Colostomy and Drainage for Civilian Rectal Injuries: Is That All?

JON M. BURCH, M.D., DAVID V. FELICIANO, M.D., and KENNETH L. MATTOX, M.D.

One hundred consecutive patients with injuries to the extraperitoneal rectum were treated over a ten-year period at an urban trauma center. The mechanisms of injury included firearms in 82 patients, stab wounds in 3 patients, a variety of other penetrating injuries in 10 patients, and in 5 patients the injuries resulted from blunt trauma. Treatment of the rectal injury was determined by the bias of the operating surgeon, the condition of the patient, and the magnitude of the rectal injury. Proximal loop colostomies were performed in 44 patients, diverting colostomies in 51 patients, Hartmann's procedure in 4 patients, and an abdominoperineal resection in 1 patient. Extraperitoneal rectal perforations were closed in 21 patients and the rectum was irrigated free of feces in 46 patients. Transperineal, presacral drainage was used in 93 patients. Infectious complications potentially related to the management of the rectal wound occurred in 11 patients (11%) and included abdominal or pelvic abscesses (4 patients), wound infections (6p atients), rectocutaneous fistulas (3 patients), and missile tract infections (2 patients). Four patients (4%) died as a result of their injuries. Of the therapeutic options available, statistical analysis revealed that only the failure to drain the presacral space increased the likelihood of infectious complications (p=0.03); however, as it could not be determined with certainty that the use of, or failure to use, any particular therapeutic option had an effect on the risk of death. It is concluded that colostomy and drainage are the foundations of the successful treatment of civilian injuries to the extraperitoneal rectum. The use of adjuncts such as diverting colostomies, repair of the rectal wound, and irrigation of the rectum has little effect on mortality and morbidity.

Cora and Webb Mading Department of Surgery, Baylor College of Medicine, Ben Taub General Hospital, Houston, Texas

THE DRAMATIC FALL IN MORTALITY related to injuries of the rectum from Wallace's 67% in World War I to Taylor and Thompson's 5.4% in a collected series from late American theaters during World War II was attributed by the latter authors to the routine employment of colostomy and presacral drainage as well as to the availability of antibiotics and blood transfusions.[1,2] Shortly after the World War II, civilian series began to appear that also demonstrated satisfactory results with the use of colostomy and drainage.[3,4] With the advent of the Viet Nam War, and presumably more destructive weapons, the use of colostomy and drainage alone appeared to be inadequate, and additional measures, such as totally diverting colostomies, repair of the rectal injuries, and irrigation of the distal rectum were employed and credited with improving results.[5–7]

With the rise in urban violence, civilian trauma centers developed and many were quick to adopt these additional measures that appeared so successful in the treatment of wartime injuries.[8–11]. Other centers have been slow to accept the need for these adjuncts and have continued to demonstrate satisfactory results.[12–14] It is safe to say that there exists today no consensus in the treatment of injuries to the extraperitoneal rectum. The purpose of this report is to explore the vagaries of diagnosis and treatment of these morbid and potentially lethal injuries based on ten year's experience with 100 patients suffering from injuries to the extraperitoneal rectum.

Clinical Materials and Methods

From January 1979 through November 1988, 128 patients with injuries to the rectum were treated at Ben Taub General Hospital in Houston, Texas. Eighteen patients with injuries confined to the intraperitoneal rectum, defined as being proximal to a plane perpendicular to the rectum at the level of the peritoneal reflection, were excluded (Fig.1). Also excluded were six patients with documented partial thickness rectal injuries, and four patients who exsanguinated from associated vascular injuries be-

Presented at the 100th Annual Meeting of The Southern Surgical Association, Boca Raton, Florida, December 5–7, 1988.

Correspondence and reprint requests: Jon M. Burch, M.D. Department of Surgery, Baylor College of Medicine, One Baylor Plaza, Houston, Texas 77030.

fore the rectal wound could be assessed or treated. The present series, therefore, represents 100 consecutive patients who were treated for injuries of the extraperitoneal rectum. The average age of the patients was 28 years and ranged from 13 to 63 years; there were 88 male patients and 12 female patients. Prehospital treatment and emergency room resuscitation have been standardized and described in detail in other reports.[15] Patients suffering penetrating abdominal trauma involving the gastrointestinal tract received preoperative antibiotics that were continued for at least 48 hours after surgery according to randomized protocols.[16] All other patients received perioperative antibiotics, usually second or third generation cephalosporins. Shock (systolic BP<80 mmHg) was present at the time of admission in 18% of patients. In 16 of these patients, shock was due to hemorrhage, but the remaining two patients suffered from septic shock due to a delay in treatment. Statistical calculations were performed with Pearson's chi square test or Fisher's exact test, where appropriate. Significance was assumed to be $p \leq 0.05$.

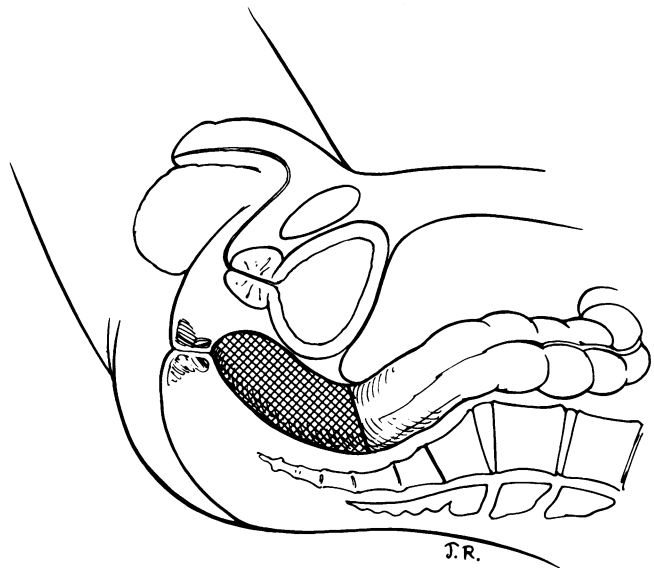

FIG. 1. All patients had injuries to the rectum represented by the shaded areas (extraperitoneal rectum). Also, see text for further explanation.

Mechanisms of Injury

The mechanisms of injury are listed in Table 1. Wounds caused by firearms were the most common and accounted for 82% of the injuries. The majority of gunshot and shotgun wounds caused modest rectal injuries; however, two devastating injuries occurred in this group. The first was in a patient who was shot at mid-range with a 12-gauge shotgun that struck the patient directly in the anus. The second patient was shot at point-blank range with an M-1 rifle with the entrance wound just above the pubic ramus. The bullet caused severe injury to the bladder and rectum and produced an enormous exit wound through the left hip and buttock. Of the three patients injured by erotic misadventures, one was "experimenting" with a broomstick when he slipped, causing the shaft to lacerate the rectum and continue superiorly, penetrating the liver and puncturing the right hemidiaphragm.

