# Contemporary management of rectal injuries at Level I trauma centers: The results of an American Association for the Surgery of Trauma multi-institutional study

**Carlos V.R. Brown, MD, Pedro G. Teixeira, MD, Elisa Furay, MD, John P. Sharpe, MD, Tashinga Musonza, MD, John Holcomb, MD, Eric Bui, MD, Brandon Bruns, MD, H. Andrew Hopper, MD, Michael S. Truitt, MD, Clay C. Burlew, MD, Morgan Schellenberg, MD, Jack Sava, MD, John VanHorn, PA-C, Brian Eastridge, MD, Alicia M. Cross, MD, Richard Vasak, MD, Gary Vercruysse, MD, Eleanor E. Curtis, MD, James Haan, MD, Raul Coimbra, MD, Phillip Bohan, MD, Stephen Gale, MD, Peter G. Bendix, MD,**
*and* **the AAST Contemporary Management of Rectal Injuries Study Group***, Austin, Texas*



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**INTRODUCTION:** Rectal injuries have been historically treated with a combination of modalities including direct repair, resection, proximal diversion, presacral drainage, and distal rectal washout. We hypothesized that intraperitoneal rectal injuries may be selectively managed without diversion and the addition of distal rectal washout and presacral drainage in the management of extraperitoneal injuries are not beneficial.

**METHODS:** This is an American Association for the Surgery of Trauma multi-institutional retrospective study from 2004 to 2015 of all patients who sustained a traumatic rectal injury and were admitted to one of the 22 participating centers. Demographics, mechanism, location and grade of injury, and management of rectal injury were collected. The primary outcome was abdominal complications (abdominal abscess, pelvic abscess, and fascial dehiscence).

**RESULTS:** After exclusions, there were 785 patients in the cohort. Rectal injuries were intraperitoneal in 32%, extraperitoneal in 58%, both in 9%, and not documented in 1%. Rectal injury severity included the following grades I, 28%; II, 41%; III, 13%; IV, 12%; and V, 5%. Patients with intraperitoneal injury managed with a proximal diversion developed more abdominal complications (22% vs 10%, $p = 0.003$). Among patients with extraperitoneal injuries, there were more abdominal complications in patients who received proximal diversion ($p = 0.0002$), presacral drain ($p = 0.004$), or distal rectal washout ($p = 0.002$). After multivariate analysis, distal rectal washout [3.4 (1.4–8.5), $p = 0.008$] and presacral drain [2.6 (1.1–6.1), $p = 0.02$] were independent risk factors to develop abdominal complications.

**CONCLUSION:** Most patients with intraperitoneal injuries undergo direct repair or resection as well as diversion, although diversion is not associated with improved outcomes. While 20% of patients with extraperitoneal injuries still receive a presacral drain and/or distal rectal washout, these additional maneuvers are independently associated with a three-fold increase in abdominal complications and should not be included in the treatment of extraperitoneal rectal injuries. (*J Trauma Acute Care Surg.* 2018;84: 225–233. Copyright © 2017 Wolters Kluwer Health, Inc. All rights reserved.)

**LEVEL OF EVIDENCE:** Therapeutic study, level III.

**KEY WORDS:** Rectal trauma; colostomy; presacral drain; rectal washout.

Civilian rectal injuries are uncommon and usually occur after penetrating trauma, particularly gunshot wounds. Management of rectal injuries has historically involved some combination of repair, resection, proximal diversion, distal rectal washout, or presacral drainage. However, owing to the infrequency of rectal injuries, there is little evidence to guide the appropriate management of these challenging injuries. The initial literature guiding the management of rectal injuries arose from military combat experience; therefore, the applicability to civilian injuries remains unclear.

During the years from the American Civil War through the end of World War I, the management of casualties with abdominal trauma and colorectal injuries progressed from watchful waiting to surgical exploration and exteriorization of colorectal injuries.[1–3] These changes in management were associated with improved mortality in patients with colorectal injuries, which ranged from 90% during the American Civil War decreasing to 60% to 75% by the end of World War I. With the advent of mandatory colostomy for colorectal injuries, antibiotics, and improved transport and resuscitation, mortality for colorectal injuries during World War II decreased to 30%.[4,5] While proximal diversion remained the mainstay of management for rectal injuries, the Vietnam War brought about the advent of direct repair of rectal injuries as well as the adjunctive techniques of presacral drainage and distal rectal washout.[6]

During the decades after the Vietnam War, civilian trauma centers began to push the envelope in the management of rectal injuries by challenging the dogma surrounding proximal diversion, presacral drainage, and distal rectal washout.[7] However, most of these were small case series with wide variation in management strategies. This has led to ongoing practice variation and controversy regarding the optimal management strategies for the management of traumatic rectal injuries. We hypothesized that intraperitoneal rectal injuries may be safely managed without proximal diversion and that extraperitoneal rectal injuries may be managed with proximal diversion (with or without repair) and that the addition of distal rectal washout or a presacral drain is unnecessary. The specific aim of this study was to perform a multicenter trial of patients with rectal injuries with a large enough sample size so as to draw meaningful conclusions regarding the management of these uncommon and challenging injuries.

