

Indications and Options for Surgery in Ulcerative Colitis

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KEYWORDS

- Inflammatory bowel disease Surgery Ulcerative colitis Total proctocolectomy
- Ileal pouch-anal anastomosis

KEY POINTS

- Current elective indications for surgical therapy in ulcerative colitis include cancer, risk for cancer (dysplasia), stricture, medical intractability, overwhelming side effects of medical treatment, and unresponsive extraintestinal manifestations.
- Patients with ulcerative colitis may require emergency surgery in the setting of acute severe colitis that fails to respond to rescue therapy, fulminant colitis, toxic megacolon, perforation, or stricture.
- Total abdominal colectomy is a surgical treatment option that allows patients who require emergency surgery to reestablish nutrition and withdraw immunosuppressive medication so that pelvic surgery and ileoanal pouch formation is performed when the patient is in good health.
- Anastomotic techniques included double-stapled anastomosis and hand-sewn techniques with mucosectomy. Outcomes for both techniques are acceptable and the clinical circumstances, such as dysplasia, need for oncologic margins, and pouch reach into the pelvis, should determine the technique used.

INTRODUCTION

Ulcerative colitis (UC) is a chronic inflammatory disease characterized by inflammation that is limited to the mucosa of the colon and rectum.¹ The disease starts at the rectum and extends proximally for varying lengths and in its greatest extent can reach the cecum.² Approximately 500,000 people in the United States carry a diagnosis of UC, with an incidence of around 12 per 100,000 per year.³ Surgery to remove the colon and rectum is considered curative. Between 4% and 9% of

Disclosures: Neither author has a disclosure to make.

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Surg Clin N Am 95 (2015) 1211–1232 http://dx.doi.org/10.1016/j.suc.2015.07.003 0039-6109/15/\$ – see front matter © 2015 Elsevier Inc. All rights reserved.

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patients with UC require proctocolectomy within the first year of diagnosis, and the risk of surgical treatment following that is 1% per year.^{4–6} Patients with the following risk factors are more likely to develop complications requiring colectomy: disease that extends proximal to the splenic flexure, male gender, patients with corticosteroid resistance, and complications related to corticosteroid administration.⁷ Ultimately, patients with UC may require surgery for presence of cancer, accumulating risk for cancer development, medical intractability, or development of a life-threatening complication such as toxic colitis, toxic megacolon, and hemorrhage. Surgical consultation can provide discussion of risks and benefits of surgery, type of surgery for which the individual patient is a candidate, and long-term outcomes of surgical treatment. This article discusses the indications and surgical options for patients with UC.

INDICATIONS FOR SURGERY IN PATIENTS WITH ULCERATIVE COLITIS Cancer Risk

Colorectal cancer is one of the most common causes for mortality in patients with UC.⁸ Cumulative risk for colorectal cancer in patients with ulcerative colitis is 2% after 10 years, 8% after 20 years, and 18% after 30 years of diagnosis.⁸ Proctocolectomy is recommended in patients with ulcerative colitis who develop colon or rectal cancer, high-grade dysplasia, nonadenomalike dysplasia–associated lesion or mass, and adenoma associated with dysplasia at the base or surrounding areas of inflammation.^{9–11} Proctocolectomy in patients with ulcerative colitis with low-grade dysplasia is controversial and should be recommended based on the individual patient's risk for carcinoma development versus surgical complication.¹² Stricture in the setting of ulcerative colitis should also prompt surgical therapy. Although only 25% of strictures that develop in the setting of UC are malignant,¹³ biopsy to differentiate benign versus malignant stricture is unreliable.¹⁴

Intractability

The most common indication for elective surgical treatment of UC is intractable disease. Intractability is present when medical therapy fails to control disease symptoms or extraintestinal manifestations, when medication side effects produce poor quality of life or problems with patient compliance, or when effective long-term medication use results in accumulating or unacceptable risks.¹²

Emergency Situations

Acute severe UC, the most common indication for emergent surgery, has been defined by passage of more than 6 bloody stools per day with associated fever, tachycardia, hemoglobin level less than 75% of normal, and an increased sedimentation rate. Fulminant colitis occurs when patients have more than 10 bloody stools per day, anemia requiring transfusion, and colonic distention on abdominal radio-graphs.¹⁵ Severe colitis that is refractory to intravenous steroid treatment may undergo medical salvage therapy with infliximab or cyclosporine. However, presence of impending perforation, multisystem organ dysfunction, or failure to respond to rescue medical therapy is an absolute indication for surgical therapy.¹⁶ Toxic megacolon is defined as the presence of transverse colon dilatation greater than 6 cm, which can progress to pneumatosis and colonic perforation.¹⁷ Because perforation is associated with a mortality between 27% and 57%,^{18,19} patients should be taken for surgery if toxic megacolon persists or does not improve with medical treatment.

EMERGENT SURGICAL TECHNIQUES Emergent Open Total Abdominal Colectomy with End Ileostomy

Open abdominal colectomy is the most common emergent procedure in patients with UC. This procedure can be performed quickly, thereby minimizing time under anesthesia. The risk of mortality and morbidity to the patient is half that of total proctocolectomy (TPC).²⁰ In addition, total colectomy allows for removal of the bulk of diseased colonic segment, patient symptoms to subside, steroid withdrawal, and nutritional improvement so further reconstruction can be performed when the patient is in optimal health.

