10 Anastomotic Complications

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Key Concepts

- Mechanical bowel prep and oral antibiotics prior to colon resection are associated with a lower risk of anastomotic leak.
- A significant proportion of anastomotic leaks present after the immediate postoperative period, especially if there is a history of pelvic radiation.
- Most early anastomotic bleeds are self-limited; late bleeds may be a sign of anastomotic leak.
- Anastomotic stricture after cancer resection should undergo endoscopic biopsy and imaging to rule out recurrent cancer.
- Benign anastomotic strictures may be amenable to endoscopic management, but some will require surgical revision or completion proctectomy with permanent colostomy if the strictured anastomosis is in the pelvis.
- Anastomotic complications often lead to significant detriments to quality of life with regard to pain, defecatory function, sexual function, and urinary function. Discussion of these issues with patients is critical for surgical decision-making.

Anastomotic Leak

The unfortunate reality faced by every surgeon who performs bowel resections is the occurrence of anastomotic leaks. The incidence of anastomotic leak after bowel anastomosis ranges from 2% to 21% and is associated with significant risk of short- and long-term morbidity [1–5]. This complication can be a devastating event that sets off a cascade of other unfortunate events, resulting in significant detriments to quality of life, increased pain, prolonged disability, and sometimes death. Anastomotic leaks are associated with significantly higher healthcare resource utilization and cost, as patients with this complication are more likely to require additional diagnostic tests, procedures or reoperations, hospital days, outpatient care, and readmissions [6, 7]. Perhaps the most frustrating aspect of anastomotic leaks in colorectal surgery is the fact that leaks and their severe consequences still occur despite the adoption of evidence-based perioperative guidelines, efforts to optimize patient risk factors, and adherence to surgical principles. Although important progress has been made toward reducing the risk of anastomotic leak, there is still much work to be done to increase our understanding of the pathophysiology of anastomotic leak, and effective strategies for prevention.

Risk Factors

The site of anastomosis is strongly related to the risk of anastomotic leak. The risk of leak is lower for small bowel and ileocolic anastomoses, and higher for ileorectal and distal colorectal anastomoses [8, 9]. Patient-related risk factors for anastomotic leak are diabetes mellitus, hyperglycemia and high HbA1c, male sex, higher body mass index, tobacco use, inflammatory bowel disease, chronic immunosuppressive medications, radiation enteritis, malnutrition, hypoalbuminemia, and active infection [10–16]. Among patients undergoing rectal cancer resection for cancer, additional risk factors for anastomotic leak include more distal anastomoses, neoadjuvant pelvic radiation therapy, and advanced tumor stage [17–20].

Intraoperative risk factors include the inability to achieve a tension-free anastomosis and poor blood supply to the ends of bowel used for anastomosis, blood loss and blood transfusions, prolonged operating time, and intraoperative contamination [10–16]. Using multiple stapler firings across the rectum, which is commonly done in laparoscopic and robotic approaches, may also be associated with a higher risk for

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anastomotic leak [21–23]. The operating surgeon is another potential risk factor, although little is known about which surgeon characteristics would increase the risk for a surgical complication [24, 25]. Closed-suction drainage is commonly used in low pelvic anastomoses, but whether its routine use reduces the risk of anastomotic leak is still under debate [26–31]. Even when an anastomotic leak occurs, it is rare that the drain placed during the initial operation would effectively control the pelvic sepsis by draining pus or stool. However, as multiple studies have not shown that drains increase the risk for a leak, placing them at the time of surgery may still be helpful in the event of an abscess or leak, as the interventional radiologists may reposition a surgically placed drain into a better location. These drains may also be useful in controlling pelvic hematomas, thus preventing them from causing inflammation and pressure on the anastomosis.

The role of proximal fecal diversion in reducing the risk of anastomotic leak is also unclear. It has been cited as a risk factor for leak, as a protective factor, and as a neutral factor [17, 32, 33]. It certainly decreases the risk of septic complications of a leak, and it may even prevent an anastomotic leak from manifesting any clinical signs [34–36]. Therefore, the risk for reoperation is lower, as is the risk of mortality [19, 37, 38].

There has been considerable debate over whether mechanical bowel preparation and/or oral antibiotics prior to colorectal resection reduces the risk of anastomotic leak, because the studies had revealed a diverse range of outcomes [39–41]. Multiple analyses using the American College of Surgeons National Surgery Quality Improvement Program database over the last several years are consistent with the conclusion that both mechanical bowel preparation and oral antibiotics together are associated with a lower risk of anastomotic leak [42–50].

An emerging body of research suggests that another risk factor for anastomotic leak resides in the gut microbiome [51]. This offers a biologic explanation for why mechanical bowel preparation with oral antibiotics is helpful for reducing anastomotic leak. This is a particularly compelling area of research as it may explain the leaks that occur in patients with no other risk factors, which are often the most frustrating and confusing events for surgeons. Enterococcus faecalis has been demonstrated to degrade collagen and activate tissue matrix metalloproteinase 9 (MMP9) in host intestinal tissue, thus potentially contributing to the pathogenesis of anastomotic leakage. Particular strains of E. faecalis have greater ability to degrade collagen and activate MMP9, and these strains are more likely to be found in leaking anastomoses in rat models [52]. Pseudomonas aeruginosa colonizing intestinal tissues can mutate to increase collagenase activity and destroy tissue more effectively [53]. Standard oral or intravenous antibiotics do not eliminate these organisms. Recent studies have examined the ability of other compounds or diet modifications to reduce the virulence of these organisms and prevent anastomotic leak in animal models [54–56]. This field of investigation continues to rapidly evolve and findings in the near future may dramatically alter our understanding of why anastomotic leaks occur and how to prevent and treat them.

Diagnosis

The diagnosis of anastomotic leak is not always obvious. Aside from extravasation of retrograde contrast enema on computed tomography (CT) scan, which has the highest sensitivity and specificity for anastomotic leak, there is very little consensus on what clinical findings are confirmatory for an anastomotic leak [57–59]. In the immediate postoperative period, clinical signs that raise concern for an anastomotic leak include fever, leukocytosis, increased pain, suspicious drainage from the wound or surgical drain, and prolonged ileus. If the CT is performed within the first 4 days of the operation, findings may be nonspecific as it often takes until the fifth day for infected fluid to develop rim enhancement. While a postoperative CT may demonstrate an obvious leak with free air, extraluminal extravasation of oral or rectal contrast, or a defect in the anastomosis with adjacent free fluid or an abscess, it more frequently demonstrates rim-enhancing fluid collections or specks of free air that are equivocal for a leak.

Leaks are commonly assumed to occur within the first week of the operation during the index hospitalization, but, in reality, up to half of leaks may present after the patient has been discharged, with a significant proportion detected over a month after surgery [8, 60]. Among patients undergoing low anterior resection for rectal cancer, a third of anastomotic leaks become clinically evident over a month after the operation [61]. In the immediate postoperative period, leaks may present with nonspecific symptoms such as ileus or low-grade fever, or with frank peritonitis and sepsis (Fig. 10.1). Late leaks tend to present insidiously with pelvic pain and failure to thrive.

Elevated serum C-reactive protein (CRP) and procalcitonin are biomarkers that serve as early indicators of anastomotic leak after colorectal surgery. These biomarkers are used in some enhanced recovery clinical pathways, as length of hospitalization has shortened significantly and thus may result in patients with leaks that are not yet clinically apparent being discharged. Serum CRP levels less than 172 mg/L on postoperative day 3, 124 mg/L on postoperative day 4, and 144 mg/L on postoperative day 5 all correspond to a negative predictive value of 97% for anastomotic leak [62]. CRP levels are expected to be higher in patients undergoing open colorectal surgery compared to patients undergoing laparoscopic surgery. In patients undergoing open surgery,

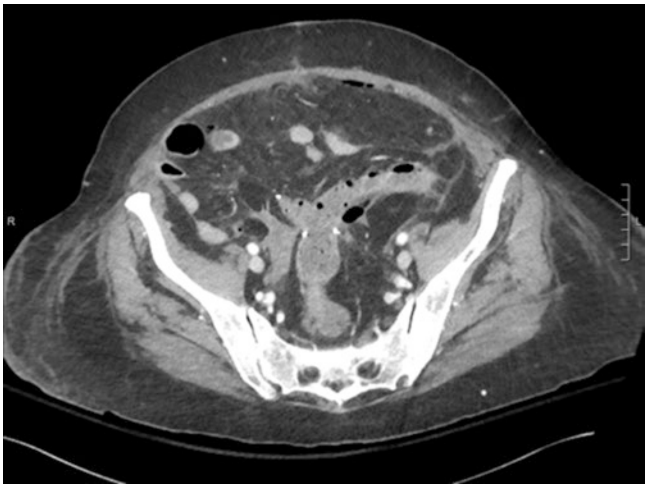


Fig. 10.1 Colorectal anastomotic leak: CT image of a patient who developed anastomotic leak on postoperative day 5 after undergoing sigmoid colectomy for diverticulitis complicated by colovaginal fistula. She required operative intervention for washout and takedown of the anastomosis and creation of an end colostomy