## METHODS

This was an American Association for the Surgery of Trauma multicenter retrospective study including all patients

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From the Dell Medical School (C.V.R.B., P.G.T., E.F.), University of Texas at Austin, Austin, Texas; University of Tennessee Health Science Center (J.P.S.), Memphis, Tennessee; Baylor College of Medicine (T.M.), Houston, Texas; University of Texas Health Science Center at Houston (J.H.), Houston, Texas; University of California San Francisco—East Bay (E.B.), Oakland, California; R. Adams Cowley Shock Trauma Center (B.B.), Baltimore, Maryland; Vanderbilt University (H.A.H.), Nashville, Tennessee; Methodist Health System (M.S.T.), Dallas, Texas; University of Colorado—Denver Health (C.C.B.), Denver, Colorado; University of Southern California (M.S.), Los Angeles, California; MedStar Washington Hospital Center (J.S.), Washington, DC; Legacy Emmanuel Medical Center (J.V.H.), Portland, Oregon; University of Texas Health Science Center San Antonio (B.E.), San Antonio, Texas; University of Oklahoma (A.M.C.), Oklahoma City, Oklahoma; Harbor-UCLA Medical Center (R.V.), Los Angeles, California; University of Arizona (G.V.), Tucson, Arizona; University of California Davis (E.E.C.), Sacramento, California; Via Christi Health (J.H.), Wichita, Kansas; University of California San Diego (R.C.), San Diego, California; Oregon Health and Science University (P.B.), Portland, Oregon; East Texas Medical Center (S.G.), Tyler, Texas; and Brigham and Women's Hospital (P.G.B.), Boston, Massachusetts.

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Address for reprints: Carlos V. R. Brown, MD, Trauma Services, Dell Seton Medical Center, University of Texas at Austin, 1500 Red River St, Austin, TX 78701; email: CVRBrown@ascension.org.

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who sustained a traumatic rectal injury between 2004 and 2015 and were admitted to one of the 22 participating Level 1 trauma centers across the United States (Table 1). Patients who died before management of rectal injury or within 48 hours of admission were excluded. From each participating center's trauma registry and chart review, data were collected to include demographics, mechanism of injury (blunt vs penetrating), admission physiology, injury severity score (ISS), location (intraperitoneal vs extraperitoneal) of rectal injury, grade of rectal injury (Table 2A), associated injuries, diagnostic tests performed, and management of rectal injury (direct repair, resection, proximal diversion, distal rectal washout, presacral drain). The primary outcome was abdominal complications (composite of abdominal abscess and/or pelvic/retroperitoneal abscess and/or fascial dehiscence) while secondary outcome was mortality. Subgroup analyses were performed by location of injury (intra vs extraperitoneal).

With the use of SAS statistical software version 9.4 (SAS Institute Inc, Cary, NC), the proximal diversion versus no proximal diversion groups were compared by univariate analysis using the unpaired Student *t*-test for continuous variables and Pearson $\chi^2$ with Yates correction for categorical variables. The two cohorts were analyzed for all variables collected and subsequently reanalyzed stratifying by location of rectal injury (intraperitoneal vs extraperitoneal). While controlling for demographics, admission physiology, mechanism of injury, injury severity score, associated injuries, and grade and management of rectal injury, logistic regression analyses were performed to determine factors independently associated with abdominal complications. Values are reported as median (interquartile range), raw percentages, or adjusted odds ratios with 95% confidence intervals. This study was approved by each participating institution's institutional review board.

**TABLE 1.** Participating Centers

| Center | Location |
|---|---|
| Dell Medical School, University of Texas at Austin | Austin, Texas |
| University of Tennessee Health Science Center | Memphis, Tennessee |
| Baylor College of Medicine | Houston, Texas |
| University of Texas Health Science Center in Houston | Houston, Texas |
| University of California San Francisco – East Bay | Oakland, California |
| R. Adams Cowley Shock Trauma Center | Baltimore, Maryland |
| Vanderbilt University | Nashville, Tennessee |
| Methodist Health System | Dallas, Texas |
| University of Colorado – Denver Health | Denver, Colorado |
| University of Southern California | Los Angeles, California |
| MedStar Washington Hospital Center | Washington, DC |
| Legacy Emmanuel Medical Center | Portland, OR |
| University of Texas Health Science Center in San Antonio | San Antonio, Texas |
| University of Oklahoma | Oklahoma City, OK |
| Harbor-UCLA Medical Center | Los Angeles, California |
| University of Arizona | Tucson, Arizona |
| University of California Davis | Sacramento, California |
| Via Christi Health | Wichita, Kansas |
| University of California San Diego | San Diego, California |
| Oregon Health and Science University | Portland, Oregon |
| East Texas Medical Center | Tyler, Texas |
| Brigham and Women's Hospital | Boston, Massachusetts |

