Anorectal Trauma and Injuries

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Introduction and Historical Perspective

"Ehud reached with his left hand, drew the sword from his right thigh and plunged it into the king's belly. Even the handle sank in after the blade, and his bowels discharged" [1]. This biblical account of Ehud slaying King Eglon on his palace roof is one of the earliest records of colorectal trauma in written history. Many principles of anorectal trauma management are rooted in the study of colorectal injuries; therefore a historical examination is prudent to understand how our past trials have shaped our current surgical landscape. As we examine the surgical history, it is through military literature that we find the best narrative highlighting the shifts in surgical management of anorectal injuries. During the pre-antibiotic era of the American Civil War and early First World War, soldiers with abdominal injuries were simply observed. The fortunate ones without an underlying bowel injury or hemorrhagic shock had reasonable odds of surviving; the alternative carried a 90% mortality rate with observation and surgical exploration was almost uniformly fatal [2, 3]. This would not change until later in World War I when surgeons began experimenting with proximal fecal diversion or externalization, as prior experience with primary repair had been abysmal.

In response to the substantial improvements in outcome seen with either proximal fecal diversion or externalization of colorectal injuries, Major General W. H. Ogilvie, who was the consultant surgeon of the Middle East Forces in the East African Command in 1943, ordered that mandatory colostomies be performed in all patients with colorectal trauma on the battlefield. This algorithmic shift, coupled with improved transport and resuscitation efforts, would result in a significant decrease in mortality rates in the range of 30% by the end of the Second World War [4]. The treatment for rectal trauma also saw major improvements during the world wars, although the volume of experience was significantly lower than that of colon injuries. The patients who survived the initial injury often died of severe retroperitoneal infections until diverting colostomy with presacral drainage became the operation of choice [2]. Surgeons during the Vietnam War often faced more destructive injuries to the rectum, which ushered in the addition of rectal repair with distal rectal washout. Regardless of colon or rectal injury, fecal diversion had become the mainstay in

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management. It wasn't until the late 1970s that civilian literature demonstrated that primary colonic repair without diversion in the right setting was an acceptable treatment option [5]. Multiple studies through the 1980s and 1990s validated this option [6, 7]. Strada and colleagues [6] used an aggressive primary repair approach and showed excellent results even in high-velocity colon injuries. As will be highlighted in the following sections of this chapter, the current treatment options for anorectal trauma contain both stalwarts of historical management and newer paradigms and algorithms. The optimal choice of operative repair and management will depend on multiple factors, most importantly the injury pattern and severity, patient physiology and comorbidities, the setting and available expertise/resources, the current evidence and literature, and individual surgeon comfort. What can be almost uniformly stated about anorectal trauma management is that there is no Level 1 evidence available, and thus it is particularly critical to understand the anatomy, pathophysiology, and prior published experience in order to tailor the best procedure or management strategy to each patient.

Injuries to the Rectum

While infrequent, a diagnosis of rectal injury is associated with risk for significant morbidity and mortality and warrants immediate evaluation and intervention. In the civilian setting, these injuries are typically seen in the setting of penetrating trauma; with gunshot wounds accounting for greater than 80% of all rectal injuries and stab wounds another 5% [8]. These injuries occur in blunt trauma less often with an incidence of 0.5–10% [9–12]. Rectal injuries occur at a higher rate in the military setting, and are typically more complex or destructive due to the predominance of high velocity penetrating or blast mechanisms not commonly seen in civilian practice [13]. Other causes of rectal trauma include impalement/straddle injuries, sex-related injuries, iatrogenic endoscopic and urologic injuries, and anorectal foreign bodies.

A high degree of suspicion is required to avoid the potentially devastating consequences in terms of morbidity, mortality, and anorectal function that can occur with a missed or delayed diagnosis. The evaluation to identify a traumatic rectal injury typically begins in the emergency department trauma bay. As with all trauma patients, the Advanced Trauma Life Support primary survey is paramount to ensuring patient stability. While anorectal injuries do take a high priority, they are not immediately life threatening and the initial evaluation should focus on the primary survey. Although the incidence of anorectal injury is a very low percentage of all trauma patients, there are several injury patterns or mechanisms that should raise suspicion and prompt particular attention to the anorectal evaluation. For penetrating trauma, any penetrating wound (stab or gunshot) to the buttocks, groin, proximal thighs, perineum, or sacral area should raise concern for an associated anorectal injury. In addition, any trans-pelvic gunshot wound should be assumed to have a rectal injury until proven otherwise. Finally, diagnosed injuries to any closely associated organ or structure such as the bladder, uterus/vagina, distal ureters, or iliac vessels should also prompt an evaluation for concomitant rectal injuries. With blunt traumatic mechanisms, an isolated anorectal injury is extremely rare, and is almost always associated with other major pelvic/perineal injuries. Obviously all impalement or straddle injuries should raise concern for direct anorectal trauma. Any pelvic fracture, and particularly the "open book" fracture or those with major posterior pelvic/sacral disruption, can cause rectal injury due to direct puncture from bone fragments or blunt shear/tearing forces.