Blunt trauma was responsible for only 5% of the injuries. Two patients fell down empty elevator shafts and had extensive perineal lacerations. These were caused by hyperabduction of the legs that tore the entire anal sphincter mechanism and extended several centimeters above the sphincters into the extraperitoneal rectum. The patient injured in a blunt aggravated assault was the victim of a violent crime who had her entire mid- and hindgut avulsed through a vaginal tear. The rectum was transected just above the anal sphincters.

Diagnosis

The diagnosis of a rectal injury was not always easy. Rectal exam was performed in 99 patients and fresh blood was noted in 79 (80%). The patient who did not undergo rectal exam was in profound hemorrhagic shock on arrival and was taken immediately to the operating room.

Proctoscopy was performed in 67 patients either in the emergency center or operating room, depending on the patient's condition or ability to cooperate. Blood was seen on proctoscopy in 45 of 51 (88%) patients who had blood present on rectal exam and 6 of 16 (38%) patients when no blood was present on rectal examination. Blood was noted on rectal exam or proctoscopy in 85% of all patients in this series. Perforations were identified in 43 of 67 (65%) patients, and 5 of these 43 patients did not have blood noted on either proctoscopy or rectal exam.

Visualization or palpation of a rectal defect is the only definitive means of diagnosing a rectal injury short of radiologic procedures. In 74 patients perforations were clearly visualized or palpated and the method of diagnosis was carefully documented. In 17 additional patients the surgeon stated that a perforation existed but the method of documentation was not clear. In nine patients the op-

TABLE 1. *Mechanism of Injury*

Penetrating		Blunt	
Gunshot wounds	66	Falls with perineal laceration	2
Shotgun wounds	15	Aggravated sexual assult	1
High power rifle (M-1)	1	Football injury	1
Aggravated sexual assult	3	Pelvic fracture secondary to car accident	1
Erotic misadventure	3		
Falls with impalement	3		
Self administered enema	1		
Iatrogenic (Foley catheter)	1		
Total	95		5

TABLE 2. *Associated Injuries*

Injury	Number of Patients	Injury	Number of Patients
None	32	Femoral vein, uterus,	
Bladder	29	Inferior vena cava,	
Small Bowel	26	kidney, prostate,	
Colon	21	stomach, spleen, major	
Pelvic fracture	14	peripheral nerve	2 each
Iliac artery	12		
Ureter	12		
Iliac vein	11	femoral artery, lung,	
Extremity	8	pancreas, liver, eye,	
Anus	5	scrotum	1 each
Vagina	4		
Urethra	3		
Diaphragm	3		

erating surgeon stated that, although a rectal defect could not be identified, the presence of blood and/or the trajectory of a missile constituted sufficient evidence to treat the patient for a rectal injury.

In two patients, the injury was missed in spite of rectal exam and proctoscopy. These patients were correctly diagnosed one day and seven days later and both had evidence of active infection (peritonitis in one and an ischiorectal abscess in the other, respectively) at the time of surgery.

Treatment

The control of active hemorrhage had the highest priority at laparotomy. When this was accomplished, other associated injuries were addressed (Table 2.) The bladder was the most frequently associated site of injury, occurring in 29% of patients. Iliac vascular injuries were not infrequent with arteries injured in 12 patients and veins in 11.

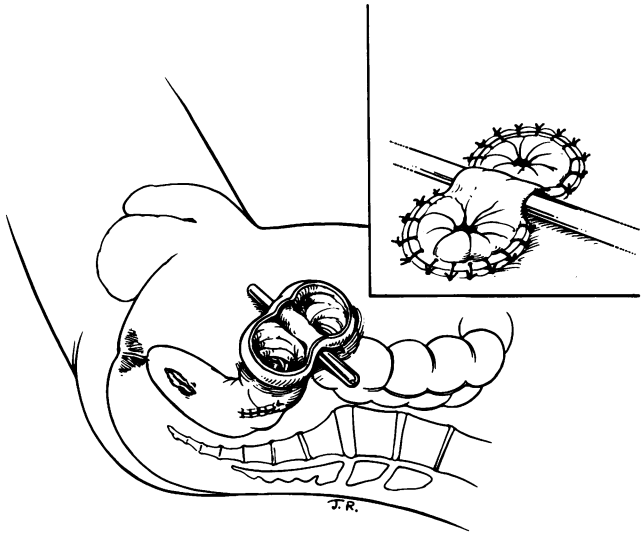

FIG. 2. Loop colostomy. Note generous spur elevated above skin level.

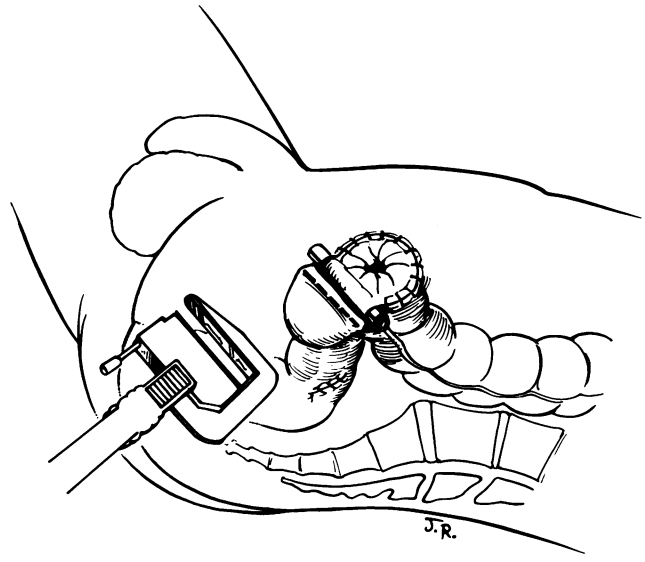

FIG. 3. Loop colostomy with closure of distal limb using a stapler. The distal limb can also be closed with a suture.

These vascular lesions presented a major technical challenge and were responsible, in part, for two deaths. The ureters were injured in 12 patients, and pelvic fractures, most caused by gunshot wounds, were noted in 14 patients. For most patients with multiple injuries, the rectum was treated last because hemorrhage or continuing contamination from the rectum were rarely, if ever, a significant problem.

