Outcomes Following Proctectomy

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KEYWORDS

• Proctectomy • Function • Outcomes • Total mesorectal excision
• Sexual dysfunction • Urinary dysfunction • Treatment • Reconstruction

KEY POINTS

- Proctectomy often results in functional outcomes that can be significantly different from preoperative baseline status.
- A comprehensive understanding of normal anatomy and function, as well as the preoperative factors that may affect postoperative function, is crucial to guide an appropriate preoperative discussion outlining risk and options.
- Familiarity with operative technique and pitfalls and reconstructive options is necessary to optimize results.
- Common postoperative complications include derangements of defecatory, sexual, and urinary function.
- A rational approach to preoperative assessment and decision making will help maximize the potential for setting expectations as patients make critical decision that affect quality of life (QOL).

INTRODUCTION

Although successful removal of the rectum with reestablishment of gastrointestinal (GI) continuity is increasingly possible for pelvic surgeons, this article focuses on the consequences of proctectomy. For better comprehension, first the normal function of the rectum as well as the appropriate surgical techniques for proctectomy that have been specifically developed to minimize the risk of postoperative complications are discussed. Various options related to reconstruction and the functional issues seen after restoration of bowel continuity are also discussed. More specifically, the authors review bowel, urinary, and sexual changes after proctectomy, as well as the intraoperative pitfalls that may precipitate these. The authors also discuss management and the impact of new surgical techniques on function and outcome. Finally, the impact that all these factors have on patient QOL are reviewed.

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FUNCTION OF THE NORMAL RECTUM

In order to best understand the derangements that can occur after proctectomy, it is important to understand, at a basic level, the anatomy, normal function, and basic nervous innervation and reflexes of the rectum. This understanding will also help guide operative maneuvers designed to try to avoid some of these complications.[1]

Normal innervation of the rectum, anal canal, and sphincter complex is both autonomic and somatic. The sympathetic supply of the rectum arises from the L1–L3 lumbar branches of the spinal cord. The main sympathetic hypogastric plexus coalesces just below the sacral promontory around the root of the inferior mesenteric artery (IMA) to form the main hypogastric nerves. These nerves course laterally carrying postganglionic sympathetic fibers from the hypogastric plexus. At this level, the sympathetic nerves meet with the parasympathetic fibers to the rectum and anal canal, known as the *nervi erigentes*, which arise from S2–S4. These fibers join at the lateral side of the pelvis adjacent to the lateral stalks and pass laterally and anteriorly. In men, these fibers then continue on to the periprostatic plexus, which is situated on Denonvilliers fascia, between the seminal vesicles and the anterior mesorectal fascia (**Fig. 1**). Sexual function is closely regulated by these autonomic components. Erection

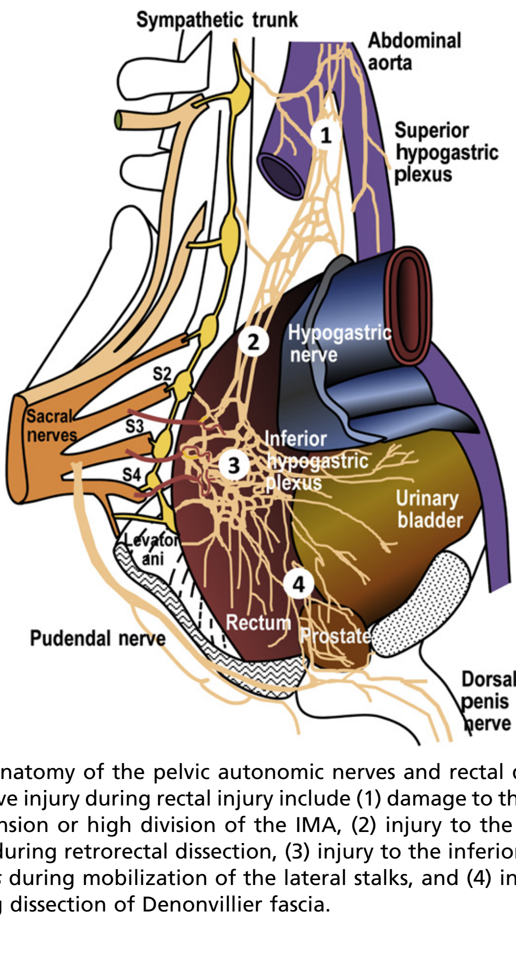

Fig. 1. Relational anatomy of the pelvic autonomic nerves and rectal dissection. Potential points of pelvic nerve injury during rectal injury include (1) damage to the superior hypogastric plexus from tension or high division of the IMA, (2) injury to the main trunks of the hypogastric nerve during retrorectal dissection, (3) injury to the inferior hypogastric plexus and *nervi erigentes* during mobilization of the lateral stalks, and (4) injury to the periprostatic plexus during dissection of Denonvillier fascia.

is primarily mediated by parasympathetic inflow, and ejaculation is primarily sympathetically mediated. Normal bladder function is also closely regulated by sympathetic function.

