Laparoscopy in Crohn's Disease

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ABSTRACT

Crohn's disease represents a challenging operative dilemma. The nature of the disease increases the technical complexity of operations, their morbidity, and the likelihood of multiple operations. In this setting, the advantages of laparoscopic surgery, including shorter hospital stays, less adhesion formation, fewer wound complications, and faster recovery of bowel function, are particularly beneficial to the patient. Patients with Crohn's disease requiring operations in the elective and semi-elective setting can all be approached initially laparoscopically. The surgeon's skill set should include extensive experience in advanced laparoscopic bowel surgery as well as open management of Crohn's disease and its complications. Strict adherence to the basic tenet of bowel preservation is imperative. The operations most commonly performed for Crohn's disease include diagnostic laparoscopy, stricturoplasty, small bowel resection, ileocolic resection, colectomy, repair of fistulae, and gastrojejunostomy for bypass of gastric or duodenal disease. Postoperative management includes resumption of steroids, typically without the need for "stress-dosing," bowel rest for a short period, and pain control, which is also less than that experienced with a laparotomy.

KEYWORDS: Laparoscopy, Crohn's disease, operative approach

Objectives: On completion of this article, the reader should be able to delineate the indications for laparoscopic management of Crohn's disease, and identify and describe the laparoscopic approach for the most common operations for Crohn's disease.

Laparoscopic management of intestinal disease continues to gain popularity with each passing year. As experience with laparoscopic colon surgery for colon cancer has increased following multiple studies demonstrating the effectiveness of the approach, interest in the management of inflammatory conditions of the colon and the small bowel has also grown. Experienced laparoscopic surgeons have utilized the laparoscopic approach to Crohn's disease to reap the benefits of minimally invasive surgery in these complicated patients (Table 1, Table 2).¹⁻⁹ As has been shown in other diseases, laparoscopy carries a lower risk of wound

infection and hernias, has improved postoperative pulmonary function, smaller scars, shorter hospital stays, quicker resumption of diet, and can reduce adhesion formation and the subsequent risk of bowel obstruction. In patients with Crohn's disease who often require multiple operations, these benefits are particularly appealing.

Crohn's disease can be challenging from an operative standpoint, regardless of the open or laparoscopic approach. Patients are often malnourished and may have been on chronic immunosuppressive therapy. These risk factors increase the likelihood of anastomotic

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Table 1 Characteristics of Patients for Resection

Patients	296
Procedures	329
Age range	16–70
Females	157
Males	139
Previous surgery	129
Steroids	97

breakdown, infection, abdominal sepsis, and wound complications such as hernias. Furthermore, these patients have often undergone previous abdominal procedures and may have had fistulas or abscesses, all of which increase the likelihood of adhesions and the risk of bowel injury during operative intervention. As such, laparoscopic management of Crohn's disease should only be attempted by surgeons with extensive experience in laparoscopic bowel procedures who also have experience managing inflammatory bowel disease via laparotomy.

PREOPERATIVE PLANNING

Patients with Crohn's disease may require operative intervention due to complications of the disease, such as fistulas, abscesses, or obstruction, or they may have intractable disease despite maximal medical management (Table 3). Surgery for Crohn's disease hinges on the basic principle of preservation of bowel length. As described in elsewhere in this issue, preoperative optimization of the patient is essential. For example, patients with abscesses can often be treated with percutaneous

drainage, antibiotic therapy, and intravenous fluids or nutrition for up to several weeks until the inflammation from the abscess has decreased. This reduces the likelihood of injuring surrounding, healthy bowel during the operation. Patients who have been on chronic steroid therapy may benefit from weaning the steroids prior to proceeding to the operating room. Obviously, patients who present in shock or otherwise in extremis should be aggressively resuscitated and operated on without attempting an initial trial of medical therapy.

The preoperative workup should include a thorough history and physical. Key points such as steroid use, previous abdominal operations, evidence of metabolic derangements, and malnutrition should be evaluated. Upper and lower endoscopy, capsule endoscopy, contrast studies, and computed tomography (CT) can all provide additional information that can prove to be invaluable during the operation. Previous operative reports should be obtained to determine how much bowel the patient has left and what the patient's anatomy is. The use of preoperative bowel preparation is limited to patients who are being operated on in the elective setting and do not have a bowel obstruction. Given the increasing rates of *Clostridium difficile* colitis and antibiotic resistance, we judiciously employ polyethylene glycol bowel preparation.

