims in critical or unstable conditions or with penetrating abdominal injuries transgressing the peritoneum must be treated at frontline hospitals. We reviewed medical records of war victims suffering penetrating intestinal injuries treated at first-line and second-line hospitals to assess complications and outcomes of management.

Material and methods

Records of 1176 Iranian war victims undergoing emergency laparotomy for penetrating abdominal injury at 1st, 2nd, or 3rd line hospitals (19 centres) were examined. Laparotomy was

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performed for all patients with an acute abdomen, whose wounds violated the peritoneum or whose abdominal radiographs showed air or shrapnel in the abdominal cavity. The lines of care were as follows:

- 1st **Line** (field) hospitals were less than 15 minutes away from the front line and well within the war zone. They were typically equipped with operation and recovery rooms, laboratory and radiology departments.
- 2nd **Line** hospitals were at least one hour behind the frontline. These were medical centres in war-zone cities like Ahwaz, Andimeshk and Kermanshah.
- 3rd **Line** (tertiary) hospitals included medical centres distant from war zones such as University hospitals in Tehran, Shiraz, Mashhad, Isfahan and Tabriz. They were typically 5-9 hours behind the front line.

Data examined included the abdominal organs injured concentrating on those who had gastrointestinal injury, the number of surgical operations performed as well as complications encountered, any missed injuries and subsequent mortality.

Results

Out of a total of 1176 Iranian war victims who underwent emergency laparotomy for penetrating abdominal trauma, 496 had colorectal or small bowel injuries and underwent GI operations at 1st, 2nd and 3rd line hospitals; 145 were performed in 1st line hospitals, 220 at 2nd line and the remaining 131 patients in tertiary units.

Primary surgery at 1st line hospitals without triage

Those first treated at front-line hospitals tended to have more severe injuries that precluded rearward evacuation for surgery and subsequently had a high rate of complications and mortality; 145 were colorectal and small bowel operations. Sixty nine out of 74 patients with small bowel injuries were treated by resection and primary anastomosis with the remaining five having an ileostomy raised after resection. A further 64 patients suffering penetrating colonic trauma were operated on at a front line hospital with 30 patients having proximal colostomy after colonic repair, and 19 undergoing resection and primary anastomosis plus proximal colostomy. Six patients were treated by exteriorisation of the injured segment, six had standard right hemicolectomies and three patients underwent defunctioning caecostomy. There were only seven rectal injuries treated via proximal colostomy in four patients and pre-sacral drainage in three.

Primary surgery at 2nd line hospitals

The 220 victims treated at 2nd line hospitals had less serious conditions and were stable enough to have been evacuated rearward from the 1st Line hospital. One hundred and thirteen were operated for penetrating small intestine injuries, the majority of which (109) had resection and primary anastomosis – three had ileostomies and a single individual had a jejunostomy created. There were 101 penetrating colon injuries; 79 cases were treated via repair and proximal defunctioning colostomy and nine patients underwent resection with primary anastomosis and proximal colostomy. Six patients had their injuries exteriorized, five had caecostomies and two had right hemicolectomies. Five rectal injuries were treated via proximal colostomy and one by pre-sacral drainage alone.

Primary surgery at 3rd line hospitals

Overall 131 victims were treated at 3rd line hospitals as they were haemodynamically stable enough for transfer. Sixty one had resection and primary anastomosis of a small bowel injury plus three ileostomies and one jejunostomy. The treatment of 61 penetrating colonic injuries utilized repair and proximal colostomy

in 14, caecostomy in 16, resection plus covering stoma in 13. Nine injuries were exteriorized and there were nine standard right hemicolectomies. There were five rectal injuries treated via proximal colostomy in two and pre-sacral drainage in three patients.

Colorectal complications

Overall there were 110 complications recorded with the highest incidence after surgery in first-line hospitals where 64 out of 145 patients (44.1%) suffered a complication compared to 40/220 (18.1%) at second-line hospitals and 6 patients (4.59%) at third-line hospitals. The types of complications are detailed in Table 1. Some of these complications required subsequent operations.

Complications	Site and number of patients undergoing primary gastrointestinal surgery		
	1 st Line n=145 (%)	2 nd Line n=220 (%)	3 rd Line n=131 (%)
Abscess	15 (10.3)	5 (2.8)	2 (1.5)
Obstruction	10 (6.9)	8 (3.6)	2 (1.5)
Peritonitis	13 (9.0)	3 (1.4)	
Gangrene	4 (2.8)	4 (1.8)	
Anastomotic leak	1 (0.7)	3 (1.4)	
Fistula formation	10 (6.9)	11 (5.0)	1 (0.76)
Intra-abdominal haemorrhage	5 (3.5)	5 (2.8)	1 (0.76)
Missed Injury ^a	6 (4.2)	1 (0.45)	
TOTAL	64 (44.1)	40 (18.1)	6 (4.59)

^a Inadequate primary laparotomy with later diagnosis of injuries of the colon, rectum, ileum – all missed injuries were located posteriorly.

Table 1: Surgical complications of operations for penetrating gastrointestinal injury according to site of primary surgery

Fistula Formation

The two commonest complications overall were intra-abdominal abscesses and fistula formation. The prevalence of ongoing intra-abdominal sepsis after penetrating gastrointestinal injury is not surprising, but the rate of fistula formation is interesting. The fistula details are given in Table 2.