The external anal sphincter (EAS) is a skeletal muscle and is voluntarily controlled by the somatic nervous system, whereas the internal anal sphincter (IAS) is primarily autonomically mediated. Sympathetic inflow to the IAS is mediated by L5 and parasympathetic nerves derived from S2–S4. Motor control of the EAS is mediated by the inferior rectal branch of the pudendal nerve. Sensation to the anal canal is through the inferior rectal branch of the pudendal nerve, which may have a significant role in maintenance of continence.

The rectum is primarily a social organ, and its job is to store stool until a socially appropriate time for elimination. There are several reflex mechanisms for facilitating normal function. The rectoanal inhibitory reflex (RAIR) is the first mechanism involved in normal defecation. When fecal material enters the rectum and causes distention, there is a transient relaxation of the IAS. It is thought that this process allows a small amount of fecal material to come into contact with the upper anal canal, where specialized receptors sample the material to determine its consistency and state. If defecation is to be deferred, "receptive relaxation" of the rectal wall is triggered, allowing for increased distention and accommodation, without an increase in pressure. The RAIR is primarily dependent on intrinsic local innervation rather than a reflex arc mediated by the central nervous system. The reflex is often disrupted after low anterior resection (LAR) and is pathognomonically absent in Hirschsprung disease in which myenteric ganglia in the anal canal are missing; however, it is preserved even after transection of the hypogastric nerves and in the presence of spinal cord lesions.

At the same time as the RAIR is being triggered, the EAS and puborectalis contract to prevent inadvertent fecal loss. This reflex is termed the rectoanal excitatory reflex (RAER). The motor impulses mediating this contraction are likely transmitted through the pudendal nerve, because pudendal nerve block or damage may interfere with this reflex. Neuropathy identified on pudendal nerve terminal motor latency testing may portend derangements related to this reflex.

Intrinsic to the rectum's storage function is the compliance of a distensible rectum. As stool moves into the rectum, the receptive relaxation reflex allows progressive dilation of the rectum with a relatively blunted increase in wall tension. This process relies not only on normal innervation and sensation but also on healthy and compliant tissue.

Ultimately, for normal defecation to occur, movement of gas, liquid, or solid stool into the rectum initiates this complex series of reflex arcs. Distention of the rectum leads to initiation of the RAIR and movement of a small amount of fecal material into the upper anal canal. This process in turn stimulates external sphincter contraction via the RAER, as well as receptive relaxation, and distention of the rectal wall. If voluntary evacuation is called for, the puborectalis muscle relaxes, the anorectal angle straightens, and the combined abdominal wall and diaphragmatic muscles contract increasing the abdominal pressure, and the rectal contents are evacuated. Simply sitting or crouching aids in this entire process.

PREOPERATIVE FACTORS THAT MAY AFFECT POSTOPERATIVE FUNCTION

Given the complex interplay between the neural and anatomic mechanisms that govern normal rectal function, it becomes clearer how to identify preoperative factors that may affect postoperative function.

Radiation Therapy

For patients who have locally advanced rectal cancers, neoadjuvant radiation therapy is the standard of care to reduce local recurrence and potentially downstage the primary tumor and enhance resectability. However, radiation therapy can induce significant problems with normal function as a result of microvascular fibrosis. Early reports[2] did not bear out any functional effects on the residual rectum or its function, but the overwhelming majority of more recent data support significant functional morbidity as a result of radiation to the pelvis.[3–5] Radiation therapy not only affects the compliance of the residual rectum, which in turn, affects the critical aspect of distensibilty and capacitance, but also affects sphincter function.[3,5] Taken together, the radiation therapy may have significant deleterious effects on continence by affecting sphincter function and causing significant urgency by further limiting the capacitance of the residual rectum. When delivered postoperatively, radiation therapy can result in more significant bowel dysfunction because of the increased negative impact on the newly reconstructed, and intrinsically inferior, colonic reservoir. Owing to both the short-term and long-term toxic effects of adjuvant radiation therapy, neoadjuvant therapy is the currently preferred approach.[6]

Radiation therapy has also been shown to have a deleterious effect on sexual function postoperatively.[7] Compared with nonirradiated patients, men who receive radiation therapy encounter increased rates of ejaculatory and erectile disorders and women who receive the same note more pronounced sexual disorders.[4]

Prior Surgery

Patients who have had prior abdominal or pelvic surgery carry unique risks after proctectomy. In patients who have undergone prior colectomy, there may not be enough well-vascularized colon to allow for easy reanastomosis to the pelvic floor. Prior left or sigmoid colectomy may necessitate a proximal transverse to rectal anastomosis, or even an ileocecal transposition to reestablish GI continuity. In addition, loss of colon length may result in significant loss of absorptive surface area and the delivery of a large volume of liquid stool to the neorectum. This effect presents a particular challenge in patients with already compromised sphincter function after proctectomy. In addition, loss of the IMA vasculature may cause the available colon conduit to have marginal perfusion and increase the risk of anastomotic complications, or induce chronic ischemia and subsequent fibrosis or stenosis of the neorectal conduit.[8] In patients with prior pelvic surgery, either for benign disease or for inflammatory bowel disease, the mesorectal fascial planes may be obliterated, increasing the risk for pelvic autonomic nerve injury and subsequent compromise of bladder and sexual function. Finally, scarring in the lower retroperitoneum may place the ureters at risk in subsequent surgical procedures, and the astute surgeon should have a low threshold for the use of preoperative ureteral stenting to assist in ureteral identification and protection during surgery.