CRP levels over 209 mg/L on postoperative day 3 and 123.5 mg/L on postoperative day 4 are most predictive of leak. In patients undergoing laparoscopic surgery, a CRP level over 146.7 mg/L on postoperative day 2 was most predictive of leak [63]. Serum procalcitonin is also a biomarker studied for its association with anastomotic leak, and can be used in conjunction with CRP. The negative predictive value is 96.9% for a procalcitonin less than 2.7 ng/mL on postoperative day 3, and 98.3% for a procalcitonin less than 2.3 ng/mL on postoperative day 5 [64, 65]. If these biomarkers surpass the cutoff values and the patient appears clinically well, the decision to discharge the patient should be weighed against the higher risk for readmission [66]. A serum CRP value less than 145 mg/L on postoperative day 3 has a 93% negative predictive value for readmission within 30 days of surgery [67].

Management of Anastomotic Leak

In the event of an anastomotic leak, the strategy for managing it depends on several factors: the patient's clinical condition, the timing of the leak, the location of the anastomosis and leak, and whether the leak is contained. On one end of the spectrum, the patient with sepsis with fecal peritonitis has a clear indication for emergent return to the operating room for exploration and washout with source control. The operative decision of whether to take down the anastomosis, or place drains and divert proximally depends on the degree of operative exposure and the location of the anastomosis. If the surgeon cannot safely gain access to the anastomosis due to obliterative adhesions, then the best option is to lay drains in the area of the leak and bring up a proximal stoma to divert the fecal stream. If the surgeon can safely expose the anastomosis, then management largely depends on the location of the anastomosis and the size of the defect. For small bowel and ileocolic anastomoses, resection and re-anastomosis can be performed if the bowel ends are viable and mobile. If the status of the patient or the bowel is marginal, then formation of an end ostomy and mucus fistula, or a divided end-loop stoma is the safest option. For colorectal anastomoses with a significant defect, then the safest option is to take down the anastomosis and bring up an end colostomy. Measures to prevent a dehiscence of the top of the rectal stump, which can lead to chronic pelvic abscesses, include oversewing the rectal stump staple line and placing a rectal tube for decompression. Drains should also be placed over the rectal stump given the high likelihood of a dehiscence. While it may be possible to use a minimally invasive approach to reoperate on patients who have recently undergone a minimally invasive operation, it is quite likely that a laparotomy will be required to perform an adequate washout and gain source control. The surgeon must maintain objectivity in what can be a trying time for all parties, and remain steadfast in doing the safest operation for the patient.

On the other end of the spectrum, the patient with a contained leak and a small abscess <3 cm may successfully undergo non-operative management with broad-spectrum antibiotics. Larger abscesses may require percutaneous drainage in addition to broad-spectrum antibiotics. Fecal diversion may or may not be necessary, depending on the severity of the leak. For colorectal or coloanal anastomotic leaks, drain placement may be performed transrectally through the anastomotic defect and into the extraluminal abscess cavity, and depending on the distance of the leak from the anus, can be performed either by the surgeon or by our colleagues in interventional radiology. Non-operative treatment of leaks may be successful in allowing maintenance of the primary anastomosis in half of patients with anastomotic leaks [68]. If the patient remains stable and the leak is well controlled, then closure of the anastomotic defect and collapse of the associated abscess cavity may occur without the need for a major anastomotic revision. If the leak is not well controlled with drainage and fecal diversion then the patient may need to undergo resection of the anastomosis. If possible, it is ideal to wait at least 3 months to reoperate to allow for resolution of inflammatory adhesions that would make reoperation more treacherous. Waiting even longer will often result in healing of the anastomosis without the need for operative intervention [69]. For colorectal anastomoses that fail to resolve with drainage, resection of the anastomosis with redo colorectal or coloanal anastomosis may be possible. However, completion proctectomy with permanent end colostomy may be necessary or preferable to maximize quality of life.

If the anastomosis is distal enough, in select cases a leak may be repaired transanally using an endorectal advancement flap, dermal advancement flap, or primary suture repair [70, 71]. Some groups have described the use of transanal endoscopic platforms such as Transanal Minimally Invasive Surgery (TAMIS) or Transanal Endoscopic MicroSurgery (TEMS) to directly repair anastomotic leaks [72, 73]. Depending on the degree of pelvic or intra-peritoneal contamination, transanal repair may be combined with laparoscopic washout. Creation of a diverting loop ileostomy should also be strongly considered if one of these techniques is used. These transanal techniques are often not feasible given how fibrotic the tissues tend to be around the site of a leak, so completion proctectomy or proctectomy with coloanal anastomosis may be the only options.

Chronic presacral sinus tracts result from anastomotic leaks in the pelvis that do not heal and are a source of ongoing inflammation (Fig. 10.2). Patients may suffer from symptoms including pelvic pain, fevers, rectal discharge, and tenesmus. These tracts typically occur if there is a leak from the posterior aspect of a colorectal anastomosis. Among patients undergoing low anterior resection for rectal cancer after neoadjuvant chemoradiation therapy, presacral sinus tracts may occur in 9.5% and thus represent a significant clinical dilemma [61]. There are several strategies for treatment of these tracts. One option is fecal diversion in combination with a septotomy, in which the bowel wall between the lumen and the sinus tract is divided, effectively unroofing the sinus tract and including the underlying cavity as part of the lumen. This can be done via a direct transanal approach if the anastomosis is distal enough [74]. The transanal endoscopic techniques can be used to access and divide the septum overlying more proximal sinus tracts. This procedure may need to be performed several times over several weeks to months to get the tract to heal in fully [75]. Fibrin glue injection into these sinus tracts has been described and can be done directly via a transanal approach if the opening is distal enough, or endoscopically if it is more proximal [76, 77]. Depending on their level of experience, interventional radiologists may be able to place a transrectal drain through the anastomotic defect into a presacral sinus tract or abscess, and when the tract is small enough, they can inject fibrin glue as they remove the drain to obliterate the space and prevent reaccumulation of an abscess (Fig. 10.3). These techniques are often not successful in eliminating the sinus tract and it may be necessary to proceed to resection of the anastomosis, debridement of the cavity, and either re-anastomosis or completion proctectomy [78].

Newer endoscopic techniques for addressing anastomotic leaks have emerged and early reports have demonstrated

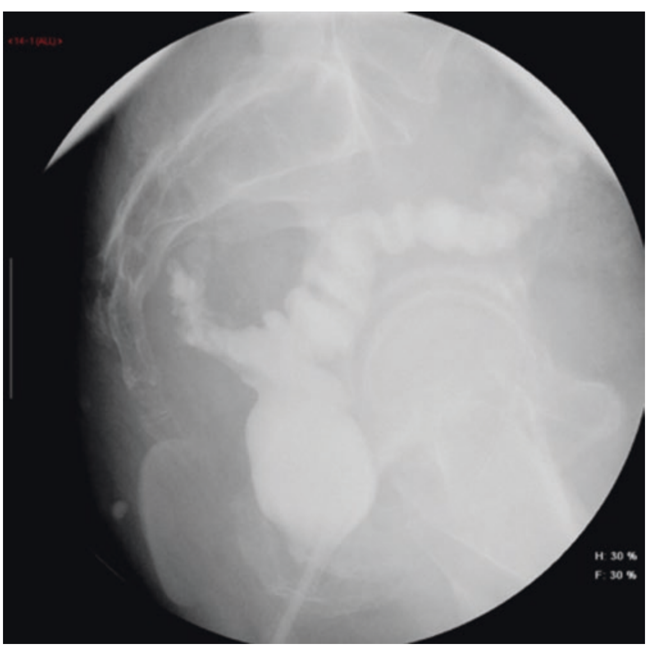


Fig. 10.2 Colorectal anastomotic leak: Fluoroscopic image of a patient who developed a leak 9 days after low anterior resection

