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Large bowel perforations in war surgery: one-stage treatment in a field hospital

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Abstract. Over a period of 14 months between 1990 and 1992, 73 Afghan war wounded with penetrating colon injuries were admitted and treated by a single surgical team in a field hospital of the International Committee of the Red Cross (ICRC). There were 67 males and 6 females, with a mean age of 23 years (range 6 to 80 years). Fifty six (77%) patients had multiple associated injuries; admission was delayed longer than 12 hours in 39 (44%); hypotension or deep shock was present at admission in 34 (47%) and 12 (16%) respectively. At laparotomy faecal contamination was limited to one quadrant in 58 (79.5%) cases and major in 15 (20.5%). Fifty-two (71.2%) patients underwent resection and primary anastomosis and 21 (28.8%) primary repair. Exteriorisation or diverting colostomy were never used. Four (5.5%) patients died and 11 (15%) had postoperative complications. Overall failure rate was 2.7%, including one faecal fistula conservatively treated and one colostomy raised as a precaution in a patient undergoing relaparotomy for intra-abdominal abscess. No primary repair leaked Deaths were significantly related to delay in admission and age, but not to surgical treatment. One stage primary treatment of large bowel injuries from penetrating abdominal wounds has low mortality, failure and colostomy rates suggesting its wider use regardless of risk factors.

Résumé. Durant une période de 14 mois, entre 1990 et 1992, 73 Afghans avec des blessures de guerre comportant une plaie pénétrante du colon ont été admis et traités par la même équipe chirurgicale dans un hôpital de campagne du Comité International de la Croix Rouge. Il avait 67 hommes et 6 femmes d'un âge moyen de 23 ans (6–80 ans). 56 (77%) patients avaient des blessures multiples associées; l'admission fut retardée de plus de 12 heures chez 39 (44%); une hypotension ou un choc profond était présent à l'admission chez 34 (47%) et 12 (16%) respectivement. A la laparotomie, la contamination foecale était limitée à un cadran chez 58 (79.5%) cas et majeurs dans 15 (20.5%). 52 (71.2%) patients subirent une résection avec anastomose primaire et 21 (28.8%) une réparation primaire. L'extériorisation ou la colostomie de décharge ne furent jamais utilisées. 4 (5.5%) patients moururent et 11 (15%) ont eu des complications post-opératoires. Le taux total d'échecs était de 2,7% y compris une fistule fécale traitée de façon conservative et une colostomie effectuée par précaution chez un malade qui a subi une nouvelle laparotomie pour abcès intra-abdominal. Aucune suture primitive n'a fistulisé. Les morts étaient reliés de façon significative au retard dans l'admission et à l'âge mais non au traitement chirurgical. Les taux d'échec, de mortalité et de colostomie sont bas dans le traitement primaire en un temps des plaies du colon au cours des plaies abdominales pénétrantes suggèrant son utilisation plus large en regard des facteurs de risque.

Large bowel is among the most frequently injured organ in penetrating abdominal war wounds [1, 2], but the surgical treatment of colon wounds is still under discussion.

A staged procedure using temporary colostomy or exteriorization is a well established practice [3–7]. However there is increasing evidence that a definitive one stage treatment can be safely carried out in selected patients [8–15]. Recently primary repair or primary resection and anastomosis has been advocated, regardless of risk factors, for nearly all penetrating colon wounds [16].

This paper reports a series of 73 consecutive war wounded patients, admitted to a field hospital for penetrating colon injuries, who underwent one stage primary repair or primary resection and anastomosis.

Patients and methods

Over a period of 14 months between 1990 and 1992, 235 patients with penetrating abdominal wounds were treated by a single surgical team (1 surgeon, 1 anaesthetist, 1 theatre nurse) in a field hospital of the International Committee of The Red Cross (ICRC) admitting victims of the Afghan conflict. Of these, 73 (31%), [67 males and 6 females, with a mean age at presentation of 23 years (range 6 to 80 years)] were found at laparotomy to have large bowel injuries, and form the basis of this report.

56 (77%) of these patients had associated intra and extra abdominal injuries (Table 1).

The abdominal injury, as clinically and radiologically assessed, was caused by a gunshot in 33 (45%) cases, and by fragments from bombs or rockets in 35 (48%) or from mine blast in 5 (7%) cases.

The time elapsed from injury to admission was shorter than 12 hours in 41 cases (56%), between 12 and 24 hours in 15 (20%), and longer than 24 hours in 17 (23%).

According to their vital signs at admission, the patients' conditions were clinically scored as "fair" ($n=27$, 37%), "poor" (hypotension) ($n=34$, 47%) and "very poor" (deep shock) ($n=12$, 16%).