**TABLE 2.** American Association for the Surgery of Trauma Organ Injury Scale (AAST-OIS) for (A) Colon and B) Rectum Injuries

| Grade | Type of Injury | Description |
|---|---|---|
| **A)** | | |
| I | Hematoma | Contusion or hematoma without devascularization |
| | Laceration | Partial thickness laceration |
| II | Laceration | Laceration <50% circumference |
| III | Laceration | Laceration ≥50% circumference |
| IV | Laceration | Transection of the colon |
| V | Laceration | Transection of the colon with segmental tissue loss |
| | Vascular | Devascularized segment |
| **B)** | | |
| I | Hematoma | Contusion or hematoma without devascularization |
| | Laceration | Partial thickness laceration |
| II | Laceration | Laceration <50% circumference |
| III | Laceration | Laceration ≥50% circumference |
| IV | Laceration | Full-thickness laceration with extension into the perineum |
| V | Vascular | Devascularized segment |

## RESULTS

After exclusions, there were 785 patients who sustained a traumatic rectal injury and survived beyond 48 hours. The mean ± SD age of the population was 33 ± 12 years, 86% male, 35% white, and 73% sustained penetrating trauma. On arrival to the emergency department, patients had a mean ± SD heart rate of 97 ± 24, systolic blood pressure of 122 ± 29, Glasgow Coma Scale of 14 ± 3, and an ISS of 19 ± 12. Diagnostic tests included rigid sigmoidoscopy (58%) and computed tomography scan (47%). The location of rectal injury included intraperitoneal (32%), extraperitoneal (58%), both (9%), and not documented (1%). Severity of rectal injury included the following grades: I, 28%; II, 42%; III, 13%; IV, 12%; and V, 5%. Associated injuries included pelvic fracture (34%), major vascular injury (15%), solid organ injury (12%), and other bowel injury (33%).

The 248 patients with intraperitoneal rectal injuries were managed with direct repair alone, direct repair with proximal diversion, resection and primary anastomosis, resection and proximal diversion, proximal diversion alone, and no intervention (Fig. 1). Overall, 154 patients (62%) with intraperitoneal injuries received proximal diversion as part of their management, while 94 patients (38%) did not. Comparison of demographics, admission physiology, injury details, and management for intraperitoneal injuries in patients with and without proximal diversion are shown in Table 3. Proximal diversion patients sustained more abdominal complications (22% vs 10%, $p = 0.003$). After logistic regression, independent risk factors for abdominal complications in patients with intraperitoneal injuries included high-grade injury [2.6 (1.2–5.1), $p = 0.006$] and penetrating mechanism [2.7 (1.1–6.7), $p = 0.04$].

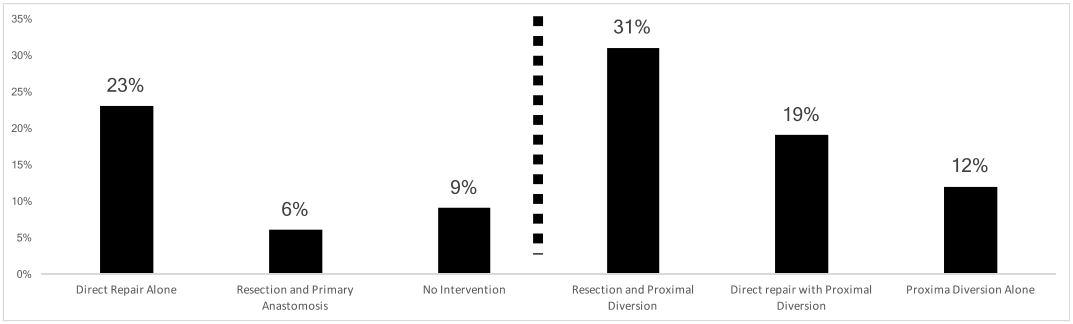


**Figure 1.** Management of 248 patients with intraperitoneal rectal injuries.

Regardless of proximal diversion, there was no difference in mortality (3% vs 2%, $p = 0.66$).

The 459 patients with extraperitoneal rectal injuries were managed with direct repair alone, direct repair with proximal diversion, resection and proximal diversion, proximal diversion alone, and no intervention (Fig. 2). Of the direct rectal repairs, 59% were transabdominal while 41% were transanal. Adjunctive procedures including distal rectal washout and presacral drainage were performed in 17% and 22% of cases, respectively. Overall, 350 patients (76%) with extraperitoneal injuries received proximal diversion as part of their management, while 109 patients (24%) did not receive proximal diversion. Comparison of demographics, admission physiology, injury details, and management for extraperitoneal injuries in patients with and without proximal diversion is shown in Table 4. Among patients with extraperitoneal injuries, there were more abdominal complications in patients who received proximal diversion, presacral drain, or distal rectal washout (Fig. 3). After multivariate analysis, distal rectal washout [3.4 (1.4–8.5), $p = 0.008$] and presacral drain [2.6 (1.1-6.1), $p = 0.02$] were both independent risk factors for developing abdominal complications. This logistic regression model performed well with a Hosmer-Lemeshow goodness-of-fit test of 10.7 ($p = 0.22$) and the area under the receiver operator characteristics curve of 0.78 ($p < 0.001$). When looking only at the 350 patients with extraperitoneal injuries who received a colostomy, 57% received neither a distal rectal washout nor presacral drain, while 43% received one or both adjunctive maneuvers. The patients who received proximal diversion with a presacral drain or rectal washout had twice as many abdominal complications (16% vs 8%, $p = 0.02$) as patients who received only a proximal diversion. Regardless of proximal diversion, there was no difference in mortality (2% vs 1%, $p = 0.55$).

