Laparoscopy for Benign Diseases of the Colon

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Abstract

Laparoscopic surgery has revolutionized the delivery of care to the surgical patient undergoing colorectal resection. Since the first laparoscopic-assisted colectomy in 1991, significant advances have been made in minimally invasive colorectal surgery. For many benign conditions, laparoscopic colectomy has been proven to be safe and effective, and in some instances superior when compared with open surgery. Complex laparoscopic resections such as those for diverticulitis and inflammatory bowel disease have also been shown to have equivalent outcomes when compared with open surgery. Short-term benefits of a minimally invasive approach include less pain, decreased rates of wound infection and postoperative morbidity, faster return of bowel function, and shorter length of stay. Improvements in long-term complications have also been noted with lower incidence of incisional hernias and small bowel obstructions secondary to adhesions. As surgeons become more facile with laparoscopic resection, more complex cases such as those for complicated diverticulitis and reoperative surgery for inflammatory bowel disease can be completed with shorter operative times and decreased cost.

Keywords
- laparoscopy
- colectomy
- minimally invasive surgery

In the late 1980s, the practice of abdominal surgery was revolutionized through the development of laparoscopic surgery. After the first laparoscopic cholecystectomy in 1989, surgeons began to explore the applications of minimally invasive techniques, applying this new approach to routine procedures such as appendectomy, liver biopsy, and lysis of adhesions. In 1991, the first laparoscopic-assisted colectomy was performed.[1] In their sentinel manuscript, the authors described a medial to lateral approach using five ports and an additional extraction excision in an 85-year-old woman with sigmoid colon cancer. The patient was discharged to home on postoperative day 7 but unfortunately died on postoperative day 14 of pulmonary embolism and pseudomembranous colitis. Significant advances have been made in minimally invasive techniques over the past 25 years, and outcomes have improved. Laparoscopic colectomy has been proven to be safe and effective, and in some instances superior when compared with open surgery.

Despite this, only a small fraction of colectomies performed in the United States are done with a minimally invasive approach. In 2011, it was estimated that less than 10% of colectomies in the United States were performed laparoscopically.[2] Further, data from the Nationwide Inpatient Sample of almost 50,000 patients admitted for Crohn disease requiring surgical intervention found that only 6% of those patients underwent a laparoscopic resection.[3] This is felt to be related to the challenges inherent to laparoscopic colectomy which include the need to access multiple abdominal quadrants, lack of tactile feedback, prolonged operative times, and potentially increased risk of injury to surrounding structures. The learning curve for laparoscopic colectomy has been estimated at 55 cases for right-sided resections and 62 cases for left-sided resections.[4] However, as laparoscopic training is becoming a routine part of modern surgical training, this number is decreasing. Through the development of new technology and techniques, colorectal surgeons have moved to the forefront of laparoscopic surgery.

Laparoscopic Colon Resection for Benign Indications

Diverticular Disease

Diverticular disease is extremely prevalent in the United States, present in an estimated 80% of the population over the

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age of 80 years.[5] In addition, 25% of individuals with diverticular disease will develop diverticulitis at some point in their life, with 30% of those requiring surgical intervention upon initial presentation.[6,7] Laparoscopic surgical management of these patients continues to gain popularity. An increasing number of cases of elective resection for both acute uncomplicated and complicated disease—including free and contained perforation, stricture formation and fistulizing disease—have been successfully performed using minimally invasive techniques (►**Table 1**).[8]

When compared with other operative indications for colectomy, diverticulitis presents many significant challenges. Acute or chronic inflammatory changes such as adhesions, mesenteric edema, hypertrophy of the colon, and inflammatory phlegmon make the colon more difficult to manipulate and cause distortion of surrounding structures. Familiar planes are lost and the tissues can be unforgiving in many situations. For these reasons, the Sigma trial, a prospective, multicenter, double-blind, parallel-arm, randomized controlled trial, was undertaken to define the safety and efficacy of laparoscopic sigmoid resection for diverticulitis.[9] In this study, 104 patients from five centers were randomized to either laparoscopic or open resection with 52 patients in each arm. Preoperative characteristics were well matched for each group. While patients in the laparoscopic group had significantly longer operative times, they had less postoperative pain, shorter length of stay, and a 15.4% reduction in major complications. The results at 6-month follow-up were also favorable for laparoscopic surgery, with a 27% reduction in major morbidity for patients who underwent laparoscopic resection.[10]