The decision to employ the various therapeutic options was based primarily on the bias of the surgeon, the condition of the patient, and the location and extent of the rectal injury. Rectal wounds confined to the extraperitoneal rectum were present in 75% of patients. In the majority of these patients, no attempt was made to mobilize the rectum to identify and repair the injury. Only 21 patients had the extraperitoneal rectal injury repaired. Most repairs were performed when a rectal wound was encountered during exposure of other structures, *e.g.*, the bladder, internal iliac vessels, or vagina. Repairs were accomplished with both single- and double-layered closures using a variety of suture materials. Wounds involved both the intra- and extraperitoneal rectum in 25% of patients, and all intraperitoneal wounds were either repaired or resected.

Diversion of the fecal stream was accomplished by one of five methods: loop colostomy in 44 patients, loop colostomy with closure of the distal limb in 49 patients, end colostomy and mucous fistula in 2 patients, Hartmann's procedure in 4 patients, and abdominoperineal resection in 1 patient (Figs. 2, 3, 4, 5, and 6). Colostomies were performed in the sigmoid colon if technically feasible. Loop colostomies were usually supported above the skin with one-half inch nylon rods. Closure of the distal limb

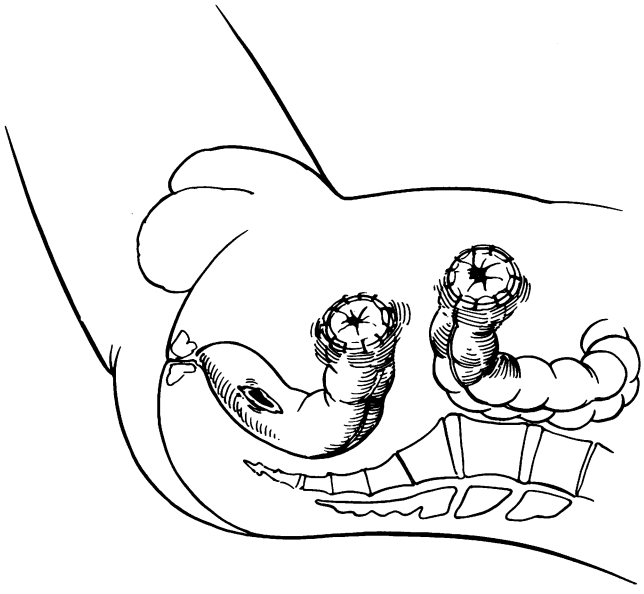

FIG. 4. End colostomy with mucous fistula. Usefulness in trauma is questionable due to complexity.

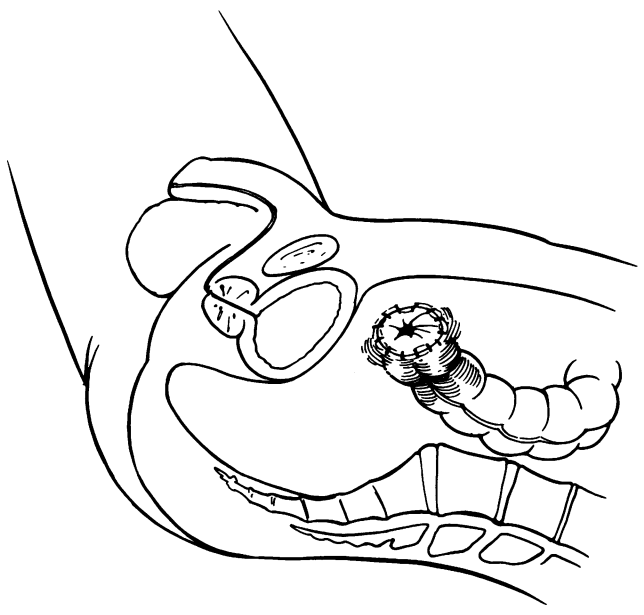

FIG. 6. Abdominoperineal resection. Indicated when anal sphincters have been destroyed.

of the loop colostomy was performed with either a suture or a stapler. The choice of loop, loop with distal closure, or divided colostomy was arbitrary. A Hartmann's procedure was selected when the patient had a severe injury to the distal sigmoid colon or an extensive rectal injury. Resection was performed at the level of the colonic or rectal injury.

The patient treated by abdominoperineal resection deserves a separate comment. This patient, mentioned above, was shot with a 12-gauge shotgun at mid-range with the entrance wound centered on the anus. The pellets destroyed the anus and extraperitoneal rectum, and these structures were removed as a matter of debridement of devitalized tissue.

Irrigation of the distal rectum was carried out in 46% of patients. Sterile normal saline was used for most patients although in a few, povidone iodine solution was added. The most efficient method for irrigation was as follows: with the abdomen closed and the patient in the dorsal lithotomy position, a 3-L bag of saline was suspended 2 to 3 feet above the patient and the irrigation tube was inserted into the distal colostomy limb (Fig.7).

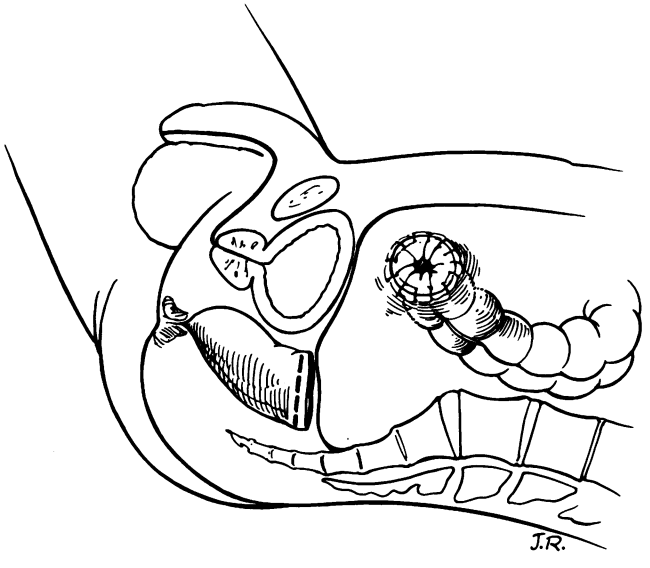

FIG. 5. Hartmann's procedure. Most often used for large injuries with loss of rectal wall. Resection is performed at level of injury.