During the secondary survey, significant history and symptoms should be obtained if possible. This includes eliciting any symptoms of abdominal, pelvic, or perineal pain or discomfort. One of the most common causes of a delay in diagnosis is the simple failure to do a careful exam, which starts by completely exposing and visualizing the lower abdomen, groin, perineum, and buttocks. This should include identification of any significant lacerations, bruising/hematomas, blood or active bleeding, and bullet or stab

wounds. A digital rectal exam (DRE) should be performed to check for the presence of blood, foreign objects, bony protrusion, and evaluate sphincter tone [10]. Some physicians have been moving away from including the DRE on every trauma patient, as its use alone has been suggested to provide little diagnostic information and has a low sensitivity and specificity for rectal injury [14–16].

This caveat is particularly true for the stool guaiac test for "occult blood", which has an extremely high false positive rate and low sensitivity. However, a good DRE is an essential part of the evaluation of a patient with a suspected anorectal injury to identify true rectal blood or bleeding, and to locate and characterize any defects, perforations, hematomas, or foreign bodies. One of the common errors in the anorectal exam is to not visualize and prepare the area by first cleaning the perineum of any old blood and controlling bleeding from nearby sources like a perineal laceration. Should only be performed after cleansing has been done to avoid confusion regarding the source and location of any identified blood and help decrease false positive rates with the finding of "gross blood". We have not found that FOBT adds any information of value in the trauma setting.

Rigid proctoscopy or flexible sigmoidoscopy should be performed in any patient with exam or imaging findings concerning for a rectal injury; with any high-risk penetrating injury as outlined above; and should be considered for all other patients with any question or concern for potential injury. The extent and degree of injury can be documented with this technique, though care must be taken not to worsen a potential defect during the exam by aggressive scope advancement or insufflation [17]. The presence of blood within the bowel lumen on proctoscopy can be considered diagnostic for rectal injury in traumatic settings other than foreign-body insertion. Care is taken to look for blood on the first pass of the scope, as repeat insertions may cause iatrogenic bleeding. Proctoscopy may also be utilized during abdominal exploration, should the surgeon encounter associated injuries that warrant further rectal evaluation.

Computed tomography (CT) has become the most common radiologic adjunct in the trauma setting. While the use of CT has been overcoming its historically poor stigma for identifying hollow viscus injury, its accuracy has not reached the point of using this technology as a standalone diagnostic tool. The use of triple-contrasted (IV, oral, and rectal) CT imaging has improved its diagnostic accuracy and can be performed should a rectal injury be suspected [18, 19]. Arguably the most important role for CT imaging in the setting of rectal trauma is the identification of high risk associated injuries such as complex pelvic fractures, or secondary signs including perirectal air, hematoma, wall thickening, or free fluid that should prompt endoscopy or surgical exploration. CT may also be helpful in depicting the trajectory of missile wounds to determine if it placed the rectum at risk of injury. Marking any external gunshot wounds with radiolucent markers and performing fine-cuts through the area of interest can often reliably re-create the missile tract and reveal whether it was in proximity to the rectum or safely distant.

The pelvis is a compact space where genitourinary, gastrointestinal, vascular, bony, and nervous anatomic structures lie in close approximation. It is not surprising that rectal injuries commonly coincide with injuries to any of the above listed groups. Associated injury patterns should trigger a surgeon's suspicion for a possible rectal injury. Any penetrating wounds that lie within, or have trajectory between, the anterior superior iliac spine (ASIS) and midthigh, including the buttocks and perineum, should prompt further evaluation. A study by Arthurs et al. from a forward combat hospital showed that 43% of patients with penetrating pelvic injuries sustained rectal trauma, half of which had associated vascular or urinary injuries [20]. Another study found that 41% of patients with penetrating bladder injuries had an associated rectal injury [21]. In one study of pediatric anorectal trauma [22], vaginal injuries were discovered in 60% of injured females. It is important to remember that blunt pelvic fractures are evidence of high energy transfer through the pelvis. In a patient with significant pelvic fractures, espe-

cially involving the sacroiliac joint or symphysis pubis, DRE and proctoscopy should be performed followed by a contrasted study if necessary [23].

Rectal Organ Injury Scale

The American Association for the Surgery of Trauma (AAST) has defined injuries to the rectum based on degree of injury thickness and extent of circumference involved (Table 28.1) [24]. Correctly defining a rectal injury is important, both for choosing the optimal management option and improving data collection and analysis. Grade I rectal injury is described as bowel wall contusion or partial thickness laceration. Any full thickness laceration of the rectal wall that involves less than 50% of the circumference is classified as a Grade II injury. Defects involving more than half the rectal circumference are classified as Grade III. If multiple injuries to the rectum are present, the grade is advanced by one level up to Grade III. Rectal lacerations communicating with open perineal wounds are graded level IV, and any devascularization of the rectum is considered the highest level of injury at Grade V.