Preoperative planning

All patients who undergo placement of a temporary or permanent ileostomy should have education regarding its function, complications, and effect on quality of life. Health care providers should show patients pictures of a stoma, explain the daily care of a stoma, and introduce the equipment necessary to pouch the stoma. Other patients who have recovered from surgeries in which a stoma was placed may volunteer to talk to patients on a peer basis to reduce fear. The patient's abdomen should be marked away from bony prominences and skin folds and in a position that the patient can visualize. The placement of a stoma should be assessed in the supine, sitting, and standing positions to visualize changes in the abdominal wall contour. Attention to these details preoperatively improves the function and care of a stoma postoperatively.

Prep and positioning

The patient is brought to the operating room and general anesthesia is induced. A Foley catheter is inserted and the patient is placed into lithotomy position. Lithotomy position allows the surgical assistant to move to a position between the patient's legs when mobilizing the splenic flexure and improve surgical visualization. The patient's abdomen is prepped and draped and preoperative antibiotics are administered.

Intra-abdominal access

A full midline laparotomy incision allows for visualization of the hepatic and splenic flexures for swift mobilization. Placement of self-retaining retractors such as a Book-walter may be used to improve exposure. Alternatively, a large or extralarge rigid wound retractor can be placed, with rolled laparotomy pads used to assist with retraction and exposure.

Right colon mobilization

The right colon must be fully mobilized by incising the white line of Toldt from inferior to superior, thereby allowing rotation of the cecum, right colon, and mesocolon medially. As the right colon is rolled medially, the avascular, areolar plane between the right mesocolon and retroperitoneum is divided. In addition, the terminal ileum attachments to the retroperitoneum above the pelvic inlet and right common iliac vessels must be incised for ileal mobility (Fig. 1). Care must be taken to avoid injury to the gonadal vessels, ureter, and duodenum, which lay posterior to the areolar plane. The retroperitoneal location of these structures is preserved as the right colon is released and rolled medially. The gastrocolic ligament is incised by dissecting the omentum off the proximal transverse colon in a medial to right lateral fashion. In addition, the hepatocolic ligament is ligated (Fig. 2).

Pitfalls

Dissection in a plane lateral to the white line of Toldt and too far superior results in right kidney mobilization. Failure to retract the right colon medially while dissecting the areolar attachments may result in duodenal injury secondary to poor visualization.



Fig. 1. The terminal ileum and its mesentery are lifted from the retroperitoneal attachments just above the iliac vessels and right ureter. *Arrow* marks right ureter.

However, excessive medial retraction of the right colon at the level of the duodenum can result in avulsion of a large venous collateral branch between the inferior pancreaticoduodenal vein and middle colic vein.

Omental preservation

The omentum is then dissected from the transverse colon by incising the avascular plane between them. The omentum with pale yellow fat is retracted superiorly as the transverse colon and deeper yellow epiploicae are retracted inferiorly. Entrance into the lesser sac can be confirmed by visualization of the posterior stomach superiorly and the transverse mesocolon and pancreas posteriorly. As the surgeon proceeds in the right to left direction, there is a double leaflet of the omentum, which should be dissected from the distal transverse colon for full mobilization. The surgeon should follow the superolateral movement of the colon into the left upper quadrant to avoid entry into the colonic lumen.

Left colon mobilization

The sigmoid colon is then identified and retracted medially in order to place the peritoneal reflection on stretch. Incision of the left line of Toldt from inferior to superior allows the



Fig. 2. The peritoneal reflection in the right paracolic gutter must be incised to rotate the right colon and its mesentery off the retroperitoneal attachments. The *white line* marks the plane required for incision.

surgeon to identify the loose areolar plane between the left mesocolon and retroperitoneum. Additional lateral attachments of the sigmoid colon may require incision to allow for full retraction in a right medial direction. As the left colon is retracted to the right side of the patient, the gonadal vessels and then more medially the ureter can be identified crossing over the iliac vessels (Fig. 3). Working in an inferior to superior direction the retroperitoneum is dissected from the mesocolon using a combination of blunt and sharp dissection. As the surgeon encounters the Gerota fascia more superiorly, this dissection becomes more difficult because the attachment between mesocolon and fascia is tougher (Fig. 4). The left colon is completely mobilized when the retroperitoneum has been released from the left mesocolon several centimeters short of the abdominal aorta.

Splenic flexure mobilization

Incision of the peritoneal reflection in the left paracolic gutter is carried cephalad past the splenic flexure. The peritoneal incision is carried cephalad past the splenic flexure of the colon. Careful medial retraction of the proximal left colon allows for further dissection of the left mesocolon off the Gerota fascia (Fig. 5). Cautery of the phrenocolic and splenocolic ligaments is performed. Eventually the surgeon should be able to encircle the splenic flexure by entering the plane from the previous omental dissection. The remaining attachments are then cauterized.

