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Civilian Extraperitoneal Rectal Gunshot Wounds: Surgical Management Made Simpler

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Abstract
Background Rectal injuries are associated with significant morbidity and mortality. Controversy persists regarding routine presacral drainage, distal rectal washout (DRW), and primary repair of extraperitoneal rectal injuries. This retrospective review was performed to determine the outcome of rectal injuries in an urban trauma center with a high incidence of penetrating trauma where a non-aggressive surgical approach to these injuries is practiced.
Methods The records of all patients with a full-thickness penetrating rectal injury admitted to the Trauma Center at Groote Schuur Hospital over a 4-year period were reviewed. These were reviewed for demographics, injury mechanism and perioperative management, anatomical site of the rectal injury, associated intra-abdominal injuries and their management. Infectious complications and mortality were noted. Intraperitoneal rectal injuries were primarily repaired, with or without fecal diversion. Extraperitoneal rectal injuries were generally left untouched and a diverting colostomy was done. Presacral drainage and DRW were not routinely performed.
Results Ninety-two patients with 118 rectal injuries [intraperitoneal (7), extraperitoneal (59), combined (26)] were identified. Only two extraperitoneal rectal injuries were repaired. None had presacral drainage. Eighty-six sigmoid loop colostomies were done. Two (2.2%) fistula, one rectocutaneous, and one rectovesical, were recorded. There were nine (9.9%) infectious complications: surgical site infection (4), buttock abscess (1), buttock necrosis (1), pubic ramus osteitis (1), septic arthritis (2). No perirectal sepsis occurred.
Conclusions Extraperitoneal rectal injuries due to low-velocity trauma can be safely managed by fecal diversion alone.

Diverting colostomy, distal rectal washout (DRW), and presacral drainage (PSD) have had a major impact on the outcome of rectal injuries [1–4]. The significant reduction in mortality from rectal injuries from 90% at the turn of the twentieth century to 15% during the Vietnam conflict can be attributed to the combination of these adjuncts. The treatment protocols for civilian rectal trauma have paralleled the principles evolved from military warfare, having been transferred without any reliable evidence of benefit in the urban setting. As a result, there is no consensus on the application of these adjuncts in the management of civilian rectal injuries. The anatomic location of the rectal injury, intraperitoneal versus extraperitoneal portions, also has a major influence on management [5, 6]. This retrospective study was performed to review the outcome of rectal injuries in an urban trauma center with a high incidence of low-velocity penetrating trauma, where a less aggressive surgical approach to rectal trauma is practiced.

Patients and methods

Permission to perform the review was granted by the Research Committee of the Department of Surgery, Groote Schuur Hospital and the Faculty of Health Sciences, University of Cape Town. The records of all patients with a full-thickness penetrating rectal injury admitted to the Trauma Center at Groote Schuur Hospital over a 4-year period, from 1 January 2002 to 31 December 2005, were reviewed. Patient

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records were reviewed for demographics, injury mechanism, and perioperative management. The anatomical site of the rectal injury, associated intra-abdominal injuries and their management were retrieved from operation notes. Complications and mortality were recorded. Injury severity was categorized using an injury severity score (ISS) and penetrating abdominal trauma index (PATI). Initial assessment and management were according to Advanced Trauma and Life Support® guidelines. All patients with a missile trajectory in the vicinity of the pelvis underwent digital rectal (DRE) and proctosigmoidoscopic examination. Shocked patients and those with signs of peritonitis underwent emergent exploratory laparotomy. Intraperitoneal rectal injuries were primarily repaired, with or without fecal diversion. Extraperitoneal rectal injuries were generally left untouched and a sigmoid loop colostomy done. A highly select group of patients with a suspected isolated extraperitoneal rectal injury with either no clinical evidence of acute peritonitis, or equivocal abdominal signs, underwent a diagnostic laparoscopy. Those patients whose laparoscopic examinations were normal had a sigmoid loop colostomy fashioned in the left iliac fossa through an abdominal wall trephine without laparotomy [7, 8]. Hematuria was investigated with a single-shot intravenous pyelogram and cystogram. All extraperitoneal bladder injuries were repaired from within the bladder via a cystostomy. Presacral drainage and DRW were not routinely performed. Triple antibiotic therapy consisting of penicillin, gentamicin, and metronidazole was administered to all patients for a minimum of 24 h, or longer at the discretion of the surgeon The regimen was continued in patients with unexplored, unrepaired extraperitoneal rectal injuries until they were afebrile for a period of 24 h. Colostomy closure was planned for 3 months from discharge. Prior to closure, all patients underwent digital rectal examination to evaluate sphincter function, and a barium contrast enema was done to exclude any stricture or fistula formation.