APPROPRIATE MESORECTAL DISSECTION—THE TME TECHNIQUE

Before the wide acceptance of total mesorectal excision (TME) popularized by Heald in the early 1980s and 1990s,[9] proctectomy was a highly morbid operation, resulting in significant blood loss, higher injury rates to pelvic autonomic nerves, and high local recurrence rates in oncologic resection. The principles of TME were developed based on rigid adherence to the known anatomic planes of dissection and preservation of the mesorectal fascial envelope. Because the dissection is based on intimate knowledge of pelvic anatomy, many of the pitfalls and complications related to rectal resection can be avoided. The basic principles of TME include careful dissection at the base of the IMA with avoidance of undue tension on the pedicle, because of the intimate association with the sympathetic hypogastric plexus. Injury to this plexus can result in urinary dysfunction (UD) and retrograde ejaculation. Careful entry into the areolar plane behind the IMA pedicle at the level of the sacral promontory guides a safe and relatively bloodless dissection posteriorly. In addition, careful dissection at this level allows for careful identification and preservation of the hypogastric nerves. Maintenance of dissection in this areolar plane laterally minimizes the risk of injury to the confluence of the sympathetic hypogastric fibers as they meet with the *nervi erigentes* in the lateral stalks of the rectum. Avoidance of deviation too posterolaterally at this level avoids disruption of the parasympathetic fibers and possible resultant sexual dysfunction (see **Fig. 1**). In addition to improving functional outcomes, proper TME technique has been shown to decrease the local recurrence and positive radial margin rate, owing to the lack of residual mesorectum left behind. Before TME, positive radial margin rates (one of the most important determinants of local recurrence risk) of 25% were not uncommon, as well as associated local recurrence rates as high as 40%.[10] After TME, rates of positive radial margins were reduced to approximately 7%, and local recurrence rates to as low as 5% to 7%, even in the absence of adjuvant radiation.[9]

More recently, the impact of minimally invasive techniques including laparoscopic and robotic-assisted proctectomy have been introduced and evaluated. Owing to the challenges and complexities of laparoscopic pelvic surgery, there is concern about the ability to perform a technically (oncologically) sound operation and preserve the pelvic nerves and the subsequent deleterious impact on postoperative outcomes including function.[11] Proponents of a minimally invasive approach counter that a magnified view of the pelvis may actually facilitate autonomic nerve preservation and optimization of postoperative outcomes.[12,13] The specific impact of robotic resection, with 3-dimensional view and fine motion control with 7 seven degrees of freedom, has not been rigorously studied. In 2012, Kim and colleagues[14] prospectively evaluated urinary and sexual function after laparoscopic (n = 39) and robotic (n = 30) TME for rectal cancer. When comparing the 2 surgical approaches, the investigators found earlier recovery of normal voiding and sexual function in patients undergoing TME after robotic resection. At least at this point in time, the study of minimally invasive options in the pelvis remains in its infancy, and formal recommendations await further experience with longer follow-up.

RECONSTRUCTION AND FUNCTION

Postoperative function after proctectomy can be significantly affected not only by preoperative and perioperative factors but also by the manner in which reconstruction is undertaken. In the setting of inflammatory bowel disease, reconstruction after proctectomy is usually limited to the surgical management of ulcerative colitis (UC). In general, restoration of GI continuity is ill advised after proctectomy for Crohn disease.[15] In the surgical management of familial adenomatous polyposis (FAP), total proctocolectomy is mandated, whereas reconstruction remains optional. Before the development of the ileal reservoir by Parks, end ileostomy was the gold standard for surgical management of patients with UC and FAP, whereas now, most patients choose restorative ileal J-pouch with pouch–anal anastomosis (IPAA). By introducing the concept of a neorectal reservoir, Parks revolutionized the concept of function after proctectomy.[16] Despite the creation of an adequate reservoir volume, there were still several functional deficits associated with the original description of the Parks pouch—mostly as a result of mucosal stripping of the distal rectal stump to the dentate line with hand-sewn ileoanal anastomosis. Despite maintenance of the sphincter mechanism, because stool consistency is always liquid or pastelike, daytime and nighttime seepage and incontinence were not infrequent. The double-stapled technique was developed to maintain the anal transition zone and its intrinsic neural pathways with the goal of preserving the physiology of the rectum and enhancing continence.[17] Although early reports showed no difference in function when comparing mucosectomy with the double-stapled technique,[18] most recent data from high-volume centers have shown convincing evidence of improved function with the double-stapled technique, with regard to daytime and nighttime seepage and continence.[19–21] This observation is believed to be due to maintenance of the sampling reflex (RAIR) afforded by preservation of a strip of the distal rectum and proximal anal canal. At present, this is the standard approach in the setting of UC, although mucosectomy and hand-sewn anastomosis still remains the option for most patients with FAP who require complete mucosal resection because of oncologic considerations.

