# Laparoscopy for Benign Colorectal Diseases

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**ABSTRACT**

The applicability of laparoscopy to many complex intraabdominal colorectal procedures continues to expand, and has been shown to be feasible and safe in experienced hands. Data are available on the elderly, rectal prolapse, diverticulitis, Hartman's takedown, small bowel obstruction, Crohn's disease, and ulcerative colitis. Clinically relevant advantages have been clearly demonstrated in selected patient populations. Laparoscopic surgery for benign colorectal disease should be considered in patients suitable for this approach to an abdominal operation.

**KEYWORDS:** Laparoscopy, prolapse, diverticulitis, colitis, bowel obstruction

**Objectives:** On completion of this article, the reader should be able to discuss laparoscopy for benign colorectal conditions.

Since the introduction of minimally invasive surgery (MIS), there has been swift adaptation of instrumentation and technology to a myriad of surgical procedures. It has become the technique of choice for many foregut surgeries including Nissen fundoplication, hiatal hernia repair, and gastric bypass, and is being applied to solid organ, hepatobiliary, and hernia surgeries. Procedures such as esophagectomy are pushing the envelope of what can be accomplished through small incisions. Increasing acceptance and utilization of laparoscopy arises from the numerous benefits it may offer over conventional "open" approach—including improved cosmesis, less postoperative pain, fewer wound complications, and faster recovery.

Not surprisingly, laparoscopy has also fostered remarkable change in colon and rectal surgery since the first reported laparoscopic-assisted colon resection in 1991. Still, after almost 20 years since inception, laparoscopic techniques are used in a minority of colon resections. Reasons include initial concerns about the oncologic adequacy of laparoscopic cancer resections and port site recurrences. Unlike cholecystectomy, early reports of laparoscopic colon surgery (LPS) failed to show clear benefits over an open approach, and took much more operative time. Scott et al noted that laparoscopic colon resection "replaces one operation with two" and simply increased cost and operating room (OR) time without any notable benefits.[1] Other concerns about the laparoscopic approach included a steep learning curve, potential complications, and increased morbidity associated with conversion to open surgery. Despite these issues, there is mounting evidence demonstrating the benefits of LPS. We have reviewed the literature to ascertain the potential benefits and limitations of laparoscopy when used for various benign colorectal conditions.

## LAPAROSCOPY IN THE ELDERLY POPULATION

It is estimated that by year 2050, ~23% of the Western population will be older than 65 years. Elderly patients generally have more medical conditions increasing their risk of postoperative morbidity and mortality. Several

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Laparoscopy and Endoscopy; Guest Editor, David E. Beck, M.D.

Clin Colon Rectal Surg 2010;23:42–50. 

DOI: http://dx.doi.org/10.1055/s-0030-1247857.
ISSN 1531-0043.

studies suggest that laparoscopic abdominal surgery may confer significant benefit specifically to the elderly patient.[2–4]

Frasson et al evaluated 535 patients in four groups undergoing various colorectal surgeries for malignant or benign lesions. Two groups consisted of patients older than 70 years randomized to either open or LPS; the other two groups consisted of patients <70 years. The patients were well matched within their age groups in terms of mean age and American Society of Anesthesiologists (ASA) score, prior abdominal surgeries, and nutritional status. They showed that although both age groups had reduced perioperative morbidity and length of stay (LOS), the benefit of LPS was much more pronounced in the elderly (morbidity reduction 17.3%; $p = 0.01$ in those >70).[5] Senagore et al reported similar results demonstrating the benefit of LPS in an elderly group when compared with younger patients.[6] Moreover, these and other studies show that laparoscopic surgery reduced the perioperative morbidity and LOS in older patients to the level found in younger patients.[7,8] Based on these reports, we can conclude that laparoscopic surgery lowers perioperative morbidity and LOS in the elderly patients to a level comparable to younger patients undergoing the same operation. In addition, the benefit of laparoscopic surgery is more pronounced in the elderly than in younger patients.