During the preoperative evaluation, patients who may require an ostomy should be seen by enterostomal nurse. The potential ostomy site should be marked with indelible ink so that the skin preparation in the operating room will not wash the marking away.

It is our practice to approach all patients with Crohn's disease who are operative candidates using the

Table 2 Laparoscopic Experience in Crohn's Disease

Author	# of Patients	Procedure	Morbidity (Patients)	Conversion (Patients)	Mortality
Wu et al ¹	46	Ileocolic resection	3	5	0
Bemelman et al ²	30	Ileocolic resection	3	2	Not stated
Kishi et al ³	20	Ileocolic resection	5	2	Not stated
Milsom et al ⁴	31	Ileocolic resection	5	2	0
Benoist et al ⁵	24	Ileocolic resection	5	4	0
Duepre et al ⁶	21	Ileocolic resection, right hemicolectomy, ileal resection	3	1	Not stated
Bergamaschi et al ⁷	39	Ileocolic resection	4	0	0
Hasegawa et al ⁸	52*	Ileocolic, ileal resection	9	5	Not stated
Shore et al ⁹	20	Ileocolic resection	0	1	0
Salky (unpublished)	296†	Ileocolic, small bowel resection, colectomy, gastrojejunostomy, stricturoplasty, abdominoperineal resection, low anterior resection	35	6	0‡

*64 procedures.

†329 procedures.

‡30-day mortality.

Table 3 Indications for Operative Intervention

Indication	Number
Diagnosis	14
Intestinal obstruction	234
Pain	50
Abscess	10
Duodenal obstruction	9
Peritonitis	2

minimally invasive technique. We feel this is safe as long as the surgeon is prepared to convert to laparotomy if (1) the anatomy cannot be clearly identified, (2) visualization is poor, (3) the patient does not tolerate pneumoperitoneum, or (4) if other local factors exist that preclude minimally invasive surgery.

PATIENT POSITIONING

Operations for Crohn's disease encompass a large number of different procedures, including diagnostic laparoscopy, lysis of adhesions, segmental bowel resection, closure of fistulae, stricturoplasty, and proctocolectomy (Table 4). On occasion and depending on the pathophysiology, a double resection may be performed. Given this variety, patient positioning will vary based on several factors, including the operation, previous abdominal procedures, the patient's anatomy, and the location of the diseased segment requiring the operation. We place patients in the modified lithotomy position with the thighs parallel to the floor so as to avoid restricting movement of the laparoscopic instruments. The position of the monitor will be opposite the surgeon, and the assistant and scrub nurse or technician will be next to and across from the surgeon, respectively.

Table 4 Procedures Performed

Procedures	Number
Primary ileocolic	157
Secondary ileocolic	63
Tertiary ileocolic	16
Quaternary ileocolic	4
Secondary small bowel resection	38
Diagnostic	14
Right hemicolectomy	11
Subtotal colectomy	10
Gastrojejunostomy	9
Sigmoidectomy	9
Left hemicolectomy	9
Low anterior resection	5
Total colectomy	2
Stricturoplasty	2
Ileorectal (Hartmann's)	2
Abdominoperineal resection	1

We utilize an orogastric tube to decompress the stomach, a Foley catheter to monitor urine output during the case, sequential compression stockings over the lower legs, and generous padding of all pressure points to prevent pressure ulcers and nerve injury. Generous use of warming blankets, warmed intravenous fluids, and warming pads allow maintenance of normothermia during the case. Patients receive a single dose of preoperative antibiotics, given 30 minutes before incision. It is our practice to perform these procedures under general anesthesia, except in very rare circumstances.

OSTOMY PLACEMENT

Crohn's patients who present with pelvic sepsis can initially be managed with a diverting ostomy. This can allow resolution of the inflammatory process so that a more definitive procedure can be performed at a later date. Laparoscopic-assisted ostomy placement is an excellent option in these patients, as the procedure can be performed quickly and with minimal morbidity. As described above, the patient is placed in the modified lithotomy position. Following skin preparation, a camera port is placed at the umbilicus. This can be performed via an open technique, a clear-port technique, or after insufflating with a Veress needle. (We prefer to use the Veress needle.) Under direct visualization, two 5-mm ports are placed, one at the stoma site and the other on the contralateral side of the abdomen. The peritoneum is inspected and the bowel run until a suitable diverting point is identified. The bowel is drawn up to the abdominal wall using the instrument that is at the stoma site. If necessary, the bowel can be mobilized as described in the following sections to create a tension-free stoma. The pneumoperitoneum is then removed. The camera port site can be closed using a suture passer under direct visualization, or by approximating the fascia using the standard suture technique. The stoma is matured following skin closure at the remaining two port sites.