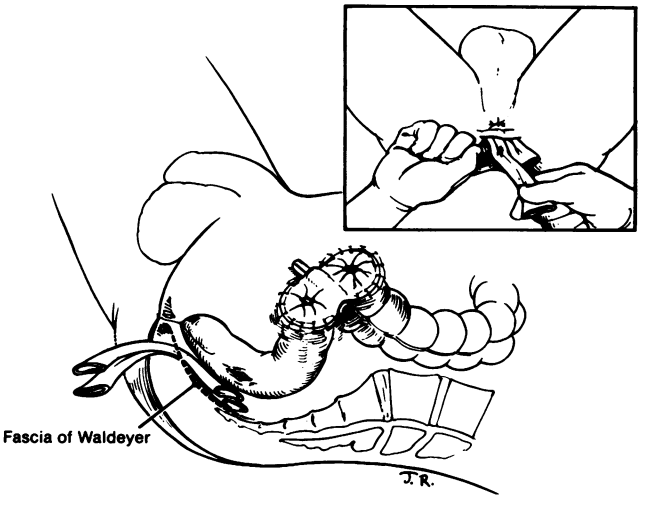

FIG. 7. Correct placement of presacral drain *via* transperineal route.

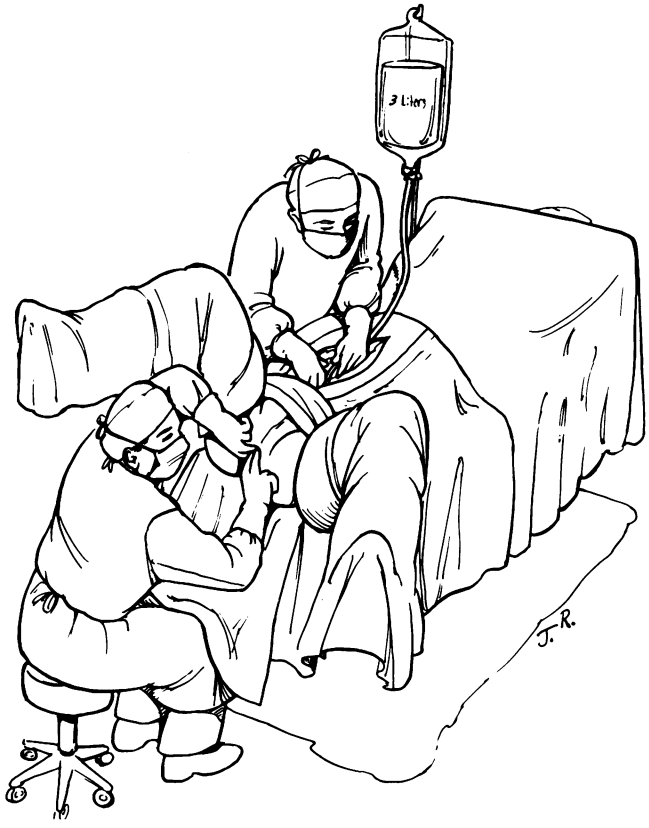

FIG. 8. Setup for rectal irrigation. The anus should be held open while the irrigant is running.

With the operating surgeon seated between the patient's legs, a gentle anal dilation was performed and the saline was permitted to run in as rapidly as possible while the surgeon maintained the anus open. Failure to keep the anus open during irrigation caused the effluent to reflux back through the colostomy stoma and contaminate the abdominal wall; furthermore, the pressure generated with irrigation theoretically may have driven feces and contaminated irrigant through unsutured wounds into the extrarectal tissues. It was remarkable that 6 L or even 9 L of irrigant were sometimes required to remove all fecal material. At the completion of irrigation the distal limb of the colostomy was closed if the surgeon so elected.

TABLE 3. *Combinations of Therapeutic Options in 99 Patients**

Style of Colostomy	Repair of Injury	Irrigation of Rectum	Number of Patients
Loop	Yes	Yes	3
Loop	Yes	No	7
Loop	No	Yes	12
Loop	No	No	22†
Diverting	Yes	Yes	6
Diverting	Yes	No	5
Diverting	No	Yes	25
Diverting	No	No	19‡
Total			99

* The patient not included was treated with abdominoperineal resection.

† Six patients had no presacral drain.

‡ One patient had no presacral drain.

Drainage of the presacral space was performed in 93 patients and was the final step of the operation. A curvilinear incision 3 cm to 5 cm in length was made between the coccyx and the posterior margin of the anal sphincters and was extended through the tough endopelvic fascia (Waldeyer's fascia; Fig.8). Using a finger or blunt-nosed clamp, the presacral space was entered and the dissection was directed toward the region of the rectal injury. A 1-inch Penrose drain was then inserted to the level of the injury and was sutured to the perianal skin. The drains were removed (or fell out) between the fifth and tenth postoperative day. Drainage was usually minimal and was easily absorbed by an ABD pad secured with a "T" binder.

The seven patients who did not have presacral drainage are of interest. In five of these patients, the surgeon was not certain of the presence of a rectal injury and two of these five were in critical condition from massive blood loss at the end of the operation. Of the remaining two patients, one presented with peritonitis and a false rectal lumen extending into the intraperitoneal rectum. The surgeon was not certain that the injury involved the extraperitoneal rectum. The seventh patient had an associated bladder injury that was drained through a suprapubic incision. The operating surgeon accepted this latter route of drainage for the rectal injury as adequate.

There are many possible combinations of colostomies, drainage, repair, and irrigation that can be used to treat rectal injuries. If one considers the four styles of loop or diverting colostomies and all combinations of repair, drainage, and irrigation, then 32 modes of treatment exist; 13 were used in the this series.

Conceptually, however, colostomies are either loops or diverting, and because most authorities agree on the need for presacral drainage, the choice becomes moot. Using this simplified format, the frequency of the eight possible combinations employed in this series is presented in Table 3. Curiously, the two combinations most often used represent the simplest and one of the more complex procedures: loop colostomy without repair or irrigation (22 patients) and diverting colostomy without repair but with irrigation (25 patients).

Results

A tabulation of all postoperative complications is listed in Table 4. Infectious complications potentially related to the rectal injury or its management included abdominal or pelvic abscesses (4 patients), rectocutaneous fistulas (3 patients), wound infections (6 patients), and missile tract

infections (2 patients). These 15 complications occurred in 11 patients (11%), none of whom died. Table 5 lists both risk factors and management for these patients.