Although there does not seem to be an overall difference on comparing men and women with regard to pouch function, women who have undergone an IPAA and have had a vaginal delivery are more likely to have nocturnal bowel frequency and seepage than women who have undergone an IPAA but have not had a vaginal delivery.[22] This observation should be a consideration regarding the mode of delivery after IPAA.

When proctectomy is undertaken for a rectal malignancy, reconstruction is generally performed using the proximal colon as conduit. As seen after proctectomy for UC, the loss of the rectal reservoir function causes significant postoperative urgency, frequency, and incontinence because of the lack of neorectal capacity. When reconstruction is done with a colorectal anastomosis, a constellation of symptoms known as "anterior resection syndrome" (ARS) develops, which is further discussed below. In order to address this problem, various operative techniques have been used to augment the neorectal capacity.

Straight colorectal or coloanal anastomosis (**Fig. 2**) is the standard by which these alternative techniques are judged because it is the modality most frequently performed to achieve adequate length to reach the pelvic floor for primary anastomosis. Initially, the 5-cm-long side-to-end or "Baker-type" anastomosis was used (**Fig. 3**), and this afforded an increase in neorectal volume via the blind loop of the efferent limb. As a result of the experience gained by ileal J-pouch reconstruction after total proctocolectomy, the colonic J-pouch was developed and initially described by Lazorthes and colleagues[23] and Parc and colleagues.[24] Typically 6 to 8 cm in length (**Fig. 4**), a colonic J-pouch can be constructed when there is adequate colonic length and pelvic volume to allow for its construction and placement. The other primary reconstructive alternative is coloplasty, which was described in 1999 by Z'graggen and colleagues,[25] in which an 8-cm longitudinal incision is made on the antimesenteric border of the conduit and then closed in a transverse manner (**Fig. 5**).

Since the development of these techniques, there have been numerous publications comparing overall outcomes and functions to each other and to straight coloanal anastomosis.[26,27] Although here have been no prospective randomized trials comparing all 4 techniques, numerous retrospective studies and trials have been published. Meta-analyses and Cochrane reviews have endeavored to accurately define the outcomes of these procedures relative to each other.[19,28–31] Initial experience with coloplasty suggested a higher leak rate, although most recent studies have not borne this out. Overall, reports indicate that within the first 12 to 24 months postoperatively, neorectal

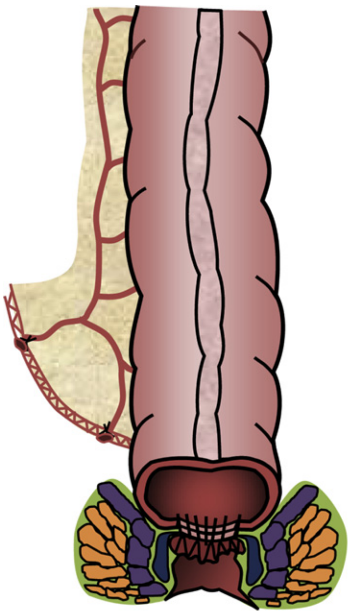

Fig. 2. Straight coloanal anastomosis.

function is best with the use of the colonic J-pouch when compared with coloplasty and straight anastomosis. There are some data to suggest, however, that creation of the pouch may be unnecessary and that side-to-end anastomosis (using the same total volume of neorectum without creating a common lumen) may offer equivalent functional results and no significant difference in complications.[32] This technique may also spare time and expense.[33] After 24 months, however, function among all the aforementioned options is essentially the same. The ability to create the colonic J-pouch is often limited by the lack of adequate length or a prohibitively narrow pelvis, especially in

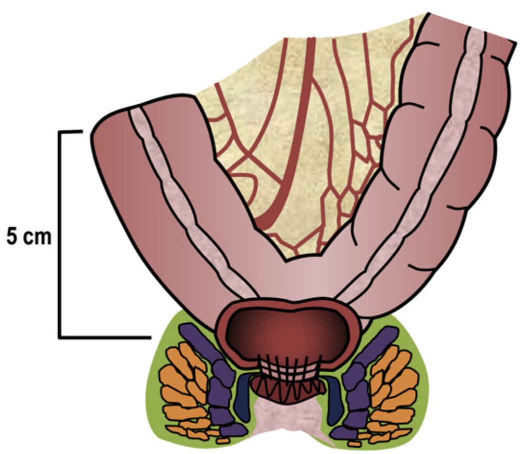

Fig. 3. "Baker"-type side-to-end coloanal anastomosis. The blind limb is constructed to be approximately 5 cm in length.

