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INVITED REVIEW

Current Management of Colovesical Fistula

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ABSTRACT

A colovesical fistula (CVF) is an abnormal communication between the large bowel and bladder. This complex condition carries significant morbidity and negatively impacts quality of life. The clinical presentation of CVF can vary from symptoms, such as pneumaturia and fecaluria, to life threatening urosepsis. The most common etiology of CVF is diverticulitis. Diagnostic work-up with accurate diagnosis is key for prompt recognition and treatment of this condition. The primary goal of treatment is to remove the diseased colonic segment. Traditionally, open surgical intervention was the preferred surgical approach. Over the last decade, there has been an increasing interest in and use of minimally invasive techniques to treat patients with CVF.

Keywords: Bladder fistula, colovesical fistula, diagnostic work-up, diverticulitis, laparoscopic surgery, surgery, surgical treatment, urinary fistula

Introduction

A fistula is an abnormal anatomic connection between two epithelialized surfaces. The term colovesical fistula (CVF) refers to an abnormal communication between the large bowel lumen and the bladder.[1-3] The most common etiology of CVF is diverticular disease (50-70%), followed by malignancy and inflammatory bowel disease (IBD).[4-8] Diverticulosis is prevalent in Western countries and the incidence of symptomatic diverticulitis is increasing, especially in young patients.[9] It is estimated that 10% to 20% of individuals suffering from diverticulosis develop diverticulitis and approximately 2% of patients progress to complications, such as abscess formation, fistula, stricture with obstruction, or hemorrhage.[10,11] The majority of diverticulitis related perforations and fistulas occur in the sigmoid colon, which is the portion of the large bowel most affected by diverticulitis. CVF is associated with significant morbidities and negatively impacts quality of life for patients. Surgical resection is the main curative modality. However, proper evaluation and diagnosis are of paramount importance to ensure prompt treatment of this condition.

The aim of this article was to provide an overview of the management of CVF in the modern era of surgical care. The information provided to the reader is based on the established literature and on the expert opinion of the senior author, who has over 20 years experience managing patients with complicated diverticulitis and complex colorectal fistulas.

Presentation and Findings

The majority of patients with CVF are symptomatic, albeit the symptoms can range from mild to life threatening. The passage of gas bubbles and/or fecal particles into the urine, termed pneumaturia and fecaluria, respectively, is consistent with large bowel fistula to the urinary system. Other symptoms include dysuria, hematuria, and suprapubic pelvic pain. The majority of urinary fistulas involve the bladder and the sigmoid colon, with a minority of patients presenting with a rectourethral fistula that is often related to prostate cancer and its treatment. Less common is an enterovesical fistula from the small bowel to the bladder. Recurrent urinary tract infections are known sequelae of CVF, with a minority of patients presenting with life threatening urosepsis.

The patient's medical and surgical history can aid in diagnosis. While a prior history of one or more episodes of diverticulitis is often reported by patients, some patients can present with *de novo* fistula without prior documented history of diverticulitis. It is important to solicit from the patient any past history of abdominal surgery, past or current digestive disease, prior radiation therapy to the pelvis, and

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history of abdominal or pelvic malignancy. Past obstetrical history should be documented in women to solicit any prior perineal trauma from forceps or vacuum delivery, episiotomy, or tear. Baseline continence level should be recorded along with patient's bowel movement habits.

Physical examination consists of visual inspection of the abdomen for scars, distention, or tenderness. Digital rectal examination and assessment of anal sphincter tone is advisable. In men with prior history of prostate cancer treatment, the addition of anoscopy is recommended, especially if there is suspicion for the possibility of rectourethral fistula, which may be palpated anteriorly within 6 to 8 cm from the anal verge.

Diagnostic Work-up

The diagnostic work-up for CVF include laboratory tests, imaging, and endoscopic examinations. Basic laboratory tests include complete blood count, renal function, urine analysis, and urine culture. Cross sectional imaging is necessary in all patients with suspected urinary fistula. Ultrasound of the abdomen and pelvis is not additionally informative and thus plays very little role in diagnosis of CVF. The preferred study is computed tomography (CT) of the abdomen and pelvis.[12,13] The presence of air in the bladder with pericolonic scarring, inflammation, or clear fistula in a patient without recent urinary catheterization is pathognomonic for CVF (Figure 1-3). CT scan confirms the diagnosis of CVF in addition to providing useful information regarding the presence of acute colonic inflammation and/or pelvic abscess (Figure 4). Magnetic resonance imaging (MRI) scan is another cross-sectional imaging study that can document CVF but in the majority of patients, CT scan is the study of choice with the advantages of being readily available at all institutions with shorter procedure time and lower cost. Furthermore, most surgeons are more comfortable interpreting CT scans than MRI.