Pitfalls

The tendon of the iliopsoas muscle may be mistakenly identified as the ureter by the novice. This tendon is located superolateral to the ureter. Complete dissection of all fat from the iliopsoas muscle may signify that the retroperitoneal structures are retracted medially with the left mesocolon. Dissection in a plane more medial, between the left colon and retroperitoneum, should be identified. The surgeon should use the same areolar plane between the proximal left colon and Gerota fascia to avoid mobilizing the left kidney or bleeding from dissection within the pararenal fat. Tearing of the splenic capsule can occur from aggressive medial and inferior traction on the proximal left colon before ligament transection at the splenic flexure. If visualization of the plane from inferior to superior becomes difficult, the surgeon should approach the splenic flexure from the previous gastrocolic dissection used to remove the omentum from the transverse colon. In addition, failure to dissect the tough Gerota facial attachments to the proximal left colon and its mesentery, whereas splenic flexure attachments to the colon are lateral and superior.



Fig. 3. The left ureter is visualized as it crosses the iliac vessels. *Arrows* mark left ureter as it crosses the iliac vessels.



Fig. 4. The areolar attachments of the left colon mesentery must be incised to mobilize it from the Gerota fascia and the retroperitoneum. The *black dotted line* marks the line of left colon mesentery attachment to Gerota's fascia and the retroperitoneum.

Bowel transection

A linear stapler is fired across the terminal ileocecal junction and at the rectosigmoid junction.

Division of the vascular pedicles

Division of the mesocolon can now proceed in a right to left fashion. The surgeon can use an energy device or clamp-and-tie technique. A window above and below each of the vascular pedicles (ileocolic, right colic, middle colic, left colic, and inferior mesenteric vessels) can be made to ensure complete ligation of the pedicle.

Pitfalls

The surgeon should take care not to enter the areolar plane between the mesorectum and parietal fascia of the pelvis in order to preserve dissection planes for future surgical reconstruction. If necessary, the surgeon may leave a cuff of sigmoid colon on the distal staple line to avoid septic complications at the pelvic inlet. It is recommended to take the vascular pedicles midway between their origin and the mesenteric side of the



Fig. 5. Blunt dissection is used to visualize the splenocolic ligament for full splenic flexure mobilization.

colon. This method allows for control of the major vessels before branching into smaller vessels but preserves a proximal length that can be grasped and easily controlled in the event of bleeding. The 1 exception to this recommendation is the ileocolic vessel when future ileoanal pouch reconstruction is planned. Preservation of the entire ileocolic pedicle length is important for ileal collateral vessels that supply the future ileal pouch.

Ileostomy creation

The right lower quadrant of the abdominal wall is optimal for the new ileostomy. Start by making a small circumferential incision through the skin and dermis, which is amputated. The surgeon then dissects down through the subcutaneous tissues using a combination of cautery and blunt dissection. Retractors are then used to visualize the anterior rectus sheath, which is incised vertically. Heavy scissors are then placed vertically, opened, and rotated 90° to bluntly retract the rectus fibers and expose the posterior rectus sheath. Retractors are replaced to include the rectus fibers, and the posterior rectus fascia is incised vertically for several centimeters to allow inclusion of 2 fingers. The terminal ileum is delivered through this orifice without tension, while ensuring that the mesentery does not become twisted through the ileostomy orifice.

Pitfalls

The terminal ileum should sit at the abdominal wall without tension. Failure to mobilize the terminal ileal mesentery from the retroperitoneum limits the mobility of the ileostomy. Inability to lift the terminal ileum through the abdominal wall orifice may be secondary to a bulky small bowel mesentery. This technique requires opening of the fascia and skin orifice to accommodate further ileal mobilization.

Procedure completion

The abdomen is irrigated and inspected to ensure hemostasis in all quadrants. The midline incision is closed. The ileostomy is matured in a Brooke fashion by amputating the distal staple line and folding the ileum over itself for 1 to 2 cm before suturing the distal ileal to the deep dermis.

Additional Considerations

Fate of preserved rectum

A total abdominal colectomy with end ileostomy and Hartmann pouch of the rectal stump is the preferred procedure for patients with UC who are acutely ill. Before reconstructive surgery, a pathologic assessment of resected tissue can confirm or change the initial diagnosis. In addition, this procedure allows patients to assess the impact of an ileostomy on their lives. This assessment allows patients to be more informed about choices for future elective surgery. If present, rectal symptoms before proctectomy can be controlled with mesalamine enemas. However, because of ongoing low-grade symptoms from the rectal pouch and the risk for rectal cancer, proctectomy should be performed whether the patient desires ileal anal anastomosis or not.²¹

Laparoscopic versus open approach

Although the technical aspects of laparoscopic colectomy, proctectomy, and ileal anal pouch creation are beyond the scope of this article, some surgeons have shown that a minimally invasive approach in patients with fulminant UC is a reasonable operative strategy. Such an approach by experienced surgeons has a low complication rate, low conversion rate, and increased ability to pursue a laparoscopic completion proctectomy with ileal pouch–anal anastomosis (IPAA) in the future.^{22–24}

Poor rectal tissue integrity

If the colorectal segment has severe disease, the tissue may not have enough integrity to hold and heal a staple line. In these circumstances, the surgeon may bring the proximal end of the Hartman pouch to the level of the skin as a matured mucus fistula, above the fascia as a possible fistula if the staple line fails within the subcutaneous tissue, or the surgeon may suture the rectosigmoid closed and place a Malecot drain into the rectal lumen for decompression and distal drainage.