A subgroup of full-thickness injuries (Grades II–V) was further analyzed to included only patients with fecal contamination. After excluding Grade I injuries, there were 162 patients with full-thickness intraperitoneal injuries and 280 patients with full-thickness extraperitoneal injuries. Patients with full-thickness intraperitoneal injuries managed with proximal diversion sustained more abdominal complications (26% vs 11%, $p = 0.04$). Abdominal complications were higher for patients with proximal diversion for both blunt (27% vs 0%, $p = 0.10$) and penetrating mechanisms (25% vs 17%, $p = 0.32$) but did not reach statistical significance owing to small sample sizes. After logistic regression, independent risk factors for abdominal complications in patients with full-thickness intraperitoneal injuries included penetrating mechanism [6.2 (1.2–31.6), $p = 0.03$] and ISS [1.05 (1.01–1.09), $p = 0.01$]. Among the patients with full-

**TABLE 3.** Comparison of Demographics, Admission Physiology, Injury Details, and Management for Intraperitoneal Injuries in 248 Patients With and Without Proximal Diversion

| | Proximal Diversion N = 154 | No Proximal Diversion N = 94 | *p* |
|---|---|---|---|
| Demographics and mechanism | | | |
| Age, years | 30 (19) | 29 (16) | 0.60 |
| Male sex | 87% | 85% | 0.67 |
| White race | 33% | 38% | 0.41 |
| Penetrating trauma | 83% | 64% | <0.0001 |
| Admission physiology and injury severity | | | |
| Heart rate | 101 (28) | 105 (36) | 0.69 |
| Systolic blood pressure | 123 (39) | 124 (38) | 0.86 |
| Glasgow Coma Scale | 15 (0) | 15 (1) | 0.38 |
| Injury severity score | 18 (17) | 17 (16) | 0.17 |
| Grade of rectal injury | | | |
| I | 18% | 52% | <0.0001 |
| II | 30% | 31% | |
| III | 27% | 9% | |
| IV | 15% | 2% | |
| V | 10% | 7% | |
| Associated injuries | | | |
| Pelvic fracture | 23% | 39% | 0.007 |
| Major vascular injury | 22% | 18% | 0.53 |
| Liver injury | 6% | 13% | 0.09 |
| Kidney Injury | 6% | 6% | 0.97 |
| Spleen injury | 1% | 9% | 0.005 |
| Other bowel injury | 57% | 57% | 0.95 |
| Intraperitoneal rectal injury management | | | |
| Direct repair alone | n/a | 51% | n/a |
| Direct repair with proximal diversion | 37% | n/a | n/a |
| Resection and primary anastomosis | 3% | 15% | 0.001 |
| Resection with end colostomy | 47% | n/a | n/a |
| Proximal diversion alone | 15% | n/a | n/a |
| No intervention | n/a | 19% | n/a |

Continuous variables are reported as median with interquartile range.

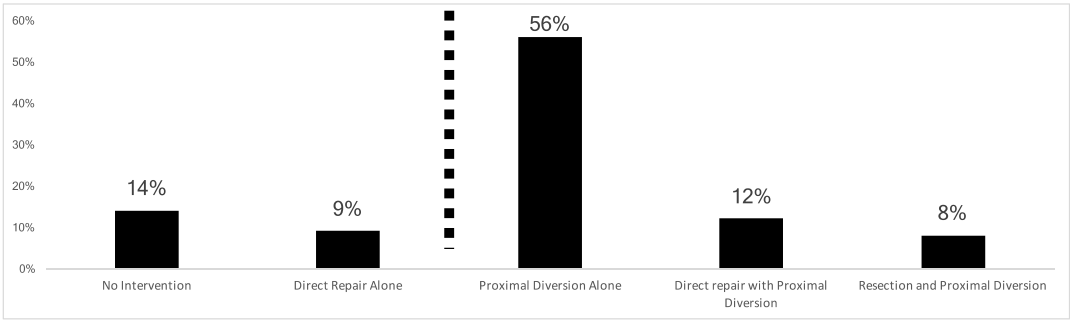


**Figure 2.** Management of 459 patients with extraperitoneal rectal injuries.

**TABLE 4.** Comparison of Demographics, Admission Physiology, Injury Details, and Management for Extraperitoneal Injuries in Patients With and Without Proximal Diversion