Fluoroscopy based studies, such as a cystogram or a gastrografin enema, are useful in documenting the presence and location of the fistula. Cystogram is a simple procedure which can demonstrate the passage of contrast material from the bladder into the large bowel to make the diagnosis of CVF (Figure 5). It is a readily available study in most radiology departments. Gastrografin enema together with injection of contrast transanally, can confirm the diagnosis of CVF, demonstrate the anatomic configuration of the large bowel, and document the presence or absence of any secondary finding, such as a colonic stricture (Figure 6). Both cystogram and gastrografin enema can exclude the presence of a fistula from other parts of the digestive tracts, such the small bowel (enterovesical fistula), which can present with similar symptoms to CVF. Endoscopic examination of the bladder and the colon is advisable in patients with suspected CVF. Both studies can provide information about the fistula and rule out conditions other than diverticulitis, such as IBD or malignancy. Cystogram can exclude malignant causes of CVF. While colonoscopy with straight forward viewing scope rarely shows the fistulous hole on the colonic side, it can pinpoint the general area of the fistula by identifying secondary findings, such as edema, erythema, pus drainage, narrowing of the bowel, and the presence of diverticulosis (Figure 7). Colonoscopy can be of paramount

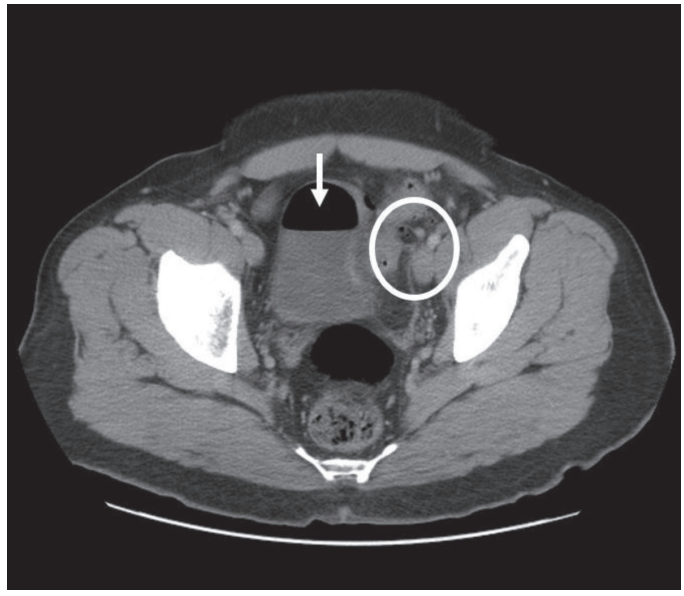

Figure 1. Axial views of CT scan of a patient with recurrent diverticulitis and colovesical fistula. Air fluid level is seen inside the bladder [arrow]. An adjacent inflamed sigmoid colon with diverticulae is noted [circle]
CT: Computed tomography

Figure 2. Coronal views of CT scan of a patient with Crohn's colitis with colovesical fistula. Note inflamed colon [arrow]. Air bubbles are seen inside the bladder
CT: Computed tomography

importance in patients presenting with iatrogenic CVF following prior pelvic surgery (Figure 8). In patients with IBD, such as Crohn's disease, endoscopic examination is necessary to document disease activity in the remainder of the large bowel and terminal ileum in order to determine whether a segmental resection vs. a more extensive colonic resection is needed and to guide medical management by the gastroenterologist. Furthermore, disease activity in the rectum will be documented to aid the surgeon in deciding whether to perform a primary anastomosis to the rectum and/or a diverting stoma. In addition, colonoscopy provides the added value of screening the non-affected area of the colon for neoplastic lesions, such as polyps and tumors.

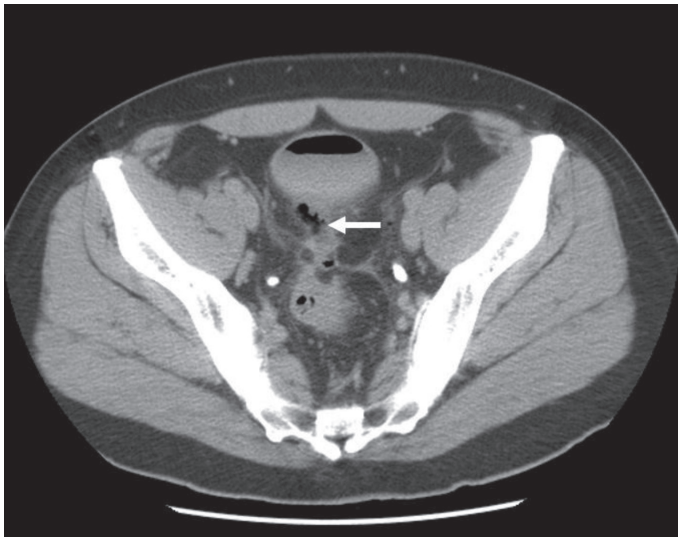

Figure 3. Axial views of CT scan of a patient with recurrent diverticulitis delineating a clear fistulous tract with gas from the colon to the bladder [arrow]
CT: Computed tomography