At admission the patients were resuscitated with intravenous fluids and started on Penicillin (2.5 to 5 million units i.v. qid, according to the body weight). Metronidazole, 500 mg i.v. tid, was added at laparotomy, according to the intraoperative findings, and continued routinely for 5 days.

Preoperative investigations included blood grouping, haemoglobin and haematocrit. When the haemoglobin level was less than 7 gr % ml, blood was crossmatched and transfused, if available.

Plain abdominal films were taken if only an entry wound to the abdomen was present, whereas they were often omitted in case of through and through wounds, or in patients clinically unstable.

Surgical findings and management

Under general anaesthesia with orotracheal intubation and muscle relaxation, the abdominal cavity was entered through a midline incision and carefully explored. Major faecal contamination (in more than one abdominal quadrant) was found in 15 patients (20.5%), while in the remaining 58 cases (79.5%) the faecal spillage was confined to the immediate area around the injury or to one abdominal quadrant. Single or multiple perforations affected the right colon in 20 (27%) cases, the transverse colon in 16 (22%), the descending colon in 25 (34%), the sigmoid in 10 (14%) and the intraperitoneal rectum in 2 (3%).

Single wall injuries up to 50% of the wall circumference were treated by excision of the margins and primary repair. Complete transection of the colon, multiple large perforations within a short segment of bowel, or lesions at the mesenteric border with impairment of the vascular supply were treated by resection and anastomosis.

All repairs and anastomoses were hand sutured in two layers using continuous polyglactin (3/0 Vicryl) sutures.

Exteriorization of the suture line or diverting colostomies were never used.

The posterior peritoneum was closed whenever possible. A tube drain was positioned in the pouch of Douglas in the presence of haemoperitoneum or multiple intra-abdominal organ injuries, and removed 24 to 48 hours later. After generous saline irrigation carried out to all parts of the abdominal cavity, the incision was closed using a single layer of continuous polyglactin suture. A continuous polypropylene suture was used for skin closure. The entry and exit wounds were debrided and usually closed primarily. A delayed primary closure of the skin was carried out in selected cases on the fifth or seventh postoperative day.

After surgery patients remained under the care of the operating surgeon. Full records were kept of their clinical progress until discharge from hospital, at which time all patients were free of abdominal sequelae. At discharge patients were instructed to return to the outpatient department, if the need should arise. No routine follow-up could be booked.

Operative mortality is therefore assumed as the observed hospital mortality. Causes of death were clinically assessed, no autopsy being possible for both practical and cultural reasons.

Statistical analysis was performed using Fisher's exact test to analyze differences in prevalence for small groups, and the Student's *t*-test to compare parametric data. Differences were regarded as significant for a P value of less than 0.05.

Table 1. Extra- and intra-abdominal injuries associated with large bowel wounds ($n=56$, 77%)

Upper or lower limb (open fracture or traumatic amputation)	23
Chest	15
Small bowel	15
Liver	6
Spleen	7
Stomach	5
Duodenum	1
Gallbladder	2
Kidney	6
Bladder	2
Pancreas	2
Major vessel	4
Other	7
Total	95

Average 1.78 intra-abdominal organs injured/casualty

Results

Resection of the affected bowel and primary anastomosis was performed in 52 (71.2%) patients and in 21 (28.8%) the colonic perforation(s) was treated by primary repair.

The postoperative course was uneventful in 58 (79.4%) patients, 4 (5.5%) died and 11 (15%) had postoperative complications.

All deaths occurred among the 46 (63%) patients whose general conditions were scored at admission as poor or very poor. Three deaths occurred in the group of 17 (37%) patients whose admission was delayed more than 24 hours from the injury, giving a mortality rate in this group of 17.6%. The mean age of the patients who died was 52.7 years. Of the 52 undergoing large bowel resection three (5.8%) died, while one (4.8%) died among the 21 undergoing primary repair.

Complications included wound infection ($n=6$, 8.2%), wound dehiscence ($n=1$, 1.4%), small bowel obstruction ($n=2$, 2.7%), faecal fistula ($n=1$, 1.4%) and intra abdominal abscess ($n=3$, 4.1%).

In the 6 cases with wound infection the skin sutures were removed and the wound dressed daily and resutured at a later stage.

Small bowel obstruction was successfully treated conservatively in one case and required laparotomy in another (1.9%).

The faecal fistula through the drainage sinus was conservatively treated. Although the fistula output greatly decreased in the following weeks, no long term follow-up is available.