| | Proximal Diversion n = 350 | No Proximal Diversion n = 109 | *p* |
|---|---|---|---|
| Demographics and mechanism | | | |
| Age, years | 28 (15) | 29 (22) | 0.23 |
| Male sex | 89% | 77% | 0.001 |
| White race | 28% | 56% | <0.0001 |
| Penetrating trauma | 78% | 60% | 0.0002 |
| Admission physiology and injury severity | | | |
| Heart rate | 94 (30) | 95 (30) | 0.51 |
| Systolic blood pressure | 126 (33) | 127 (30) | 0.41 |
| Glasgow Coma Scale | 15 (0) | 15 (0) | 0.27 |
| Injury severity score | 17 (14) | 10 (14) | 0.0001 |
| Grade of rectal injury | | | |
| I | 16% | 64% | <0.0001 |
| II | 55% | 28% | |
| III | 12% | 3% | |
| IV | 15% | 5% | |
| V | 2% | 0% | |
| Associated injuries | | | |
| Pelvic fracture | 41% | 27% | 0.008 |
| Major vascular injury | 12% | 8% | 0.28 |
| Liver injury | 4% | 2% | 0.34 |
| Kidney injury | 1% | 1% | 0.99 |
| Spleen injury | 3% | 1% | 0.30 |
| Other bowel injury | 19% | 10% | 0.03 |
| Rectal injury management | | | |
| Direct repair alone | n/a | 39% | n/a |
| Direct repair with proximal diversion | 16% | n/a | n/a |
| Resection and primary anastomosis | 0% | 0% | n/a |
| Resection with end colostomy | 11% | n/a | n/a |
| Proximal diversion alone | 73% | n/a | n/a |
| No intervention | n/a | 61% | n/a |
| Management adjuncts | | | |
| Distal rectal washout | 21% | 6% | 0.0006 |
| Presacral drainage | 27% | 6% | <0.0001 |

thickness extraperitoneal injuries, there were more abdominal complications in patients who received proximal diversion (10% vs 0%, $p = 0.04$), presacral drain (16% vs 5%, $p = 0.002$), and distal rectal washout (18% vs 6%, $p = 0.003$). Increased complications for full-thickness extraperitoneal injuries persisted regardless of blunt [proximal diversion (16% vs 0%, $p = 0.10$), presacral drain (31% vs 7%, $p = 0.01$), and distal rectal washout (19% vs 3%, $p = 0.04$)] or penetrating [proximal diversion (9% vs 0%, $p = 0.14$), presacral drain (13% vs 5%, $p = 0.02$), and distal rectal washout mechanism (17% vs 7%, $p = 0.08$)]. After multivariate analysis, distal rectal washout [4.6 (1.6–13.6), $p = 0.005$] and presacral drain [4.7 (1.7–13.0), $p = 0.003$] were both independent risk factors for developing abdominal complications.

## DISCUSSION

This is the largest series to date investigating the management of traumatic rectal injuries. Most of our population sustained a penetrating injury to the rectum and more than half of the injures were to the extraperitoneal rectum. Almost three quarters of the injuries were lower grade (I–II), and there was a high incidence of associated abdominal and pelvic injuries. Patients with intraperitoneal rectal injuries were more often treated with some type of proximal diversion, and patients who received

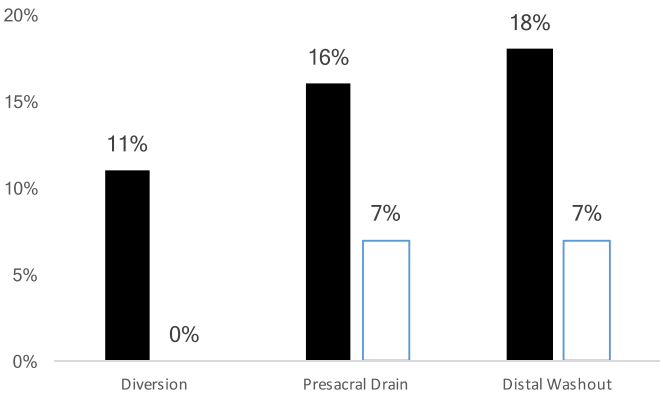


**Figure 3.** Abdominal complications among extraperitoneal injuries in patients with (*black*) and without (*white*) proximal diversion ($p = 0.0002$), presacral drain ($p = 0.004$), and distal rectal washout ($p = 0.002$).

a proximal diversion sustained more abdominal complications (22% vs 10%). Patients with extraperitoneal injuries were treated with a proximal diversion in 76% of cases, and in three quarters of the cases, this was the only treatment for the rectal injury. Approximately 20% of patients with extraperitoneal injury received a presacral drain and/or distal rectal washout; both interventions were independently associated with a three-fold increase in abdominal complications.

The combination of *d*irect repair, *d*iversion, *d*istal rectal washout, and presacral *d*rain for management of rectal injuries can be traced back to a Vietnam-era study published in 1971.[6] This study reported on the management of rectal injuries in 28 combat casualties and found that application of the four "D's", particularly adding distal rectal washout, led to a "striking reduction in complications and no mortality". While surgeons initially accepted this management strategy as a standard of care, the next several decades began to see publications challenging one or more of the four "D's". In particular, surgeons have challenged the need for compulsory proximal diversion in patients with intraperitoneal injuries and the need for repair, presacral drain, distal rectal washout, and even proximal diversion for extraperitoneal injuries.