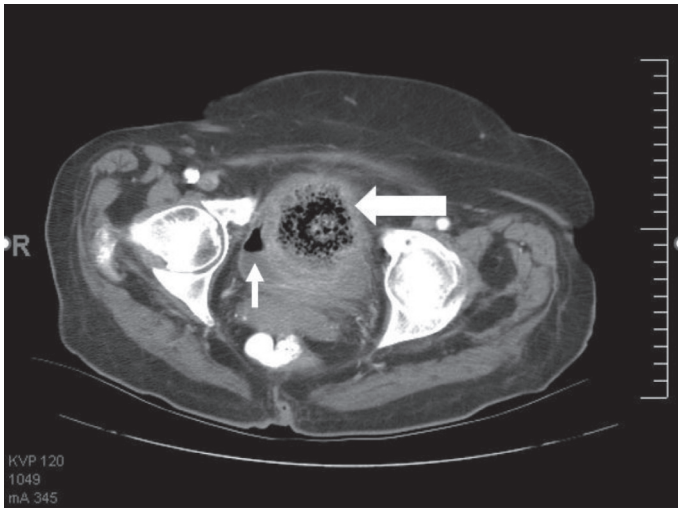

Figure 4. Axial views of CT scan of a patient with diverticulitis and pelvic abscess [wide arrow] with colovesical fistula and air in the bladder [narrow arrow]
CT: Computed tomography

Initial Management and Preparation of the Patient with Colovesical Fistula

The majority of patients with CVF will be symptomatic and require treatment. The mainstay of treatment for this condition is surgical intervention, as medical therapy usually temporizes the symptoms but does not cure the fistula. Surgical intervention is best performed in the

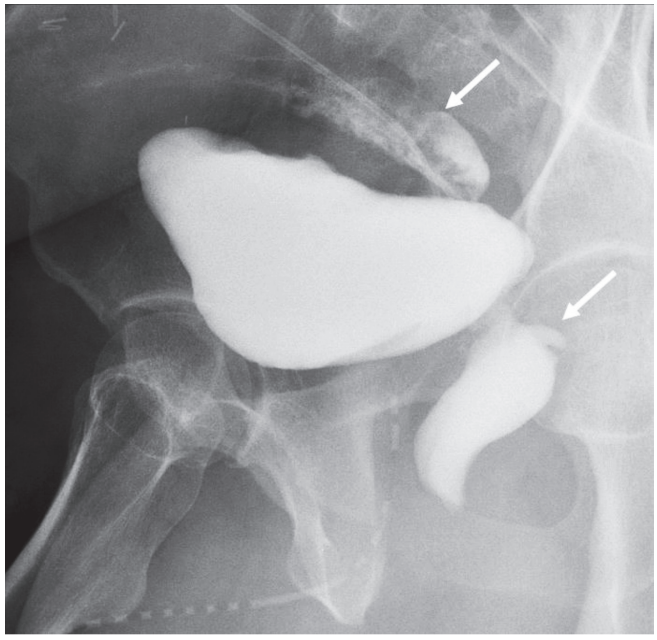

Figure 5. Fluoroscopic cystogram in a patient with a colovesical fistula demonstrates filling of the bladder with passage of contrast into the rectosigmoid area [arrows]

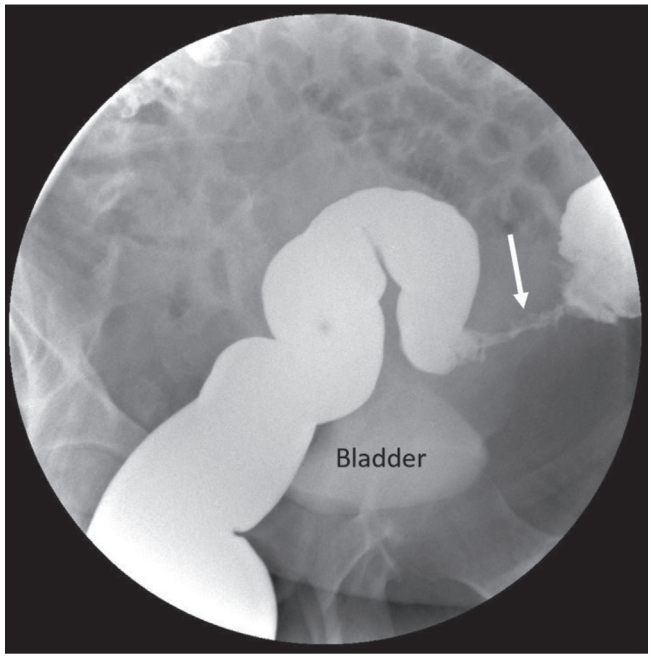

Figure 6. Gastrografin enema in a patient with colovesical fistula reveals a sigmoid stricture. Contrast spillage into the bladder confirms the presence of the fistulous communication