## RECTAL PROLAPSE

Rectal prolapse (RP) tends to occur in older patients, and is much more common in women than men (F:M = 6:1).[9] Surgery for RP can be categorized into either an abdominal or perineal approach. Transperineal repair of RP is associated with higher recurrence rates than abdominal repair;[10,11] however, this technique has very low operative morbidity and is well suited for high surgical risk patients. It is the preferred approach for treating incarcerated, strangulated, or gangrenous rectal prolapse. The most commonly used transabdominal surgical repair of RP involves mobilization and fixation of the rectum to the sacrum (rectopexy), either with or without sigmoid resection. Transabdominal rectopexy results in reliable improvement in incontinence and is associated with low rates of recurrence.[12,13] Several studies suggest that rectopexy combined with resection tends to improve constipation.[10,14–16] Resection rectopexy therefore may be well-suited for patients with redundant sigmoid colon and constipation, whereas rectopexy alone may be ideal for patients with complaints of incontinence.

Given that rectal prolapse is a condition found most commonly in the elderly population, the application of laparoscopy to this disease process seems logical. Since the first report of laparoscopic repair of RP in 1992,[17] new authors have demonstrated similar benefits and limitations already seen in other minimally invasive colorectal procedures. When compared with the open approach, laparoscopic RP procedures result in an earlier return of bowel function, less postoperative pain and shorter hospital stay (LOS), but at the cost of longer operative time.[18–20] Solomon et al randomized 34 patients to either open or laparoscopic rectopexy. In addition to faster recovery of bowel function and shorter LOS, laparoscopy was associated with decreased morbidity and hospital costs despite longer operative times.[21] Postoperative levels of cortisol, C-reactive protein (CRP), and 24-hour urine catecholamines were significantly lower in the laparoscopic group, suggesting a less-intense inflammatory response with laparoscopy. The recurrence rate and functional outcome were similar in both groups at a follow-up of 2 years. In addition, studies that have looked at long-term results after laparoscopic RP procedures illustrate no difference in rates of recurrence and functional outcome in comparison to open repairs.[18,22–25] In a case control study, Kariv et al followed 111 patients who had laparoscopic RP procedures (42 mesh rectopexy, 32 resection rectopexy, 37 suture rectopexy), comparing them to open repairs at a mean follow-up of 5 years. Improvements in continence, recurrence rate, and satisfaction scores for surgery were similar for laparoscopic and open groups.[26] Byrne et al reported on 10-year outcomes of laparoscopic rectopexy, open rectopexy, and open resection rectopexy. Both open and laparoscopic rectopexy resulted in significant and similar improvements in continence. Pre- and postoperative constipation scores were similar and unchanged in all groups. Recurrence rates and overall satisfaction with surgery were also similar between the three groups.[22]

Laparoscopic procedures for rectal prolapse are associated with short-term benefits of faster recovery and lower overall costs at the expense of longer OR time. Long-term functional outcomes and recurrence rates are similar for open and laparoscopic groups.

### Diverticulitis

Sigmoid diverticulosis is a common condition in people on a traditional Western diet; ~10 to 25% of those with diverticulosis will develop diverticulitis.[27] Medical management is an effective strategy for the majority of cases of uncomplicated diverticulitis. Complicated diverticulitis is an episode associated with abscess, fistula, obstruction, bleeding, or free perforation. Urgent surgical intervention is indicated in patients with diffuse peritonitis and for those who fail nonoperative management of acute diverticulitis. An elective sigmoid resection is often considered after successful nonoperative treatment of complicated diverticulitis.[27–29]