Fig. 10.3 Presacral sinus tract: CT image of a patient who developed a chronic presacral sinus abscess after a colorectal anastomotic leak. A transanal drain was placed through the anastomotic defect and into the presacral abscess. When the cavity had become essentially a sinus tract, fibrin glue was injected into the tract as the drain was removed to fill the tract and prevent reaccumulation

promising results. These include endoscopic vacuum sponge placement, intraluminal covered stents, and over-the-scope clips. Endoscopic vacuum-assisted closure of presacral abscess cavities caused by chronic anastomotic leaks has been shown to be effective in healing the majority of patients [79, 80]. The endoluminal vacuum sponge system is generally managed on an outpatient basis and changed every 2–3 days. It is unclear whether it results in faster healing as it takes weeks to months for complete resolution. It may prevent the formation of a presacral sinus tract and is generally well-tolerated and safe [81–84]. Fecal diversion is commonly part of the strategy, but not in all cases that have been effectively treated. Timely diagnosis and treatment increases the likelihood of success, as patients who start primary endoluminal vacuum therapy within 15 days of diagnosis have a higher chance of success compared to those who undergo salvage therapy with this technique more than 15 days after diagnosis of the leak [85, 86]. Endoscopic placement of covered intraluminal stents has been used to treat colorectal anastomotic leaks with some success in small series [87, 88]. Endoscopic closure of colorectal anastomotic leak using an over-the-scope clip has also been described [89]. Data on the success of this strategy are sparse so the likelihood of successful healing is not known [90, 91]. It should be used only in select cases that would be most amenable to this, and in cases in which the intra-abdominal sepsis has been well controlled. As more surgeons and gastroenterologists report on their experience with these advanced endoscopic techniques, we will gain a better understanding of the indications and limitations of these strategies.

Outcomes After Anastomotic Leak

The risk of perioperative mortality increases in the presence of an anastomotic leak, and ranges from 3% to 14% [9, 11, 92]. For patients with rectal cancer, anastomotic leaks are associated with decreased overall 5-year survival (44–53% versus 64%) and cancer-specific 5-year survival (42% vs 67%) [20, 93, 94]. In some series, patients with anastomotic leaks after colorectal cancer resections were found to have increased local and systemic recurrence rates while in others, there was no difference between those who had anastomotic leaks and those who did not [94–100]. The worse oncologic outcomes have traditionally been attributed to the delay in adjuvant chemotherapy due to the septic complications of a leak. However, there are other potential mechanisms for increased recurrence in patients who suffer a postoperative infection. Postoperative infection has an effect on the cytokines present in the peritoneal fluid and peripheral blood of patients in such an inflammatory state which may increase the ability of residual tumor cells to migrate and invade, and thus potentially allow them to contribute to recurrences [101, 102]. Anastomotic leak and intra-abdominal abscess is also associated with upregulation of genes that encode for cytokines that promote tumorigenesis and angiogenesis, further contributing to this understanding of the pathophysiology of increased recurrence after postoperative infection [103].

The risk of a permanent ostomy after an anastomotic leak depends on the location of the anastomosis – the more distal the leaking anastomosis is, the higher the risk of a permanent ostomy. Functional outcomes and quality of life are also worse after anastomotic leak, particularly one that occurs in a pelvic anastomosis [104, 105]. Colorectal anastomotic leaks are associated with more bowel dysfunction including more frequent bowel movements, poorer continence, and increased pad use [106]. It is likely that the pelvic fibrosis from the chronic inflammation induced by a leak reduces the compliance of the rectum, thus contributing to these symptoms. The potential impact of anastomotic leakage on defecatory dysfunction is underestimated, as many patients who would have had such symptoms opt for an end colostomy [107]. Sexual and urinary functions are also adversely affected and symptoms often go unreported [108]. It is important, therefore, for surgeons to be cognizant of these potential sequelae and be proactive about asking patients about their symptoms rather than passively wait for patients to bring them up. Referral to specialists in urology and gynecology may be helpful for symptomatic management.

Anastomotic Fistula

Anastomotic fistula can be due to either anastomotic leak or a technical error. Symptoms that present in the immediate postoperative period are generally attributable to an intraoperative technical complication. These most commonly occur in pelvis, if the anterior rectal wall has not been adequately mobilized from the posterior vaginal wall, allowing the posterior vaginal wall to be incorporated into the circular stapler fire and creating a stapled fistula between the bowel and the vagina. It is also possible for the ureters or urethra to be inadvertently incorporated into an anastomosis if the rectal stump has not been properly mobilized from the surrounding structures. These fistulas will certainly require reoperation with fecal diversion and reconstruction of normal anatomy. In these situations, it is highly likely that a permanent colostomy will be the result, because usually the rectal stump is rather short and the pelvic dissection was difficult during the initial operation. A coloanal anastomosis is likely to be required if restoration of intestinal continuity is to be attempted.

The more likely etiology of anastomotic fistula is an anastomotic leak that fails to heal. These can occur from a leak from any location along the GI tract. Intra-abdominal leaks from the small bowel or colon may result in an enterocutaneous fistula. High-output fistulas and persistent low-output fistulas require

Fig. 10.4 Fistula from ileocolic anastomosis: CT image of a patient who underwent right colectomy complicated by a leak, which subsequently developed into a persistent low-output fistula tract through the abdominal wall. Treatment consisted of resection of the anastomosis and creation of a new ileocolic anastomosis

Fig. 10.5 Pelvic abscess and colovaginal fistula: CT image of a patient who underwent sigmoid colectomy for diverticulitis complicated by anastomotic leak. The leak caused pelvic abscesses that necessitated through the vaginal cuff, thus resulting in a colovaginal fistula

reoperation with resection of the leaking anastomosis and construction of a new anastomosis (Fig. 10.4). Judicious timing of reoperation is critical for avoidance of a hostile surgical field that will lead to more injuries and fistulas.

Colorectal anastomotic leaks in the pelvis may also fistulize to the skin of the anterior abdominal wall, or inferiorly to the skin of the buttock. These fistulas can result from a persistent tract of a transgluteal drain initially placed for abscess drainage. Pelvic leaks can also result in fistulas to the vagina, usually if the patient has had a prior hysterectomy, and rarely via the fallopian tube. Reoperation is generally necessary to address these complications, although some may heal with fecal diversion. Patients who undergo sigmoid resection for diverticulitis that was complicated by a colovaginal or colovesical fistula are at risk for recurrence of those fistulas if a colorectal anastomotic leak occurs, since either the vagina or the bladder has a fresh suture line that will be a vulnerable site through which an abscess will necessitate (Fig. 10.5). Placement of an omental flap in the pelvis to form a physical barrier between a fresh bowel anastomosis and other suture lines in the pelvis may decrease the risk of a recurrent fistula.

A rare and potentially very morbid sequela of anastomotic leak is a fistula to the epidural space causing an epidural abscess. This can occur as a complication of a chronic colorectal anastomotic leak and may present initially with nonspecific symptoms such as weight loss, low-grade fever, and malaise. Source control and systemic antibiotics should be the first steps in management. This may involve washout of the pelvic sepsis and fecal diversion or takedown of the anastomosis. Epidural decompression and debridement may also be necessary [109, 110].

Blind Loop Syndrome

Blind loop syndrome (or blind pouch syndrome) is an occasional complication of side-to-side antiperistaltic anastomoses. The blind sac of an antiperistaltic side-to-side bowel anastomosis may dilate over time. In most patients this does not cause any symptoms, but in some, it can be the cause of complications such as small intestinal bacterial overgrowth (SIBO), pseudo-obstruction, volvulus, ulcers, bleeding, and even perforations. These complications usually occur years after the operation. With dilation leading to SIBO or pseudo-obstruction, it is often the case that patients have months to years of vague abdominal symptoms such as bloating, nausea, weight loss, poor appetite, and abdominal discomfort [111, 112]. These symptoms are inconsistently related to dietary intake or eating habits. They may undergo multiple diagnostic studies that are largely unrevealing, as the dilation of the anastomosis is considered to be within normal limits, and the anastomosis is widely patent (Fig. 10.6a, b). Anastomotic ulcers rarely occur and may cause gastrointestinal bleeding or perforation (Fig. 10.7) [113, 114]. Capsule endoscopy or double balloon enteroscopy may be helpful in making the diagnosis. The treatment for any of these complications is resection of the anastomosis with an end-to-end anastomosis. The potential for these rare complications with side-to-side anastomoses should not dissuade surgeons from using this anastomotic technique routinely. However, this syndrome should be considered if patients with a prior side-to-side anastomosis present with these symptoms, and if surgical resection is indicated, an end-to-end anastomosis should be performed to prevent recurrence of the problem.