elective setting as rarely CVF requires emergency surgery. The initial management of CVF will include making the proper diagnosis and optimizing the patient for elective surgery. Medical optimization includes control of sepsis while addressing malnutrition and anemia, if present. Patients with urosepsis should receive an appropriate course of antimicrobial therapy and, if a pelvic abscess is present, consideration for percutaneous drainage should be made for any collection larger than 4 centimeters to expedite resolution of acute sepsis. Control of sepsis, and correction of anemia and malnutrition when present can shift the patient to elective surgical intervention under more optimal conditions, which can improve the chances of a minimally invasive approach with less conversion to open surgery and lower rate of stoma formation. When significant colonic inflammation is present in the setting of diverticulitis, a full antimicrobial course and deferring the operation for a minimum of four to six weeks decreases the chances of encountering a hostile abdominopelvic cavity during surgery.

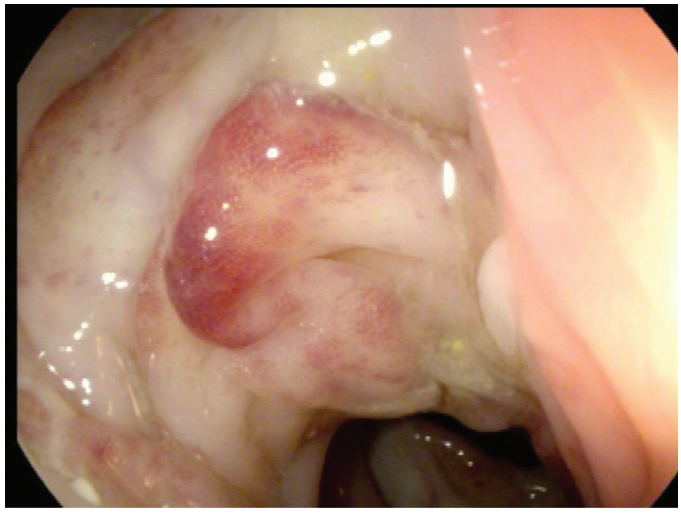

Figure 7. Colonoscopic view of area of colovesical fistula in the sigmoid colon. Noted are the secondary findings of bowel edema and erythema with pus drainage

Figure 8. Endoscopic view of an iatrogenic rectovesical fistula following stapled rectal anastomosis [arrow]. Note the 2 metal staples in the center of the fistula

A urologic consultation is advisable to aid in diagnosis and to provide surgical assistance as required on the day of the operation. If a stoma is contemplated as a possibility by the surgeon, the patient should be evaluated by an enterostomal nurse for skin marking and should be educated about stoma care. Patients with a prolonged history of CVF with numerous prior antimicrobial courses can benefit from an infectious disease review of prior cultures for recommendations of the optimal antimicrobial coverage at time of surgical resection.

A mechanical oral bowel preparation is advisable in all patients. Various bowel preparations are available and the surgeon can administer the standard bowel preparation for colonic resection at their institution. The addition of an oral antibiotics regimen to the bowel preparation can be considered, if it is part of the surgeon's standard bowel preparation for colorectal resection. Their usefulness has been debated over the last few decades. At our institution we do not currently use them.

CVF surgical treatment can be straightforward in some cases, yet very challenging in some patients with prolonged operative time and blood loss. It is advisable to type and cross-match all patients undergoing resection for CVF for 2 to 4 units of packed red blood cells, depending on the level of preoperative hemoglobin.

Surgical Care and Technique

Intraoperative

Operative interventions for CVF can be challenging. We typically schedule these cases as the first case in the morning. The operating room is set up for a minimally invasive operation. Trays of open instruments and retractors are made available in the room in case conversion to open surgery is needed.

All operations are performed in the lithotomy position under general endotracheal anesthesia. Both arms are tucked and safely padded (Figure 9). We advise for a bilateral transversus abdominis plane block, as part of the postoperative pain management protocol. It is best performed under ultrasound guidance prior to surgical incision. An orogastric tube is inserted to decompress the stomach and it is removed at the completion of the surgical procedure. Intravenous antibiotics are administered, along with chemical deep venous thrombosis prophylaxis with subcutaneous injection of unfractionated heparin or low molecular weight heparin.