Elective and emergent surgical treatment of diverticulitis using laparoscopic techniques has been described. Early on, there was concern that inflammatory

changes and complications associated with diverticulitis may make laparoscopic techniques hazardous and difficult. Interestingly, studies that have compared laparoscopic colectomy for diverticulitis and nondiverticular disease report no significant differences in postoperative recovery and morbidity.[30,31] Furthermore, data regarding the safety and applicability of laparoscopy for the treatment of diverticulitis suggest that it can be applied with good results to a broad spectrum of disease severity, including complicated diverticulitis.[32–37] Jones et al described outcomes with 500 laparoscopic resections for both complicated and uncomplicated diverticulitis. Operative times LOS were similar in both groups. The rate of major morbidity and mortality was low, and not statistically different between groups (11.5% vs. 10.9%). The conversion rate to open surgery was higher in patients with complicated diverticulitis, but this did not reach statistical significance (5.3% vs. 2.1%).[38] Titu et al reported on 66 emergent laparoscopic operations for complicated diverticulitis. Included were 29 patients (44%) with Hinchey stage II, 7 patients (11%) with Hinchey stage III, and 16 patients (24%) with diverticular fistula. The overall morbidity (21%) and mortality (3%) was low, suggesting that laparoscopic techniques can be safely applied in emergency cases.[39]

Klarenbeek et al reported a randomized trial comparing elective LPS and open resection for diverticulitis. Although the overall postoperative morbidity was similar in the two operative approaches, the incidence of major complications (anastomotic leak, intraabdominal bleeding, abscess, evisceration) were significantly less in the LPS group (9.6 vs. 25%; $p = 0.038$).[40] Other comparative studies have reported similar benefits of faster recovery and decreased perioperative morbidity in the laparoscopic group.[41–43] In addition to these short-term benefits, a laparoscopic approach may also reduce overall hospital costs.[44,45] Reports by Liberman et al and Lawrence et al both demonstrated that the shorter LOS associated with laparoscopic colectomy translated into overall cost savings for the hospital.[34,41]

Conversion rates during LPS for diverticulitis range from 4 to 19%, and are influenced by surgical expertise and the severity of the diverticular process. Le Moine et al identified surgical experience, presence of sigmoid stenosis or fistula, and the severity of diverticulitis on the pathologic examination, increased the likelihood of conversion to open surgery. Although such conversions resulted in longer OR time and slower recovery, perioperative morbidity did not differ from the laparoscopically completed cases.[46] In Jones' study of 500 consecutive laparoscopic colectomies for diverticulitis, the conversion rate, and major morbidity rate, for the first 100 cases was 8% and 21%, respectively. This rate dropped to 1.5% (conversion) and 8.5% (morbidity) for the subsequent 400 cases.[38] Scheidbach et al demonstrated that outcomes after laparoscopic sigmoidectomy for diverticulitis are significantly better when performed in high volume centers (>100 procedures) when compared with low volume centers (<30 procedures). Despite operating on more patients with complicated diverticulitis, high volume centers had lower conversion rates and less intraoperative and postoperative complications than low volume centers.[47]

In summary, laparoscopic colonic resection for diverticulitis is a challenging procedure that requires time and patience to master. In experienced hands, however, even severe diverticular disease can be safely resected laparoscopically with less morbidity, faster recovery, and lower overall cost than an open operation.

## Hartmann's Takedown

The restoration of bowel continuity after a Hartmann procedure is a challenging abdominal operation associated with high rates of morbidity (4 to 43%) and mortality (5 to 10%)[48–50]. Consequently, less than 60% of these patients undergo colostomy closure.[51,52] There have been few reports on laparoscopic reversal of Hartmann's procedure.[48,51,53–55] Reported complication rates vary widely (0 to 41%) with most studies within the 10 to 30% range. Conversion rates to open surgery range from 4 to 22%. Compared with open surgery, there are several potential advantages provided by a laparoscopic approach. First, the size of the abdominal incision is minimized, reducing the risk of wound infection—a frequent complication with colostomy reversal.[48,54,55] Second, splenic flexure mobilization is facilitated by laparoscopic visualization of the upper abdomen without extending an incision into the midepigastrium. Third, midline adhesions from prior operations can potentially be left undisturbed.