A commonly utilized binary descriptive system categorizes all colon and rectal injuries as either "destructive" or "non-destructive". The definition of "destructive" is any injury involving greater than 50% of the circumference of the bowel wall or any mesenteric injury that compromises the perfusion of that segment of bowel. Additionally, most surgeons would include multiple smaller injuries that are in very close proximity in the destructive category. The clinical relevance of this categorization is that while many non-destructive injuries can be safely managed with primary repair, all destructive injuries should undergo segmental resection and either primary anastomosis, colostomy with no anastomosis, or primary anastomosis with a proximal diverting ostomy.

Table 28.1 AAST organ injury grading scale for injury to the rectum

Grade[a]	Type of injury	Description of injury
I	Hematoma	Contusion or hematoma without devascularization
	Laceration	Partial-thickness laceration
II	Laceration	Laceration <50% of circumference
III	Laceration	Laceration ≥50% of circumference
IV	Laceration	Full-thickness laceration with extension into the perineum
V	Vascular	Devascularized segment

Source: Adapted from Moore et al. [24]
[a]Advance one grade for multiple injuries up to grade III

Anatomic Considerations

The rectum is a unique segment of the gastrointestinal tract with multiple encasing layers of tissue that differ along its length. Anteriorly and laterally, the proximal two-thirds of the rectum are covered with peritoneum, while the posterior surface is extraperitoneal. The distal third of the rectum lies completely extraperitoneal. The mesorectum is a thick connective tissue and fat layer surrounding the extraperitoneal rectum and contains the neurovascular supply. Its location within the bony pelvis provides some protection, however this anatomy can make injury exposure difficult, perhaps more so in males [25]. This will also vary by gender. Males typically have a longer and more narrow pelvis that makes mobilization/exposure of the mid- to distal rectum much more difficult than in females with naturally wider pelvises. The anatomical location of injuries has come to play a major role in determining the optimal operative pathway. The significant amount of dissection required to expose the extraperitoneal rectum leads to vast management differences as compared to the proximal intraperitoneal rectum. The other key factor in the management of rectal injuries, and particularly in the operative exposure and repair, is a clear understanding of the anatomic locations and relationships of the key pelvic structures/organs that are in close proximity to the rectum. These structures include the bladder anteriorly, the sacrum and sacral venous plexus posteriorly, the iliac vessels and

ureters posterolaterally, the prostate and seminal vesicles anteriorly (in males), and the uterus/vaginal wall anteriorly in females.

Management of Intraperitoneal Rectal Injuries

A review of the literature on management specific to intraperitoneal rectal injuries reveals a paucity of reliable data on which to base definitive conclusions. As a result, this injury has historically been managed like that of a left colon injury. In instances of non-destructive injuries, commonly defined as lesions involving less than 50% of the bowel wall circumference and without major mesenteric injury or devascularization, the use of primary repair without diversion is a safe option. Multiple studies during the 1990s consisting of level I and II data demonstrated lower rates of intra-abdominal sepsis and overall complications with primary repair of colonic injuries as compared to diversion [26–28]. While these data do not apply directly to the rectum, multiple small studies [11, 29, 30] have subsequently replicated similar results in patients with intraperitoneal rectal injuries. Primary repair also avoids the added risk of forming and closure of a diverting stoma [31–33], not to mention the physical and emotional stresses that accompany a colostomy.

Any rectal perforation adjacent to, or involving, another abdominal structure should be repaired in a way to separate the two injured structures; thus decreasing the likelihood of fistula formation [34]. The key is placement of ample, viable tissue such as omentum between the injured rectum and adjacent organ [35]. If omentum is not available, then a flap of peritoneum can usually be fashioned. If primary repair is not feasible due to a destructive lesion or to multiple adjacent smaller lesions, resection with primary anastomosis is a viable option in the majority of patients. Hemodynamically unstable or tenuously stable patients receiving large volume blood transfusion, or who have severe concomitant injuries or comorbidities, many have advocated forgoing any attempt at primary repair or anastomosis and instead performing a proximal diverting colostomy (Hartmann's procedure). Although this method has been touted as the "safe" option, it has not been found to reduce the overall morbidity or mortality. Furthernore, it also carries the risks of the subsequent operation to reverse the colostomy, as well as the risk of the patient never having the colostomy reversed. Several other viable alternatives now exist that are superior to the standard fallback of the Hartmann's procedure.

The first is to perform a "damage control laparotomy" where the rectal injury is temporized with either a rapid primary repair or resection, and the abdomen is then left open to facilitate a planned second-look laparotomy. This option is ideal for the unstable patient where rapid surgery is of the essence, and the decision for reconstruction versus diversion is deferred to a time when the patient has been resuscitated and stabilized (Fig. 28.1).