The first phase of the operation consists of cystoscopy with bilateral ureteral catheters placement for intraoperative

identification and protection of the ureters. While most CVFs involve the dome of the bladder, some inflammation may extend to the area of the trigone. Furthermore, some patients may have significant inflammatory changes in the retroperitoneum, away from the area of the fistula. Prior retroperitoneal perforation with abscess from diverticulitis or Crohn's disease may lead to retroperitoneal fibrosis which can render the ureter susceptible to laceration during the division of the sigmoid vascular pedicle or the mobilization of the left colon (Figure 10). Ureteral catheters can allow the surgeon to identify the ureter by visualization and/or palpation. In cases with significant fibrosis, ureteral catheters can also facilitate detection of intraoperative ureteral laceration, which can be promptly repaired.

After insertion of ureteral catheters, the abdomen is prepped and draped in the usual sterile fashion. As the majority of CVFs involve the rectosigmoid colon, the room set-up is geared towards a standard left sided resection. For the last two decades, the senior author has been advocating for a minimally invasive approach for CVF.[14,15] A minimally invasive approach, for example with laparoscopic surgery, yields significant short and long-term patient benefits, such as faster recovery, less postoperative complications, and lower rates of incisional ventral hernia and adhesive small bowel obstruction.[16] With advanced laparoscopic expertise, CVF can be treated with keyhole surgery. In this article, we will focus on the laparoscopic approach, as laparoscopic equipment is readily available at most hospitals. In addition, most of the available literature on minimally invasive techniques for CVF concerns laparoscopic surgery with a paucity of data on robotic surgery. However, with the gradual global adoption of robotic surgery, the robot may play an increasing role in the treatment of CVF in the future.

For laparoscopic resection, a 4-trocar technique is favored: 5 or 10 mm infraumbilical trocar for the camera, 5 mm trocars in the right upper quadrant and in the left mid-lower abdomen as working ports for the surgeon and the assistant, and 12 mm right lower quadrant trocar for the use of the endoscopic stapler (Figure 11). For specimen extraction site, there are three possibilities: A transverse left lower quadrant incision (extending the 5 mm trocar site), a limited infraumbilical midline, or a short Pfannenstiel incision. For the majority of our resections, we use a transverse left lower quadrant extraction site.

A variety of laparoscopic approaches have been described. After obtaining laparoscopic access, we start from a medial to lateral approach making a mesocolic window by opening the retroperitoneum, starting at the sacral promontory. Retrograde dissection identifies the left ureter and the vascular pedicle to the rectosigmoid. For a sigmoid resection, division of the sigmoidal vessels is achieved with an energy sealing

Figure 9. Lithotomy position with patient secured to the table and both arms tucked and well padded

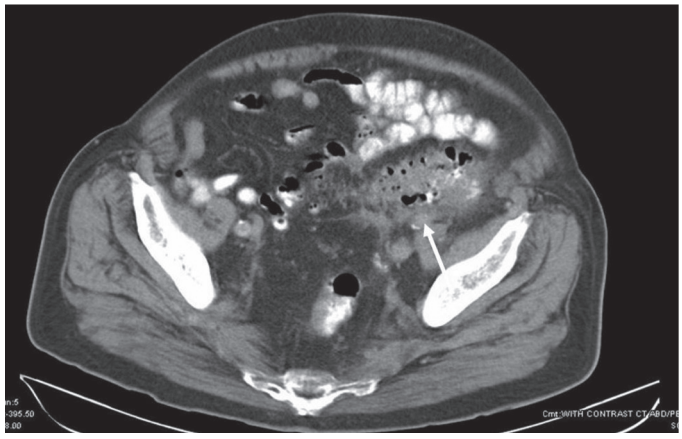

Figure 10. Sigmoid diverticulitis with perforation into the retroperitoneum surrounding the iliac vessels and left ureter [arrow]