STRICTUREPLASTY

To maintain the principle of preserving bowel length, patients with one or two short segments of strictured small bowel can be treated with strictureplasty. This option is typically reserved for patients who have had previous resections or in whom there is an eminent risk of short bowel syndrome. Although laparoscopic strictureplasty has been described, in our experience it is very technically challenging. We prefer to use a laparoscopic approach to "run" the small bowel and tag segments of stricture using silk suture. Alternatively, we grasp the strictured segment with an atraumatic bowel clamp. We then enlarge the umbilical port incision to a length of 4 to 5 cm and deliver the affected segments of bowel. While protecting the wound with lap pads or a plastic

drape, the strictureplasty is performed via the Heineke–Mikulicz or Finney techniques. The bowel is returned to the peritoneal cavity. The incisions are irrigated and closed. We have found that this technique is much simpler, has the benefit of a very small incision, and is much quicker than performing the strictureplasty completely intracorporeally. If multiple strictures are present and it is necessary to perform a Michelassi strictureplasty, this should be approached via laparotomy.

TREATMENT OF FISTULAE

Crohn's fistulae commonly occur between adjacent loops of bowel, the bladder, the abdominal wall, or the vagina (Table 5). As described above, when possible the initial management should be medical. Drainage of related abscesses via a percutaneous approach, antibiotics, and antiinflammatory treatment can reduce the amount of inflammatory tissue around the fistula. This reduces the risk of injury to adjacent structures and often simplifies the dissection between the involved organs.

A 10-mm port is placed infraumbilically. Five-mm ports are placed in the abdominal wall quadrant that is opposite the fistula. Additional ports should be placed as needed to allow the assistant to retract.

There is always an anatomic, surgical plane between the diseased bowel and the healthy tissue. We use scissors or the ultrasonic scalpel to dissect in this plane. When necessary, we err on the side of the diseased bowel to avoid causing injury to healthy tissue. If difficulty is encountered during the dissection, approaching the fistula from a different angle is often helpful.

In the case of bladder fistulae, once the intestine is separated from the bladder, the opening should be closed using absorbable suture in a figure-eight stitch. Although the cystostomy can usually be identified, filling the bladder with dyed liquid can assist in localizing the defect. In the event that the hole is not found, the Foley catheter can be left in place for at least 4 to 5 days to allow the hole to close. The patient can undergo a cystogram prior to removing the Foley to confirm that there is no leak, although it is not our routine to do so if the patient has no clinical indicators of a leak.

Table 5 Fistulas

Fistulas	Number
Entero-entero	70
Enterocutaneous	33
Ileosigmoid	47
Ileovesical	19
Ileotransverse colon	7
Colovesical	3
Coloduodenal	3
Ileo-ovarian cyst	1
Jejunum-transverse colon	1

When fistulae occur between the vagina or small bowel, the tract can be stapled across using the laparoscopic stapler. The choice of staple cartridges is based on the thickness of the tissue present. Although it is not always possible to do so, the staple line should be positioned transverse to the long axis of the healthy bowel. If a stapler cannot be used due to excessive inflammation or thickness of the tissue, the tract can be separated and then closed using intracorporeal suturing, again taking care not to create a stricture in the bowel. The integrity of the staple or suture line should be assessed prior to completing the case. We generally use atraumatic bowel clamps on either side of the repair to increase intraluminal pressure and observe for evidence of a leak.