Table 1 Comparative studies of laparoscopic vs. open sigmoid colectomy and restorative proctocolectomy

Author/Year	*N*	Morbidity (%)	Length of stay (d)
Bruce/1996[56]	Lap: 25 Open: 17	12 1	4.2 6.8
Liberman/1996[57]	Lap: 14 Open: 14	14 14	6.3[a] 9.2
Kholer/1998[58]	Lap: 27 Open: 34	16 61.7	7.9[a] 14.3
Dwivedi et al/2002	Lap: 66 Open: 88	18 23.8	4.8[a] 8.8
Senagore et al/2002	Lap: 61 Open: 71	1.6[a] 12.6	3.1[a] 6.8
Lawrence et al/2003	Lap: 56 Open: 215	9[a] 27	4.1[a] 9.0
Araki/2001[59]	Lap: 11 Open: 21	46% 33%	36.1 39.3
Berdah/2004[60]	Lap: 12 Open: 12	25% 25%	11 12
Brown/2001[61]	Lap: 12 Open: 13	17% 15%	8 7.5
Dunker/2001[62]	Lap: 15 Open: 17	13% 24%	9.9 12.5
Larson et al/2005	Lap: 33 Open: 33	6% 12%	– –
Hashimoto/2001[63]	Lap: 11 Open: 13	55% 38%	24 31
Larson/2006[64]	Lap: 100 Open: 200	33% 37%	4 7
Maartense/2004[65]	Lap: 30 Open: 30	20% 17%	10 11
Marcello/2000[66]	Lap: 20 Open: 20	20% 25%	7[a] 8
Schmitt et al/1994	Lap: 22 Open: 29	55%[a] 30%	8.7 8.9

Abbreviations: Lap, Laparoscopic surgery; Open, open surgery.
[a]$p < 0.05\%$.

Many authors have reported on the reduced rate of complications after laparoscopic segmental resection for diverticular disease.[9,11–14] Short-term benefits include decreased wound infection and less cardiopulmonary dysfunction in the postoperative period. Improvement in long-term complications has also been appreciated with a decreased incidence of incisional hernias and adhesive small bowel obstructions.

Faster return of bowel function has also been reported with laparoscopic resection for diverticular disease. A meta-analysis of 12 nonrandomized studies which included more than 19,000 patients found an improvement in time to liquid diet, regular diet, and first bowel movement.[11] In 2003, Kasparek et al aimed to investigate colonic motility after laparoscopic and open resection using colonic manometry.[15] Following sigmoid resection, a transanal monomeric transducer was placed with the tip at the splenic flexure and continuous recordings were performed until postoperative day 3. There was an improvement in colonic motility in those patients who underwent laparoscopic resection when compared with open. The authors noted equivalent narcotic requirement but faster oral intake and decreased length of stay in the laparoscopic cohort.

Despite longer operative times and the need for more instrumentation, laparoscopic segmental colectomy has been found to be more cost-effective. Senagore et al performed a direct cost analysis of 71 consecutive elective open resections for diverticular disease and compared this to 61 laparoscopic resections.[13] Patients in the laparoscopic group had a significantly shorter length of stay with fewer wound infections and pulmonary complications. While the operating costs were not significantly different between the two groups, the total direct cost per case was significantly less for laparoscopic procedures when compared with open at $3,458 and $4,321, respectively. Many other studies have demonstrated cost savings associated with laparoscopic surgery for diverticular disease, and these results are generally attributed to decreased length of stay and lower postoperative morbidity.[14,16–18]

Of patients with diverticulitis, 20% will develop complications including abscess, fistula formation, obstruction, and free perforation during the initial episode. For any subsequent recurrence, the incidence of complications can reach up to 60%.[19] Classically, complicated diverticular disease has

been managed using a staged approach with primary sigmoid resection and end colostomy followed at a later date by restoration of bowel continuity. In recent years, resection with primary anastomosis has become more commonplace. Laparoscopic-assisted colectomy in the setting of complicated diverticular disease has been found to be safe in many series. Hassan et al analyzed the overall morbidity in patients undergoing laparoscopic surgery for complicated diverticulitis.[20] The authors found no difference in the rate of short- or long-term morbidity (defined at 30 days) between complicated and uncomplicated diverticular resections. Pendlimari et al noted similar findings when comparing laparoscopic and open resection with respect to return of bowel function, duration of hospitalization, and major morbidity.[21]