Results

During the study period, 94 patients (88 men, 6 women) with full-thickness penetrating rectal injuries were admitted to the trauma center. There were two deaths unrelated to the rectal trauma and these patients were excluded from further analysis. The mean age was 28.9 (range: 15–50) years. Ninety-one patients sustained gunshot wounds (90 low-velocity, 1 shotgun), and a single patient had a stab wound. A transpelvic trajectory was present in 86 (93.5%) patients. Eighty-four (91.3%) patients presented with signs of peritonitis, eight with hypovolemic shock, and one in septic shock. Damage-control laparotomy was performed in three patients. Diagnostic laparoscopy was performed in eight (8.7%) patients and proceeded to laparotomy in three. The remaining five patients had a trephine sigmoid loop colostomy created in the left iliac fossa. The mean ISS was 17.2 (range: 9–43).

Digital rectal examination was performed in 90 patients, and 66 of those examinations revealed blood. Perioperative sigmoidoscopy was performed in 80 patients. Blood was seen in 71 patients, and an injury was visualized in 37 patients at a mean level of 9.6 (range: 5–17) cm. A total of 118 rectal injuries in 92 patients were treated: 7 (7.6%) intraperitoneal, 59 (64.1%) extraperitoneal, and 26 (28.3%) combined intra- and extraperitoneal injuries. Eighty-six sigmoid loop colostomies were performed. Figure 1 sum-

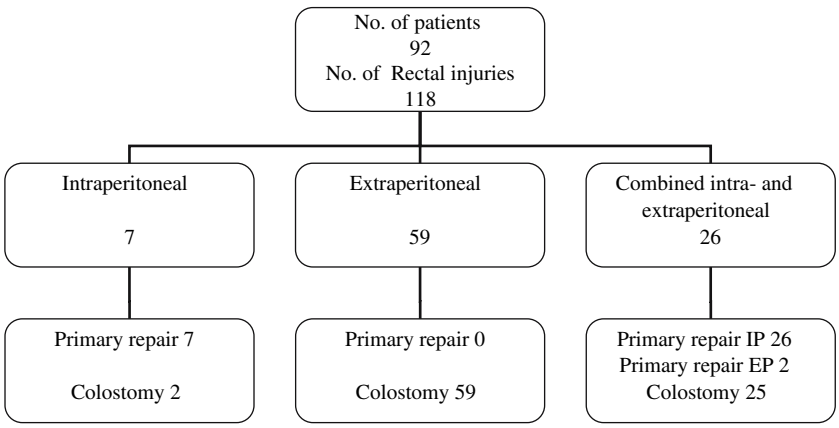

Fig. 1 Site of rectal injury and management. *IP* intraperitoneal; *EP* extraperitoneal *Colostomy* skin-level sigmoid loop colostomy

marizes the anatomical sites of rectal injuries and their management.

No patient had presacral drainage. Two patients underwent distal rectal washout, one with delayed presentation and established buttock sepsis, and another at the request of the attending orthopedic surgeon in a patient with hip joint involvement. Table 1 summarizes the patients presenting with hematuria and the investigations performed. A total of 31 (33.7%) bladder injuries [intraperitoneal, 16; extraperitoneal, 12; combined, 13] were treated. Frequently associated abdominal injuries are shown in Table 2. The mean PATI score was 23.6 (range: 12–46). Infectious and genitourinary complications are listed in Tables 3 and 4, respectively. There were two (2.2%) documented fistulae: one rectocutaneous fistula with associated sacral osteitis requiring an anterior resection, and one rectovesical fistula managed conservatively with prolonged bladder catheter drainage (18 days) and delayed colostomy closure (6 months). There were four surgical site infections. One patient with sheath dehiscence was treated with saline dressings and delayed split-skin grafting; the hernia was later repaired at time of colostomy closure. There were two (2.2%) cases of buttock sepsis, both managed with aggressive drainage and debridement. Sinograms failed to show any communication with the rectum. Two cases of osteitis (pubic ramus and sacrum) and two of septic hip arthritis were encountered. Colostomy outcome is summarized in Table 5. There were no deaths directly related to the rectal trauma.