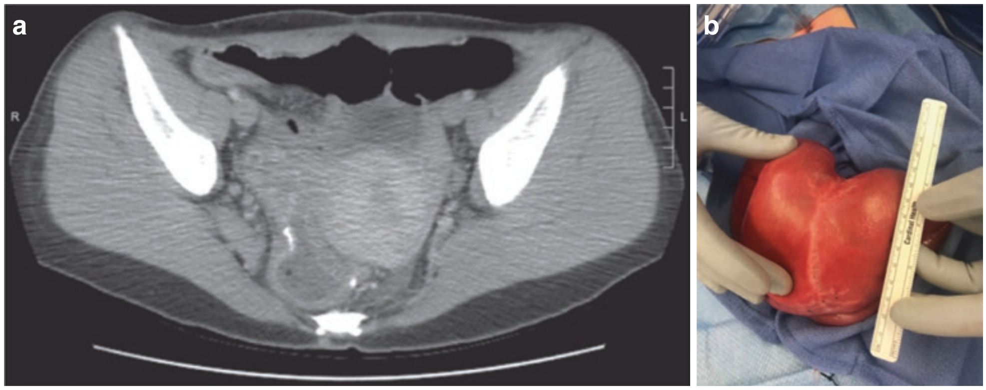


Fig. 10.6 (**a**) Dilated side-to-side stapled anastomosis: CT image of a patient who underwent total proctocolectomy with J-pouch and had a side-to-side anastomosis at the ileostomy takedown site. She had symptoms of intermittent obstruction causing weight loss and chronic abdominal discomfort. (**b**) Dilated anastomosis that appeared atonic and causing intermittent partial obstruction. After resection with end-to-end handsewn anastomosis, symptoms resolved

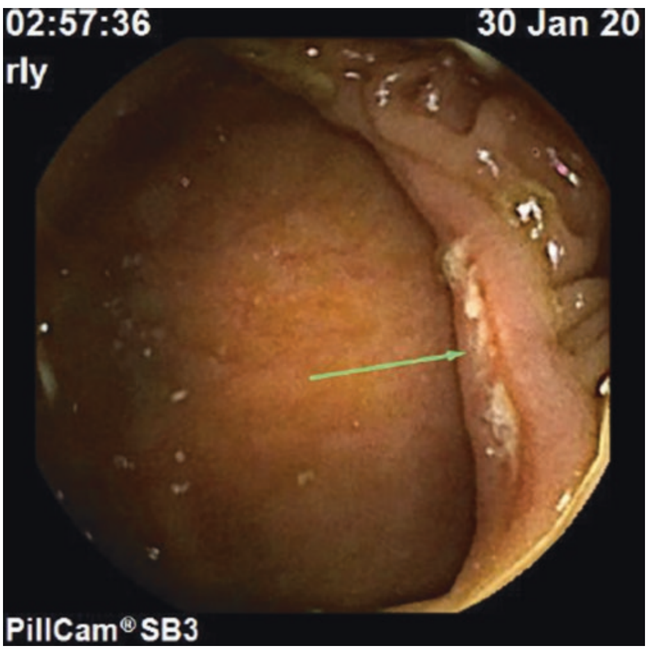


Fig. 10.7 Anastomotic ulcer: Capsule endoscopy diagnosed an anastomotic ulcer in a side-to-side jejunal anastomosis that was created 10 years prior, caused acute gastrointestinal bleeding that spontaneously resolved

Anastomotic Bleeding

While adequate blood supply is critical to the healing of a colonic anastomosis [115], careful hemostasis must be obtained to limit the possibility of postoperative anastomotic bleeding. The true incidence of anastomotic bleeding is difficult to know and depends on the definition of a "bleed." Undoubtedly all anastomotic suture/staple lines bleed to some extent, which may be clinically apparent when patients pass a small amount of dark blood shortly after a colonic resection. However, in patients with normal coagulation and platelet function, clotting rapidly occurs and the blood loss is minimal. Because most of these bleeding episodes are self-limited and of little clinical significance, the majority of bleeds go unreported.

Anastomotic bleeding has been reported in up to 5% of patients having a colorectal anastomosis [116–119]. In a recent study of 314 patients having colorectal surgery, the overall incidence of anastomotic bleeding, defined as a decrease in hemoglobin of 2.0 mg/dL in the setting of hematochezia, was 2.3% [118]. The timing of these bleeds ranged from 1 to 10 days postoperatively with a mean of 6 days. Of the 7 patients who had an intraluminal bleed only 4 required a blood transfusion and of these only one needed an additional intervention. Malik et al. reported on a series of 777 patients having a colorectal resection. In this series, while the total number of anastomotic bleeds was not reported, only 0.8% experienced bleeding that required an intervention. In this series the majority of the major bleeding episodes occurred within the first 24 hours with delayed bleeds being unusual [117]. In a similar series from Martinez-Serrano et al., only 0.5% of the 1389 colon resections had a significant anastomotic bleed requiring blood transfusions. These authors used endoscopy to confirm the diagnosis, but without performing any intervention. Only one patient required an anastomotic revision. Similar to the previous study, the bleeds most commonly occurred within the first 24 hours of surgery [120]. These series suggest that most bleeds will stop on their own with supportive care. Transfusion may be necessary but endoscopic or surgical intervention is rarely needed. Furthermore, while there are some delayed bleeds [121], most significant bleeding is detected within the first 24–48 hours from surgery [122]. When there is delayed bleeding anastomotic breakdown should also be considered and endoscopy or imaging should be performed to evaluate anastomotic integrity (Fig. 10.8a, b) [123].

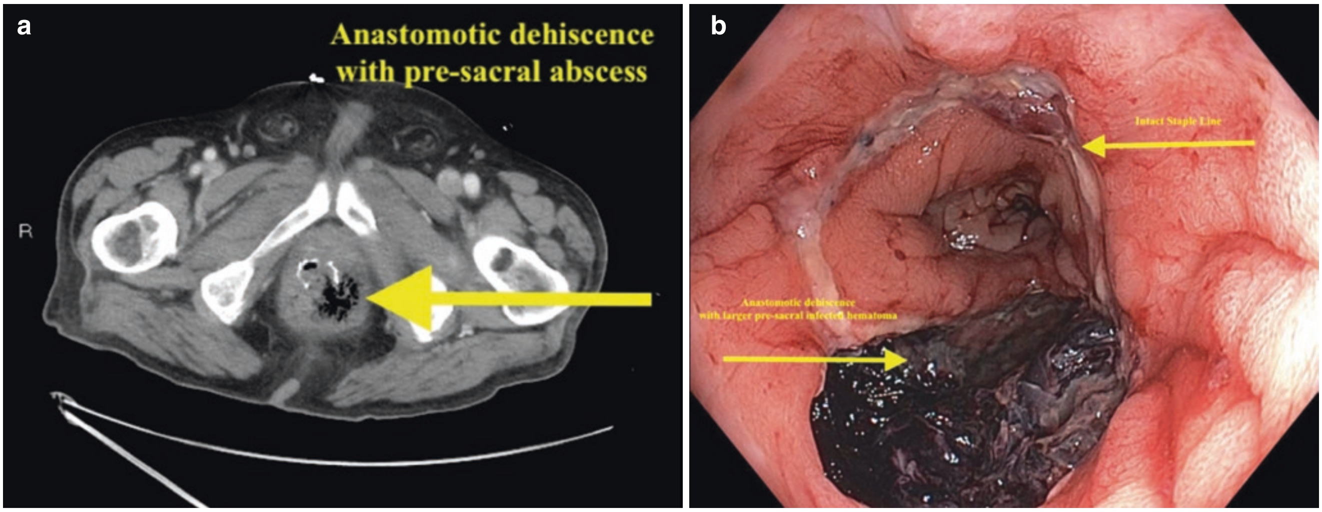


Fig. 10.8 (**a**) CT scan of patient presenting with an anastomotic bleed on POD 9 showing a pelvic abscess and anastomotic dehiscence. (**b**) Endoscopic exam confirming anastomotic dehiscence with pelvic hematoma

The clinical presentation for most anastomotic bleeds is similar to other etiologies of lower gastrointestinal bleeding. Depending on the level of the anastomosis bleeding can be either bright red blood (left-sided anastomosis) or darker clots (right-sided anastomosis) without abdominal pain. The quantity ranges significantly from a small amount to massive bleeding [117, 118]. Patient's vital signs can also range from completely normal to hemodynamic shock. Because of this variability in presentation all bleeding must be respected and mandates, at a minimum, close observation. If bleeding is persistent then monitoring serial hematocrits and coagulation parameters is important for making decisions about clinical management.