	Patients treated at first-line hospitals 145 patients (%)	Patients treated at second-line hospitals 220 patients (%)	Patients treated at third-line hospitals 131 patients (%)
Small Intestine	0	4 (1.8%)	0
Colon	5 (3.4%)	3 (1.4%)	1(0.76%)
Rectum	5 (3.4%)	4 (1.8%)	0
Total	10	11	1

Table 2 The number and percentage of postoperative intestinal fistulas in 496 patients operated on at the 1st, 2nd and 3rd line hospitals for small bowel and colorectal injury.

Whilst the absolute numbers of colonic and rectal fistulae are similar, in terms of the incidence, rectal fistulae were extremely

common, occurring in 10/18 rectal injuries compared to 9/226 colonic injuries. The rectal fistulae occurred mainly in those with rectal injuries above the peritoneal reflection who were treated by repair of the injury without defunctioning colostomy or in those in whom the defunctioning transverse loop colostomy was formed without washing the colon during the operation.

Mortality

The overall mortality from gastrointestinal surgery was 3.6%. Eleven out of 145 patients (7.6%) whose first GI operation was performed at a frontline hospital died, as did 7/220 patients (3.2%) whose first surgery was at a 2nd-line hospitals. All deaths occurred because of complications of surgery such as anastomotic leakage or abscess formation. There were no deaths at the 3rd line hospitals.

Discussion

All information regarding the injuries and veterans affairs relating to the Iraq-Iran war (1980-1988) has until recently been classified information in Iran, which is why the data is only now being reported. Mohebbi et al reported 1897 injuries in 1000 Iranian victims of war, 199 (10.5%) of which were abdominal injuries [6]. The most prevalent abdominal organs injured in a series of 522 war victims were the colon (66 injuries), small intestine (41 injuries) and the stomach (27 injuries) [8].

Evacuation

Victims wounded at the frontline were immediately attended to by a trained soldier who was able to keep the airway patent, splint fractures, control external bleeding and safely transfer the patient via stretcher to the front-line emergency posts. These posts were only a few minutes behind the frontline and performed basic life support, resuscitation, serum administration and further splinting of fractures before immediate transfer to the front-line hospital via ambulance. The front-line hospital was less than 15 minutes away from the front; a time crucial for patients with high-energy transfer projectile or ballistic injuries [9]. Less urgent patients were evacuated and transferred to second-line hospitals by helicopter or ambulance.

Evaluation

As a rule, little preoperative evaluation was required for firearm injuries that penetrated the peritoneal cavity because the chance of internal injury was over 90 %. - laparotomy was mandatory. If in doubt, it is always safer to explore the abdomen. Injuries that do not penetrate the peritoneal cavity do not require further evaluation [10]. Other indications for surgery were a patient presenting with an acute abdomen or whose abdominal radiographs showed air or shrapnel in the abdomen [11].

In this series of patients the small intestine and the colon were the most commonly injured organs comparable to other studies [12] and suggests that war surgeons should be alert to the possibility of missing gastrointestinal injury; the commonest overlooked sites of injury are the retroperitoneal portion of the colon and rectum below the peritoneal reflection and the retroperitoneal portion of the duodenum. Missed injuries may compromise eventual outcome and there are a number of factors which may contribute to an inadequate primary laparotomy, especially in 1st line hospitals, such as surges of patients at periods of high operational tempo or overworked and potentially inexperienced surgeons dealing with war injuries outside of their normal experience.

The majority of complications relate to colorectal injuries – anastomotic leakage, peritonitis and abdominal hemorrhage are important issues in war victims. The debate surrounding the optimal management of colorectal war injuries has continued over the three decades since the start of the war reported here. It was our experience that primary colonic closure without a proximal stoma after war injury is a contributing factor to subsequent leakage, abscess formation, and peritonitis and should not be performed.

Injuries of the right colon should be treated by right hemicolectomy with ileostomy and mucous fistula or ileotransverse anastomosis if no spillage of faecal material has occurred and there is no need for any other intra-abdominal surgery. Care should be taken to recheck previous treatments. Injuries of the left colon should be treated via colostomy. Injuries of the rectum should be treated via double barreled colostomy and repair of intra-abdominal injury after resection of the damaged portion or presacral drainage if the injury is below the peritoneal reflection. Injuries of the small intestine should be treated by excision and anastomosis rather than primary repair [10,11].

Expediting evacuation and proper triage of the wounded at the front-line hospital, ideally headed by an expert medical team and advanced medical equipment may be effective in decreasing the incidence of death in war-wounded victims [13-15]. This was also our experience during planned attacks on Iraq when expert medical teams were sent to front-line hospitals at the time of attack.

Conclusion

Penetrating abdominal wounds are common in war victims and cause multiple organ injuries. The colon and small intestine were the most commonly injured organs and had the most postoperative complications. Both mortality and morbidity (major complications) at 1st line hospitals were more than double that of 2nd line hospitals. Adherence to standard surgical protocols, proper evaluation and management such as colostomy instead of primary colonic repair are factors which may lessen complications. The greater number of deaths seen in victims treated at frontline hospitals was due in part to the fact that these victims were more seriously injured and could not be transferred behind the frontlines for treatment. Missed injuries were seen more at the frontline hospitals. An inadequate number of expert front-line surgeons and issues which relate to the surgical setting also may have been influential to these surgical outcomes.

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