Table 1 Patients presenting with hematuria and their investigations

Microscopic studies	16
IVP and cystogram	6 (normal studies)
No investigation	10
Macroscopic studies	28
IVP and cystogram	18
Findings	
Intraperitoneal bladder rupture	3
Extraperitoneal bladder rupture	5
Intra- and extraperitoneal rupture	1
Ureter injury	1
Normal study	8
No investigation	10
Total studies	44

Table 2 Associated intra-abdominal injuries

Organ	No. of patients (%)
Small bowel	56 (60.9)
Bladder	31 (33.7)
Intraperitoneal	6
Extraperitoneal	12
Combined intra- and extraperitoneal	13
Ureter	6
Urethra	1
Vagina	3
Uterus	1
Ovary	1
Colon	16 (17.4)
Iliac vasculature	3 (3.3)
Pelvic fractures / hip joint involvement	23 (25)
Spinal cord	4 (4.3)
Mean penetrating abdominal trauma index	23.6 (12–46)

Discussion

The majority of rectal injuries (80%) reported from urban trauma centers occur secondary to firearm injuries. This series reports firearms as being the causative agent in 98.9% of rectal injuries. The treatment of choice for the majority of civilian gunshot intraperitoneal colorectal injuries is primary repair. However, the repair of extraperitoneal rectal perforations is not always technically feasible, and there is very little evidence to support the primary repair of these injuries. The anatomic considerations and technically difficult dissection make fecal diversion without primary repair a safe procedure. Ivatury et al. [9] closed the rectal defect in only 37% of patients, with no increase in the rate of sepsis. Tuggle and Huber [10] were unable to demonstrate an advantage to repair, and Mangiante et al. [11] reported that many injuries in their series were not amenable to repair. Burch et al. [12] repaired only 21% of rectal injuries, and these only by virtue of mobilizing other structures like the vagina and bladder, which required repair. Velmahos et al. [13] reviewed 30 patients with extraperitoneal rectal wounds, and they showed that a diverting colostomy without rectal repair or drainage appeared to be safe. Similarly, Levy et al. [14] reported an experience with 26 extraperitoneal gunshot injuries, and their results did not support the need for primary repair, PSD, and DRW. Navsaria et al. in series of 10 (retrospective) [7] and 20 (prospective) [8] patients with isolated extraperitoneal rectal injuries managed by defunctioning sigmoid loop colostomy alone, without PSD, showed similar complication rates to other series. Many authors have suggested that penetrating extraperitoneal rectal injuries can be managed without fecal diversion [12, 15, 16]. Gonzalez et al. [17] recently reported on 14 patients with nondestructive (< 25% circumference) extraperitoneal rectal injuries managed without repair, fecal diversion, rectal washout and drainage, with no infectious complications. While the numbers are extremely small to

Table 3 Infectious complications

Abdomino-pelvic and related	N (%)	Treatment
Surgical site infection	4 (4.7)	Wound opened, dressings
Buttock abscess (bullet exit site)[a]	1 (1.1)	Incision and drainage
Buttock sepsis (multiple gunshot wounds)[a]	1 (1.1)	Multiple debridement
Pubic ramus osteitis	1 (1.1)	Multiple debridement
Septic arthritis—hip joint	2 (2.2)	Multiple washouts
Sacral osteitis with rectocutaneous fistula	1 (1.1)	Anterior resection
Recto-vesical fistula	1 (1.1)	Conservative, spontaneous resolution[a]
Nosocomial pneumonia	2 (2.2)	Antibiotics
Atelectasis	1 (1.1)	Bronchoscopy
Meningitis	1 (1.1)	Antibiotics
Necrotizing fasciitis thigh[b]	1 (1.1)	Debridement and skin graft