Indeterminate colitis

In 10% of patients who undergo total abdominal colectomy for acute severe or fulminant colitis, a definite diagnosis of Crohn versus UC cannot be made. Patients with indeterminate colitis have a higher rate of future Crohn's disease, perineal complications, pouchitis, and eventual IPAA loss. Patients with indeterminate colitis should be counseled regarding these increased risks before reconstructive surgery. Use of serologic markers to identify patients with indeterminate colitis who are at increased risk for these complications may inform individual patient decision making.²⁵

ELECTIVE SURGICAL TECHNIQUES Total Proctocolectomy with End Ileostomy

Patients who require elective surgery for UC may undergo a TPC with end ileostomy. This procedure has less associated morbidity because of the lack of an intestinal anastomosis. This procedure should be considered in patients with UC with impaired sphincter function, low rectal cancer, significant comorbid conditions, or patients who do not wish to assume the additional risk with restorative procedures.

Follow steps previously described for total abdominal colectomy but do not transect the colon at the rectosigmoid junction.

Rectal dissection

The small bowel should be retracted into the upper abdomen. The left ureter is identified as it crosses over the iliac vessels. The peritoneal reflection overlying the rectum is incised bilaterally, and the presacral space is entered. Blunt dissection is performed beneath the superior hemorrhoidal vessels posterior to the mesorectal plane and in the areolar tissue until both sides meet (Fig. 6). The superior hemorrhoidal vessels



Fig. 6. The rectum is raised superiorly and anteriorly to expose the areolar plane posterior to the mesorectum and inferior to the superior hemorrhoidal vessels (*right arrow*). The up arrow marks the peritoneal refection over the left mesorectum, which must be incised to further mobilize the rectum.

are ligated with an energy device or suture ligation. The hypogastric nerves can be identified and swept posteriorly away from the mesorectum in order to preserve their function. Using a St Mark retractor, the mesorectum is retracted anteriorly while the avascular areolar plane is dissected. Care must be taken to follow the areolar plane as it meets the mesorectum anteriorly in order to avoid entry into the posterior presacral fascia and venous plexus, which can cause troublesome bleeding (Fig. 7). The plane is followed until the levators can be visualized within the posterior pelvic floor distal to the coccyx. Division of the lateral stalks on the right and left sides of the rectum is taken in a semicircular fashion. The areolar plane of the lateral stalks is exposed by retracting the rectum superiorly and placing the St Mark retractor on the rectum with medial force (Fig. 8). The surgeon can then incise lateral stalks as they course anteriorly. The anterior peritoneal plane is then incised with cautery and the areolar plane closest to the rectum is cauterized to preserve the parasympathetic plexus and avoid injury to the seminal vesicles, prostate, and vagina. Visualization of the anterior plane is best with superior and posterior retraction of the rectum and the St Mark retractor placed just above the plane of dissection and retracted anteriorly (Fig. 9). The dissection is complete when the rectum is fully mobilized to the levator ani muscles circumferentially.

Pitfalls

Dissection in the presacral plane away from the posterior mesorectum or failure to adequately replace the St Mark retractor as the dissection proceeds more distally on the rectum may lead to bleeding within the presacral space. This bleeding is most common in the distal third portion of the rectum as it begins to lie more anteriorly and horizontally within the pelvis compared with the more vertically oriented proximal rectum.

Anorectal dissection

The distal rectum and anal canal are removed from a perineal approach. For patients with UC with no malignancy, an intersphincteric proctectomy can be performed to preserve skeletal muscle and facilitate perineal wound closure and healing. However, in patients with UC who have distal rectal cancer and require a clear circumferential margin, an extrasphincteric perineal dissection should be performed.



Fig. 7. A St Mark retractor is used to retract the rectum superiorly and anteriorly and expose the areolar plane between the presacral fascia and the mesorectum. The dotted line marks the plane of dissection.



Fig. 8. The left lateral stalk of the rectum is exposed before incision. The rectum is retracted to the right and superiorly with the St Mark retractor. The left ureter and ovary are protected from injury with a malleable retractor. The dotted line marks the plane of dissection from posterior to anterior around the rectum.

Intersphincteric proctectomy

Eversion of the anal canal is performed by placing a self-retaining anal retractor (Lone Star anal retractor) or with 2 Gelpis. The intersphincteric plane is identified by palpation and injected with local anesthetic with epinephrine to facilitate hemostasis and plane dissection. The anoderm overlying the intersphincteric plane is incised. The plane is developed between the white-appearing internal anal sphincter and the red external anal sphincter. Initially, dissection is performed in the posterior plane more proximally toward the abdominal dissection. An assistant at the abdomen can assist with retraction of a Deaver placed within the intersphincteric plane as the perineal surgeon approaches the levator ani. Using the second hand, the abdominal surgeon palpates the plane between the abdominal surgeon's fingers to identify the plane through the levator ani. Once the abdominal and perineal planes are connected, the perineal surgeon follows the same planes circumferentially around the distal rectum and anal



Fig. 9. The anterior peritoneal reflection to be incised using a semicircular extension of the plane exposed during lateral stalk division.

canal. In the anterior plane, the perineal surgeon must avoid straying away from the intersphincteric plane into the vagina or prostate anteriorly or the cervix and seminal vesicles superiorly. Placement of a finger with the vagina by the perineal surgeon and assistance from the abdominal surgeon to identify the plane used for pelvic dissection of the rectum away from the vagina or prostate is helpful to avoid injury (Fig. 10).