The second alternative is to perform a primary anastomosis and then protect it with a proximal loop ileostomy. This intervention provides fecal diversion and theoretical "protection" of the anastomosis while it heals, mitigates the consequences of an anastomotic leak, and facilitates a much

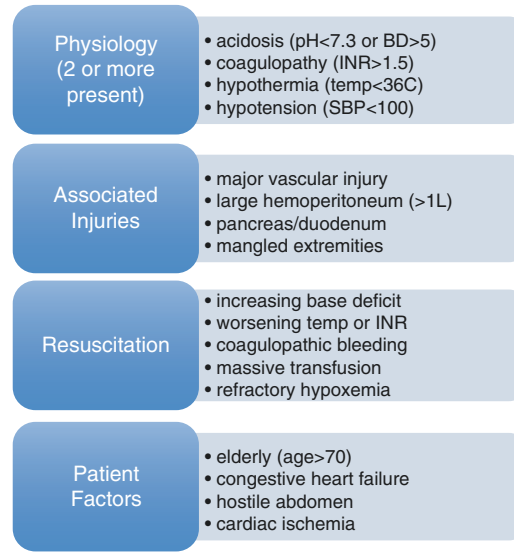

Fig. 28.1 Triggers for damage control laparotomy. With permission from [50] © 2014 Springer

easier subsequent surgery to reverse the ostomy. We believe that this option is superior to a Hartmann's procedure for the patient who is stable but is felt to be at higher risk for anastomotic breakdown (i.e. elderly, malnourished, chronic steroid use, etc.). Numerous patient, surgeon, and situational factors such as age, nutritional status, use of immunosuppressive or chemotherapeutic agents and hemodynamic status must be considered in the therapeutic algorithm. Table 28.2 outlines multiple decision points and operative points in the setting of colorectal trauma.

Table 28.2 Key intraoperative management issues and decisions in colon and intraperitoneal rectal trauma

Key decision	Factors to consider	Technical pearls
Primary repair or resection?	– Size of injury – Shape of injury (linear, round/stellate) – Single or multiple – Tissue quality – Mesentery status (rents, hematomas, devascularized segment)	– Debride injured or burned tissue – Connect close injuries rather than leaving "bridges" – Evacuate large mesenteric hematomas – Close mesenteric tears – Resect segment with "bucket-handle" mesenteric defect
Damage control?	– Patient stability – Transfusion requirement – Acid/base getting better or worse? – Multiple injuries? – Another reason for a "second-look" (i.e. borderline bowel viability)	– Make decision early in the case – Proceed if patient improving, terminate if getting worse – Vacuum-assisted temporary closure works best – Usually no need for other drains
Anastomosis or ostomy?	– Patient baseline status (age, comorbidities, meds) – Physiologic status – Quality of the tissues – Other injuries and proximity to anastomosis – Body habitus, ability to properly site an ostomy	– Consider difficulty and risk of ostomy takedown – Be wary of anastomosis with an associated pancreatic injury! – Obesity increases difficulty and complications with ostomy
Anastomosis: hand-sewn or stapled?	– Operative time – Other injuries to address – Personal experience and comfort – Tissue quality, edema – Anatomic area and bowel alignment – Available equipment	– No difference in leak or complication rates in most series – Hand-sewn potentially more secure with suboptimal tissue quality, bowel wall edema – Laparoscopic staplers great for pelvis, hard-to-reach areas or sharp angles
Ostomy: loop, end, other?	– High risk anastomosis that needs protection? – Need access to distal bowel segment? – Body habitus – Mesentery—shortened, edematous	– Loop or end-loop may reach the skin easier with obesity or shortened mesentery. – May not get complete fecal diversion with a loop – Use an ostomy bar if any tension or obese patient – Wrap ostomy in Seprafilm© (Sanofi-Aventis, Cambridge, MA) for easier takedown
Leave a drain?	– No indication for routine drainage of bowel anastomoses – Widely drain any other adjacent injuries (pancreas, bladder, etc.) – Other reasons: associated abscess cavity, control ascites in cirrhotic patient	– Avoid direct contact of drain with anastomosis – Larger sump drains usually not beneficial – Make exit site remote from incision and any ostomy
Place a feeding tube?	– Degree of bowel injuries and surgery – Estimated need for prolonged NPO status – Estimated inability to take oral nutrition – Need for feeding access as well as gastric decompression? – Pancreatic or duodenal injury?	– Generally avoid making additional holes in bowel in the trauma setting – Stamm gastrostomy relatively safe and secure – Higher complications with jejunostomy tubes with little benefit – Consider intraoperative placement of nasojejunal tube

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Management of Extraperitoneal Rectal Injuries

As mentioned above, experiences during the Vietnam War resulted in a shift in operative management that has since dictated treatment algorithms [36]. This experience led to the wide promulgation of the "4 D's" of rectal injury management: Divert, Drain, Direct repair, and Distal washout. The use of this paradigm of performing a proximal diverting colostomy, placing a presacral drain, exploring and directly repairing the injury, and performing a distal rectal washout as the standard treatment for all extraperitoneal rectal injuries has been repeatedly questioned during the last two decades. Performing all four of these components is almost never truly required or indicated. Arguably the most important of these for treating the true full-thickness rectal injury is proximal diversion, and often this maneuver alone will suffice. The remaining three procedures each have specific scenarios in which they may provide added benefit, and thus should continue to be utilized, albeit on a highly selective basis.