[a] Sinogram showed no communication with rectum

[b] Bullet trajectory through rectum into thigh

Table 4 Genitourinary complications

Bladder		
Persistent extraperitoneal leak	2	Conservative/prolonged suprapubic catheter drainage
Rectovesical fistula	1	Conservative/prolonged suprapubic catheter drainage
Urethral stricture	1	Dilatation
Urinary retention	1	Catheter
Ureter		
Missed at initial laparotomy	2	Repair over stent
Iatrogenic ligation	1	Reimplantation
Intrauterine death	1	Cesarean section

Table 5 Colostomy outcome (%)

No. of stomas done	86	
Type	Loop sigmoid	
No. closed	75 (86)	
Colostomy contrast enema	75 (100)	
Normal	74 (98.6)	
Rectocutaneous fistula	1 (1.1)	
Complications		
Parastomal necrotizing fasciitis	1 (1.1)	Debridement/re-site
Parastomal hernia	1 (1.1)	Redo
Prolapse colostomy	2 (2.2)	Redo
Anastomotic leak following closure, low-output fistula	1 (1.1)	Conservative

make any definitive conclusions, the results are promising and need further investigation. In our experience, the primary repair of extraperitoneal injuries is often difficult because of the confined pelvic space, the adjacent sacral venous and hypogastric nerve plexus, and the adjacent urogenital structures. This confined space is not familiar territory to the surgeon who is untrained or inexperienced with low rectal dissection. In the present series only two (2.4%) extraperitoneal rectal injuries were repaired.

Lavenson and Cohen in 1971 published their experience with DRW in the Vietnam conflict and showed that since its application, morbidity was reduced from 72% to 10% and mortality dropped from 22 % to zero [4]. Shannon et al. [18], in a retrospective study of a small group of 26 patients, reported septic pelvic complications in 6 of 13 patients (46%) without irrigation and only 1 of 13 (8%) with irrigation. Interestingly, the benefit was the greatest for high-energy trauma due to high-velocity gunshot wounds and pelvic fractures. Several reports on civilian trauma also advocate distal rectal irrigation, although the data do not support that conclusion [9, 10, 12].

Present-day experience with civilian rectal trauma from low-velocity gunshot wounds tends to show no benefit from DRW. Burch et al. [12], in a retrospective review of 128 patients, of whom 50% had DRW, showed no benefit. Similarly, Tuggle and Huber [10], in their retrospective study of 47 patients, performed DRW in only one patient and experienced no increase in sepsis. There is no conclusive evidence that irrigation of the distal rectal lumen is an essential adjunct to the management of civilian rectal injuries caused by low-velocity weapons. In the present series, this was done only twice, with no increase in adverse outcomes.

Presacral drainage (PSD) was popularized during the Second World War and became an important adjunct in the management of rectal injuries after Lavenson and Cohen [4] reported their results in 1971. The reported reduction in the pelvic abscess rate from 36% to 25% with retro-rectal drainage by Armstrong et al. [19] made presacral drainage routine in many centers. However, many series, including those by Thomas et al. [20], Mangiante et al. [11], and Bostic et al. [21], showed no benefit from presacral drainage for extraperitoneal rectal injuries. In the only randomized study that evaluated PSD in civilian rectal trauma, Gonzales et al. [22] found that PSD without DRW

Table 6 Results of the treatment of civilian penetrating extraperitoneal rectal injuries in the last 3 decades in series with more than 80% penetrating mechanism of injury