Laparoscopic surgery for fistulous complications of diverticulitis has also been proven to be safe despite the technical challenge of these operations. Several series have demonstrated that laparoscopic segmental resection in patients with fistulas are associated with increased operative times, longer length of stay, and higher rate of conversion to an open procedure when compared with elective laparoscopic resection for uncomplicated recurrent diverticulitis.[22] A recent meta-analysis including 11 nonrandomized series compared laparoscopic surgery for fistulizing diverticular disease to an open cohort. The authors found no significant difference in their primary endpoints of fistula recurrence, reintervention within 30 days, or need for stoma between the laparoscopic and open groups.[8] It is generally agreed that laparoscopic surgery for fistulizing disease is equivalent to an open technique; however, quality evidence is lacking to support a true advantage to the minimally invasive approach.

There are numerous case series to support a laparoscopic approach to Hartmann's procedure in the setting of acute perforated diverticulitis in patients unfit for primary anastomosis.[23] A recent analysis of the American College of Surgeons National Surgical Quality Improvement Program compared laparoscopic to open resection for the emergency treatment of diverticulitis and found equivalence in the two techniques.[24] Approximately 1,200 patients were included in their analysis, which found that patients in the laparoscopic cohort had fewer overall complications with a shorter length stay, and no difference in operative time. When compared with a propensity-matched cohort, the laparoscopic approach did not significantly reduce postoperative morbidity or mortality.

Evidence also supports the use of laparoscopy for Hartmann's colostomy reversal. A recently published meta-analysis of eight nonrandomized trials that compared open and laparoscopic reversal of Hartmann's procedures found less blood loss, lower mortality, and lower length of stay and no difference in anastomotic leak with a minimally invasive approach.[25] Randomized controlled trials are needed to further delineate the role of laparoscopy in this patient population.

Laparoscopic peritoneal lavage and drainage without resection is another minimally invasive option in the management of perforated diverticulitis with peritonitis. While more surgeons have recently adopted this technique in selected patients, its use has been widely debated. Although the use of laparoscopic lavage has the potential to avoid the morbidity associated with sigmoid resection and likely colostomy, this method of management carries with it the risk of insufficient source control.

While lavage and drainage is supported by many retrospective reviews, randomized controlled trials have shown this modality to carry risks that are not insignificant. Recently, the short-term outcomes of the "DIverticulitis—LAparoscopic LAvage vs. resection for acute diverticulitis with peritonitis" (DILALA) trial were reported.[26] This randomized controlled trial compared the short-term outcomes of patients with Hinchey III diverticulitis randomized to laparoscopic lavage or open Hartmann's procedure. Any patient treated for diverticulitis with pneumoperitoneum or free fluid on imaging was taken to the operating room for diagnostic laparoscopy. Patients with purulent peritonitis were randomized to laparoscopic lavage and drain placement or Hartmann's colostomy. Laparoscopic lavage of all four quadrants was performed with 3 L or more of warmed normal saline until the aspirate was clear.

Patients in the lavage group had significantly shorter operating time and shorter length of stay but had an indwelling drain for significantly longer than patients in the Hartmann's group. There was no difference in morbidity, reoperation, readmission, and overall mortality between the two groups. In 2015, the results of the SCANDIV trial, also known the Laparoscopic Lavage versus Primary Resection for Acute Perforated Diverticulitis, were reported.[27] This study was a multicentered, clinical superiority trial that randomized 101 patients to laparoscopic peritoneal lavage and 98 patients to colon resection in perforated diverticulitis without feculent peritonitis. The authors noted no difference in the rate of major morbidity, length of stay, or mortality between the two groups, but they did note a significantly higher reoperation rate in the laparoscopic lavage group. The authors of this study recommended against laparoscopic lavage and drainage.

The Ladies trial, an international multicenter randomized trial, examined the management of patients with perforated diverticulitis with purulent peritonitis.[28] All patients treated in the study period were randomized to laparoscopic lavage, Hartmann's procedure, or primary anastomosis in a parallel design after diagnostic laparoscopy to exclude feculent peritonitis. The two arms were known as the LOLA group which compare laparoscopic lavage with sigmoidectomy and the DIVA group comparing Hartmann's procedure with sigmoidectomy plus primary anastomosis. A total of 90 patients were randomly assigned in the LOLA arm and underwent laparoscopic lavage. The trial was prematurely terminated for an overall combined morbidity and mortality of 67% in the laparoscopic lavage group. The DIVA trial is still underway.