Extrasphincteric proctectomy

Patients with UC with distal rectal cancer require a clear circumferential margin to provide oncologic control. This margin requires resection of the entire sphincter complex. A self-retraining anal retractor is placed to evert the anal canal. A circumferential incision is made outside the anoderm and to include a portion of perianal skin. The dissection proceeds proximally outside the external sphincter within the ischioanal fossa laterally, anterior to the coccyx posteriorly and at the peroneus muscle anteriorly. The perineal surgeon then dissects in the posterior plane between the coccyx posteriorly and external sphincter anteriorly. Once dissection is proximal to the coccyx, the abdominal surgeon guides the perineal surgeon through the levator ani via palpation of the posterior dissection plane within the pelvis. Continued proximal dissection by the perineal surgeon allows connection of the perineal and abdominal surgical planes. Once this is achieved, the perineal surgeon can hook a finger along the levator ani muscles bilaterally, which allows the perineal surgeon to safely cauterize the ischioanal fat and levator ani posterolaterally. The anterior dissection should be performed carefully to prevent intrusion into the vagina and prostate, which can bleed, or even more anterior intrusion into the membranous urethra. Placement of a finger around the anterior tissue still requiring dissection at the level of the distal pelvic dissection can help guide the perineal surgeon to stay anterior to the Denonvilliers fascia along the rectovaginal septum and posterior to the prostate.

End ileostomy creation

Same as previously described.

Procedure completion

Complete circumferential excision of the anorectum allows removal of the colon and rectum from the abdominal incision. The midline incision is closed after abdominopelvic irrigation and assurance of hemostasis. A drain is placed in the posterior pelvis to



Fig. 10. The intersphincteric dissection is complete with exposure of the incised levator muscles and the retained external anal sphincter.

prevent fluid accumulation, abscess formation, and breakdown of the perineal closure. The perineal incision is closed in an interrupted fashion with 0 Vicryl sutures by first closing the levator ani from posterior to anterior. The external anal sphincter muscle or ischioanal fat from proximal to distal is also loosely approximated. Because of the propensity of this wound to become infected and break down, the skin is left opened and packed with damp to dry Kerlix gauze.

Additional Considerations

Long-term complications

Although the risk of postoperative complications is lower with this procedure, patients remain at risk for parastomal hernia, stomal prolapse, pouching difficulties, small bowel obstruction, and/or delayed healing of the perineal wound. In addition, the pelvic dissection puts patients at risk for pelvic nerve damage with impairment of sexual or urinary function.

Delayed intersphincteric proctectomy

Patients who are severely malnourished or steroid dependent may benefit from a delayed intersphincteric proctectomy. Placement of a low staple line at the anorectal junction within the pelvis allows the anal canal to be removed at a later date from a perineal approach.

Total Proctocolectomy with Ileal Pouch–Anal Anastomosis

TPC-IPAA was developed in the early 1980s and is the procedure of choice for many patients with UC, because it eliminates all active disease and eventually leaves the patient stoma free.

Preoperative considerations

Patients who undergo TPC-IPAA have multiple semisolid bowel movements per day. Thus, it is crucial that patients have adequate sphincter function in order to maintain continence. Patients with poor preoperative fecal continence have poor functional outcomes after this surgery and should instead undergo proctocolectomy with end ileostomy. It is controversial whether an ileal pouch should be created in patients with middle or distal rectal cancers because this may not leave adequate cancer resection margins above the dentate line. In addition, patients with locally advanced rectal cancer should receive radiation treatment before surgical treatment and formation of an ileal pouch in order to avoid direct radiation enteritis, poor pouch function, and pouch failure. Patients with a cecal cancer may require resection of distal ileum and its associated mesenteric vessels to obtain adequate margins, and thus may not allow the formation of a tension-free IPAA.²⁶

Staged procedures

Proctectomy with formation of an ileal pouch may follow an earlier total colectomy in patients with severe malnutrition, chronic steroid use or dependency, or need for emergent surgery. For these high-risk patients, avoidance of proctectomy and ileal pouch formation avoids pelvic sepsis and higher risk of pouch failure.

Perform a total proctocolectomy to the point of circumferential rectal dissection to the level of the levator ani.

Separation of distal colon and rectum A digital rectal examination is performed to confirm the level of rectal transection at the top of the anal canal. The rectum is amputated transversely with various techniques (Fig. 11). A transverse stapler is used across



Fig. 11. Transanal digital assessment to mark the level of planned stapled anastomosis. (*From* Kirat HT, Remzi FH. Ileal pouch-anal anastomosis: indications and technique. Semin Colon Rectal Surg 2009;20(2):82–7; with permission; and *Courtesy of* CCF, 2003.)

the distal rectum if a double-stapled approach is used. Alternatively, a purse-string suture is placed at the anorectal junction and a right-angled bowel clamp placed across the distal rectum. The rectum is then sharply amputated above the purse-string suture.

Mobilization of distal ileum An energy device or cautery is used to mobilize the mesentery of the distal terminal ileum to the mesenteric root above the third portion of the duodenum. This method allows the ileal pouch to reach the anal canal without tension.