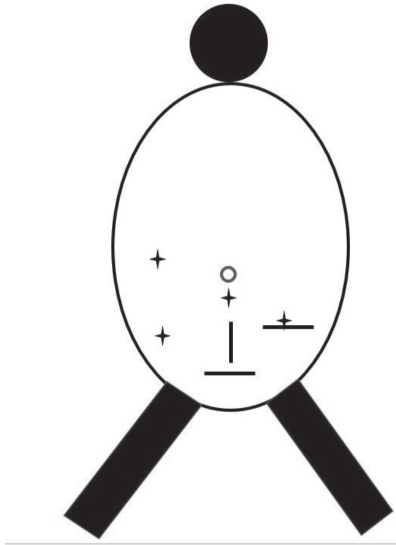

Figure 11. Trocar site placements [stars] and potential specimen extraction site [lines]

device. In case of an anterior resection, the vascular division and sealing is at the level of inferior mesenteric vessels. The retroperitoneum is dissected further by lifting the mesocolon anteriorly. Following that step, the proximal descending colon is dissected from a lateral to a medial approach by incising the left lateral gutter and going towards the sigmoid colon. Once the area of inflammation is reached, attention is directed anteriorly to the area of the bladder fistula (Figure 12). Using blunt dissection by horizontal sweeping of the laparoscopic instrument back and forth across the fistula, the bladder is separated from the large bowel. In cases where blunt dissection is not sufficient, the fistula is divided with an energy sealing device or electrocautery. The bladder is inspected carefully. Often there are inflammatory changes at the site of the fistula without an identifiable obvious hole in the bladder. Gentle debridement and irrigation of the area of inflammation is performed allowing the affected area to heal by secondary intention. If a clear fistulous hole is noted with visualization of the bladder lumen (Figure 13), a one to two layers repair of the bladder is done with absorbable sutures. Next, the upper rectum is transected in an area of soft and pliable bowel using an endoscopic stapler. Splenic flexure mobilization is conducted in select cases, if needed for a tension free anastomosis. The specimen is exteriorized through an extraction site exposed by a wound protector. The descending colon is divided extracorporeally at an area of soft and non-thickened large bowel and the specimen is sent for histologic evaluation (Figure 14). The anvil of a circular EEA stapler is inserted in the cut end of the descending colon after purse stringing the bowel with a suture. The bowel is reduced internally and the extraction site is closed. A stapled end to end colorectal anastomosis is performed under direct visualization. The integrity of the anastomosis is checked with the air leak test. In our practice we also perform flexible endoscopy to directly visualize the intraluminal aspect of anastomosis. Areas of bleeding are controlled with endoscopic clips and the anastomosis is checked for completeness and good vascularity. A surgical drain is left anterior to the anastomosis, behind the bladder. Fecal diversion with ileostomy is uncommon in our practice but considered in select cases based on the surgeon's judgement.

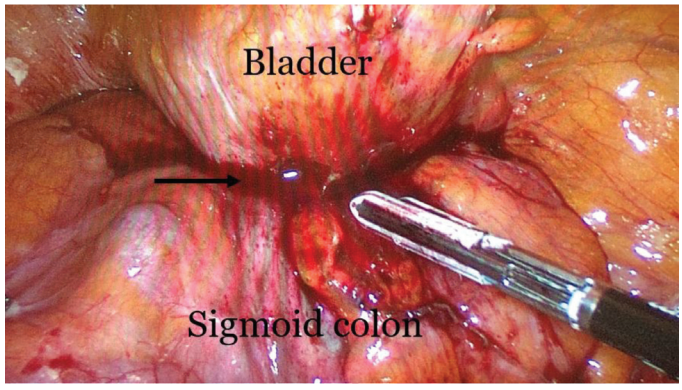

Figure 12. Intraoperative view of colovesical fistula involving the sigmoid colon [arrow]

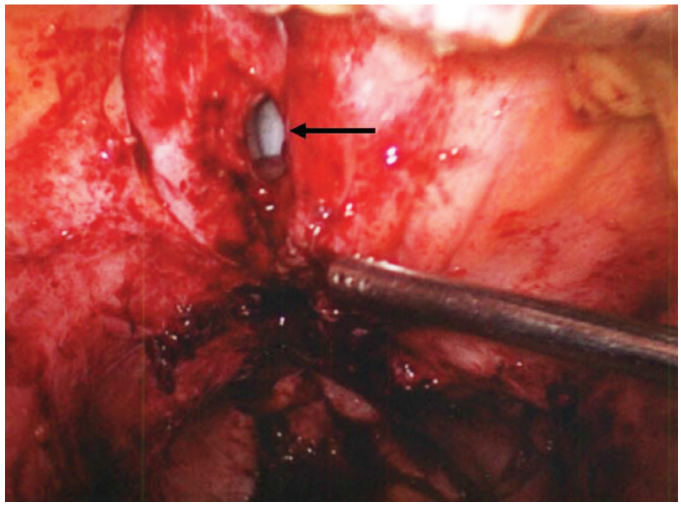

Figure 13. Intraoperative view of the bladder lumen with urinary catheter [arrow]