GASTRODUODENAL DISEASE

Treatment of gastroduodenal disease differs from more distal disease in that bypass is the primary management strategy. A 10-mm port is placed at the umbilicus. A 5-mm port is placed approximately 7 cm to the left side of the supraumbilical port and a 12-mm port is placed 7 cm to the right of the supraumbilical port. Another 5-mm port can be placed about 7 cm lateral to the left port in the subcostal region. An opening is created in the gastrocolic omentum around the junction of the body and antrum of the stomach using the ultrasonic scalpel. This opening will be ~4 to 5 cm in size to allow access to the posterior stomach for a retrogastric anastomosis. An opening is then created in the transverse mesocolon, with care taken to avoid the middle colic vessels. This opening should permit the gastrojejunal anastomosis to pass through it. The posterior stomach at the point of the anastomosis is then circumferentially secured to the transverse mesocolon using 2-0 silk suture. The small bowel is run beginning at the ligament of Treitz and proceeding at least 40-cm downstream. This loop of bowel is tacked to the stomach at the point chosen for anastomosis using an absorbable tacking suture. The ultrasonic scalpel is used to create a gastrotomy and enterostomy. One to two firings of the laparoscopic stapler are then used to create a gastrojejunostomy. The common opening is closed using 2-0 braided absorbable suture in a running fashion. The left upper quadrant is irrigated with saline and endoscopy is performed to visualize the anastomosis. The saline is carefully observed for signs of air bubbles leaking from the staple or suture lines during insufflation. The saline is then evacuated and the ports closed in the usual fashion.

ILEOCOLIC RESECTION

Terminal ileal disease is a very common presentation in Crohn's disease. Port placement begins with a 10-mm camera port infraumbilically. A 12-mm port is placed in

the left lower quadrant just below the umbilical port. A 5-mm port is placed in the epigastrium and a second 5-mm port is placed suprapubically. Additional ports are placed as needed to facilitate the operation. Use of the table to assist in visualization is very important in these cases. The table should be placed in Trendelenburg position, with the right side up.

The operation commences with a careful examination of the entire bowel. Any diseased segments are marked using a silk suture. These segments, when they are close to the ileal disease, are resected en bloc with the ileocolic specimen. However, if they are too proximal to be included in the ileocolic resection, they are resected separately. We have found that multiple anastomoses have a greater risk of complication, so whenever possible, we attempt to have just one staple line.

The cecum is grasped using an atraumatic grasper. It is retracted anteriorly and to the right. The mesentery is then examined. With appropriate traction on the cecum, the ileocolic vessels are usually identified where the mesentery is tented. The peritoneum on the mesentery is opened using the scissors or scored using the cautery. The LigaSure device (Valleylab, Boulder, CO) is used to ligate the ileocolic vessels. The dissection is then continued in a medial to lateral direction. If the dissection proceeds in this avascular plane, not only is bleeding minimized, but injury to the ureter, gonadal vessels, and duodenum is avoided. Mobilization of the colon continues in this fashion to the posterolateral abdominal wall. The line of Toldt is then opened using scissors or electrocautery. The mobilization is taken up to the hepatic flexure and the third portion of the duodenum. During this process, the ureter and duodenum must be identified. Failure to identify these structures is reason to convert the procedure to laparotomy.

Once the mobilization is complete, an assist incision is made in the midline incorporating the infraumbilical port or suprapubically in the transverse direction. The incision should accommodate the bowel being extracted. Occasionally, it needs to be large to enable removal of a phlegmon. The specimen should be grasped with an atraumatic clamp prior to removing the laparoscope, and it is delivered through the incision. The wound is protected using lap pads or a plastic camera drape. A stapler is used to transect the bowel proximally and distally, and an enterotomy and colotomy are made using cautery. An end-to-side anastomosis is constructed using the largest circular stapler. If the bowel does not permit use of the largest stapler, a side-to-side functional end-to-end anastomosis should be constructed. However, the proximal bowel is almost always dilated and will allow the 33-mm stapler. Once the anastomosis is constructed, it is carefully inspected to ensure its integrity and then returned to the peritoneal cavity.

The assist incision is closed, and the abdomen is reinsufflated. The right side of the abdomen is irrigated. All raw edges are carefully assessed for evidence of bleeding. The ports are then removed under direct visualization and the fascia at the 10- and 12-mm sites is closed. Skin incisions are closed using monofilament absorbable suture or skin adhesive.

POSTOPERATIVE MANAGEMENT

The gastric decompression tube is removed during endotracheal extubation. The patient is generally admitted to the surgical ward and can begin to clear liquids by the evening of surgery. The Foley catheter remains in place until the first postoperative day unless the patient had a fistula to the bladder, in which case it remains for 4 to 5 days. The patient is given Toradol (Roche Pharmaceuticals, Nutley, NJ) around-the-clock for the first few days. Additional pain relief is provided by narcotic medications on an as-needed basis. We typically use Percocet (ENDO Pharmaceuticals, Chadds Ford, PA) for breakthrough pain. Heparin (5000 units subcutaneously) is administered to reduce the risk of deep vein thrombosis, in addition to sequential compression stockings.