The management of an anastomotic bleed is also similar to other patients with a lower gastrointestinal bleed. The major difference between a postoperative gastrointestinal bleed and a spontaneous one is the initial workup. The etiology in the postoperative setting is rarely a diagnostic dilemma and therefore diagnostic studies, such as tagged red blood cell scans and CT angiography, are generally unnecessary. Patients are understandably anxious when passing blood, so reassurance from all healthcare providers is critical. This may mandate moving the patient to a monitored setting with close nursing observation and monitoring. All patients should have adequate intravenous access and blood products available. If there are hemodynamic changes, initial resuscitation with isotonic fluids is appropriate. Any coagulopathy should be corrected and all medications that interfere with coagulation, including nonsteroidal anti-inflammatory drugs, should be held. The need for blood transfusions will depend on the patient's hemodynamics and the clinical judgment necessary to decide if the bleeding has stopped or is ongoing. However, in the setting of large blood loss, transfusions are commonly necessary, and the practitioner need not wait for a low hematocrit to initiate a blood transfusion.

If the bleeding persists then endoscopic interventions are preferred [117, 121, 123]. Other options include angiography [124] and surgery, but both are less preferable compared to the less invasive option of endoscopy [122]. The decision to intervene depends on many factors, including the ease of endoscopic access. Left-sided anastomoses are more accessible endoscopically, so the threshold to intervene for left-sided operations is lower. Nevertheless, a right-sided anastomosis can be safely reached with an experienced endoscopist. Air insufflation should be minimized to avoid putting too much stress on the anastomosis, but anastomotic disruption is rare [123–125]. Bowel preparation is often unnecessary, especially for a left-sided anastomosis, but a rapid purge can be done if there is too much intraluminal blood to do an effective examination. If a clear bleeding site is identified, endoscopic clipping has been shown to be both safe and effective at stopping the bleeding (Fig. 10.9a, b) [117, 123]. Injection of the bleeding site with epinephrine [123] can also be done, especially when the bleeding is not focal, but this strategy may induce ischemia of the rest of the anastomosis. Electrocautery has also been successfully used but also runs the risk of anastomotic fistula [126]. Despite these potential complications endoscopic interventions appear to be safe with a low chance of secondary morbidity [123].

In the rare case when the bleeding neither stops with supportive case nor can be controlled endoscopically, the options for intervention are limited to angiography and surgery. While angiography, either with a vasopressin infusion [127] or embolization, has been successfully used to treat an anastomotic bleed, it does run the very real risk of compromising the blood supply to the anastomosis which can result in subsequent anastomotic breakdown. Therefore, angiography should be used selectively [117]. Surgery may be the better option if the anastomosis is readily accessible and there is

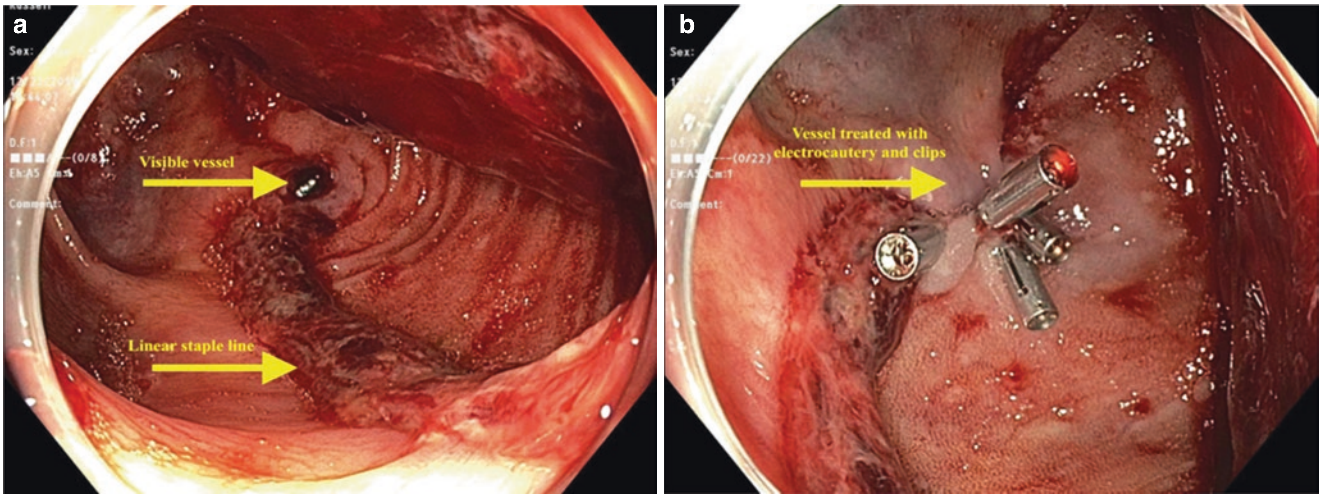


Fig. 10.9 (**a**) Endoscopic evaluation of a functional end-to-end ileocolic anastomosis 48 hours after anastomotic bleed showing staple line and visible vessel. (**b**) Anastomosis after successful use of electrocautery followed by placement of endoscopic clips to stop bleeding

appropriate colonic length for a revision. Anastomotic revision has been shown to stop bleeding in most cases and can be done safely in situations in which the bleeding cannot be otherwise controlled [117].

While there are options to treat anastomotic bleeding, prevention is always preferable to treatment. Proper healing of an anastomosis is dependent upon good blood supply, so seeing pulsatile blood flow when constructing an anastomosis should be comforting. Nevertheless, active examination and controlling this bleeding is important. Unfortunately, all anastomotic techniques are susceptible to bleeding. The Cochrane collaborative noted a slight, but statistically insignificant, difference between a handsewn and stapled anastomosis (3.1% vs. 5.4%) [116, 128] and therefore did not favor one technique over another. Regardless of the technique a well-constructed anastomosis should avoid incorporating the associated mesentery, so the antimesenteric border (Fig. 10.10) should be used for a functional end-to-end anastomosis and the mesentery cleared for an end-to-end anastomosis [118]. However, even when the mesentery is clearly free, bleeding from the staple/suture line is often noted. Therefore, for a functional end-to-end anastomosis direct visualization of the inside of the anastomosis should be done prior to closing the transverse opening. If pulsatile bleeding is present, treatment with cautery should be avoided. Instead, a well-placed figure of eight suture can control the bleeding and then be used to evert the anastomosis, so the entire staple line can be examined (Fig. 10.11). For left-sided anastomoses, endoscopic examination allows one to check for intraluminal bleeding while testing the integrity of the anastomosis [119, 129, 130]. If bleeding is noted, either a clip can be applied or a stitch can be directly placed from the outside of the bowel lumen, using the colonoscope to guide stitch placement [119, 130].

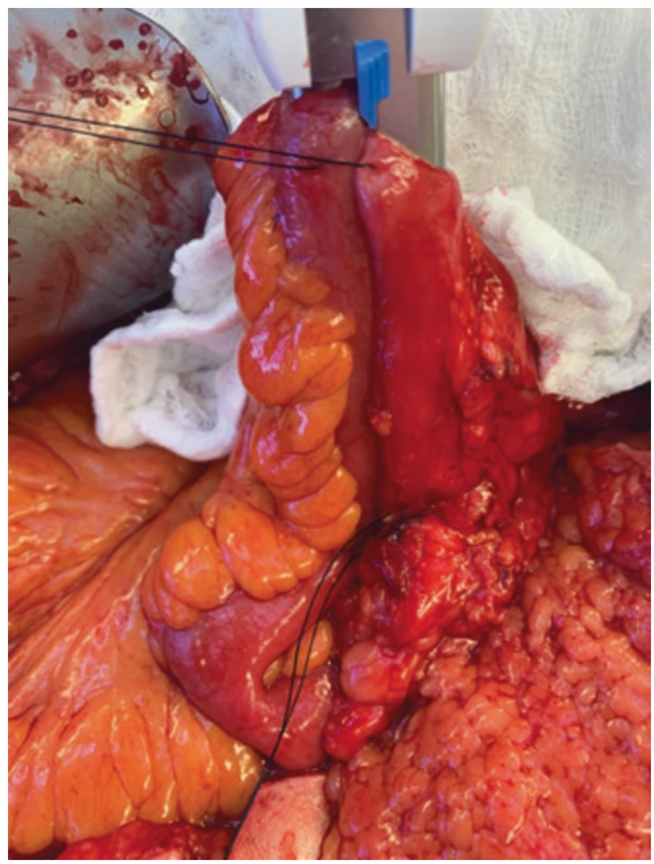


Fig. 10.10 Proper construction of functional end-to-end ileocolic anastomosis using the antimesenteric borders for staple line