The 3 patients with intra-abdominal abscess underwent relaparotomy and drainage. In one of these the anastomosis was taken down and converted to end colostomy, despite its sound appearance, fearing that intra-abdominal infection might precipitate suture line failure. Thus the failure rate of primary resection and anastomosis was 2 (3.8%) out of 52 and eventually 1 (1.9%) colostomy was required. No primary repair failed.

Two (18.2%) of the eleven patients with postoperative complications eventually died (Table 2).

Table 2. Hospital mortality and cause of death ($n=4$, 5.5%)

Patients' characteristics	Cause of death
Case 1	
30 yrs. Established peritonitis from multiple large and small bowel injuries.	Septic shock (postop day 1)
Case 2	
68 yrs. Septic shock, established peritonitis from R colon rupture.	Renal failure (postop day 3)
Case 3	
80 yrs. Established R colon perforation, multiple large soft tissue wounds. Relaparotomy for wound infection and dehiscence 8 days later.	Heart failure, respiratory insufficiency (postop day 10)
Case 4	
33 yrs. Multiple large and small bowel perforations. L haemopneumothorax. Relaparotomy for small bowel obstruction 14 days later.	Sudden death Electrolytic imbalance? Pulmonary embolism? (postop day 17)

The mean hospital stay was 12.6 days (range 6 to 39 days).

Discussion

Morbidity and mortality from penetrating colon injuries has decreased dramatically since the routine performance of colostomy during World War II [3–6]. The advent of antibiotics and the improvement in surgical techniques led to more selective forms of therapy including exteriorization of the repair and primary repair with or without proximal decompression [7–10] in order to avoid or reduce multi-stage surgery, length of hospitalization and cumulative surgical risk. During the last few decades definitive one stage management of penetrating colon injuries has been reported increasingly, suggesting its safe use both in civilian and war casualties [2, 9, 11–16].

A surgical approach avoiding multiple or staged procedures may be particularly advisable in situations where cultural, social and economical factors all contribute to complicate the management of patients with stomas. Furthermore later access to medical and surgical facilities for further treatment may be difficult or impossible in areas of conflict.

In our experience all patients with penetrating colonic injuries underwent one stage primary resection and anastomosis or primary repair.

Our hospital mortality (5.5%) compares favourably with other series [1, 14, 16, 18] and was not significantly related to the type of surgical procedure (resection vs repair, 5.8 vs 4.8%, $P=0.67$). The 4 deaths occurred in patients with delay in admission longer than 24 hours ($n=3/17$, $P<0.05$) and a mean age of 52.7 years compared to 23 years of the whole series ($P<0.01$), while poor or very poor general conditions at admission did not correlate with mortality ($P=0.15$).

The failure rate was respectively 3.8% ($n=2$) for resection and anastomosis and zero for primary repair, giving an overall failure rate of 2.7%. However the overall colostomy rate was 1.9%, one faecal leak having been treated conservatively.

Eleven (15%) patients had postoperative complications, mostly (10/13) infectious, intraabdominal abscesses ($n=3$, 27%) being the most severe. These occurred in patients with thoraco-abdominal injuries or multiple organ lesions requiring, in addition to a segmental colectomy, splenectomy ($n=2$), nephrectomy ($n=1$), liver resection ($n=1$) and chest drainage associated with diaphragm repair ($n=2$). In 1 of these patients at relaparotomy the anastomosis was converted to end colostomy as a precaution. Two (18%) of the 11 eventually died. However, only 1 had infection and this was not related to the anastomotic site. Thus mortality was not the result of failure of surgical treatment, but mainly due to preexisting sepsis and organ failure.

From the surgical point of view, a few factors may contribute to these results. First of all, most (72%) injuries occurred in the transverse and left colon, where stool consistency is rather firm. This might explain the rather surprising, but already reported [7] observation that faecal contamination was limited to the area surrounding the injury or to one abdominal quadrant in 80% of the patients. Secondarily, 44 (56%) of these were admitted and treated within 12 hours of injury. Recent reports [17] suggest that operative repair of penetrating colon wounds can be delayed up to 12 hours without undue morbidity related to infection. Thirdly, colonic resections in war surgery are usually limited, making the procedure easier and minimizing tension and ischaemia at the anastomosis. Finally, the patients are usually young and presumably healthy before injury.

In conclusion our experience suggests that even in a field hospital with limited facilities a definitive one stage treatment of large bowel injuries can be carried out safely and satisfactorily avoiding all the obvious disadvantages of multiple procedures.

In our opinion, the routine use of colostomy or exteriorization in these conditions seems no longer to be justified: such procedures should be reserved for lesions of the lower rectum or critically ill patients.

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