Rosen et al reported a comparative study demonstrating the feasibility and advantages of laparoscopic approach to colostomy closure. The operative times were similar but the blood loss was significantly less in the laparoscopic cohort. Interestingly, splenic flexure mobilization was performed in all laparoscopic cases, but in only 33% of patients during open surgery. Intent-to-treat analysis of postoperative morbidity favored the laparoscopic group (14 vs. 59%; $p = 0.01$). Notably in the open group, there were five midline wound infections, and one anastomotic leak. There were three complications in the laparoscopic group, including superficial wound infection at the colostomy site. Time to flatus and length of hospital stay were significantly shorter in the LPS group.[54] Haughn et al reported their experience with 122 patients (61 laparoscopic, 61 open surgery), including OR time, blood loss, LOS, and return of bowel function; all favored the laparoscopic approach. Thirty-day morbidity rates were similar. However, at 6-month follow-up, the open Hartmann's reversal group had a higher incidence of complications

(16.4 vs. 3.3%; $p = 0.015$) mostly related to the abdominal incision (four wound infections, three incisional hernias).[55] Mazeh et al illustrated less operative blood loss, faster recovery, and lower complication rate in a laparoscopic group (intent-to-treat morbidity 26.8%; laparoscopy vs. 47.8% open surgery, $p < 0.05$). Severe adhesions and failure to identify the rectal stump were reasons for conversion. Interestingly, severity of prior abdominal catastrophe and number of previous abdominal surgeries were not different in the converted and the laparoscopically completed group. Wound infection occurred in four patients in the converted, eight patients in the open, but only two patients in the group completed laparoscopically.[48]

Although studies looking at laparoscopic reversal of Hartmann's procedure are few, we can conclude from the available information that it is feasible and safe, associated with faster postoperative recovery and reduced wound complications, compared with a traditional open operation.

## Small Bowel Obstruction

Small bowel obstruction (SBO) is one of the leading causes of hospital admissions. Although the cause of obstruction may be hernia, tumor, and Meckel's diverticulum, more than 75% of cases of SBO are caused by postoperative adhesions.

Although the first reported successful laparoscopic treatment for SBO was reported almost 20 years ago, the use of laparoscopy for the treatment of acute SBO has not been widely embraced. In fact, it seems a daunting task to work laparoscopically in the setting of obstruction where distended loops of bowel limit working space, impair visualization, and increase the risk of enteric injury. However, as the experience and confidence with minimally invasive surgery grows, there are more frequent reports of successful laparoscopic treatment of SBO. Most are small series reports attesting to the feasibility and safety of laparoscopy in this clinical setting.[56–61] The conversion rates range from 10 to 50% and risk of bowel injury ranges from 3 to 20%.[61] Some of the common reasons for conversion include poor visualization, bowel necrosis, dense adhesions, and iatrogenic bowel perforation. From these reports, one can surmise several potential predictors of successful laparoscopic treatment of SBO. The diameter of small bowel may be one such predictor. Suter looked at laparoscopic treatment for SBO in 83 patients and found that small bowel diameter greater than 4 cm significantly increased the risk of conversion.[62] Pearl, however, found no correlation between small bowel diameter and conversion in 19 patients.[63] The second predictor of success may be type of antecedent surgery. Some studies have shown higher rates of successful laparoscopic treatment of SBO when appendectomy was the antecedent operation.[64] Levard reported 71% success rate for laparoscopic adhesiolysis when the antecedent surgery was appendectomy alone, in comparison to the success rate of 43% when the previous surgery was something other than appendectomy.[65] Dense adhesions increase the likelihood of conversion whereas a single restrictive band can be more easily managed laparoscopically.[66] Miller's retrospective study of 410 patients presenting with SBO after various types of open surgical procedures revealed that antecedent colorectal surgery was associated with higher rates of multiple, dense adhesions whereas previous gynecologic procedures, appendectomy, and cholecystectomy resulted in an equal tendency for either multiple- or single-band formation. This study also showed that midline and paramedian incisions were associated with higher rates of multiple dense adhesions.[67] Interestingly, Suter found that patients who had undergone appendectomy alone tended to have isolated adhesions or single bands. Nonetheless, that study showed that the type of antecedent operation did not influence the conversion rate.[62] Lastly, the number of prior surgeries may be a predictor of successful laparoscopic management of SBO. A retrospective study by Levard et al looking at 308 patients presenting with SBO showed higher success rates with LPS when patients had one or two antecedent surgeries than in patients who had more than two prior operations (56% vs. 37%, $p < 0.05$).[65] Wullstein noted higher rates of intraoperative complications during laparoscopic treatment of SBO in patients who had more than two prior laparotomies compared with subjects with less than two ($p = 0.06$).[68] On the other hand, some studies suggest that the number of prior operations have no impact on the successful laparoscopic management of SBO. Khaikin et al laparoscopically treated 31 patients with acute SBO and compared them with an equal number of patients who were treated by laparotomy. In the laparoscopic group, 32% required conversion, which was not associated with the number of previous operations, episodes of SBO or the duration of obstructive symptoms. The study also demonstrated successful laparoscopic treatment of SBO was associated with lower morbidity and faster recovery when compared with the laparotomy group.[69]