The patients are encouraged by our nursing staff to use the incentive spirometer 10 times per hour while awake. They are out of bed to a chair by the evening of their operation and ambulating by postoperative day 1.

The patients are advanced to a low-residue diet once they are passing flatus. Typically, they are discharged home once they can tolerate the low-residue diet, have adequate pain control on oral medication, and are ambulating. Our average length of stay is 4 days.

Patients who were on steroids preoperatively need to resume the same dose postoperatively. It has been our experience that a stress-dose is not required. The stress response from laparoscopic surgery is reduced when compared with that of open surgery. In fact, during the postoperative course, the steroid dose can begin to be gradually tapered for many of these patients.

COMPLICATIONS

Despite the benefits of laparoscopic surgery, complications occur in patients with Crohn's disease at a higher rate than other patients. The most common complications are bowel obstruction, anastomotic leak, urinary tract infection, postoperative bleeding, wound infection, and *Clostridium difficile* colitis (Table 6).

Bowel obstruction in the postoperative setting is generally related to adhesion formation or a kink at the anastomosis. Patients with Crohn's disease tend to form adhesions, most likely because of the severe inflammatory reaction that accompanies their disease process. The obstruction is initially managed conservatively, with

Table 6 Operative Complications

Complications	Number
Small bowel obstruction	18
Intestinal leak	7
Postoperative bleeding	4
Urinary tract infection	1
Wound infection	4
<i>Clostridium difficile</i> colitis	1

nasogastric tube decompression and intravenous fluids. It is our preference to return to the operating room for diagnostic laparoscopy and lysis of adhesions if the patients do not improve within 2 days.

Urinary tract infections occur in the setting of indwelling catheters and also from fistulae to the bladder. Treatment includes appropriate antibiotic administration and removal of the catheter or repair of the fistula. These infections, when dealt with promptly, are usually very brief.

Postoperative bleeding occurs from either the staple line at the anastomosis or at the raw edge of the mesentery. Staple line bleeding is typically self-limited and does not usually require operative intervention. Mesenteric bleeding that becomes clinically evident should prompt return to the operating room for diagnostic laparoscopy, wash-out, and control of bleeding. Prior to induction of anesthesia, the patient should be aggressively resuscitated. The bleeding can be controlled with suture ligation, electrocautery, or clips.

Anastomotic leaks should be managed with operative repair of the leak. They tend to occur around postoperative day 4. Wound infections are very rare in the laparoscopic setting. If they do occur, they are managed by draining the wound. They can be prevented by maintaining normothermia during the operating, protection of the wound during handling of the specimen, gentle handling of the tissues, and careful hemostasis.

Clostridium difficile colitis is an increasingly morbid complication that can be prevented through judicious use of preoperative bowel preparation and antibiotics. Patients are treated with metronidazole or oral vancomycin, and in severe cases, with subtotal colectomy. Fortunately, these infections have been very unusual in our series.

CONCLUSION

Laparoscopic surgery has many benefits for the Crohn's patient who requires intestinal operations. The advantages of shorter hospital stay, smaller incisions, less pain, faster return of bowel function, quicker resumption of diet, fewer adhesions, and better cosmesis found in conventional laparoscopic surgery

also apply to these patients. Additionally, these benefits lead to an overall decrease in the cost of care and presumably simplify future operations due to a less hostile abdomen. Young-Fadok et al¹⁰ demonstrated that patients undergoing laparoscopic ileocolic resections had shorter time to regular diet (2 versus 5 days), shorter lengths of stay (4 versus 7 days), and decreased costs (\$9895 versus \$13,268) when compared with the open procedure.

Patients with Crohn's disease are particularly challenging via either the open or laparoscopic approach. Previous abdominal operations, inflammatory changes, and friable tissue from steroid therapy complicate the operative procedure. As such, the laparoscopic approach should only be attempted by skilled surgeons. Furthermore, the procedure should be converted to laparotomy if local factors preclude safe progress laparoscopically. In particular, it has been shown that conversion to laparotomy does not significantly alter complications, length of the operation, or hospital stay if it is undertaken as soon as safe progress is no longer feasible.

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