The use of fecal diversion with a proximal colostomy remains the mainstay treatment for an extraperitoneal rectal injury. Whether an end colostomy or a loop colostomy is performed depends on injury extent, the associated injuries, the operative approach, the patient's body habitus, colon mobility, and surgeon preference. For destructive rectal injuries, a Hartmann's resection with end colostomy has been the time-honored procedure of choice. However, as with intraperitoneal rectal injuries, there is no convincing evidence that this is the superior alternative or provides better protection than a proximal loop colostomy. In addition, the reversal of an end descending or sigmoid colostomy, particularly following a major traumatic rectal injury, can be a major undertaking with higher risks than even the original operation. The majority of extraperitoneal rectal injuries can safely be treated with diverting loop colostomy alone, which has been shown to provide complete fecal diversion and avoids the added risks of complicated takedown procedures for an end colostomy [35, 37]. Although these stomas were performed via laparotomy, there is now an increasing body of experience with performing a simple laparoscopic colostomy (end or loop). Laparoscopic stoma creation is an ideal option for scenarios where there is no other indication for a laparotomy, or where there are associated abdominal injuries that are also amenable to laparoscopic exploration and repair. Laparoscopy can also be a highly useful diagnostic adjunct in cases where there are equivocal imaging or endoscopy findings, and can evaluate the intraperitoneal rectum and the extraperitoneal mesorectum for any signs of full thickness injury (i.e. hematoma, bleeding, fecal soilage).

The direct repair of extraperitoneal injuries, in general, is best performed only when easily accessible without significant tissue dissection, or when the injury is encountered during the exposure of an associated injury [25]. The typical injuries amenable to direct repair include injuries to the proximal extraperitoneal rectum that can be easily exposed and repaired via abdominal mobilization, and injuries to the distal rectum that can per repaired via a transanal exposure. As with intraperitoneal injuries, if a perforation is encountered near or involves an adjacent structure, repair of the perforations and placement of viable omentum or other vascularized tissue between the injuries should be performed to prevent fistulae formation. This precaution is particularly important in females to help avoid rectovaginal fistulae. Success has been demonstrated with primary repair of extraperitoneal injuries alone without diversion in selected patients, especially if dissection is not extensive [11, 12, 29]. A transanal approach can offer access to the injury and has been shown to provide adequate repair without the need for diverting colostomy in selected patients [11]. In general, proximal diversion should still be performed even if direct repair was accomplished in patients with large or complex injuries, with significant surrounding soft tissue defects or cavities, or for combined injuries to surrounding structures.

Once lauded for its improvement in mortality rates, presacral drainage has lost significant sup-

port after the publication of a 1998 American Association for the Surgery of Trauma prospective, randomized trial [38] that demonstrated no difference in pelvic sepsis between those who received the extra procedure and those who did not. Albeit a small study of only 48 patients, it represented the first Level 1 data on rectal injuries and has led to a further decline in its use. It should be noted that all of the patients in the study were treated with diversion regardless of the use of closed-suction presacral drains. Still, some advocate for the use of a presacral drainage for those inaccessible injuries that cannot be repaired, in addition to diversion [29, 35, 39]. Such a drain is placed by making a curved, transverse incision posterior to the anus and bluntly dissecting the presacral space to the level of the rectal injury (Fig. 28.2). It is imperative to place the drains anterior to the presacral fascia (Waldeyer's fascia); a characteristically tough membrane that commonly requires incision with a sharp instrument in order to traverse. A misplaced drain, which is not uncommon due to the difficulty of this dissection, is rendered ineffective. The use of coccygectomy to widen the area of drainage is not supported due to the potential for osteomyelitis.

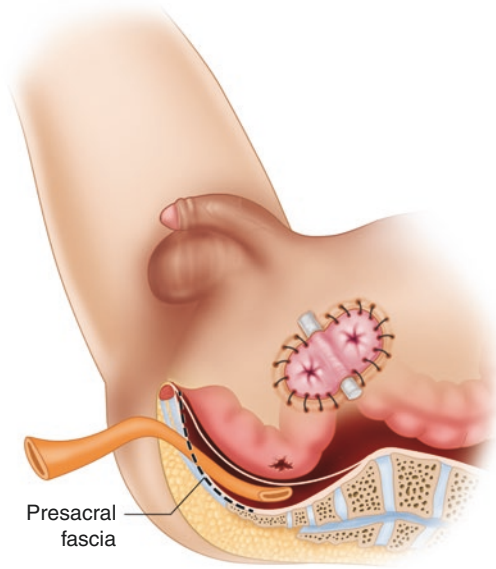

Fig. 28.2 Placement of drains in the presacral space, anterior to Waldeyer's fascia, up to the level of the rectal injury. © Baylor College of Medicine 1988 [40]

Drains should be placed near the rectal injury, avoiding direct contact with any suture or staple lines. Both Penrose and closed-suction drains have been used successfully and are removed once drainage becomes serous and low in volume [40]. Presacral drain placement should also be considered for any large posterior rectal defects, for significant fecal soilage of the presacral space, or for injuries that have created a significant cavity in the presacral space due to hematoma or soft tissue loss. For all others there appears to be little to no benefit of placing a presacral drain, and there are concerns for iatrogenic injuries during drain placement or contaminating the presacral space if it had not already been violated.