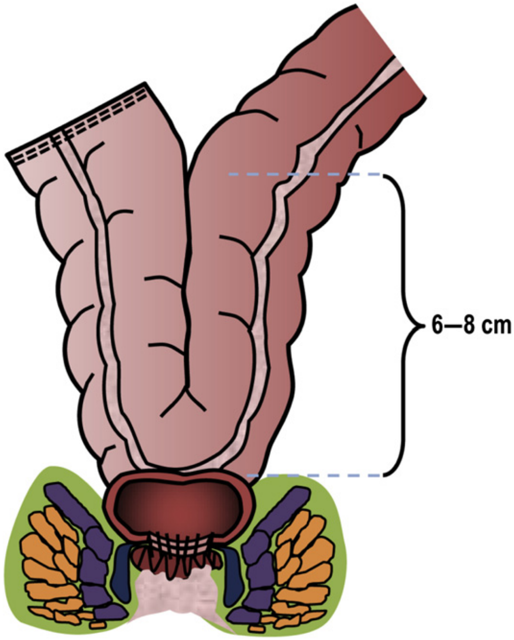

Fig. 4. Colon J-pouch. The typical colon J-pouch is constructed to be 6 to 8 cm in length.

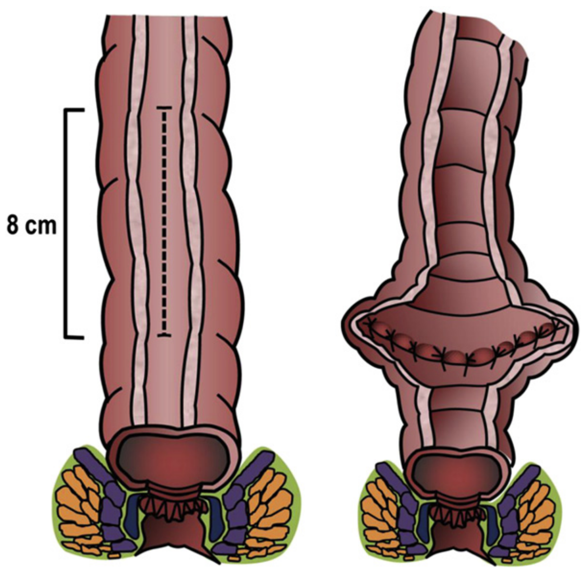

Fig. 5. Coloplasty: an 8-cm longitudinal incision is made along the antimesenteric taenia. The incision terminates 2 to 3 cm from the stapled end of the colon. The incision is then closed longitudinally.

men. The authors' preference is to perform a colonic J-pouch or Baker-type side-to-end anastomosis when technically feasible and reserve a straight coloanal anastomosis for the remaining cases. Alternative approaches such as transanal endoscopic microsurgery resection can be used in appropriately selected patients to preserve short-term and long-term anorectal function and QOL.[34]

SEXUAL FUNCTION POSTOPERATIVELY

Sexual dysfunction after proctectomy is frequently encountered in men, and likely underreported in women. As indicated earlier, before the development of the TME technique, rates of sexual dysfunction were as high as 75% in men. Sympathetic neuropathy caused by injury to the pelvic autonomic plexus at the sacral promontory causes ejaculatory difficulty, usually manifested as retrograde ejaculation. This difficulty can be avoided by minimizing traction on the IMA pedicle and trying to leave a 1-cm margin at the root of the IMA when dividing.[35] Parasympathetic injury either due to excessively lateral dissection along the lateral stalks or due to injury to the periprostatic plexus can cause impotence in up to 25% to 30% of men. With the anterior dissection in the TME, except when resecting an anteriorly based tumor, it is important to preserve the integrity of Denonvillier fascia that is invested by the periprostatic plexus, which can cause additional parasympathetic injury and impotence.[36] Before TME, postoperative impotence and retrograde ejaculation rates were observed in 25% to 75% of cases; however, careful adherence to TME principles have decreased this rate to 10% to 29% of cases.[1] Sexual manifestations of autonomic injury are much less pronounced in women but may cause vaginal dryness and dyspareunia. In addition, women have reported a loss of sexual desire and fear of fecal incontinence during intercourse after proctectomy and IPAA. On the contrary, in the setting of UC, men typically report improved sexual desire and function in the absence of any nerve damage after pelvic reconstruction.[37,38] As oncologic operations for rectal cancer may be more extensive, rates of sexual dysfunction have been shown to increase significantly after abdominal perineal resection (APR),[39,40] beyond the age of 65 years, after radiotherapy, and following intra-abdominal sepsis.[41]

Management of postoperative sexual function is multifactorial. Pilot studies of patients with neurogenic impotence after prostatectomy have shown that multidisciplinary treatment can demonstrate improvements in as soon as 6 to 12 months.[42] After proctectomy, pharmacologic treatment with phosphodiesterase inhibitors, such as oral sildenafil, has been shown to improve sexual function in 80% of patients compared with 17% with placebo.[43] Other, less-efficacious options include local intracavernous and intraurethral injections and vacuum constriction devices. Counseling of couples not only helps to reassure patients and their partners but also can enhance response to medical therapy.[35] Ultimately, in the event of failure of behavioral and pharmacologic therapies, placement of a penile prosthesis is effective but irrevocable and should be considered as a last resort.