Author/year	Period (years)	N	Penetrating mechanism (%)	EPR injury (%)	EPR repair (%)	DRW (%)	PSD (%)	Morbidity (%)	
								Pelvic sepsis	Rectal fistula
Trunkey et al., 1973 [24]	10	45	44 (98)	[a]	[a,b]	[a]	45 (100)	0	0
Tuggle and Huber, 1984 [10]	9	47	46 (98)	[a]	19 (40)[d]	1(2)	45 (95)	1(2)	3(6)
Mangiante et al., 1986 [11]	15	43	43 (100)	12 (30)	[d]	40 (93)	21 (43)	4 (9)	0
Burch et al. 1989 [12]	10	100	95 (95)	100 (100)	21 (21)	46 (46)	93 (93)	4 (4)	3 (3)
Thomas et al., 1990 [20]	8.5	52	50 (96)	?37 (71)	3 (8)	26(50)	35(67)	0	0
Ivatury et al., 1991 [9]	14	51	51 (100)	?42	17 (40)	22 (43)	43 (84)	3 (5)	1 (2)
Bostic and Johnson, 1993 [21]	2.8	28	28 (100)	28 (100)	9 (32)	13 (46)	25 (89)	1 (4)	0
Levy et al., 1995 [14]	1.6	26	26 (100)	26 (100)	10 (38)	16 (62)	12 (46)	6 (24)	2 (8)
Levine et al., 1996 [25]	4	30	26 (87)	30 (100)	3 (10)	10 (67)	22 (73)	1 (3)	1 (3)
Steinig and Boyd, 1996 [26]	10	22	22 (100)	22 (100)	5 (23)[e]	12 (60)	8 (40)	0	0
Gonzales et al., 1998 [22]	3.7	48	48 (100)	48 (100)	[a]	0	23 (48)	3 (6)	1 (2)[f]
McGrath et al., 1998 [5]	5	58	58 (100)	42 (72)	4 (10)	33 (87)	30 (79)	3 (8)	0
Morken et al., 1999 [27]	10	45	38 (84)	[a]	21 (46)[g]	24 (53)	12 (26)	2 (4)	0
Velmahos et al., 2000 [13]	4	30	30 (100)	30 (100)	12 (40)	0	6 (20)	1 (3)	2 (6)
Navsaria et al., 2001 [7]	5	10	9 (90)	10 (100)	0	2 (20)	0	0	0
Navsaria et al., 2004 [8]	5	20	20 (100)	20	0	0	0	0	2(10)
Weinberg et al., 2006 [6]	5	54	54 (100)	50 (92)	11 (22)	0	38 (70)	0	0
Navsaria, present study	4	92	92 (100)	85 (92)	2 (2)	2 (2)	0	0	2 (2)

EPR extraperitoneal rectum; *DRW* distal rectal washout; *PSD* presacral drainage

[a] Not stated

[b] ''Repaired when feasible''

[c] Rectal injuries repaired in 19 patients

[d] So few ''amenable to closure''

[e] Five had debridement

[f] Related to foreign body with ''resolution of fistulous tract following missile removal''

[g] Damage repair

did not reduce infectious complications. The evidence to support PSD for civilian rectal trauma caused by low-velocity gunshot wounds is not very convincing. In the present series, no presacral drainage was performed, and there was no increase in the rates of pelvic sepsis or fistula.

Genitourinary (GU) tract injuries are among the commonest lesions associated with rectal trauma [5, 10, 19]. The bladder alone has been reported to be injured in approximately 30% of patients with rectal injuries [10, 12]. In the present series, there were 31 (33.7%) bladder injuries. Franko et al. [23], in their series of 17 patients with combined penetrating rectal and genitourinary tract injuries, showed a high complication rate including a recto-vesical/urethral fistula rate of 24%. They implicated the failure to perform PSD or DRW, rectal wound repair, prolonged suprapubic drainage, and failure to separate the rectal and GU tract wounds as the major factors in the pathogenesis of such complications. The current recommendation and practise is to close both perforations and separate the suture lines by interposing viable omentum between them. In the present series, all extraperitoneal bladder injuries were repaired from within the bladder without repair of the extraperitoneal rectal injury, omentum interposition, DRW, and PSD. There was only one (3.2%) rectovesical fistula that healed spontaneously with prolonged urethral catheter drainage.

Table 6 provides a summary of the results of the treatment of civilian penetrating extraperitoneal rectal injuries in the last 3 decades in series where more than 80% of the patients presented with penetrating mechanism of injury. Primary repair of extraperitoneal rectal injuries ranges from 2% to 46%, DRW and PSD being utilized in 0%–87% and 0%–100% of cases, respectively. Pelvic sepsis and rectal fistula rates range vary from 0%–24% and 0%–8%, respectively. Only relative conclusions can be drawn when comparing outcomes in this series with those in Table 6.