Formation of J pouch The distal 30 to 40 cm of ileum is folded back on itself, approximating the antimesenteric sides, and creating a 15-cm J pouch (Fig. 12). The reach of this pouch to the anal canal is typically adequate if the base of the J pouch reaches



Fig. 12. Creation of J pouch. (*From* Kirat HT, Remzi FH. Ileal pouch-anal anastomosis: indications and technique. Semin Colon Rectal Surg 2009;20(2):82–7; with permission; and *Courtesy of* CCF, 2003.)

below the pubic symphysis. If the approximated base of the J pouch does not reach, further mobilization maneuvers must be performed before pouch creation. For J-pouch formation, an enterotomy is made at the base of the J pouch on the antimesenteric border. A linear 75-mm or 100-mm stapler is fired through the enterotomy after ensuring no small bowel mesentery is included with the staple line, which can be confirmed by medial rotation of the antimesenteric boundaries of the 2 small intestinal limbs toward the posterior aspect of the pouch before stapler closure. The surgeon can also place a finger between the mesentery of the pouch and the anterior stapler to ensure that there is no mesenteric impingement. A second or third reload may necessary to achieve a pouch of 15 to 20 cm in length.

Further mobilization if the pouch does not reach

- A. The ileocolic vessels can be excised at the proximal and distal takeoff to allow the distal apex of the pouch more mobility (Fig. 13).
- B. Peritoneal tissue superior to the third portion of the duodenum and to the right of the superior mesenteric artery can be dissected.
- C. Transverse linear incisions along the peritoneum overlying the mesentery or vascular pedicles of the small intestine can be incised in a stepladder approach from distal to proximal. Care should be taken to only incise the peritoneal reflection overlying the mesentery because deeper dissection can cause bleeding that requires vascular ligation and possible pouch ischemia and necrosis.
- D. A bulldog over distal branches of the ileal pouch to further release the mesentery and test for pouch ischemia before vessel ligation can be used when small increments of mobility are needed. Again, the risk of pouch ischemia and necrosis is present when this approach is undertaken.
- E. Ileal pouch creation in an S configuration can achieve up to an additional 4 cm of reach to the anal canal. The S pouch is created by using three 12-cm to 15-cm limbs of small intestine, which are approximated with seromuscular stay sutures and a 2-cm afferent distal limb on the third arm of the pouch. An S-shaped enterotomy is made on the antimesenteric side of the pouch. Two running seromuscular suture lines are placed on the shared wall of the small intestinal limbs located on the posterior aspect of the S pouch. A continuous anterior seromuscular suture line between the 2 lateral limbs is used to close the anterior portion of the pouch (Fig. 14).



Fig. 13. Maneuvers for pouch to reach the level of the levator floor. (*From* Kirat HT, Remzi FH. Ileal pouch-anal anastomosis: indications and technique. Semin Colon Rectal Surg 2009;20(2):82–7; with permission; and *Courtesy of* CCF, 1998.)



Fig. 14. Creation of S pouch. (*From* Kirat HT, Remzi FH. Ileal pouch-anal anastomosis: indications and technique. Semin Colon Rectal Surg 2009;20(2):82–7; with permission; and *Courtesy of* CCF, 2003.)

Formation of anal anastomosis A purse-string suture is placed within the enterotomy used to create the J pouch in order to secure the anvil of a circular stapling device. An assistant then goes to the perineum to place the stapler through the anal canal. Care should be taken to control the stapler placement through the anus so as not to rip the apex of the short anal canal. The abdominal and perineal surgeons work together to place the base of the stapler so that the trocar of the stapler, once advanced, passes through the distal rectum posterior to the staple line (double-stapled technique) or through the purse-string suture, which is then tied around the trocar. The trocar of the stapler is inserted into the anvil. As the stapler is closed, the ileal pouch is advanced to the anal canal. The ileal pouch tends to rotate and the abdominal surgeon should ensure that the mesentery of the ileal pouch is maintained in an untwisted posterior position. Before complete closure of the circular stapler, the abdominal surgeon must ensure that neither the vaginal cuff nor the anal sphincter is included in the stapling device. The circular stapler is then fired (Fig. 15). Proximal and distal tissue donuts are inspected for continuity and the integrity of the IPAA can be tested by air insufflation through the pouch, which is submerged under pelvic irrigation.

Diverting loop ileostomy creation An area of ileum is identified approximately 20 cm proximal to the pouch. This area should be freely mobile and able to be brought up through the abdominal wall rectus muscle without tension. A loop ileostomy is formed through the ileostomy orifice described earlier.

Procedure completion A closed suction drain is placed in the pelvis posterior to the ileal pouch. The incisions are closed and the loop ileostomy is matured. A loop ostomy



Fig. 15. Creation of double-stapled anastomosis. (*From* Kirat HT, Remzi FH. Ileal pouch-anal anastomosis: indications and technique. Semin Colon Rectal Surg 2009;20(2):82–7; with permission; and *Courtesy of* CCF, 2003.)

bar may be used to assist with abdominal wall fixation. However, in obese patients or patients with a foreshortened mesentery in which a mobile ileal segment cannot be identified, an end ileostomy can be fashioned by an additional stapler transection of the small intestine.