In summary, while the true incidence of anastomotic bleeding is not known, clinically significant bleeding is uncommon. Most will stop with supportive care, which may include blood transfusions. For bleeding that persists, endoscopic management is the preferred intervention. Anastomotic

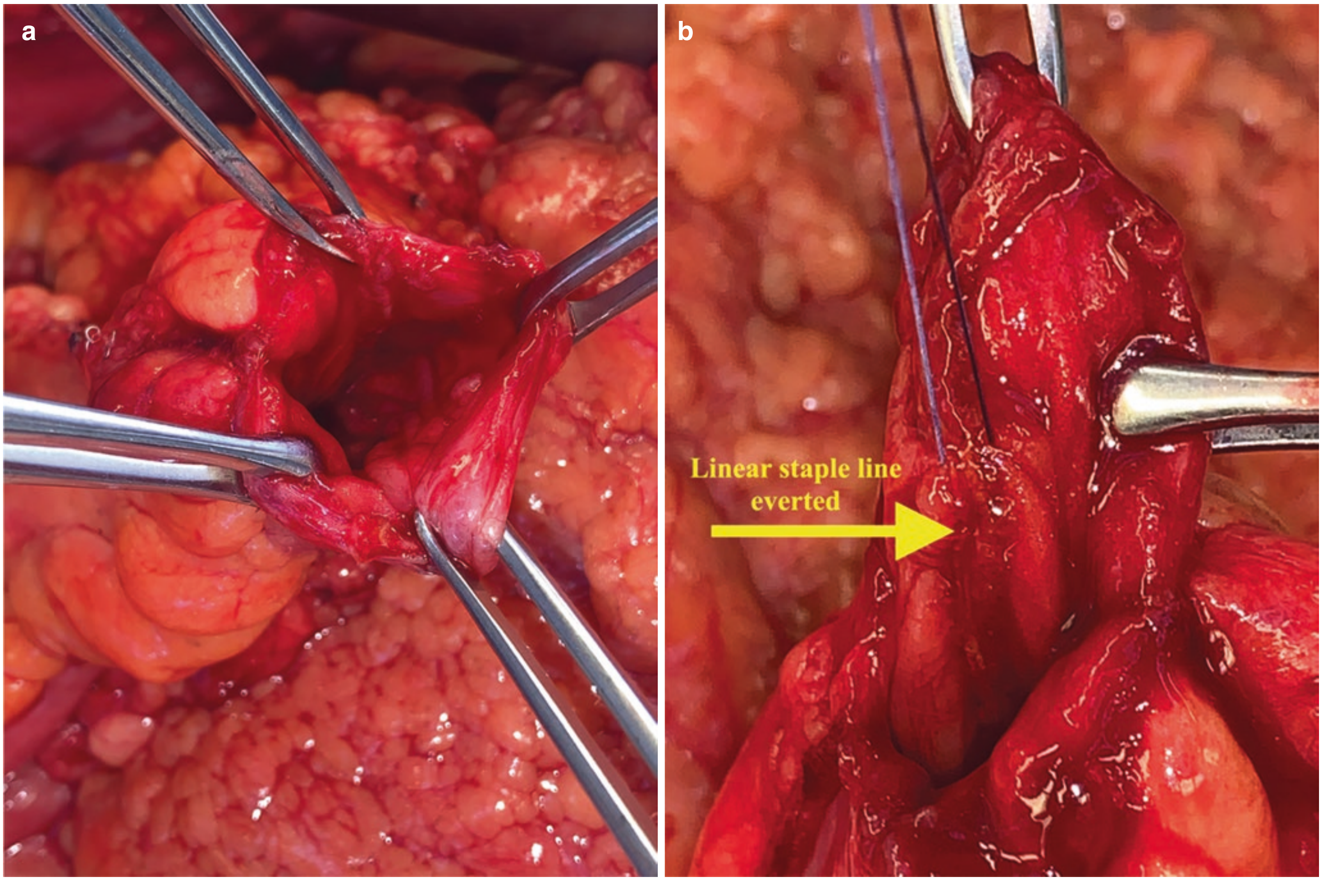


Fig. 10.11 (**a**) Direct examination of staple line prior to closing transverse enterotomy. (**b**) Placement of stitch to evert linear staple line to examine and ligate active pulsatile bleeding

revision is reserved for the rare situation when endoscopic interventions have failed [117].

Anastomotic Stricture

As with anastomotic bleeding the true incidence of anastomotic stricture is not well established, which reflects variability in the definition of a stricture throughout the literature and in clinical practice. It has been estimated to be as high as 30% but this includes clinically insignificant strictures. The most common definition of a stricture is a narrowing of an anastomosis that does not allow passage of either a 12-mm colonoscope or a rigid proctoscope [131–133]. Using this definition, the incidence is likely less than 10% [128, 134, 135]. Many of these patients will develop obstructive symptoms, which can include constipation, cramping, and a decreased caliber of stool [135]. In extreme cases patients may experience overflow diarrhea and incontinence as solid stool cannot pass the stricture. The diagnosis is usually made several months following the initial resection but usually within 12 months if not associated with recurrent disease [134–136]. In addition to impacting patient function, a stricture that cannot be traversed limits the ability to completely evaluate the stricture and to monitor the proximal colon. This is particularly important for patients whose surgery was due to malignant disease since the stricture may represent recurrence and, even if benign, the patient requires ongoing surveillance of the entire colon. What is clear is that the lower the anastomosis the higher the stricture rate, with ileal pouch anal anastomoses and coloanal anastomoses [134, 137] having the highest stricture rates compared with more proximal anastomoses, such as ileocolic anastomoses.

The etiology of an anastomotic stricture is likely multifactorial. A stricture forms when the lumen is compromised by ongoing fibrosis. This can be the result of ischemia, infection, anastomotic leak, radiation and/or recurrent disease [131, 133]. Proximal diversion has also been shown to be a risk factor for a low pelvic anastomosis since no stool is passing through to dilate the anastomosis regularly [135]. In a Cochrane review left-sided end-to-end stapled anastomoses had a higher stricture rate than handsewn anastomoses (8% vs 2%) [128]. However, this may be confounded by the fact that staplers are more often used for low anastomoses, which have a higher risk for ischemia and leak, which can result in stricture. The authors of the review stated that this finding does not necessarily favor a handsewn approach [138]. For ileocolic resections the Cochrane analysis concluded that the stricture rate of handsewn vs. stapled anastomoses were similarly low [139].

Understanding the exact anatomy of a stricture is important prior to planning an intervention [140]. This can be done endoscopically if the stricture can be traversed with a smaller endoscope or with fluoroscopic imaging if not (Fig. 10.12). It is also important to understand the anastomotic construction since an inexperienced endoscopist may not recognize that with an end-to-side or side-to-side reconstruction the anastomosis may be at 90 degrees to the lumen and misinterpret the "dog ear" as a pinpoint stricture (Fig. 10.13). Once again, when the anatomy is unclear a fluoroscopic examination can be enlightening.

Treatment of an anastomotic stricture depends on the anatomy and the etiology. In the setting of prior malignancy, recurrent disease must be ruled out with biopsies. While many malignant strictures will be clinically evident by the presence of an ulceration and/or a mass, the stricture itself may preclude and adequate evaluation. CEA monitoring and PET CT scans may be helpful under these circumstances. If the suspicion for malignancy remains high even after initial biopsies are negative, repeat biopsies may be necessary [131].