BLADDER FUNCTION

Micturition is controlled by parasympathetic (contraction of the detrusor muscle), sympathetic (relaxation of the pelvic floor muscles and contraction of the trigone of the bladder), somatic (external sphincter muscle), and central nervous mechanisms.[44] Bladder dysfunction after pelvic surgery has been attributed to damage to the pelvic nerves, the sacral splanchnic (parasympathetic) nerves, the hypogastric (sympathetic) nerves, and the pelvic autonomic nerve plexus, with overall rates of dysfunction reported to range from 10% to 70%.[45–48] This variability in incidence may be explained by factors such as different degrees of preoperative symptoms, patient age, gender, length of follow-up, assessment instruments, and technical considerations, such as TME techniques, height of IMA/superior hemorrhoid vessel division, width of lateral node dissection, and nerve preservation technique.

As previously noted, the nerves that innervate the bladder course in close proximity to the rectum and its fascia propria. These nerves can be traumatized, damaged, or divided as a consequence of radiation and/or surgery. Injury to the sacral splanchnic nerves can also result in detrusor denervation and decreased sensitivity of the bladder with resultant urinary retention and overflow incontinence. The ligation of the IMA and dissection of the retrorectal space can cause damage to the superior hypogastric plexus and/or hypogastric nerves, causing reduced bladder capacity and urge incontinence. Anterolateral dissection in the "lateral ligament" area and division of Denonvillier fascia can damage the inferior hypogastric plexus and efferent pathways, resulting in urinary incontinence, voiding dysfunction, and bladder irritation (especially when injured bilaterally). Perineal dissection can indirectly damage the pudendal nerves, resulting in functional difficulties.[49]

In the immediate postoperative period, patients may have bladder dysfunction as a result of medications or inflammatory changes in the paravesical tissues or anatomic displacement of the bladder. This condition is typically managed with Foley catheter drainage/decompression, although it carries the concomitant increased risk of postoperative urinary tract infection. At 72 hours after proctectomy, the catheter can usually be removed and voiding proceeds normally. Approximately 40% of patients develop transient urinary retention, often requiring Foley catheter reinsertion.[50,51] Accordingly, the current Surgical Care Improvement Project guidelines exclude pelvic surgery from the requirement that Foley catheters are removed within 48 hours of surgery. The incidence of postoperative urinary retention seems to be higher in the elderly, generally men, and specifically higher in men with existing prostatic hypertrophy. However, there does not seem to be a significant difference when comparing APR with LAR.

Surgical technique plays a major role in preserving bladder function. The TME technique, coupled with nerve-preserving maneuvers, results in the most favorable outcomes. When conventional surgery is performed, and anatomic pelvic planes are not respected, permanent neurogenic bladder dysfunction can be seen in up to 10% of cases. In these cases, urodynamic studies identify significant signs of detrusor denervation including increases in bladder capacity, bladder compliance, residual volume, and an associated decrease in detrusor contraction pressure with increased volume of first sensation to void.[52] With meticulous dissection and preservation of the pelvic autonomic nerves, neurogenic bladder is not observed. The incidence of major UDs has decreased from 26% to 4% with the introduction of nerve-sparing mesorectal excision.[53] In Japan, autonomic nerve-preserving surgery for rectal cancer combines a radical lymphadenectomy along the aorta and iliac vessels with a sharp dissection along the presacral plane. Such extended lymphadenectomy has not been accepted outside of Japan because of unconvincing oncological results and fear of increased morbidity, such as bladder and sexual dysfunction. The laparoscopic approach may affect UD incidence, although recently, a study by Sartori and colleagues[54] suggests a very low incidence of UD when TME principles are followed. No sufficient data exists to comment on the impact of robotic dissection on bladder function. Intraoperative electrical stimulation of pelvic autonomic nerves and neuromonitoring may have a role in prevention or prediction of postoperative urinary[55] or fecal incontinence.[56] In the setting of inflammatory bowel disease, even when a "cancer surgery" is not performed and the dissection plane is kept close to the rectum, patients should be counseled regarding the risk of UD, including straining and sensation of incomplete emptying.[57] A recent study evaluating function in women after IPAA showed more severe UD and earlier onset of symptoms when compared with controls.[22]

Contradictory findings exist regarding the impact of radiation therapy on bladder function. Owing to variable regimens with regard to both dosage (short course vs long course) and timing (preoperative vs postoperative), it has been difficult to clearly delineate the impact of radiation therapy in relation to surgery. Most recently, Lange and colleagues[58] attempted to parse out the contribution of each treatment component (surgery and preoperative radiotherapy) to the development of long-term UD. QOL forms were available for 785 patients from the Dutch TME trial who were randomized to TME or TME with short-course preoperative radiation. The 5-year follow-up data showed that both new development and aggravation of UD occurs frequently after rectal cancer treatment. Postoperative urinary incontinence (38%) was associated with preoperative incontinence and female sex. Risk factors for difficulty in bladder emptying (31%) included preoperative difficulty, blood loss, and autonomic nerve damage. Preoperative radiation therapy did not seem to increase the risk of UD, highlighting the importance of surgical expertise and technique.