Four patients (4%) died as a result of their injuries. Potential risk factors and treatment of these patients are listed in Table 6. It is notable that all patients who died were in shock before operation; this condition persisted during the operation. This circumstance was noted to be associated with a 58% mortality rate for previously reported patients with colon injuries treated at this institution.[15]

All patients in the present series died of multisystem organ failure. Patient 1, mentioned above, was transvaginally disemboweled, and had no remaining small bowel or colon and only a short rectal stump. The ureters were also avulsed from the bladder and the spleen was torn. She was in profound shock on admission and relentlessly deteriorated; she died on the seventh postoperative day from respiratory and renal failure complicated by disseminated intravascular coagulopathy. Patient 2 suffered a gunshot wound to the abdomen and lost seven liters of blood from mesenteric and bladder hemorrhage. He developed pneumonia and adult respiratory distress syndrome (ARDS) followed by acute renal failure; he died on the third postoperative day. Patient 3 suffered a gunshot wound with injuries to the external iliac artery and vein, small bowel, and bladder. She lost 12.5 liters of blood during the initial operation. After the operation, a popliteal artery embolus occurred, and after several unsuccessful attempts at revascularization, an above-the-knee amputation was necessary. She developed small bowel fistula, followed by pneumonia and ARDS and she died on the 26th postoperative day. Patient 4 suffered shotgun wounds to the lower abdomen and hip, with injuries to the femur, small bowel, and colon. He was injured at least 24 hours prior to admission and septic shock was present due to feculent peritonitis. Sepsis and ARDS persisted from the time of surgery and he died 12 days after operation. With the exception of the last patient who had diffuse peritonitis at the time of surgery, none of the patients who died had evidence of infection related to the rectal injury prior to death.

TABLE 4. *Postoperative Complications in 100 Patients*

Complications	Number of Patients
Atelectasis	10
Wound infection	6
Acute renal failure	6
Ileus	5
Acute Respiratory Distress Syndrome	4
Urinary tract infection	4
Intraabdominal or pelvic abscess	4
Rectocutaneous fistula	3
Intra-abdominal hemorrhage	3
Gastric mucosal hemorrhage	2
Peristomal evisceration	2
Bladder fistula	2
Missle tract infection	2
Small bowel fistula	2
Wound dihiscense	1
Phlebitis	1
Stomal necrosis	1
Popliteal artery embolus	1
Acalculus cholecystitis	1
Deep venous thrombosis	1
Osteomyelitis	1

Long-term follow-up was difficult to obtain. At the present time only 43 patients (45%) who were candidates for colostomy closure have had the procedure performed at this institution. In these patients, one postoperative complication occurred: bleeding from the colon suture line. This patient was reoperated on, the bleeding was controlled, and recovery was uneventful.

The patient treated with abdominoperineal resection was hospitalized for 3 months. One year later he was rehospitalized with septic shock due to a urinary tract in-

TABLE 5. *Risk Factors and Treatment for 11 Patients Who Developed Infectious Complications*

Preoperative Shock	Major Vascular Injury	Small Bowel Injury	Colostomy	Repair	Irrigation	Drain	Complications
Yes	Yes	Yes	Diverting	No	Yes	Yes	WI*
No	No	No	Loop	No	No	No	ABS† Fist‡
No	No	Yes	Loop	Yes	Yes	Yes	ABS Fist
Yes	Yes	No	Diverting	No	No	Yes	MTI§
No	Yes	Yes	Loop	No	No	No	WI
No	No	No	Diverting	Yes	Yes	Yes	ABS WI Fist
No	No	No	Loop	No	No	Yes	MTI
Yes	Yes	Yes	Diverting	No	Yes	Yes	WI
Yes	Yes	Yes	Loop	No	No	Yes	WI
No	No	No	Diverting	No	No	Yes	WI
No	Yes	Yes	Loop	No	No	No	ABS

* WI = wound infection.
† ABS = abscess.
‡ FIST = rectocutaneous fistula.
§ MTI = missile tract infection.

TABLE 6. *Risk Factors and Treatment of Patients Who Died*

Preoperative Shock	Intraoperative Shock	TIFITO* (hours)	Major Vascular Injury	Estimated Blood Loss	Colostomy	Repair	Irrigation	Drain
Yes	Yes	12.0	Yes	4.5	Diverting	No	No	Yes
Yes	Yes	6.8	No	7.0	Loop	Yes	No	Yes
Yes	Yes	1.0	Yes	12.5	Loop	No	No	No
Yes	Yes	24.0	No	.5	Loop	No	No	Yes

* TFITO, time from injury to operation.

fection and he died from fulminant sepsis. Another patient who survived a devastating injury can justly be described as a treatment failure. This patient was shot with an M-1 rifle and had a large rent in the bladder, which was detached from the prostatic urethra. In addition, he had an extensive rectal injury with partial loss of the rectal wall. He was treated with a diverting colostomy, repair of the rectal injury, presacral drainage, and irrigation of the distal rectum. The bladder was repaired and reattached to the urethra. Omentum was then interposed between the bladder and rectal repairs. Within 72 hours, the colostomy became cyanotic, and at reoperation, the distal limb of the colostomy and the bladder were both necrotic; a pelvic abscess was also present. A total cystectomy with cutaneous ureterostomies and Hartmann procedure were performed. A wound dehiscence later occurred due to a necrotizing wound infection but the patient refused reoperation. He was transferred to another hospital and developed multiple small bowel fistulas as well as a rectocutaneous fistula and pelvic osteomyelitis. Local wound care healed the rectal fistula and osteomyelitis but the small bowel fistulas persisted for many months because of the patient's adamant refusal to undergo reoperation. In retrospect, a Hartmann's procedure at the level of the rectal injury and total cystectomy at the initial operation may have prevented many of these complications.

Rectal fistulas occurred in two other patients. The first was a victim of anal rape who had a long false rectal lumen noted at surgery. The assault occurred three days prior to admission and feculent peritonitis was present at operation. A loop colostomy was performed but the presacral space was not drained. He developed an ischiorectal abscess which, following drainage, became a rectal fistula. The fistula healed after 1 month and, 5 months later, his colostomy was closed uneventfully. The third patient with a rectocutaneous fistula suffered a large-caliber gunshot wound that injured both the intra- and extraperitoneal rectum. A loop colostomy was performed and the perforations were repaired. The rectum was irrigated and the presacral space was drained. A pelvic abscess and rectal fistula developed. The fistula communicated with the intraperitoneal rectal injury and closed 4 months later.

One patient developed a paracolostomy hernia that was treated successfully. The two patients with extensive perineal lacerations and anal sphincter injuries had satisfactory sphincter control following colostomy closure.

Statistical Analysis of Results

A credible analysis using statistical methods is difficult in a retrospective series in which so many risk factors and therapeutic options exist. Nevertheless, some insights may be gained regarding the impact of these risks and treatments, although the results must be interpreted with caution. All analyses were univariate, that is, the effect of one variable was tested in all patients. This method improved sampling but did not consider the impact of other variables. Multivariate analysis would have considered all variables simultaneously but would have reduced the number of patients to levels too small to be believable. The patient who required abdominoperineal resection was not included in this analysis because the usual treatment options did not exist. Finally, the number of individual infectious complications was so small that to attempt analysis of them individually would have been meaningless. Therefore, they were grouped together and regarded as "infectious complications." Surgeons not concerned about statistical calculations would have found this dilemma a pleasant surprise.