The use of distal rectal washout was also introduced after the Vietnam War and has since seen fluctuations in support and utilization. Supporters claim the removal of remaining stool in the defunctioned rectal vault will decrease the risk for sepsis, especially with a potentially open rectal wound. Those opposed to this view hypothesize that the forceful irrigation of liquid into the rectal vault will push bacteria and fecal material into otherwise unaffected or minimally contaminated tissues. Many of the studies reporting on the value of rectal washout, positive or negative, are clouded by the varied coexistent use of fecal diversion and presacral drainage. Therefore, the ability to draw conclusions on this practice is limited and the authors of this chapter do not routinely employ it in the setting of rectal trauma. In select situations where there is a large volume of retained stool in the rectal vault, and the injury has been controlled or excluded from the area of the washout, then a distal washout can be performed. Another less common scenario would be in the setting of a rectal resection and primary anastomosis in the face of a significant volume of retained stool in the rectum. This method can help facilitate the anastomosis and also theoretically decrease the chance of an anastomotic complication due to distal fecal impaction/obstruction. Distal washout can be performed antegrade from the abdominal cavity or through the distal limb of a loop colostomy, or retrograde via a catheter inserted from the perineum.

The Eastern Association for the Surgery of Trauma (EAST) recently released a set of practice

guidelines for the management of nondestructive, penetrating injuries to the extraperitoneal rectum (Table 28.3). It should be mentioned that the conditional recommendations *for* proximal diversion and *against* presacral drainage and rectal washout are based on evidence graded as "very low" by the authoring committee [41]. Any of these interventions may be indicated in specific scenarios and tailored to the extent of injury at the discretion of the operating surgeon.

The authors of this chapter use the following algorithm (Fig. 28.1) for extraperitoneal rectal injuries based on the above reviewed literature. If the injury is limited and easily accessible, either through transanal or abdominal exposures with minimal dissection, then primary repair with or without loop colostomy diversion should be performed. Destructive or inaccessible injuries should be diverted with loop colostomy. In rare cases when a formal rectal resection is deemed necessary, then either a primary anastomosis with a proximal diverting loop ileostomy, or resection with an end colostomy (Hartmann's procedure) is performed based on patient and injury factors. Distal rectal washout and presacral drainage are not routinely performed, but should be reserved for those select indications described above where they may confer some additional benefit.

Retained Rectal Foreign Bodies

The insertion of a foreign body into the rectum typically presents to the hospital as a retained object. Less commonly, an actual rectal injury has occurred. Often, these patients attempt removal or passage of the foreign body at home, causing them to present hours to days after the inciting event. As a result of their delay, these patients can present quite sick. Supine and upright abdominal radiographs should be obtained to define the characteristics and location of the object, as well to look for pneumoperitoneum. Small objects will likely naturally pass and passage can be facilitated with an enema or cathartics. The vast majority of foreign bodies can be removed at bedside in the emergency department [42]. A retractor or speculum device should be inserted into the anus and the foreign body grasped if easily visualized. Blindly grasping for the object is not suggested, as this maneuver can cause further mucosal damage. Once the object is firmly grasped, a suction effect may be encountered that prevents easy withdrawal. Suction can be diminished with the use of a Foley catheter placed beyond the object and air instilled through the catheter lumen to break the suction. The inflated Foley balloon may also assist in the extraction. If the patient presents with peritonitis, laparotomy is indicated. A stable patient without peritonitis, from whom the object cannot be retrieved at bedside should be taken to the operating room for transanal extraction under conscious sedation. A foreign body located in the sigmoid colon is predictive for operative intervention [42]. If this technique is unsuccessful, then laparotomy should be performed to milk the object distally so that it can be transanally retrieved. In some instances, a colotomy may be required to remove the object. Foreign bodies that are in danger of causing mucosal injury during extraction, such as fragile glass items that may break while

Table 28.3 Summary of recommendations from the 2016 EAST Practice Management Guideline on Penetrating Extraperitoneal Rectal Injuries [41]

PICO question	Recommendation	Number of studies	Quality of evidence
1. Should proximal diversion be performed versus primary repair without diversion?[a]	Conditional recommendation FOR proximal diversion	14	Very low
2. Should presacral drainage be performed?[a]	Conditional recommendation AGAINST presacral drainage	17	Very low
3. Should distal rectal washout be performed?[a]	Conditional recommendation AGAINST distal rectal washout	13	Very low

[a]All recommendations are based on the scenario of a non-destructive penetrating extraperitoneal rectal injury; PICO = methodology considering the population, intervention, comparator, and outcome

inside the rectum, may warrant laparotomy with colotomy earlier in the algorithm for safe removal. The use of a flexible sigmoidoscope with a snare or basket may be beneficial to retrieve smaller objects that are out of reach from manual extraction. Once the object is successfully removed, proctoscopy or flexible sigmoidoscopy should be performed to evaluate the mucosa. Often mucosal examination will show excoriations or small mucosal tears that will heal without intervention. Should a full thickness injury be found, carry on with one of the algorithms described above.