Treatment Options

Various treatment options exist in the management of postoperative UD. In the short-term, indwelling catheter can bypass issues due to incontinence and voiding dysfunction. If symptoms fail to improve with time, alternative options exist. It is prudent to consider formal urodynamic testing to aid in the diagnosis and implementation of a tailored treatment plan. Medications such as alpha-blockers function to relieve mechanical prostatic obstruction by relaxing the smooth muscle at the bladder neck and the prostatic capsule. 5-Alpha-reductase inhibitors only result in the reduction of prostatic size and therefore do not have a role in acute voiding dysfunction. Clean intermittent catheterization provides an alternative to prolonged indwelling catheter placement, which can cause local irritation, inconvenience, and risk of bladder infection. When catheters cannot be placed through the urethra, typically because of obstruction/stricture that cannot be successfully dilated, a suprapubic tube can be placed. If an enlarged prostate is the cause of retention, surgery may be considered when medication is not successful, and there are several types of surgical treatments available including transurethral resection of the prostate. Severe, persisting postoperative bladder dysfunction can be treated with stimulation of the sacral nerves using the Interstim (Medtronic Inc., Minneapolis, MN, USA) neuromodulation device, which is implanted into the buttocks with leads going into the S3 neural foramen. In severe recalcitrant cases, one has to consider urinary diversion with neobladder and urostomy construction.

ANTERIOR RESECTION SYNDROME

Regardless of the method used for rectal reconstruction, and potentially independent of the use of pelvic radiation therapy, 60% to 90% of patients undergoing proctectomy develop ARS.[59–62] To variable incidence and degrees, this syndrome of defecatory dysfunction is defined by a constellation of symptoms including frequency, urgency, fragmentation (incomplete evacuation and bowel movement “stacking”), and fecal incontinence. For many patients, ARS results in “toilet dependence,” and this fear of leaving the home has an obvious major impact on QOL. Multiple causative factors are involved, including a loss of the reservoir function of the resected rectum with impaired capacity and compliance of the neorectum,[63] iatrogenic internal sphincter damage,[64] autonomic nerve injury,[65] effects of chemoradiation,[66] changes in the colonic motility after mobilization of the descending colon,[67] and pelvic floor disease predating surgery.[68,69]

It is imperative that the surgeon counsel the patient preoperatively regarding the functional expectations after rectal resection and reconstruction. Such proper and comprehensive education and counseling can better empower patients as they decide on the prudence of rectal reconstruction and the consequences of that decision. Although ARS is predominately a physical problem, it can have a major impact on body image and psychosocial aspects of life for patients, specifically surrounding confidence and normality.[59] In reality, it is the rare patient who wishes to opt for permanent stoma simply because of the *potential* of postoperative bowel dysfunction.

ARS Treatment

Although a host of treatment options exist, most patients struggle through a difficult 6- to 12-month transition period while they trial various approaches. Bowel function changes over time, and patients can experience "good days" and "bad days" without any obvious cause or inciting event. Support services, either from experienced providers or patient support groups, can provide counsel and often ease this transition period.

Standard options

Fiber Modification of the stool texture and consistency is the mainstay of treatment of ARS. Oral supplementation with insoluble dietary fiber products reliably makes the stools bulky, facilitating the evacuation process by maintaining soft cohesive feces. Avoiding loose stools that are difficult to retain or hard small piecemeal stools can be challenging.

Time ARS symptoms tend to improve with time. Waiting for improvement of symptoms during a 6- to 12-month adaptation period can be frustrating but can provide patients with hope.

Antidiarrheal agents Antidiarrheal agents such as loperamide, diphenoxylate, codeine, and dilute tincture of opium function by slowing GI transit. This slowing helps to prevent multiple small stools and provides patients with a simple "tool" that can be used to provide some control of bowel dysfunction.

Enemas Transanal irrigation has been objectively studied and found to be an effective treatment of ARS, resulting in a marked improvement of continence scores and QOL.[70]

Biofeedback

Biofeedback therapy, aimed at lowering the threshold for discrimination of a rectal sensation of distension and synchronizing voluntary contraction of the EAS in response to such distension, may be an effective treatment of patients with ARS. Using a biofeedback program Kim and colleagues[71] have shown improvements in fecal incontinence scores, number of bowel movements, use of antidiarrheal medication, and anorectal manometry values. After a successful course of rehabilitation, many patients show an improvement in objective incontinence scales, whereas others become symptom free.[72]

Sacral nerve stimulation

More recently, investigators have studied the utility of neuromodulation, delivered by the implantable sacral nerve stimulator, on ARS in the postoperative setting. The largest study prospectively evaluated 14 patients for a median of 12 months.[73] Of these patients 7 noted considerable improvement in incontinence, frequency, and QOL after sacral nerve stimulation implantation. A possible explanation for poor outcome in the other 7 patients is surgical damage to the nerve supply innervating the rectum and pelvic floor and pelvic fibrosis resulting from neoadjuvant treatment and surgery.