Additional Considerations

Laparoscopic versus open approach

Studies comparing laparoscopic versus open IPAA have shown lower morbidity with a laparoscopic approach and equivalent long-term function and quality of life.²⁷

Surveillance

TPC-IPAA greatly reduces the long-term risk for carcinoma in patients with UC. However, the rectal mucosa left behind must be monitored, because a small risk for carcinoma still exists. Flexible fiberoptic pouchoscopy with surveillance biopsies of the ileal pouch should be performed approximately every 5 years.

Long-term outcomes

Pouchitis is the most common long-term complication after an IPAA, and represents a nonspecific inflammation of the ileal reservoir. Pouchitis can be seen in 23% to 46% of patients and significantly affects their quality of life by causing symptoms such as increased stool frequency, urgency, incontinence, nocturnal seepage, abdominal cramping, pelvic discomfort, and arthralgias.²⁸ Other complications associated with IPAA include strictures, cuffitis, Crohn's disease of the pouch, and neoplasia.

S-pouch function

The S-pouch configuration of an ileoanal pouch may over time cause elongation of the afferent limb causing the patient to have obstructive defecation. This condition may require catheterization of the S pouch to allow evacuation or, in refractory patients, surgical revision of the ileoanal pouch if technically possible.

Total Proctocolectomy and Ileal Pouch–Anal Anastomosis with Mucosectomy and Hand-sewn Anastomosis

In patients with midrectal dysplasia or carcinoma, mucosectomy with hand-sewn IPAA is performed to obtain adequate oncologic margins. In this procedure, the mucosa from the distal rectum is removed transanally. This procedure is more technically difficult to perform than the previously described stapled anastomosis.

Steps of a TPC with IPAA are followed up to but not including creation of the anal anastomosis.

Perineal dissection

After formation of the ileal pouch, the surgeon performs a perineal dissection. A selfretaining anal retractor is placed to evert the anal canal. Local anesthetic is injected in the submucosal plane at the dentate line to facilitate dissection of the anorectal mucosa off the sphincter complex. The mucosal dissection can be performed circumferentially or in quadrants to lift the mucosa from the dentate line to the level of the anorectal transection. Mucosal dissection must be complete so no islands of mucosa remain deep to the hand-sewn anastomosis. Four Vicryl stay sutures are placed through the anal canal wall and including a small portion of internal anal sphincter. Anterior sutures should be placed with care to avoid inclusion of the vaginal wall.

Hand-sewn anastomosis

The ileal J pouch is then brought down to the anus by placing a Babcock through the anal canal and onto the base of the ileal pouch. The abdominal surgeon places a hand posterior to the pouch and guides the pouch movement through the pelvis to avoid pouch rotation or trauma. The 4 stay sutures are placed full thickness through the enterotomy at the base of the ileal pouch and secured. Additional full-thickness interrupted sutures are placed circumferentially to complete the anastomosis (Fig. 16).

Ostomy creation

A diverting loop ileostomy is then created in the right lower quadrant as previously described.

Additional Considerations

Hand-sewn versus double-stapled technique

There is debate as to which anastomotic technique provides better functional results and long-term outcomes.

The hand-sewn technique involves anastomosis of the J pouch to the dentate line after endoanal mucosectomy, which has the advantage of removing all potential disease-bearing mucosa. However, this technique may result in higher risk of anal sphincter damage caused by stretching of the anal canal at the time of surgery.²⁹ In the double-stapled technique, an ileoanal anastomosis is created 1 to 2 cm above the dentate line. The disadvantage of this technique is that the transitional mucosa is left in situ so the potential for cancer in the retained rectal mucosa still exists. Annual surveillance of this transition zone is required, although the incidence of rectal cancer is small.³⁰ The advantage of a double-stapled technique is an improved ability to achieve a tension-free anastomosis, decreased risk of anal sphincter damage, and maintained anorectal sensation by maintenance of the anal transition zone.²⁹ In a meta-analysis of patients with IPAA, Lovegrove and colleagues³¹ showed that patients with double-stapled anastomoses experienced higher resting sphincter pressures and less nighttime incontinence and seepage than their counterparts with hand-sewn anastomosis. In addition, a large prospective study of patients with IPAA followed long term showed that the double-stapled technique resulted in fewer



Fig. 16. Mucosectomy and creation of hand-sewn anastomosis. (*From* Kirat HT, Remzi FH. Ileal pouch-anal anastomosis: indications and technique. Semin Colon Rectal Surg 2009;20(2):82–7; with permission; and *Courtesy of* CCF, 2003.)

postoperative anastomotic strictures, septic complications, intestinal obstructions, reservoir failures, and permanent ileostomies than the hand-sewn anastomotic technique.³² However, these results are not consistent across the literature, and another meta-analysis, by Schuendler and colleagues,³³ showed no statistically significant differences in functional outcome or manometric sphincter continence between hand-sewn versus double-stapled techniques. At present, surgeons should perform the technique with which they are most comfortable unless mucosectomy is needed to obtain oncologic margins for rectal malignancy or dysplasia at the time of pouch formation.³⁴

Ileal pouch-anal anastomosis in patients with rectal cancer Patients who undergo proctectomy according to oncologic principles and preservation of the anal canal and sphincter can have ileoanal pouch reconstruction. However, radiation should be performed before surgery in locally advanced rectal cancers to avoid direct radiation exposure of the ileal pouch. In addition, patients should be counseled that pelvic radiation exposure with ileal pouch formation can cause a chronic decrement in pouch function compared with patients with no radiation exposure. A loop ileostomy should be maintained during chemotherapy treatments to help with quality-of-life issues that can be associated with chemotherapy-induced diarrhea.³⁵

Surveillance Because rectal mucosa is left behind with either double-stapled anastomosis or mucosectomy, long-term annual examinations via pouchoscopy and biopsies of any retained rectal cuff or suspicious areas in the ileal pouch are recommended for all patients with IPAA regardless of the anastomotic technique.