While sometimes controversial, numerous prospective studies have supported the practice of primary repair or resection without proximal diversion for patients with colonic injury.[8–18] Extrapolating from these studies on colon trauma, other authors have recommended a similar approach for patients with intraperitoneal rectal injuries.[7,19] However, there are actually few studies that specifically address the management of intraperitoneal injuries, as most studies focus on the management of extraperitoneal rectal injury. Haas and Fox[20] were one of the earliest authors to advocate primary repair of civilian intraperitoneal rectal injuries in 1979. They reported 21 patients with intraperitoneal rectal injuries, 10 of whom underwent a direct repair alone. The other 11 patients underwent repair and diversion. However, they did not describe outcomes for either group. In 1998, the Memphis group reported on 58 patients with rectal injuries, 16 of whom had an intraperitoneal injury.[21] Six of these patients underwent a primary repair of the intraperitoneal rectal injury without proximal diversion, and none of the repairs leaked. They concluded that most intraperitoneal injuries can be managed with primary repair alone. The same group published a follow-up study in 2006,[22] once again advocating for primary repair of intraperitoneal injuries without diversion, although there were only three patients who underwent the procedure. Navsaria et al.[23] described 92 patients with rectal gunshot wounds, five of whom had repair of intraperitoneal injury without proximal diversion. Despite not reporting the outcomes of these five patients, they recommend that "the treatment of choice for the majority of civilian gunshot intraperitoneal colorectal injuries is primary repair." Despite the recommendations against proximal diversion for intraperitoneal injuries, 62% of patients with intraperitoneal injury in our series received proximal diversion. Presumably, surgeons include a proximal diversion in the management of intraperitoneal injuries to avoid complications, but patients in our series who received a proximal diversion sustained significantly more complications (22% vs 10%).

As the extraperitoneal rectum may be difficult to access, either via a transabdominal or transanal route, routine repair of these injuries has been challenged. The Parkland group described an early series[24] of patients with extraperitoneal injuries who were managed without direct repair of the injury. Of the 47 patients in their series of rectal injuries, only 19 patients (40%) had direct repair of the rectal injury. The authors concluded that "the absence of repair had no influence on postoperative morbidity or length of hospital stay." In 1988, the Denver group reported 26 patients with extraperitoneal rectal injuries,[25] and only 9 (35%) underwent direct repair of the injury. Regardless of repair, they found no difference in rates of pelvic abscess (repair, 33% vs no repair, 24%). The group out of Ben Taub published a landmark paper describing the management of 100 patients with extraperitoneal rectal injuries,[26] only 21% of whom had rectal repair. They concluded that colostomy was the foundation to treatment of extraperitoneal rectal injuries, but adjuncts such as repair of the rectal wound had little effect on mortality and morbidity. Another study, published in 1993, reported 28 extraperitoneal rectal injuries,[27] 19 (68%) of which were managed without direct repair. Only one pelvic abscess developed in the group managed without repair. Velmahos et al.[28] likewise found there was no need to repair extraperitoneal rectal injuries. Among 30 patients with extraperitoneal rectal injuries, all received proximal diversion but only 12 (40%) had their rectal injury repaired. There was no difference in complications (25% vs 30%) regardless of repair of rectal injury. Another large study out of South Africa[23] was published in 2007. These authors described a series of 92 rectal injuries and only two of the extraperitoneal injuries were repaired; all others received proximal diversion. No patients in this series developed an intra-abdominal or pelvic abscess. In our series of patients with extraperitoneal rectal injuries, there was no difference in abdominal complications (8% vs 9%, $p = 0.87$) regardless of whether or not the rectal injury was repaired.

Presacral drain and distal rectal washout have been used as adjuncts in the management of extraperitoneal civilian rectal injuries since the 1971 landmark military paper published by Lavenson and Cohen.[6] A similar military study likewise supported the use of proximal diversion, presacral drain, and distal rectal washout for patients with extraperitoneal rectal injuries.[29] A civilian study[25] in 1988 emphasized the importance of distal rectal washout in addition to diversion and presacral drain, as distal rectal washout was associated with reduced septic morbidity. Since those publications, multiple civilian authors have challenged one or both of these adjunctive procedures. Many authors have supported the need for diversion and presacral drain but questioned the use of distal rectal washout,[24,26,27,30] while others have argued that neither drain nor washout is a necessary adjunct.[23,28,31,32] Most studies that have specifically disputed the need for presacral drainage have been retrospective in design.[21,22,33] The single prospective randomized trial investigated the use of presacral drainage in the management of extra peritoneal rectal injuries.[34] The authors randomized 48 patients with rectal injuries to either diversion plus presacral drain or diversion alone. They found no improvement in infectious complications with the addition of a presacral drain. Despite the lack of support for these adjunctive maneuvers, a significant number of patients with extraperitoneal rectal injuries in our current series received a presacral drain (22%) and/or distal rectal washout (17%), both of which were independently associated with a three-fold increase in abdominal complications.