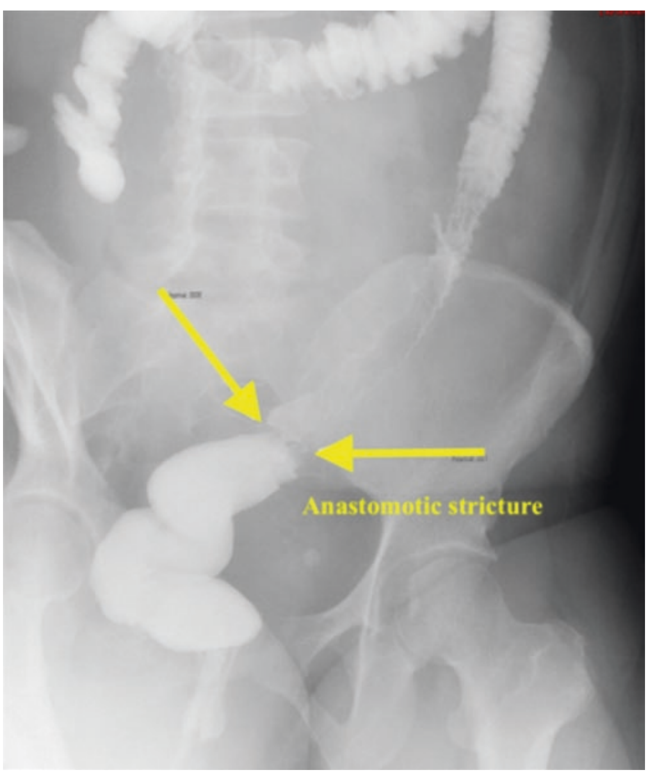


Fig. 10.12 Fluoroscopic image of a stapled end-to-end anastomosis showing a short, tight stricture

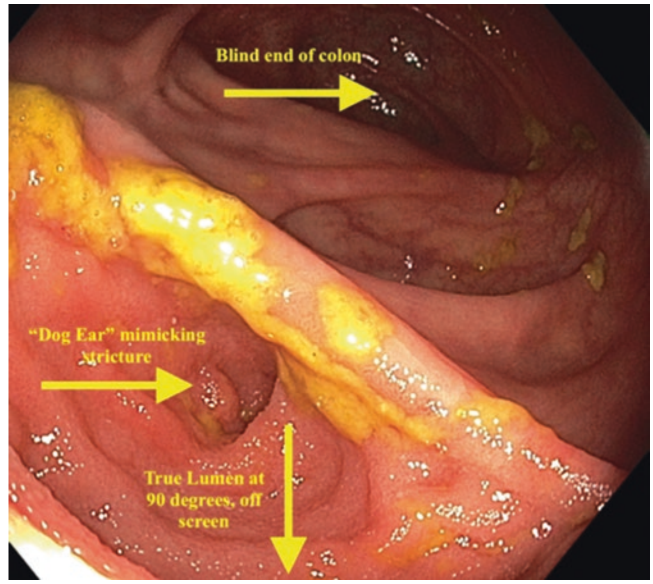


Fig. 10.13 Endoscopic image of functional end-to-end anastomosis demonstrating how the small bowel "dog ear" is easily misinterpreted as an anastomotic stricture

For strictures near the anal canal, such as after a low pelvic anastomosis or an ileal pouch anal anastomosis, dilation can often be accomplished with a digital exam. This is particularly true for patients that have a protective ileostomy who demonstrate a short stricture on a water-soluble contrast enema. For patients with a handsewn coloanal anastomosis, a digital exam prior to reversal is important since a fluoroscopic study may not appreciate the stricture if the tip of the catheter for contrast infusion is placed proximal to the strictured area. Since dilation with a digital exam can be uncomfortable, it is often done under anesthesia (Fig. 10.14). If successful, patients may require intermittent dilation to keep the anastomosis open. Patients can learn to self-dilate with Hegar dilators (Fig. 10.15) if there is a tendency for the stricture to recur. For patients with strictures that are more proximal, mechanical dilation using a bougie has also been successful.

Endoscopic balloon dilation has emerged as the preferred first line treatment for an anastomotic stricture with a success rate ranging from 67% to 100% [141, 142]. Unfortunately, most studies are small and retrospective, and lack details on the specific nature of the anastomotic strictures. Most strictures referred for dilation are probably short (<2 cm), which seems to be the population that is best treated for dilation [133, 141]. Therefore, defining the characteristics of stricture is important prior to intervention. In a series of 94 patients using endoscopic balloon dilatation, Suchan et al. reported an overall success rate of 67%. They noted that the success rate for patients having had an initial benign diagnosis was 88% with few complications. In contrast, in patients having had an initial malignant diagnosis, the success rate was only

59% with many patients experiencing recurrent strictures that needed surgical interventions [131]. In a more recent report, Biraima et al. reported on the long-term success of 76 patients with an anastomotic stricture. They reported a recurrence rate at 1 year, 3 years, and 5 years of 11%, 22%, and 25%, respectively. In 50% of the patients, success was obtained with either one or two dilations. Even in the 25% who eventually recurred most were successfully managed with repeat dilation and only two ultimately required a surgical intervention. Therefore, the secondary success rate was high at 97%, although in the 25% who initially failed, multiple dilations were often necessary. The serious complication rate was low with most being minor bleeding and one perforation, none of whom required a surgical intervention [134]. Of note, the authors did include a significant number of patients with mild stenosis (10–20 mm). When looking at risk factors for recurrence of a stricture following balloon dilation, the authors found that strictures with a luminal diameter < 10 mm, those from a handsewn anastomosis, and those requiring more than two dilations were more likely to recur over time (Fig. 10.16a–c) [134].

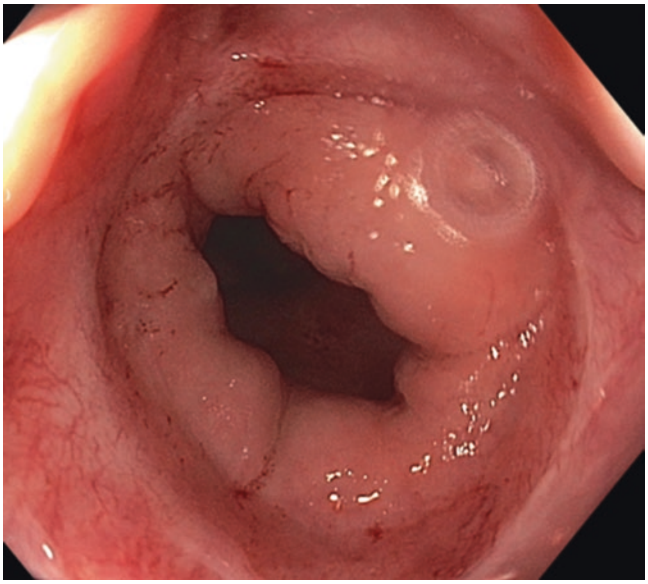


Fig. 10.14 Endoscopic image of handsewn coloanal anastomosis amenable to digital dilation

Fig. 10.15 Hegar dilators

For patients with a significant stricture, endoscopic electrocautery incision (EECI) [143–145], either using cautery or a laser, can initially open up the stricture either as definitive therapy or in conjunction with other therapies, including balloon dilation or steroid injection [146]. Several radial incisions are placed through the fibrotic mucosa along the most resistant portion of the stricture in order to relieve the tension on the stricture (Fig. 10.17) [143–145]. In the previously mentioned series from Suchan et al., 37 of the 68 patients with an initial malignant diagnosis had an incision placed through the stricture using a variety of energy devices. Most were then able to undergo balloon dilation [131]. Endoscopy, TEMS, [147], and TAMIS [148] have all been used to access the stricture and to perform the superficial incisions along the stricture or, in some cases, to fully resect the fibrotic tissue [149]. Using these techniques, success rates of 90–100% have been reported, albeit in small studies with variable long-term follow-up data. [142, 143]. Nevertheless, for short fibrotic strictures that recur following balloon dilation this is a viable alternative to anastomotic revision.