Clostridium Difficile Associated Colitis

In 2011, *Clostridium difficile* was responsible for an estimated 453,000 infections and was associated with approximately 29,000 deaths.[29] This rise in incidence is multifactorial and has been attributed to an increase in antibiotic resistance requiring broader antibiotic coverage, an increased awareness of treating clinicians, and an improvement in the sensitivity of available testing.

The majority of patients with *C. difficile* associated colitis (CDAC) will respond to conservative therapy, but 3 to 10% of patients progress to fulminant colitis with resultant multisystem organ failure and systemic signs of severe sepsis.[30–32] The definitive treatment of fulminant CDAC has historically been total abdominal colectomy with end ileostomy. Subtotal colectomy allows for control of sepsis with aggressive source control followed by ongoing resuscitation with the potential to establish gastrointestinal continuity at a later date. While this approach is the advocated surgical treatment and has been shown to improve the survival in severe fulminant CDAC, the mortality has been reported as high as 80%.[33]

Efforts have been made to apply minimally invasive surgical techniques in attempt to reduce the morbidity and mortality seen after surgical intervention. In 2011, Neal et al reported the use of laparoscopic diverting loop ileostomy with antegrade colonic lavage as an alternative to subtotal colectomy with end ileostomy in patients with fulminant CDAC.[34] The study included 42 patients in the treatment arm of which 90% required ICU care, 64% required mechanical ventilation, and 74% required vasopressor support. Laparoscopic diversion was successful in 83% of patients, with the remainder requiring an open approach. The patients underwent intraoperative colonic lavage though the ileostomy with warmed polyethylene glycol 3350/electrolyte solution and postoperative vancomycin colonic flushes every 8 hours for 10 days along with intravenous metronidazole. All patients in the trial who underwent diversion and lavage had resolution of CDAC. Three patients required postoperative total abdominal colectomy, two for abdominal compartment syndrome and one for ongoing vasopressor requirement. Eight patients (19%) died in the perioperative period and one patient had CDAC recurrence. At the time of publication, nearly 80% of patients had their ileostomies reversed. The authors compared these outcomes with the previous 42 patients treated in their institution who underwent total abdominal colectomy and end ileostomy as primary therapy for CDAC. The patients had a similar preoperative APACHE-II score, yet they experienced 50% mortality in the perioperative period and only 19% underwent ileostomy reversal. While very limited evidence exists to support this technique, these results should prompt further investigation into this approach to treatment in this very high-risk patient population.

Inflammatory Bowel Disease

Approximately 20% of patients with ulcerative colitis (UC) and 80% of patients with Crohn disease (CD) will undergo surgical intervention during their lifetime.[35] Many of these operations—including fecal diversion, small bowel resection, stricturoplasty, segmental resection, total abdominal colectomy, and restorative total proctocolectomy—can be performed using minimally invasive techniques with excellent success. While surgery is curative for patients with UC, up to 60% of patients with CD will develop clinical symptoms of recurrence after their index procedure and up to 30% will require additional surgery. Endoscopic recurrence after ileocolic resection can be seen in up to 80% of patients at 1 year, and clinical recurrence is observed in ~20% of patients at 2 years and in 80% at 20 years.[35] Indications for surgery in IBD includes fibrotic stricturing without acute inflammation, abscess unable to be treated by percutaneous drainage, refractory symptoms, perforation, hemorrhage, fistula formation, toxic colitis, malnutrition, and malignancy.

In many ways, minimally invasive techniques are ideally suited for this patient population. Patients with IBD are often times young and fit. They may require reoperation making subsequent procedures challenging and morbid. They are at high risk for infectious complications, and laparoscopy confers the advantage of smaller incisions in these patients who are often on immunosuppression and immunomodulation. Conversely, IBD patients often have edematous and friable mesentery and the nature of fistulizing disease can make minimally invasive surgery very challenging.