Although there are no clear predictors of success, features such as diameter of bowel, previous number, and types of surgeries may influence the outcome of laparoscopic surgery for SBO. Intestinal obstruction managed by laparoscopy may result in reduced postoperative morbidity and faster recovery in comparison to traditional laparotomy.

## Crohn's Disease

Crohn's disease (CD) represents a unique opportunity for the laparoscopic surgeon. Because it occurs predominantly in the ileocecal region, it lends itself to easy

laparoscopic access. Improved cosmesis and faster return to daily activities are often important concerns for the young patients most often afflicted with CD. Laparoscopy may potentially decrease adhesion formation, a consideration that is important with a disease process associated with high rate of reoperation. However, inflammation associated with Crohn's disease can make a laparoscopic operation extremely difficult and hazardous. In addition, complications of CD such as abscess, phlegmon, and fistula are commonly encountered during surgery.

Yet a laparoscopic approach to CD may have a favorable outcome.[70–74] This is reflected in a recent meta-analysis by Tan et al looking at laparoscopic and open surgeries for CD performed between 1990 to 2006.[75] The study showed a statistically significant reduction in morbidity ($p < 0.01$), earlier return of bowel function, and shorter hospital stay ($p < 0.02$) in the LPS group. Recurrence rates were similar among groups. All studies that looked at cost found it to be lower in the LPS group ($p < .05$ in all studies). Even difficult cases involving abscess, phlegmon, and recurrence after prior ileocecectomy may be amenable to a laparoscopic approach. Wu et al reviewed their experience with 46 laparoscopic ileocolic resections for CD. Comparisons between patients undergoing their first laparoscopic operation for CD (without abscess or phlegmon) showed no statistically significant differences in OR time, complication rate, or LOS[76] when compared to those having surgery for recurrent disease, abscess, or phlegmon.

Dunker et al reported higher patient satisfaction with the incisional scar after LPS than those having open surgery for CD ($p < 0.01$).[77] The majority of patients reported a willingness to pay out of pocket for a laparoscopic procedure even if its only benefit was smaller operative scars. In another patient survey study of open versus laparoscopic ileocolic resection (ICR), Alabaz et al reported earlier return to employment, normal activity, and improved satisfaction with cosmesis and social/sexual life after laparoscopic resection.[78]

Overall quality of life (QOL) in patients with CD is primarily affected by recurrence; small incisions make little difference in this group. Long-term studies comparing the recurrence rates after ICR show no difference between open and LPS. A 10-year follow-up study by Milsom comparing LPS with open surgery for refractory ileocolic disease revealed no significant differences in either endoscopic, radiologic, or surgical recurrence.[79] Importantly, medication requirements and the number of reoperations at follow-up were also similar in the two groups (26 LPS vs. 28% open; $p = 0.89$).[79] Lowney et al also reported no appreciable difference in recurrence in their series of ICR. The mean time to recurrence after the initial resection was similar between open and LPS.[80] Not surprisingly, the QOL measures show no significant difference between the two surgical approaches.[80]