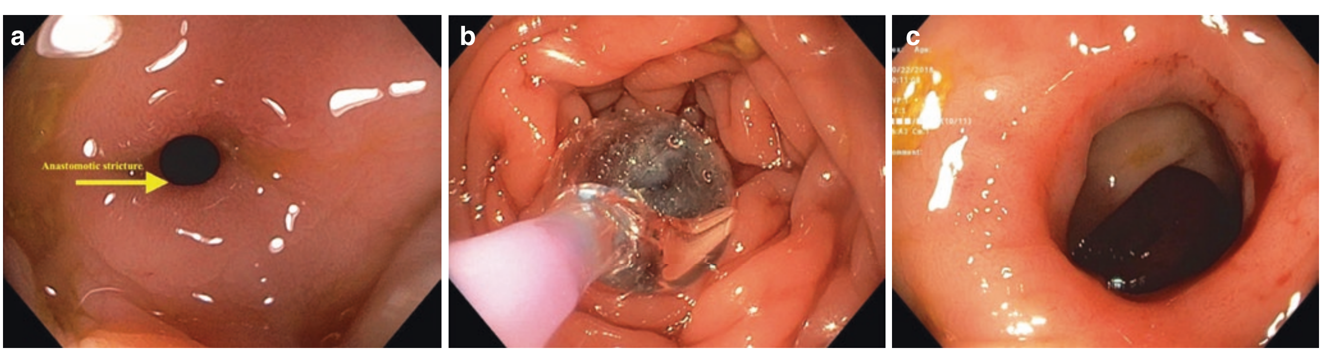


Fig. 10.16 (**a**) Endoscopic view of tight end-to-end stapled anastomosis. (**b**) Balloon dilation. (**c**) Final view after serial dilations showing a wide-open lumen

Self-expanding metal stents (SEMS) have also been used as an adjunct to treat a stricture. In theory, the radial force of the stent will allow persistent pressure on stricture which may reduce recurrence rates [150]. Unfortunately, in this setting the stents frequently migrate and therefore have not been consistently successful. In addition, there have been reports using a circular stapler via a transanal approach to resect the stricture (Fig. 10.18) [151]. However, this technique is only amenable to more mild strictures that would allow the passing of an anvil above the stricture and therefore has not been widely adopted [137]. Finally, both linear staplers [152] and electrocautery [150] have also been used to transanally perform a strictureplasty by resecting a portion of the stricture wall to open the anastomosis. Most data are limited to case reports and small series, so firm conclusions about long-term success are limited.

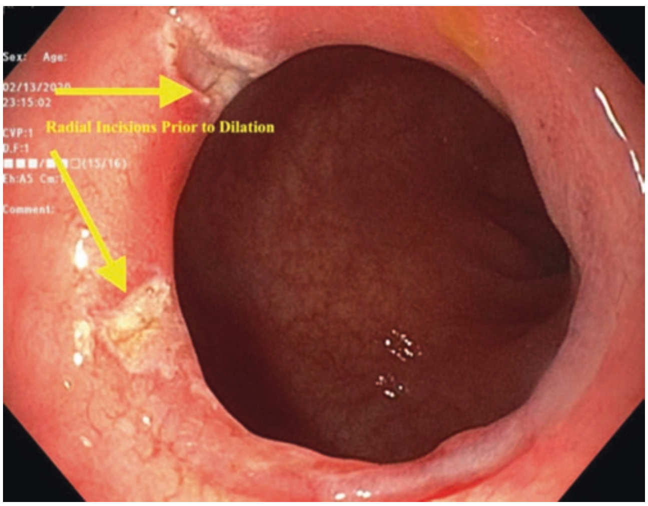
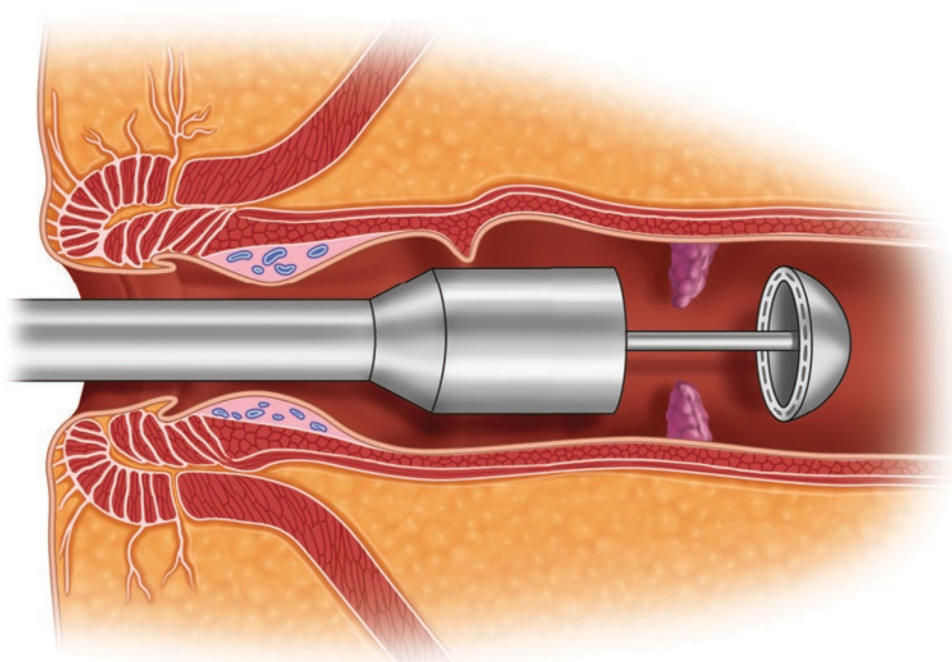


Fig. 10.17 Initial radial incision along the stricture to facilitate a safe and successful balloon dilation

Unfortunately, some anastomotic strictures are not amenable to these noninvasive procedures. Long (> 2 cm), irregular, and angulated strictures either fail interventions or are not anatomically appropriate for these procedures [133]. In these cases, a surgical revision may be the only option [136–142]. Resection and re-anastomosis are very challenging and should not be undertaken without careful consideration. Ureteral stents can help identify the left ureter which is often adherent to the colon and the associated mesentery. The area around the anastomosis will be severely fibrotic and perforation at the anastomosis is common during the resection. The key to a successful anastomosis is to get below the area of fibrosis to soft, pliable colon or rectum [133]. If this is not possible, then a handsewn coloanal anastomosis can be done [136]. Given the complexity of this operation, proximal diversion is reasonable to maximize the chances of long-term success.

Studies looking at re-do pelvic surgery following a failed colorectal anastomosis include a heterogenous group of patients with stenoses, anastomotic fistulas, and even recurrent cancer. Therefore, these studies are not limited to patients with a stricture. Nevertheless, the fibrosis associated with all these processes is significant, so these studies still provide necessary insight into the complexities of these procedures. Despite the challenges presented

Fig. 10.18 Illustration demonstrating a transanal resection of an anastomotic stricture using an EEA stapler



with these patients, successful revisions have been noted in 57–100% [136] of selected series with a pooled success rate of 79%. When the stricture is located above 11 cm from the anal verge, a new stapled colorectal anastomosis is often feasible. However, if the stricture is less than 11 cm from the verge a handsewn coloanal anastomosis is almost universally constructed [133]. Since pelvic fibrosis is often significant a straight coloanal is most commonly performed, but if there is room in the pelvis a colonic J-pouch remains an option [153]. Both immediate and delayed (Turnbull-Cutait) procedures have been described. Depending on the amount of fibrosis, the entire anastomosis can be resected or alternatively a mucosectomy can be done leaving a rectal muscular tube similar to a Soave procedure [133, 153]. Given the high-risk nature of these anastomoses, proximal diversion is generally the rule [136]. While this success rate is promising, it is important to note that these reports are of highly selected patients and performed by very experienced surgeons in tertiary care facilities. The mean age was relatively young at 58 years, suggesting that older patients may not do well with this approach. Furthermore, while intestinal continuity was achieved in nearly 80%, 17% did have incontinence and nearly 60% had some degree of low anterior resection syndrome [136]. It is critical, therefore, to have frank discussions with patients about functional expectations and to not solely focus on defining success as being "stoma free." Nevertheless, in the fit and highly motivated patient, re-do surgery is certainly a viable option.

Remembering that preserving a high quality of life is of prime importance, it is essential to make the patient aware of all the available options, including a permanent stoma. If a stricture is either not amenable to or fails the previously described non-surgical approaches, or if the patient is not a good surgical risk due to comorbidities or anatomic constraints, a well-functioning colostomy may be the most definitive option that will maintain a high quality of life.

In summary, clinically significant anastomotic strictures will occur in up to 10% of patients following a colorectal resection. Most of these will be left-sided and within the rectum. Fortunately, many strictures are simple and can often be treated with dilation either using a balloon or manually. While often successful, repeat procedures are not uncommon. For those that fail simple dilation, a step-up approach to include incision of the stricture followed by dilation or a transanal strictureplasty may be an option [137]. Revision of the anastomosis is a daunting undertaking, but in the properly selected patients it can be successful. For those patients who are not successfully treated by any of these means, a properly constructed colostomy can restore a high quality of life and should be considered a viable option under these difficult conditions.

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