Many retrospective comparative studies have demonstrated the short-term benefits of laparoscopic ileocolic resection for isolated CD when compared with open surgery. Decreased postoperative ileus, narcotic requirement, length of stay, and cost have all been reported in patients who underwent laparoscopic ileocolic resection.[36–38] To date, two randomized controlled trials have been completed which elucidated the advantage of a minimally invasive approach for these patients. In 2001, Milsom et al conducted a prospective, randomized trial in 60 patients undergoing elective ileocolic resection for refractory Crohn disease.[39] In this study, patients were randomized to either a laparoscopic or open procedure. Postoperatively, the authors measured pulmonary function tests at regular intervals, and patients were treated on a highly regimented protocol with regard to analgesic administration, feeding, and all other elements of postoperative care. Recovery of 80% of forced expiratory volume and forced vital capacity was significantly improved in the laparoscopic group. There was no difference in the amount of narcotic used, time to return of bowel function, length of stay, major complications, or mortality between the two groups. There was a statistically higher rate of minor morbidity in the open group. It is important to note that randomization was performed after diagnostic laparoscopy confirmed laparoscopic resection would be feasible, making this a potential source of selection bias.

In 2008, long-term follow-up of this trial was reported.[40] These data points captured incidence, location, and behavior of recurrent disease, medical therapy required, need for hospital admission, incidence of endoscopic and radiologic recurrence, recurrence requiring operation, and outcomes after additional operative intervention. At a mean follow-up of 10.5 years including 56 of the original 60 patients, the authors found no significant differences in any of these factors. Of note, despite an equal recurrence rate in both groups, of those patients who required reoperation, patients who initially underwent open resection were more likely to require multiple operations. The authors concluded that laparoscopic ileocolic resection is equivalent to open surgery.

In 2006, a second randomized controlled trial comparing laparoscopic-assisted and open ileocolic resection for primary Crohn disease was published.[41] While this study was also a randomized trial, the primary end point was directed at

quality of life measures at 3 months following resection. Secondary outcomes included operative time, length of stay, pain and analgesia requirements, costs, and morbidity. The authors found no difference in the quality of life between the two groups at 3 months. The median operative time was longer in the laparoscopic group, but those patients had a shorter hospital stay, decreased postoperative morbidity, and had a significantly decreased cost of care. Similarly, the long-term follow-up of patients in this study evaluated outcome measures of reoperation, readmission, repeat resection rates, quality of life, body image, and cosmesis. Fifty-five patients were followed up at a median of 6.7 years. The authors found an increased rate of incisional hernias and bowel obstruction in the open group and improved body image and cosmesis in the laparoscopic-assisted group. Fistulizing and recurrent CD can represent a challenge to a minimally invasive approach. A retrospective review in 1997 compared the outcomes of 14 patients who underwent laparoscopic ileocolic resection for fistulizing CD with the outcomes of 22 patients with resection for uncomplicated disease.[42] The authors found no difference in conversion rates, morbidity, or postoperative recovery. In a more recent prospective study, 54 patients with fistulizing or recurrent Crohn disease were compared with 70 patients who underwent uncomplicated primary ileocolic resections.[43] Patients undergoing reoperation or those who had fistulizing disease had statistically significant longer operative times (214 vs. 191 minutes), an increase in conversion to open, and a higher rate of stoma formation. No difference, however, was seen in postoperative morbidity and length of stay.

Laparoscopic subtotal colectomy for the treatment of inflammatory bowel disease has been found to be safe and feasible in numerous studies. Bleeding, disabling extracolonic symptoms, medically recalcitrant disease, and the risk of malignancy may require patients to undergo either urgent or elective surgery while on immunosuppressive therapy. In many situations, the medication profile and underlying disease process make restoring continuity unsafe, requiring total abdominal colectomy with an end ileostomy. As in other benign diseases, equivalence between laparoscopic and open surgery has been established.[44,45] In 2009, a comparative study to evaluate the short-term outcomes of laparoscopic subtotal colectomy and end ileostomy for severe ulcerative colitis found that patients had a lower postoperative narcotic requirement, faster return of bowel function, and shorter length of stay.[46] Patients in the laparoscopic group were also found to undergo restorative proctectomy sooner than the open cohort. While not conclusive, this study suggests that significant short-term benefits of laparoscopy lead to faster recovery and definitive treatment in those patients undergoing total abdominal colectomy of UC.

There have been multiple series published regarding the safety and feasibility of laparoscopic restorative total proctocolectomy with ileal pouch anal anastomosis for UC (►**Table 1**). In several of the initial series, studies showed that laparoscopic surgery had higher blood loss and longer operative time with no improvement in time to return of bowel function or length of stay.[47] As experience grew and technology and techniques improved, many single-institution series began to show equivalence when comparing laparoscopy to an open approach. In the LapConPouch Trial, 21 patients were randomized to either a laparoscopic or open procedure.[48] This study showed no difference in operative blood loss, length of stay, postoperative pain, return of bowel function, or quality of life; however, the trial was stopped prematurely due to insufficient patient recruitment. In 2009, a Cochrane review performed a meta-analysis of 11 trials comparing laparoscopic to open restorative proctocolectomy with ileal pouch.[49] While the laparoscopic group did have significantly longer operative times, the authors found no differences in readmission, reoperation, overall morbidity, or mortality between the two groups. Total incision length and cosmesis were superior with the laparoscopic approach.