Elective Total Abdominal Colectomy with Ileoproctostomy

This technique is rarely performed in patients with UC but may be considered in patients with minimal rectal involvement, good rectal compliance, and normal sphincter tone.³⁶ It can additionally be considered in young women of childbearing age who want to preserve fertility, because the lack of pelvic dissection reduces the risk of pelvic nerve damage and sexual dysfunction. Perform a total abdominal colectomy without ileostomy creation.

Ileorectal anastomosis

The terminal ileum is identified and the mesentery is inspected to ensure it is not twisted. The surgeon may choose to proceed with a hand-sewn or stapled anastomosis at this time. A stapled anastomosis is described. An enterotomy is made in the antimesenteric border of the ileum and an end to end anastomosis (EEA) anvil is secured with a purse-string suture. An assistant then advances the EEA stapler through the rectal stump. The 2 ends are joined, tightened appropriately, and the stapler is fired. The anastomosis can be tested for air leak under pelvic irrigation with proctoscope insufflation through the rectum. All incisions are then closed, sterile dressings applied, and the patient is awoken from anesthesia.

Pitfalls

Ability to advance the EEA stapler may require posterior rectal mobilization to straighten the rectum or hand-sewn anastomosis.

Additional Considerations

Persistent proctitis

Although functional outcome and quality of life after ileorectal have been shown to be comparable with IPAA, these patients have more urgency affecting work and diet restrictions than their IPAA cohorts.³⁷ Ileoproctostomy is not a definitive operation for all patients with UC; approximately 25% of these patients eventually require a proctectomy because of severe proctitis. If rectal resection is later required, these patients can undergo an IPAA, Brooke ileostomy, or a continent ileostomy. Most of these patients are able to undergo completion proctectomy and conversion to an IPAA if they wish to avoid a stoma.³⁷

Rectal cancer risk

Close mucosal surveillance with rectal biopsies is recommended every 6 to 12 months following ileoproctostomy. Approximately 10% of patients develop malignant disease of the rectum.³⁸

Elective Kock and Barnett Continent Ileostomies

Dr Nils Kock, a Swedish surgeon, developed the first continent intestinal reservoir (ie, the Kock pouch). Continent ileostomies allow patients to avoid wearing an ostomy appliance by way of a nipple valve that is created with intussusception of a portion of ileum into the planned reservoir. When this procedure is performed, approximately 60 cm (2 feet) of distal ileum is used to create the continent ileostomy and reservoir. The distal ileum is intussuscepted into a pouch constructed of more proximal bowel in order to form a continent nipple. The stoma can then be flush with the skin of the abdominal wall. However, this procedure has a high failure rate, mostly because of valve slippage and subsequent bowel obstruction.^{39,40} Dr William Barnett developed the Barnett Continent Intestinal Reservoir, which modified the Koch pouch by adjusting the length of the valve and developing a collar to keep the valve from slipping.⁴¹

At present, these procedures are performed infrequently because of the excellent long-term outcomes with the ileal J pouch and the high complication rate associated with continent ileostomies. Continent ileostomy is a reasonable option for patients who are not candidates for IPAA because of poor sphincter function, previously having failed IPAA, or wanting to avoid an ileostomy.⁴² Patients are not candidates for a continent ileostomy if they have Crohn's disease, obesity, or advanced age. For most patients, a continent ileostomy is not a permanent surgical treatment because complications from these procedures include intestinal obstruction from nipple valve slippage, pouchitis, stenosis, and incontinence.⁴⁰

SUMMARY

Emergent surgical therapy with subtotal colectomy and end ileostomy is recommended in patients with UC who develop fulminant colitis, toxic megacolon, colonic perforation, or life-threatening hemorrhage. This procedure is the safest option and these patients can undergo later conversion to restorative procedures such as IPAA. Elective surgical therapy is indicated in patients with UC who do not tolerate medical therapy or who have failed medical management, or in patients with dysplasia or malignancy. Proctocolectomy with end ileostomy remains the safest procedure with the fewest complications and is a good option for patients who are not candidates for restorative procedures. Proctocolectomy with IPAA has been shown to be a safe and effective treatment of patients with good sphincter function because it eliminates the source of disease and does not require a permanent stoma. Mucosectomy can be performed in patients with rectal dysplasia or carcinoma to extend distal margins and achieve appropriate oncologic control. Total colectomy with ileoproctostomy is rarely performed because of the amount of residual disease left behind. Continent ostomies can be created in patients with UC. However, these are much less popular because of a high associated complication and failure rate compared with the proven long-term success and higher quality of life seen with restorative IPAA procedures.

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