Anal Trauma

Non-obstetric trauma to the anus or sphincter complex is a decidedly rare diagnosis [22, 43]. Injury may occur via penetrating or blunt trauma and result in separation of the anus from surrounding tissues or extension of injury from the perineum into the anus and involve the sphincter musculature [44]. In contrast to the colon and rectum, examination of the literature yields a relative void of information on the treatment of non-obstetric trauma to the anus and sphincter complex. Much of the data focus on the results of late sphincter repair in patients with resultant fecal incontinence [45, 46]. With the onset of the recent wars in Iraq and Afghanistan, an increase has been seen in wartime perineal and pelvic wounds due to improvised explosive devices (IEDs) [47]. Using the Department of Defense Trauma Registry, Glascow et al. [43] identified a 0.1% prevalence of wartime anal trauma, with the vast majority occurring due to blast injuries (76%) and gunshot wounds (24%). However, these injuries were typically seen in conjunction with massive destructive injuries to the perineum, mangled or amputated extremities, and concomitant truncal trauma that is uncommonly seen in the civilian setting. In the majority of civilian trauma settings, trauma to the anus and anal sphincter complex is typically seen with penetrating injuries to the perineum, blunt straddle or impalement injuries, or in association with complex open pelvic fractures. Additionally, anal trauma can come in the form of sexual assault, autoeroticism ("fist fornication", insertion of myriad objects that fit in the rectum), and iatrogenic injuries (enema use, thermometer insertion). Unlike rectal injuries, which can have subtle external signs and be easily missed, the majority of significant anal injuries are readily apparent both by symptoms and on physical exam. In addition, they rarely require any evaluation beyond a careful history and physical exam to guide the initial diagnosis and plan of care.

A careful understanding of the anal canal anatomy and its surrounding muscles is necessary to identify and potentially treat injuries to this complex region (Fig. 28.3). The anal canal begins proximally at the levator ani muscles and extends to the anal verge for a total length of about 4 cm. The canal is surrounded by two circular layers of strong musculature that can be envisioned as two concentric muscular tubes. The inner tube is a continuation of the circular, smooth muscle layer of the rectum and becomes the internal anal sphincter, which is under tonic contraction via autonomic innervation to act as a constant barrier to involuntary loss of stool and gas [48]. The outer tube is made of striated, skeletal muscle under voluntary control. This funnel-shaped external muscle consists of the levator ani and puborectalis muscles proximal and the external anal sphincter distally, ending slightly distal to the internal sphincter. The external anal sphincter has been described as having three portions (deep, superficial, and subcutaneous), though this distinction has been questioned and it is probably best to think of it as a single sheet of muscle. The external sphincter bolsters the resting tone of the internal sphincter through both voluntary and reflex mechanisms, while also having a component of resting tone through spinal reflex arcs. While physiologically strong, these muscle layers are quite thin at 2–3 mm and 6 mm for the internal and external sphincters, respectively [48]. This demonstrates how anal and perineal trauma can have a significant effect on fecal continence; and how difficult it can be to make sense of the anatomy after an injury.

Literature on the acute management for anal trauma is relatively sparse, though basic princi-

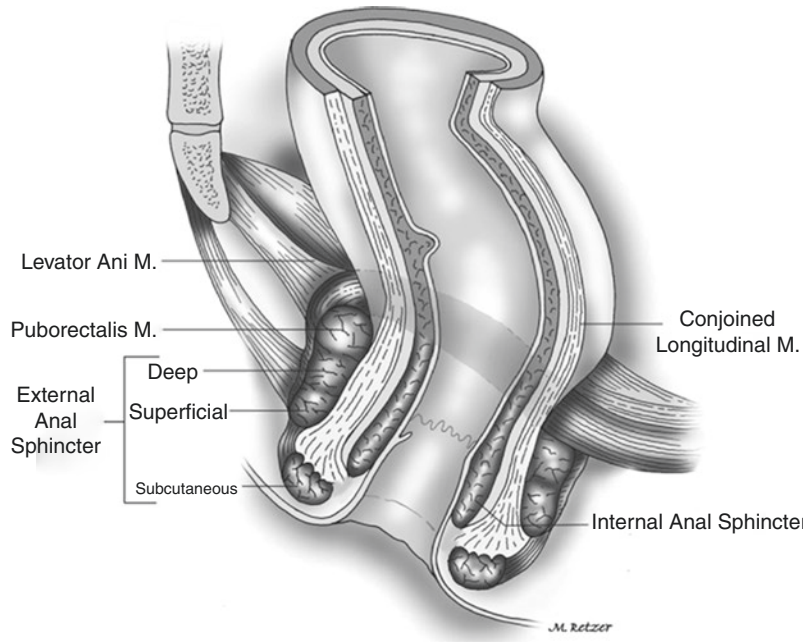

Fig. 28.3 Anal canal anatomy and its surrounding muscles. With permission from [48] © 2011 Springer