Postoperative Care

The patient is admitted to the ward and started on a full liquid diet within six hours of the operation. Early ambulation is encouraged and intravenous fluid maintenance is infused at a low rate, avoiding fluid overload. Pain control is achieved with non-steroidal anti-inflammatory medications and paracetamol, with the addition of narcotics medications if needed. Deep venous thrombosis chemical prophylaxis is administered subcutaneously during the hospitalization and continued after discharge for two weeks. The urinary bladder catheter is kept on average for 7-10 days, at which time a

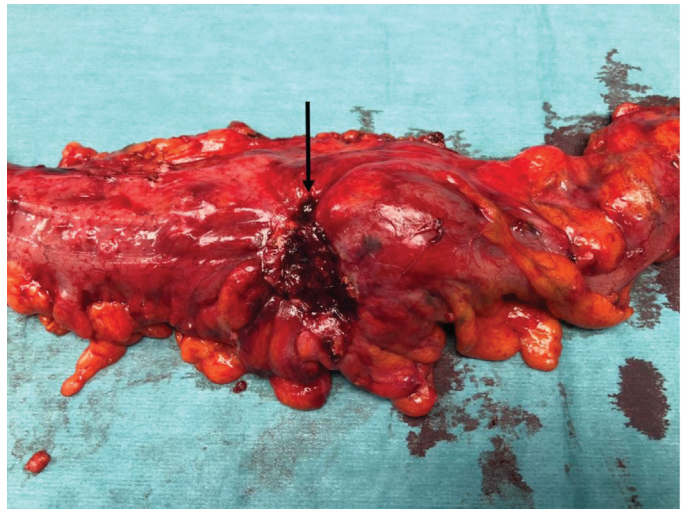

Figure 14. Sigmoid colon specimen with area of the large bowel involved by the fistula [arrow]

contrast cystogram is performed in radiology to confirm healing before catheter removal. Antibiotics are continued while the urinary catheter is in place. The surgical drain is kept until the drainage amount is less than 30 mL in 24 hours, and then removed.

Discussion

Colorectal fistulas carry significant morbidity and negatively impact the quality of patient's life. Several types of colorectal fistulas have been classified and these include CVF, colovaginal, coloenteric, colocutaneous, rectourethral, and rectovaginal fistulae. The senior author previously reported his experience at a tertiary center with this spectrum of conditions in the modern surgical era.[17] The focus of this article was to provide the reader with a framework of how to approach CVF, based on data available in the literature and the two decades experience of the senior author treating this condition.

Until recently, the majority of CVF cases have been surgically treated with an open approach. In a recent retrospective review of over 500 cases of CVF documented in the American College of Surgeons National Surgical Quality Improvement Program data base, only 29.7% of the cases were operated laparoscopically.[18] In this retrospective study open surgery was an independent risk factors for complications. For nearly two decades, the senior author has advocated a minimally invasive technique to treat CVF, previously reporting his experience with laparoscopic surgery and subsequently robotic surgery.[14,15] CVF can be safely approached with a minimally invasive technique. In his initial series on laparoscopic surgery for CVF, the senior author compared the results of patients who underwent laparoscopic surgery for diverticulitis with colonic fistulas [group 1: (n=21), of whom 15 (71.4%) had CVF] with patients with diverticulitis but without fistula [group 2: (n=21)].[14]

There was no difference between groups in terms of demographics. Intraoperative outcome was similar between groups. Median operative time and median blood loss was similar in both groups (group 1 vs. group 2: 240 vs. 260 minutes, p=0.36, and 150 mL vs. 150 mL, p=0.94). No difference was noted in intraoperative complications or the need for diverting stoma (group 1 vs. group 2: 0 vs. 5%, p=1.0, and 5% vs. 5%, p=1.0). Conversion rate to open surgery was 0% in group 1 vs. 10% in group 2 (p=0.48). Similarly, postoperative outcome was similar between groups. Median length of stay was 4 days in both groups (p=0.17). Overall complications rate was 38% in group 1 compared to 33% in group 2 (p=1.0). Readmission rate was 10% in group 1 vs. 5% in group 2 (p=1.0). Reoperation rate was 10% in both groups (p=1.0). There was no mortality in either group and 100% of the patients with CVF healed their fistula at last follow-up. The conclusions drawn from this initial experience was that laparoscopic surgery in patients with diverticulitis complicated by colonic fistulas including CVF is technically feasible with low conversion rate, low stoma rate, low readmission and need for reoperation, and with 100% success in healing the fistula. Furthermore, the overall intraoperative and postoperative results are similar to patients operated laparoscopically for diverticulitis without fistula.[14]

Table 1 summarizes results of several studies published in the last decade on laparoscopic and/or endoscopic repair of CVF.[14,19-24] Mean operative time ranged from 135 to 240 minutes. Mean estimated blood loss varied from 75 to 267 milliliters. Conversion rates to open surgery were reported to be between 0 and 46%. Mean length of stay ranged from 4 to 10 days. The majority of patients healed the fistula after laparoscopic repair.