Two very small series have even challenged the need for proximal diversion in extraperitoneal rectal injuries.[32,35] One group reported 30 patients with extraperitoneal rectal injuries, six of whom were directly repaired without proximal diversion, and there was no morbidity associated with not receiving a diverting procedure. The second paper studied 14 patients with nondestructive penetrating extraperitoneal rectal injuries managed with a nondiversion protocol and compared them to historic controls with similar injuries who had been diverted. They likewise reported no complications in patients managed without proximal diversion. In our series of patients with extraperitoneal rectal injuries, 76% received proximal diversion while 24% did not. Of those who did not receive a diversion, 39% had rectal injury repaired while 61% did not. Patients who underwent proximal diversion sustained more abdominal complications (11% vs 0%) than those managed without diversion.

While our large multicenter study adds significantly to the existing literature regarding the management of traumatic rectal injuries, several limitations are worth mentioning. First, and foremost, the biases inherent in retrospective design still hold true. Second, we have no information regarding the surgeon's decision making when managing the rectal injuries, so we cannot with certainty determine the indications for repair, resection, diversion, drain, or rectal washout. Finally, we have no data regarding long-term outcomes in our populations, and specifically regarding rates of colostomy reversal for patients who underwent proximal diversion.

Overall, 62% of intraperitoneal injuries in this series were managed with proximal diversion, and patients who are diverted have more abdominal complications. Our data suggest that proximal diversion may be omitted from the management of intraperitoneal rectal injuries. Most of patients with extraperitoneal injuries were managed with proximal diversion, and approximately 20% received an adjunctive presacral drain and/or rectal washout. These adjunctive maneuvers were associated with a three-fold increase in abdominal complications and should not be included in the management of extraperitoneal rectal injuries. Select extraperitoneal rectal injuries may be managed without direct repair or proximal diversion, but further prospective studies are needed to determine the optimal patient population.

## AUTHORSHIP

C.V.R.B., P.G.T., and E.F. reviewed the literature. C.V.R.B., P.G.T., E.F., J.S.P., T.M., J.H., E.B., B.B., H.A.H., M.S.T., C.C.B., M.S., J.S., J.V.H., B.E., A.M.C., R.V., G.V., E.E.C., J.H., R.C., P.B., S.G., and P.G.B. designed the study. E.F., J.S.P., T.M., J.H., E.B., B.B., H.A.H., M.S.T., C.C.B., M.S., J.S., J.V.H., B.E., A.M.C., R.V., G.V., E.E.C., J.H., R.C., P.B., S.G., and P.G.B. collected the data. C.V.R.B., P.G.T., and E.F. analyzed the data. C.V.R.B., P.G.T., E.F., J.S.P., T.M., J.H., E.B., B.B., H.A.H., M.S.T., C.C.B., M.S., J.S., J.V.H., B.E., A.M.C., R.V., G.V., E.E.C., J.H., R.C., P.B., S.G., and P.G.B. interpreted the data. C.V.R.B., P.G.T., and E.F. wrote the manuscript. C.V.R.B., P.G.T., E.F., J.S.P., T.M., J.H., E.B., B.B., H.A.H., M.S.T., C.C.B., M.S., J.S., J.V.H., B.E., A.M.C., R.V., G.V., E.E.C., J.H., R.C., P.B., S.G., and P.G.B. performed critical revision of the manuscript.

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## DISCLOSURE

The authors declare no conflicts of interest.

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## DISCUSSION

**Dr. Timothy C. Fabian** (Memphis, Tennessee): Drs. Reilly and Kurihara, members and guests. I would, first of all, like to compliment Carlos and the collaborative group from the AAST Multi-Institutional Trials Committee on this study addressing the current state of management of rectal injuries.

These are uncommon injuries and a multi-institutional analysis is certainly warranted. However, a retrospective review of this injury is even more ticklish than most retrospective studies.

Our group has had an interest in rectal injury management over the past couple of decades. We believe that precise anatomic characterization of the injury is necessary to both dictate therapy and to interpret results.

Is the wound intraperitoneal or extraperitoneal? If extraperitoneal, is the wound posterior on the upper two-thirds or is it in the lower one-third?

The serosa is clearly the most important layer of the bowel relative to healing of repair or anastomosis. There is no serosa on the extraperitoneal portions of the rectum.

If serosa is present, there is little need for a diversion. Without serosa, repair is tenuous. How accurate do you believe operative notes are for anatomic definition in a 22-site retrospective study? I will return to anatomy in a bit.

In all studies of bowel injury I've been involved with over the years there are the – quote – usual suspects relative to risks for infectious morbidity. Those include fecal contamination, blood loss, and shock. You didn't report on any of these in the manuscript. Please explain.

Twenty-eight percent of the 785 injuries were Grade 1. Those injuries are either hematoma or partial thickness. And those injuries have no fecal contamination. I think it would be best to analyze results with exclusion of those injuries.

I'm sure the vast majority of those were blunt. And I don't believe they compare in any way with full-thickness penetrating wounds. Yet it is puzzling why 18 percent of intraperitoneal and 16 percent of extraperitoneal wounds having proximal diversion were Grade 1. What do you think? Along similar lines, how many presacral drain injuries were Grade 1?