Table 7 lists the variables tested, number of patients in each category, percentage of infectious complications and deaths, and statistical results. On the basis of this evaluation, it could not be determined with certainty that any therapeutic option, other than not draining the presacral space, correlated with outcome. Risk factors that correlated with the development of infectious complications were intriguing: (1) patients in whom the surgeon was not certain that a rectal injury existed;(2) the presence of a major vascular injury; and (3) the presence of a small bowel injury. Factors that correlated with death were, in general, those that reflected the degree of shock and hemorrhage.

To evaluate the circumstances where various therapeutic options were used, a tabulation of clinically relevant risk factors *versus* the frequency of application of each

TABLE 7. *Univariate Analysis of Results in 99 Patients**

Variable		Infectious Complications			Mortality		
		Number of Patients	Percent	p-value	Number of Patients	Deaths %	p-value
Injury	No	78	12%	NS†	3	4%	NS
Repaired	Yes	21	10%		1	5%	
Diverting colostomy		55	9%	NS	1	2%	NS
Loop colostomy		44	14%		3	7%	
	No	53	13%	NS	4	8%	NS
Irrigation	Yes	46	9%		0	0%	
	No	7	43%	.03	1	14%	NS
Drain	Yes	92	9%		3	3%	
Time from injury	<3.2 hrs.	51	14%	NS	1	2%	NS
Operation (hours)	>3.2 hrs.	48	8%		3	6%	
Preoperative	No	82	9%	NS	0	0%	<.01
Shock	Yes	17	24%		4	24%	
Intraoperative	No	88	11%	NS	0	0%	<.01
Shock	Yes	11	9%		4	36%	
Estimated	<350cc	50	10%	NS	0	0%	.04
Blood Loss	>351cc	49	12%		4	8%	
Injury	No	90	9%	.03	3	3%	NS
Suspected Only	Yes	9	33%		1	11%	
Extensive	No	78	9%	NS	2	3%	NS
Damage	Yes	21	19%		2	10%	
Firearm	No	18	11%	NS	1	6%	NS
Injury	Yes	81	11%		3	4%	
Major Vascular	No	86	8%	.02	2	2%	NS
Injury	Yes	13	31%		2	15%	
Fecal	No	67	10%	NS	1	1%	NS
Contamination	Yes	32	12%		3	9%	
Small Bowel	No	74	7%	.02	0	0%	<.01
Injury	Yes	25	24%		4	16%	

* Patient treated with abdominoperineal resection not included. † Not Significant.

adjunct was performed (Table 8). The options of diverting or loop colostomy and repairing or not repairing the rectal injury seem to have been used in quite similar clinical settings. On the other hand, patients who did not have a presacral drain or who did not have the rectum irrigated more often suffered from shock and hemorrhage and had major vascular injuries. It was not surprising that the time-consuming tasks of irrigation and presacral drainage were not used as often in critically ill patients.

Discussion

Lessons learned in the treatment of wartime casualties often become deeply embedded in the minds of civilian

TABLE 8. *A Comparison of Risk Factors for Each Therapeutic Option in 99 Patients**

Procedure	Preoperative Shock (%)	Intraoperative Shock (%)	Preoperative and Intraoperative Shock (%)	Associated Vascular Injury (%)	Small Bowel Injury (%)	Extensive Rectal Damage (%)
Loop colostomy (N = 44)	14	14	11	14	27	18
Diverting colostomy (N = 55)	20	11	7	7	25	24
Drain (N = 92)	16	10	8	8	23	21
No drain (N = 7)	29	29	29	43	71	29
Irrigation (N = 46)	9	7	2	2	20	26
No irrigation (N = 53)	25	15	15	17	32	17
Repair (N = 21)	14	10	10	10	33	52
No Repair (N = 78)	18	12	9	10	24	13

* Patient treated with abdominoperineal resection not included.

surgeons in spite of a vast and ever-increasing experience with civilian trauma. Lavenson and Cohen's report from Viet Nam stressed the importance of diverting colostomies, debridement and repair of rectal perforations, and, especially, irrigation of the distal rectum.[7] They observed that when the rectum was irrigated, morbidity fell from 72% to 10% in a series of 28 cases. Although this experience was small, the results were so impressive that they have been hard to disregard. As noted by Lung et al. in a similar series of rectal injuries from Viet Nam, the majority of wounds were caused by the notorious AK-47 rifle that fires a small caliber, very high velocity missile, as well as by fragments from exploding shells.[5] Typically, in civilian series like the present one, the majority of injuries are caused by handguns that fire slow-moving, although sometimes large, missiles. The profound differences in the wounding potential of these weapons cannot be overemphasized and makes comparisons between these different patient populations difficult at best. It is equally difficult to compare the above injuries to those caused by extensive pelvic fractures from blunt trauma in which large bony spicules are found in the lumen of the bowel and are still attached to the bony pelvis at the time of surgery.[8,9,17] Further complicating comparisons are the myriad of other mechanisms of injury ranging from enema perforations or those caused by urologic manipulations to accidents of anal eroticism.[18-20] Although carefully conducted, prospective, randomized studies on patients with similar injuries may answer some questions regarding the merits of the various adjuncts in limited circumstances, the rarity of these lesions and the multiplicity of combinations of therapeutic options would make such studies almost impossible. What, then, should the surgeon who is obliged to treat these patients do? To answer this question each adjunct will be addressed individually.