ples exist. The perineum and anus should be thoroughly evaluated as soon after presentation as possible. After the primary trauma survey is completed, bedside evaluation can be performed by inspecting and palpating the perineum and grossly assessing sphincter function with DRE and asking the patient to squeeze down on your finger. Females should undergo vaginal exam as well. As mentioned earlier, anal trauma is typically identified quickly on secondary survey and prompts an evaluation in the operating room. Careful examination of the wound should determine which sphincter muscles are involved, whether the injury is a laceration through the muscle or represents actual tissue loss, and gentle proctoscopy performed to evaluate both the anal canal and look for associated rectal injury. Minor injuries to the anal canal can be treated with transanal debridement back to healthy tissue and primary suture repair with absorbable suture. Early debridement of non-viable soft tissues is paramount to prevent infection and pelvic sepsis, though care must be taken to minimize muscular debridement to preserve the anal sphincter mechanism. Primary repair/approximation of the internal and external sphincters with absorbable suture can be performed acutely for simple

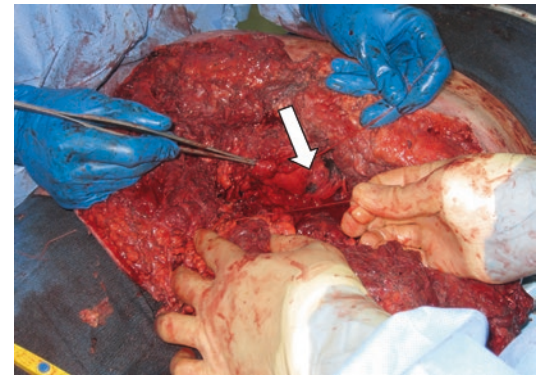

Fig. 28.4 Massive perineal blast wound with destruction of the sphincter complex and exposed distal rectum (arrow). These patients warrant immediate operative intervention to prevent exsanguination, perform debridement, and in this case perform diverting colostomy. With permission from [50] © 2014 Springer

lacerations in otherwise uninjured and hemodynamically stable patients [49], and fecal diversion may not be necessary in such patients [22].

Significant perineal injuries often present from motor vehicle and motorcycle collisions or auto-pedestrian incidents and can result in the significant loss of tissue and complex wounds (Fig. 28.4). For large or complex perineal wounds, immediate operative debridement and

prevention of exsanguination is mandatory. In the trauma bay, the wound should be rapidly packed and wrapped with elastic gauze for compression to stem blood loss on the way to the operating room [50]. The sphincter complex and anal canal are examined as before, but in this circumstance management of the anal trauma is clearly secondary to resuscitation and repair of life-threatening injuries. The cut ends of sphincter muscle should be tagged with suture and any non-viable tissue removed, with the plan for repeat visits to the operating room for serial debridement of surrounding soft tissue as it declares viability. A colostomy should be performed early in the surgical management of the patient if the perineal injury is devastating or there is concomitant involvement of the rectum [17, 22, 43]. Once the patient has been resuscitated and viable tissue remains, the sphincter injury should be readdressed. If the musculature can be approximated, repair should be performed as best possible with absorbable suture. If the anal sphincter complex has been destroyed or is unable to be approximated, diversion allows maintenance of a clean wound for healing. Surrounding perineal soft tissue wounds may require negative pressure vacuum-assisted closure or grafting.

Subsequent evaluation of the sphincter muscles in the outpatient setting will dictate further therapy, if necessary. An easy and early test of continence is the use of an enema challenge. If the patient can retain a 100 mL saline enema, further surgical or physical therapy treatment is unlikely to provide added benefit [51]. To determine whether a patient has a resultant sphincter defect contributing to their incontinence, anal endosonography can be performed and has been found to have the highest sensitivity over other modalities. Endoanal-coil magnetic resonance imaging (MRI) allows a comparable detection of defects to endoanal ultrasound, but is superior in distinction of between muscle fibers and fibrous tissue. Anorectal manometry is used to determine the patient's basal and squeeze pressures, though its prediction of incontinence or improvement has been debated and is beyond the scope of this chapter. The use of pelvic floor physical therapy with sphincter exercises and biofeedback can improve tone and squeeze mechanics with resultant improvement of continence of feces and flatus in the setting of minor traumatic sphincter injuries [43, 49, 52]. The presence of a small sphincter defect and continued fecal incontinence despite sphincter exercises may warrant overlapping sphincteroplasty or sacral neurmodulation [53]. Muscle transpositions or interpositions may be subsequently indicated for patients with significant sphincter complex loss. Some of these patients, especially those individuals with poorly or non-functioning sphincter complexes, may be best served with a permanent colostomy.

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