Abdominal complications included abdominal abscess and/or pelvic/retroperitoneal abscess and/or fascial dehiscence. These were not defined in the manuscript and there was no delineation of which of those occurred in the various treatment categories in which they were reported.

Distal washout and presacral drainage were independently associated with the infectious complications by multivariate analysis. But there were no differences in mortality noted.

It has been said that regardless of statistics – quote – "for a difference to be a difference, it has to make a difference." Could you shed some light on these complications?

The only real treatment recommendation, however, that I quibble with is that presacral drainage is not indicated for rectal wound management. I agree that the majority of them do not.

However, there is one anatomic location of injury that I believe is quite important. Those very few extraperitoneal full-thickness injuries in the lower one-third of the rectum that have not been explored should have presacral drainage.

Fecal contamination occurs in a closed space that left undrained can lead to serious rectal infection that can ascend into the retroperitoneum and thigh producing life-threatening sepsis.

I'm afraid statistical analysis of retrospective study of an uncommon injury will not be able to adequately address this concern.

I thank the authors for an important study that should stimulate more research in the area. And I thank the association for the privilege of the floor.

**Dr. Sheldon H. Teperman** (Bronx, New York): Carlos, beautiful work. Vexing topic. Question is to a specific type of injury, the sub-peritoneal injury. It's the middle of the night, gunshot wound with worrisome trajectory. You don't see anything in the belly. You sigmoidscope the patient and there is blood mixed with stool.

From your data it suggests that some folks – so it's poorly anatomically defined. It's three o'clock in the morning. You're not really sure what it is. You don't see the hole.

From your data there is a suggestion that you might just let it fly, no diversion. Can you comment?

**Dr. David V. Feliciano** (Edgewater, Maryland): Dave Feliciano, Edgewater, Maryland. Carlos, I enjoyed this study but I would encourage you to temper your conclusions in the retrospective nature of this study because many people, as you know, read either the abstract or the conclusions and they might not understand you had a lot of Grade 1 injuries here that are meaningless to many of us.

One of the things to mention in the manuscript is that there are no good prospective data on rectal washout and presacral drains. Everyone recognizes that rectal washout is logistically awkward. For the younger surgeons in the room, I would recommend that they manually evacuate stool from the rectum instead as this will likely help early healing and allow for more same-admission colostomy closures. Finally, if you are not going to close rectal holes, it makes sense to put in a presacral drain even if unproven scientifically.

**Dr. Carlos V.R. Brown** (Austin, Texas): Thank you. Thanks, Dr. Fabian, for your insightful comments. It's a real honor and privilege to have you review our paper as much of the literature came from your institution. In addition, your center was the largest contributor to this study.

Regarding the accuracy of the op notes and the medical record, obviously, that's one of the limitations of a retrospective study. We asked very specifically what we were looking for but, as you know, what we get back is going to be up and down.

The variables of fecal contamination, blood loss and shock. We weren't really able to capture fecal contamination very well in a retrospective study. Blood loss and shock we did capture. And there was no difference in the groups once we excluded the patients who died within 48 hours.

I appreciate your recommendation to remove Grade 1 injuries as well as subgroups of penetrating and blunt. I got that revision, I think, presumably, from you for the Journal. We're in the process of doing that analysis.

The question – I had the same question you did. Why divert Grade 1 injuries? I really don't have a good answer for that. I think for so long the dogma for rectal injuries has been diversion, diversion, diversion so people see even a small hematoma on the rectum they end up bringing up a colostomy.

I think if nothing else this paper may say, well, obviously for low grade injuries, specifically Grade 1 injuries, you don't need to do any of these interventions at all.

The abdominal complications, we defined them just as they are stated: abscess (either in the abdomen or retroperitoneum) and fascial dehiscence. We didn't go any further than that.

No difference in mortality. Yes, I agree with that. But the one thing we don't capture is what is the long-term outcome of the colostomy and what is the long-term outcome of the drain, of the washout, any other fall-out from having those complications down the road.

But I think though there may be no difference in mortality, clearly there are going to be added complications from having those interventions.

And then the role of presacral drain, selectively and on a case-by-case basis may be considered. What I think we need to probably try to get people away from is opening that presacral space just because there is a rectal injury.

If the injury is already there and you are already looking at it, sure, you can drain that. But I think opening the presacral space just to put a drain in should probably be avoided.

Dr. Teperman, you know, if you are working it up and you don't see the injury, you're not really sure where it is, I think from this literature you can just watch that patient. If you haven't found any injury at all, hematoma or nothing, I think watch that patient or bring up a diversion, either is safe.

The extraperitoneal injuries seem to behave a little bit differently. I think from the intraperitoneal side we can say colostomy is not indicated in those situations. But for extra I think I have to waffle a little bit. But if you present me the case you mentioned I probably would not divert that patient.

And Dr. Feliciano, thank you for your wise words. Yes, tempering the conclusions, I've gotten that feedback several times from our coauthors on the manuscript so I think the final product may be somewhat tempered, like you said.

Thank you all very much.