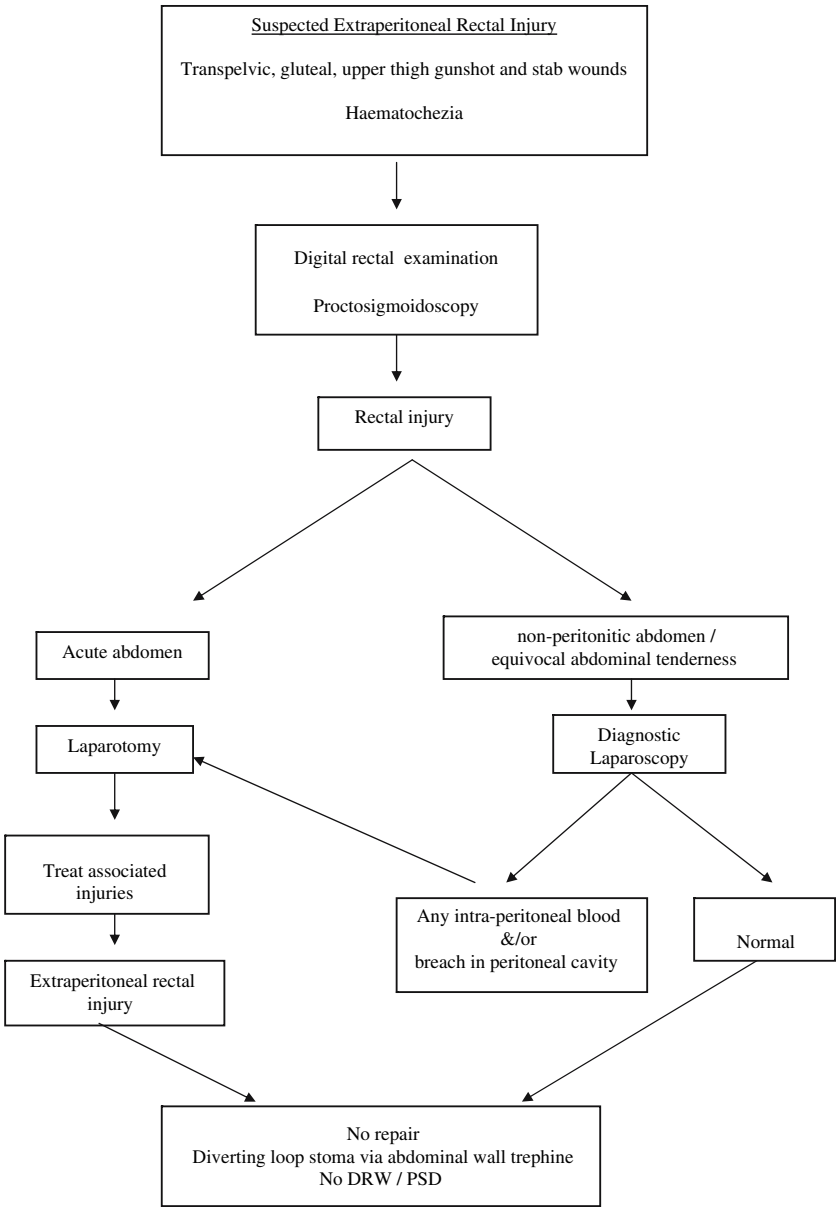

Fig. 2 Management algorithm for low-velocity penetrating extraperitoneal rectal injuries

However, as demonstrated universally, civilian low-velocity penetrating rectal injuries probably do not benefit from PSD, DRW, and primary repair.

Distal rectal washout and PSD were introduced in the management of wartime high-velocity missile rectal injuries. They undoubtedly showed a significantly reduced incidence of sepsis and fistulae, and improved survival. However, civilian rectal injuries, which occur predominantly from low-velocity trauma, appear not to benefit from DRW and PSD. There is very little evidence in the current trauma literature, and the results of this series further indicate that DRW and PSD are not essential adjuncts in the management of penetrating low-velocity rectal trauma. Evidence is also lacking regarding the primary repair of extraperitoneal rectal injuries without colostomy, and this mode of treatment remains to be investigated in the next phase of studies to determine the optimal approach to extraperitoneal rectal injuries. Figure 2 illustrates our current institutional management algorithm for low-energy trauma to the extraperitoneal rectum based on the available literature and local experience.

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