The potential for a loop colostomy to completely divert the fecal stream has long been debated. Devine believed that it was essential to separate the proximal and distal stomas with a skin bridge to achieve this result.[21] Others have argued that a properly constructed loop colostomy could function as a diverting colostomy. Wangensteen used two glass rods beneath the loop of colon, pulling the proximal and distal limbs slightly apart and fixing the colostomy above the skin level to achieve complete diversion.[22] Recently, Rombeau et al. in a prospective study using barium meals, were able to demonstrate complete fecal diversion with loop colostomies.[23] The technique they used was described by Turnbull and consisted of a loop supported with a solid rod above the level of the skin, a longitudinal incision in the colon, and immediate maturation of the colostomy. The rod was removed after seven days. The success of this technique was attributed to a generous spur elevated above the skin and immediate mucocutaneous suturing. The attractiveness of loop colostomies in trauma surgery is their rapid and simple construction in addition to their ease of closure. Loop colostomies have been used successfully at other civilian trauma centers in the treatment of rectal injuries.[14,24]

Many authors continue to advocate techniques that unequivocally result in complete diversion.[9-11,25] This goal can be accomplished with colostomy and mucous fistula, Hartmann's procedure, or closure of the descending limb of a loop colostomy. The choice of diverting colostomy should be determined by the operative findings. Extensive rectal injuries with loss of rectal wall are best treated by resection at the level of injury and Hartmann's procedure. Subsequent closure may be more difficult, but is preferable to potential pelvic complications related to a necessary, but tenuous, rectal repair. If a completely diverting technique is selected for a routine rectal injury, loop colostomy with a distal closure is the best choice. With the development of suture and staple techniques to achieve complete diversion, the choice of the more complex end colostomy and mucous fistula seems difficult to justify.[26,27]

Repair of extraperitoneal perforations was recommended enthusiatically by the Viet Nam-era military surgeons, although it was not recommended by their predecessors during the second World War.[2,5-7,28,29] Opinion remains divided among contemporary civilian centers, although most recommended repair when possible.[9-12,17,25] In contrast, Tuggle and Huber were not able to demonstrate any advantage to repair, and Mangiante et al. stated that many of the injuries in their series were not amenable to repair.[14,24] On the basis of these observations and the present series in which repair was performed in only 21% of cases, it would appear to be prudent to repair injuries that are encountered during exposure of associated injuries to make a modest effort to identify and repair injuries easily accessible (near the peritoneal reflection), and to repair large lacerations not associated with significant loss of the rectal wall. Clearly all injuries that communicate with the peritoneal cavity should be closed. Repair of large wounds with loss of the rectal wall should not be attempted; rather, a resection should be performed at that level. Finally, if the anal sphincters are destroyed, an abdominoperineal resection is indicated regardless of the nature of the rectal injury.

The one adjunct about which there is almost unanimous agreement is the need for drainage of the presacral space. Armstrong demonstrated a reduction of greater than 50% in the incidence of pelvic infections with the use of transperineal drainage.[30] Coccygectomy to improve drainage has been recommended but is not often practiced

TABLE 9. *Mortality and Morbidity from Collected Series of Civilian Rectal Injuries Published During this Decade*

Author	Date	Number of Patients	Mortality (%)	Pelvic or Abdominal Abscess (%)	Rectal Fistula (%)
Vitale et al.	1982	32	6	6	0
Grasberger and Hirsch	1983	20	10	25	5
Tuggle and Hubber	1984	47	0	2	6
Mangiante et al.	1985	43	0	9	0
Shannon et al.	1987	26	4	27	15
Present series	1988	100	4	4	3

today.[5,6] In addition to the transperineal route, the drain should be placed in juxtaposition to the site of the injury.

Rectal irrigation remains controversial. In the present series it was performed in about 50% of cases with no evidence of benefit or harm. Patients whose rectums were not irrigated were more often in shock and had more frequent vascular injuries—the very group that might benefit most from irrigation. Huber and Tuggle also questioned its necessity.[14] In a series of 47 patients with rectal trauma, only a single patient was irrigated. There were no deaths, five wound infections, and only one abdominal abscess reported. These results, from a major civilian trauma center, are in striking contrast to those reported by Lavenson and Cohen during the Viet Nam War. Shannon et al. also reported a reduction in pelvic abscess, rectal fistula, and sepsis in patients who were irrigated compared to those who were not.[25] The explanation for the remarkable differences between the present series along with Huber & Tuggle's as compared to those of Shannon et al. and of Lavenson and Cohen is not apparent, but it may be related to differences in patient populations or coincidence. Armstrong made the interesting observation that soldiers in field may not have had a bowel movement for several days, leaving the rectum full of feces at the time of wounding. This situation was rarely encountered in the present series. Nevertheless, the weight of contemporary civilian opinion favors irrigation.[9-11,17,24,25,27]

The attractiveness of irrigation is both intuitive and theoretical. One would assume that mechanically removing gross feces would decrease the likelihood of continuing contamination of the presacral space. Shannon et al. hypothesized that irrigation may also reduce septic complications by diminishing the possibility of bacterial translocation from the gut.[25] In a discussion of the paper by Shannon et al., Trunkey raised the question about the fate of intraluminal feces when irrigation was performed in patients in whom perforations were not repaired.[25] Vitale et al. addressed this issue previously by stating that anal dilation should be performed and maintained during irrigation to prevent this problem. The authors of the present series agree with this recommendation.

One recent series deserves special mention. Haas and Fox treated three patients with gunshot wounds of the extraperitoneal rectum without operation and without complication.[31] Certainly some of these injuries will heal satisfactorily without surgery; however, selecting the appropriate patients must be difficult and the consequences of failure may be severe. This approach is not recommended.

For reasons stated above, the necessity of various adjuncts may never be proven unequivocally, or at least not for many years. Surgeons should not despair, however, because one of the reasons why proof is elusive is the low rates of morbidity and mortality currently being reported (Table 9). Based on the present series, the following recommendations can be made for the diagnosis and treatment of extraperitoneal rectal injuries:

(1) Rectal exam and proctoscopy are complementary and should be performed in stable patients; however, neither technique is infallible, even when both are used.

(2) If the surgeon suspects that an injury exists, even though a perforation or intraluminal blood cannot be identified, it is wise to treat the patient as if an injury was identified.

(3) Colostomy and presacral drainage remain the foundation of the successful treatment of civilian rectal injuries.

(4) Properly constructed loop colostomies can function satisfactorily provided that the spur is maintained above the level of the skin.

(5) Presacral drains should be placed by the transperineal route and should not be omitted in cases in which only the suspicion of an injury exists.

(6) The repair of rectal injuries is not necessary unless they are uncovered during the exposure of other structures, but it is essential to repair all injuries that may communicate with the peritoneal cavity. Large injuries associated with substantial loss of the rectal wall are best treated by resection at the level of the injury and Hartmann's procedure.

(7) Irrigation of the rectum is not mandatory for the successful treatment of civilian rectal injuries but may be performed at the discretion of the surgeon provided that the patient is in stable condition at the end of the operation.

Acknowledgments

The authors wish to thank Kenneth Hess, M.S., of the Sakowitz Computer Lab, for statistical analyses, and Marian Torres for her technical and clerical assistance.