Finally, laparoscopic abdominal surgery may decrease the risk of adhesion formation. Animal model experiments and available clinical studies (mostly dealing with infertility/pregnancy) suggest this to be true.[81–84] The implication of decreased adhesions is especially pertinent to CD because the patients are generally young and reoperations are frequent. Bergamaschi et al followed 92 patients (39 LPS, 53 open) for 5 years after their initial ileocolic resection for CD. The main objective was to evaluate for recurrence and incidence of small bowel obstruction (SBO). Recurrence rates were similar. The rate of SBO was, however, significantly higher in the open group (35.4 vs. 11.1%; $p = 0.02$). Moreover, six of 17 patients with SBO in the open group ultimately required surgery for obstruction whereas 0 of 4 in the LPS group needed surgical intervention.[85] Alabaz et al also reported a lower incidence of SBO in the LPS group after ileocolic resection (31% open surgery vs. 8% laparoscopy; $p < 0.02$).[78] In contrast, Stocchi et al found no difference in rates of SBO between the LPS and the open group.[79]

In summary, laparoscopic surgery for CD has short-term benefits over open surgery in terms of reduced postoperative morbidity, shorter hospital stay, faster recovery, and better cosmesis, perhaps at a reduced overall cost. Recurrence rates and QOL are similar in the two approaches.

## Restorative Proctocolectomy

Ileal pouch anal anastomosis (IPAA) is the operation of choice for highly selected patients with familial adenomatous polyposis (FAP) and ulcerative colitis (UC). This technically complex operation can be performed with low morbidity and good functional outcome using traditional open surgical techniques. Like CD, UC and FAP generally affect young, motivated patients to whom cosmetic outcome of surgery can be an important factor. Early reports failed to demonstrate any benefits of performing IPAA in a minimally invasive fashion. As expected, laparoscopy significantly prolonged the operative time, but the anticipated benefits of lower morbidity, faster recovery, and shorter LOS were not evident early on.[86–88] In fact, some studies reported worse outcomes with a laparoscopic approach when compared with open surgery. For example, in Schmitt's study, complication rates were significantly higher in the laparoscopic group, and more patients in this group required perioperative blood transfusions.[87]

Although outcomes of more recent laparoscopic IPAA studies are improved over older series, there remains no compelling long-term evidence to support laparoscopic restorative proctocolectomy over open surgery. Short-term benefits of a laparoscopic IPAA have

been limited to faster return of bowel function and shorter hospital stay, without any reduction in perioperative morbidity.[89] Moreover, the operative time and the overall hospital costs are markedly higher in the laparoscopic group.[90] When looking at the long-term outcome, the only demonstrable benefit of a laparoscopic approach appears to be improved cosmesis. Dunker et al looked at 32 patients (15 laparoscopic, 17 open surgery) after IPAA for FAP/ulcerative colitis, and reported no difference in bowel function and overall quality of life at 1-year follow-up (QOL accessed by SF-36 questionnaire). The only notable difference was increased satisfaction with cosmesis in the laparoscopic group.[91] Polle et al found similar results in terms of bowel function, sexual function, and QOL 1 year after either hand-assisted laparoscopic or open restorative proctocolectomy. In this study, the improved perception of body image and cosmesis was found primarily in female patients in the laparoscopic group. At median follow-up of 3 years, there were no differences in the incidence of incisional hernia or bowel obstruction.[92] In another study, the overall QOL and body image/cosmesis scores were similar in the open and laparoscopic IPAA group one year after surgery.[93]

In summary, a laparoscopic approach to restorative proctocolectomy does not appear to offer significant short-term or long-term benefits over conventional surgical techniques. Although it may offer faster surgical recovery, the laparoscopic approach necessitates significantly longer operative time and thus increased hospital costs. The long-term benefit is largely limited to improved cosmesis. For patients who desire minimal external scarring, laparoscopic IPAA may be an attractive, viable alternative.

## CONCLUSION

The applicability of laparoscopy to many complex intra-abdominal colorectal procedures continues to expand, and has been shown to be feasible and safe in experienced hands. Clinically relevant advantages have been clearly demonstrated in selected patient populations. Laparoscopic surgery for benign colorectal disease should be considered in patients suitable for this approach to an abdominal operation.

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