Additionally, functional outcomes in laparoscopic-assisted pouch surgery have been found to be equivalent to an open approach.[50] A single-institution prospective study followed up patients for a median of 13 months and conducted surveys regarding quality of life and pouch function. The authors demonstrated that patients in both groups have no difference in the number of day- or night-time incontinence episodes, number of bowel movements, or measures of quality in their social life, home life, family, travel, sports, recreation, and sexual activity.

Laparoscopic surgery in a stable patient with toxic colitis requiring total abdominal colectomy has also been described; however, only one study has examined the role of laparoscopy in this setting.[51] The authors described a retrospective review of 18 patients with fulminant UC who underwent laparoscopic subtotal colectomy. Approximately 33% of the patients in this study suffered a postoperative complication. The average length of stay was 5 days which was statistically shorter when compare with an open cohort, and all but one of the patients went on for successful pouch reconstruction. While these data are very limited, laparoscopic subtotal colectomy for IBD may be offered to selected patients by highly skilled minimally invasive surgeons in high-volume centers. Currently, fulminant colitis is a contraindication to laparoscopic approach.

Technical Approach

Numerous technical approaches exist for minimally invasive colorectal surgery and are largely based on resources and surgeon preference. Laparoscopic technology continues to evolve, and as the instrumentation improves, so does the ability to perform safer, faster, and less morbid surgery.

Single-incision laparoscopic surgery (SILS) was first described in colorectal surgery in 2008. Many different platforms, instruments, and cameras exist, which come in variable lengths and degrees of angulation and articulation, allowing the surgeon to avoid operating in a single axis. The SILS port site can also be utilized as the extraction excision or stoma site, enabling scarless operations such as total abdominal colectomy and end ileostomy. Many studies have evaluated the safety and efficacy of SILS for the treatment of benign colon pathology, including diverticulitis, IBD, and slow transit

constipation. SILS has demonstrated similar results of traditional multiport laparoscopy, including morbidity, conversion rate, and readmission rates.[52,53] In some instances, SILS has been found to be superior to multiport laparoscopy. Along with cosmetic advantages, the single incision has been associated with lower rates of port-site complications and hernias as well as decreased postoperative pain and opioid use.[53] A recent meta-analysis of 1 randomized controlled trial and 13 nonrandomized trials comparing SILS to conventional laparoscopy demonstrated equivalent postoperative morbidity, conversion, and operative time.[54] The authors also found patients who underwent SILS had less blood loss, decreased transfusion requirement, faster return of bowel function, shorter length of stay, and smaller incision size. Because these operations are technically demanding, they should only be performed by skilled laparoscopic surgeons in carefully selected patients.

Hand-assisted laparoscopy is an alternative to straight laparoscopy for colorectal resection. The hand port is a sealed port placed into the planned extraction site that allows the surgeon to introduce a hand into the abdomen to mitigate some of the technical challenges associated with laparoscopic surgery. This technique also allows for dissection that requires tactile feedback and may help decrease the learning curve of laparoscopic resection. Many studies have investigated whether the benefits of laparoscopy are lost by placing a hand port. A recent meta-analysis by the Cochrane group included three randomized controlled studies comparing hand-assisted to straight laparoscopy for both benign and malignant indications of the colon.[55] The authors found a significantly lower rate of conversion in patients undergoing hand-assisted surgery but no difference in operative time or complication rates. Hand-assisted laparoscopic surgery may be beneficial in complex cases with dense inflammatory adhesions, case of diverticulitis with associated fistulas and phlegmon, or in cases where a larger extraction site is already required.

Conclusion

Laparoscopic colectomy is safe and effective in the treatment of benign disease. Short-term benefits include less postoperative pain, faster return of bowel function, and a shorter length of stay. As technology continues to improve and surgeons become more comfortable and facile with minimally invasive techniques, these techniques may be offered to patients with more complex conditions. With more experience, operative times decrease and shorter length of stays lead to lower overall costs.

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