Diversion/colostomy

Although generally considered a "last resort," some patients become so frustrated with ARS that they opt for fecal diversion, which can be accomplished either with a colostomy or ileostomy. Technically, the creation of a left-sided colostomy can be challenging because the redundant sigmoid has already been resected. While taking extreme care to protect the blood supply to the neorectum (to prevent necrosis), complete splenic flexure mobilization generally provides adequate length for a descending colostomy. Ultimately, the prolapse and pouching dysfunction commonly seen with a transverse colostomy and the intrinsic fluid and electrolyte issues associated with an ileostomy are avoided.

Quality of life and the stoma—its impact on ARS

As we better understand anatomy and pathophysiology, while concurrently embracing technologic advances in anastomotic staplers and surgical techniques, sphincter-preserving and reconstructive procedures have become the preferred form of treatment for patients with either low-lying rectal cancers or inflammatory bowel disease. Patients actively seek out specialists who can offer any option other than a permanent stoma. In reality, when evaluated systematically, the preconception that restoration of bowel continuity offers superior QOL has been challenged. Published reports suggest that the QOL after LAR might even be worse than after APR.[74–77]

In 2005, a Cochrane review of the literature regarding QOL after LAR and APR was performed. A total of 11 studies met the inclusion criteria: 6 showed no difference in QOL, 1 study showed that a stoma slightly affected QOL, and 4 showed significantly poorer QOL for patients with stoma after APR. The investigators concluded "It is not possible to draw conclusions whether the QOL measures of stoma patients are poorer than for non-stoma patients. However, the results challenge the assumption that people with stoma generally fare less well than non-stoma patients."[78]

To better understand this discrepancy, Cornish and colleagues[79] performed a meta-analysis in 2007. The investigators included 1443 patients from 11 (3 prospective) studies that assessed QOL using validated tools. Their results showed no difference in general health preconceptions after rectal cancer excision by LAR or APR. Patients with permanent stomas did not show any difference in "body image" and, in fact, had improved psychological and emotional scores. The most plausible explanation is that the negative psychological attitudes toward a stoma were balanced by poor functional outcomes associated with a low colorectal/anal anastomosis. Perhaps the "finality" of treatment with a permanent procedure also contributes to improved emotional scores for APR patients. Long-term comparison remains in question because most studies follow-up patients for 1 year and perhaps patient perceptions would change over time. Interestingly, when patients undergoing APR were asked postoperatively if they would choose LAR or APR, 80% stated that they would choose APR again.[80]

While there exists an extensive literature evaluating QOL after total proctocolectomy and restorative IPAA, there are little data comparing reconstruction to end ileostomy. Camilleri-Brennan compared QOL after total proctocolectomy with end ileostomy (TPC I) to that of the general public and found that when the diseased colon and rectum were removed, the patients' QOL was restored to normal, despite the presence of a permanent ileostomy.[81] The investigators then compared IPAA to end ileostomy. A total of 19 patients undergoing IPAA were matched and compared with those undergoing TPC I. Objective QOL tools were used to compare the 2 groups. IPAA was associated with a better perception of body image, although the general QOL was similar in both groups.[82]

Understanding the challenges of ARS and its importance in the management of patients with low rectal cancers underscores the fact that ARS should be addressed during the initial discussions as patients choose between reconstruction and stoma options, and this can be challenging on multiple levels. It is difficult for the average patient to appropriately understand the functional changes of ARS along with its impact on QOL. It is hard enough for patients to comprehend the new diagnosis of rectal cancer. Their initial focus is on survival, not on the decision between reconstruction and permanent stoma. Armed with a more comprehensive perspective, an experienced surgeon may recognize a patient with a high risk of postoperative ARS/incontinence and counsel that patient toward a stoma, even though a sphincter-sparing resection and anastomosis would be technically feasible. Such a recommendation often scares and motivates a patient to seek a second opinion. Hospital-based education programs, enterostomal nurse consultation,[83] stoma models, patient support groups, and online education and support options may be useful aids for many patients as they ponder and make this critical decision.

SUMMARY

Proctectomy often results in functional outcomes that can be significantly different compared with preoperative baseline status. A comprehensive understanding of normal anatomy and function, as well as preoperative factors that may affect postoperative function, is crucial to guide an appropriate preoperative discussion outlining risk and options. Familiarity with operative technique and pitfalls as well as reconstructive options is necessary to optimize results. Common postoperative complications include derangements of defecatory, sexual, and urinary function. Management of these disorders can be complex and at times unsuccessful and require an understanding of the social and emotional factors involved. A rational approach to preoperative assessment and decision making will help maximize the potential for setting expectations as patients make critical decision that affects QOL.

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