References

1. Wallace C. Gunshot wounds of the abdomen. Br J Surg 1917; 4: 679–743.
2. Taylor ER, Thompson JE. The early treatment, and results thereof, of injuries of the colon and rectum. Internat Abstr Surg 1948; 87:209–228.
3. Woodhall JP, Ochsner A. The management of perforating injuries of the colon and rectum in civilian practice. Recent Advances in Surgery 1949; 20:305–321.
4. Wanebo HJ, Hunt TK, Mathewson C, Jr. Rectal Injuries. J Trauma 1969; 9:712–722.
5. Lung JA, Turk RP, Miller RE, et al. Wounds of the Rectum. Ann Surg 1970; 172:985–990.
6. Ganchrow MI, Lavenson GS, McNamara JJ. Surgical Management of Traumatic injuries of the colon and rectum. Arch Surg 1970; 100:515–520.
7. Lavenson GS, Cohen A. Management of rectal injuries. Am J Surg 1971; 122:226–231.
8. McKenzie AD, Bell GA. Nonpenetrating injuries of the rectum and colon. Surg Clin N Am 1972; 52:735–746.
9. Howell HS, Bartizal JF, Freeark RJ. Blunt trauma involving the colon and rectum. J Trauma 1976; 16:624–632.
10. Vitale GC, Richardson JD, Flint LM. Successful management of injuries to the extraperitoneal rectum. Am Surg 1983; 49:159–162.
11. Grasberger RC, Hirsch EF. Rectal Trauma: a retrospective analysis and guidelines for therapy. Am J Surg 1983; 145:795–799.
12. Trunkey D, Hays RJ, Shires GT. Management of rectal trauma. J Trauma 1973; 13:411–415.
13. Bartizal JF, Boyd DR, Folk FA, et al. A critical review of management of 392 colonic and rectal injuries. Dis Col Rect 1974; 17:313–318.
14. Tuggle D, Huber PJ. Management of rectal trauma. Am J Surg 1984; 148:806–808.
15. Burch JM, Brock JC, Gevirtzman L, et al. The injured colon. Ann Surg 1986; 203:701–711.
16. Feliciano DV, Gentry LO, Bitondo CG, et al. Single agent cephalosporin prophylaxis for penetrating abdominal trauma. Am J Surg 1986; 152:674–681.
17. Strate RG, Grieco JG. Blunt Injury to the colon and rectum. J Trauma 1983; 23:384–388.
18. Saltzstein RJ, Quebbeman E, Melvin JL. Anorectal injuries incident to enema administration. Am J Phys Med Rehab 1988; 67:186–188.
19. McDowell GC II, Wise, HA II. Rectal perforation as a complication of urethral instrumentation: 2 case reports. J Urol 1988; 40:605–606.
20. Crass RA, Tranbaugh RF, Kudsk KA, Trunkey DD. Colorectal foreign bodies and perforation. Am J Surg 1981; 142:85–88.
21. Devine HB, Melb MS. Carcinoma of the colon. Br Med J 1935; 3: 165–194.
22. Wangensteen OH. Complete fecal diversion achieved by a simple loop colostomy. Surg Gynecol Obstet 1947; 84:409–414.
23. Rombeau JL, Wilk PJ, Turnbull RB, Fazio VW. Total Fecal diversion by the temporary skin-level loop transverse colostomy. Dis Colon Rectum 1978; 21:223–226.
24. Mangiante EC, Graham AD, Fabian TC. Rectal gunshot wounds: management of civilian injuries. Am Surg 1986; 52:37–40.
25. Shannon FL, Moore EE, Moore FA, McCroskey BL. Value of distal colon washout in civilian rectal trauma—reducing gut bacterialial translocation. J Trauma 1988; 28:989–994.
26. Hines JR. A method of transverse loop colostomy to a diverting colostomy. Surg Gynecol Obstet 1975; 140:433–437.
27. Maull KI, Sachatello CR, Ernst CB. The deep perineal laceration an injury frequently associated with open pelvic fractures: a need for aggressive surgical management. J Trauma 1977; 17:685–696.
28. Ogilvie WH. Abdominal wounds in the western desert. Surg Gynecol Obstet 1944; 78:225–238.
29. Morgan CN. Wounds of the rectum. Surg Gynecol Obstet 1945; 81: 56–62.
30. Armstrong RG, Schmitt HJ, Jr, Patterson LT: Combat wounds of the extraperitoneal rectum. Surg 1973; 74:570–583.
31. Haas PA, Fox TA, Jr. Civilian injuries of the rectum and anus. Dis Col Rect 1977; 2:17–23.

Discussion

DR. GEORGE F. SHELDON (Chapel Hill, North Carolina): Dr. Berry, Dr. Jones: I enjoyed this paper very much, and I think all of us would agree that the hallmark of treating these injuries is a diverting colostomy.

I think the authors have added something to the literature by showing that presacral drains have a role, a fact that was assumed, but not established, prior to this paper.

(Slide) This is the standard accepted treatment.

I think we all agree that a colostomy is the most important element.

I think a loop colostomy is not diverting; the most important treatment is a totally diverting colostomy. I take issue with doing a loop colostomy even though I agree with the work of Rombeau at the Cleveland Clinic that showed that a colostomy above the skin will divert. Many times, such colostomies are not totally diverting, and that is something to be avoided.

It is best to do a mucous fistula if it is done for the obvious reason of ease of reconstruction in the future. Irrigation of the distal segment is a bit of a "straw man." It is so easy to do, and it is very hard to imagine that solid bacterial-laden stool in the midst of a traumatized perineum would be useful. I see no reason not to do it, even though its value is hard to prove statistically.

I think the additional important point is documented in the value of presacral drains.

As in the series reported, perineal injuries are often accompanied by associated injuries, sometimes with a perineal cloaca, a bladder injury, etc.

I enjoyed the paper very much and congratulate the authors on their presentation.

I would like to ask that they comment on the issue of total diversion. I ask why they have such a low rate of colostomy closure. If properly done and with good rectal tone documented in the postoperative period, there is no reason why these patients can't have their GI tracts reconstituted. I suspect that this is mainly due to the patient population rather than any problem with sphincter tone.

DR. J. DAVID RICHARDSON, (Louisville, Ky): I, too, appreciated the opportunity to review the manuscript. I had a bit of trouble with the title, which I thought might be misleading. "Is that all?" implies that maybe there wasn't a lot done to these patients. In truth, as the authors pointed out, over 90% of them had a colostomy. The colostomy appeared to be totally diverting in most of those patients, regardless of the mechanism by which it was created. Likewise, almost all of the patients had retrorectal drainage, and that appeared to be very important.

We would agree with Dr. Sheldon about the time required to create a double-barrel colostomy and we often use the loop colostomy with a stapler fired across the distal end, which we believe makes it more of a