Data on the use of robotic surgery for colonic fistula including CVF remains scarce. Currently most published data consists of case reports or video presentations. The senior author reported his initial experience with the robotic approach for colonic fistulas in 2015.[15] Eleven patients with colonic fistulas including six with CVF (54.5%) were operated robotically. Conversion rate to open surgery was 18%. Stoma formation rate was 18%. Median operative time was 250 minutes with a median blood loss of 250 milliliters. No intraoperative complications were noted. Median length of stay was 7 days with 27% complication rate. The readmission rate was 9%. All patients healed their fistula at last follow-up. The conclusion of this study was that patients with colonic fistulas including CVF can be treated by the robotic approach with 100% healing rate and acceptable operative times and blood loss. However, in comparison to the laparoscopic experience of the senior author, the conversion rate was higher and length of stay longer but it was unclear whether these results were attributable to the early learning curve of the senior author with robotic surgery at the time and/or the small number of patients in the study.[15] In 2014, Maciel et al.[25] published their experience with laparoscopic and robotic surgery for CVF. During their study period, 55 patients were operated laparoscopically for CVF and 20 patients underwent robotic surgery for CVF. The two groups were similar demographically. Two patients in the robotic group had colovaginal fistula in addition to the CVF. Mean total operative time was shorter in the laparoscopic group compared to the robotic group (181.7 minutes vs. 274.8, p=0.001). The complication rate was similar in both groups, 29.1% in the laparoscopic group and 20% in the robotic group (p=0.69). Mean estimated

Table 1. Results of several studies published in the last decade on laparoscopic and/or endoscopic repair of CV

Study	Patient number, (n)	Mean age (years)	Type of surgery	Mean operative time (minutes)	Mean blood loss (mL)	Conversion rate, (%)	Mean length of stay (days)	Reoperation within 1 month, (n)	Anastomotic leak, (n)	Non-healing of bladder
Martinolich et al.[19]	49	60	49 lap	152	162	46	6	0	NR	0
Kawada et al.[20]	1	76	Combined lap and cystoscopic	NR	NR	0	NR	0	0	0
Velayos et al.[21]	1	69	Novel device for endoscopic closure	NR	NR	-	-	0	0	0
Marney and Ho[22]	15	63	15 lap	135	75	33.3	6	0	0	0
Abbass et al.[14]	15	49	15 lap	240	150	0	4	0	0	0
Badic et al.[23]	28	68	14 lap 14 open	206	NR	43	10	0	0	0
Spector et al.[24]	34	62	21 lap 13 open	145	267	0	6	1	1	2

Lap: Laparoscopic, NR: Not reported

blood loss was 187.7 milliliters in the laparoscopic group compared to 101.3 milliliters in the robotic group (p=0.06). Conversion rate was higher in the laparoscopic group (14.6% vs. 0%, p=0.001). The mean length of stay was similar in both groups (4.6 days vs. 3.5 days, p=0.08). No mortality was noted in the study. One patient in each group developed colocutaneous fistula postoperatively, with recurrence of CVF in one patient in the laparoscopic group. The overall conclusions of the study were that the robotic approach was feasible in patients with CVF with longer operative time compared to the laparoscopic techniques but similar blood loss, complication rates, and length of stay. However, patients operated robotically had significantly lower conversion rate. In view of the limited data on robotic surgery for CVF and difference in results in the above cited studies, more research is needed with larger number of patients to determine the outcome of laparoscopic and robotic surgery for patients in CVF.

Conclusion

CVF is a complex colorectal condition, which carries significant morbidity and negatively impacts quality of life. Proper evaluation starting with an accurate history and physical examination is the initial step in the management of the patients. Prompt recognition of CVF by imaging study is the initial necessary phase prior to treatment. CT scan of the abdomen and pelvis is the preferred diagnostic modality and this can be supplemented with fluoroscopy-based contrast study, such as cystogram and gastrografin enema. Endoscopic evaluation with cystoscopy and colonoscopy are helpful adjuncts to confirm the diagnosis and provide useful information on the etiology of CVF and disease activity. Surgical resection of the diseased segment of colon remains the mainstay of treatment in the 21st century. Patients can benefit from laparoscopic surgery. Additional data is needed on robotic surgery to determine its outcome compared to laparoscopic surgery. Due to the challenging aspect of CVF, surgical intervention should be conducted by experienced surgeons with advanced surgical skills and robust clinical judgment, in order to optimize the outcome for the patient with CVF.

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