Surg Endosc (2009) 23:1876–1881
DOI 10.1007/s00464-008-0308-z

Safety, feasibility, and short-term outcomes of laparoscopically assisted primary ileocolic resection for Crohn's disease

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Received: 13 June 2008 / Accepted: 16 December 2008 / Published online: 28 January 2009

Abstract
Background Outcomes of laparoscopic resection for ileocecal Crohn's disease have been reported previously in smaller studies, suggesting its short-term advantages over open surgery. This study assessed the safety and recovery parameters in the largest, consecutive, single-institution series to date.
Methods Consecutive patients undergoing laparoscopically assisted primary ileocolic resection for Crohn's disease between 1994 and 2006 were identified in an institutional prospectively collected database. Operative and postoperative outcomes at 30 days were studied.
Results In this study, 109 patients (35 men) with a mean age of 35 ± 14 years and a mean body mass index (BMI) of 25 ± 6 kg/m^2 were identified. The main indications for surgery were medically refractory disease (63%) and fibrous stenosis (27%). In 41% of the cases, previous abdominal surgery had been performed. The surgery had a mean duration of 150 ± 45 min and a conversion rate of 6%. The overall 30-day morbidity rate was 11%, and the reoperation rate was 1%. The mortality rate was 0%. The median postoperative hospital stay was 4 days (range, 2–15 days).
Conclusions This series, the largest reported to date, concurs with recent metaanalyses findings that laparoscopically assisted primary ileocecal resection for Crohn's disease is safe and feasible, resulting in better short-terms outcomes than open resection. This operation is therefore the procedure of choice for Crohn's disease at our institutions.

Keywords Crohn's disease · Ileum · Laparoscopic colectomy · Laparoscopy · Outcome assessment

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Laparoscopic surgery has been adopted in many centers for the resection of colon cancer since the demonstration of its short- and long-term safety and efficacy in three large multicenter trials and several smaller studies [1–3]. In several trials and in the most recent metaanalysis, laparoscopic resection of colon cancer was found to be associated with significant advantages over open resection in the short term including reductions in wound morbidity, narcotic analgesia requirements, time to first bowel movement, and time to discharge from hospital [3].

Laparoscopic colectomy has been evaluated for resection in other settings, including ileocolic resection for Crohn's disease. The risks and benefits of laparoscopically assisted ileocolic resection for Crohn's disease may differ from those found with laparoscopically assisted resection for colon cancer. The risks may differ due to technical difficulties posed by increased fragility of inflamed bowel, inflammatory masses, and adhesions.

Furthermore, tactile examination of the entire length of the bowel may be difficult, raising the possibility of overlooked synchronous strictures. The benefits of laparoscopically assisted surgery may differ also for Crohn's disease because of younger patients, for whom a return to normal activities and a satisfactory cosmetic result may be more important. Furthermore, many patients are receiving

immunosuppressive therapy before or during surgery, which may increase the benefits of less traumatic surgery. For all these reasons, data from the laparoscopic literature on colon cancer cannot be applied directly to surgery for Crohn's disease.

Several nonrandomized series and two randomized clinical trials [4, 5] compare outcomes between laparoscopically assisted and open ileocolic resection for Crohn's disease. A recent metaanalysis of this published literature demonstrates significant short-term benefits with the laparoscopic approach compared with open surgery [6]. However, the published studies all were small, with 20–59 patients in the laparoscopic arms, and many have specific exclusion criteria such as palpable mass or previous laparotomy.

This study aimed to evaluate the short-term outcomes for a larger series of unselected patients. It examined the feasibility, safety, and short-term outcomes for all consecutive patients undergoing their first resection for terminal ileal Crohn's disease. All patients who had undergone a laparoscopically assisted primary ileocolic resection for Crohn's disease during a 12-year period in our institution were studied. We hypothesized that this procedure is feasible and safe for a large unselected cohort.

Patients and methods

Patient population

All patients undergoing laparoscopically assisted primary ileocolic resection for Crohn's disease between 1994 and 2006 were identified in a prospectively collected institutional database of laparoscopic colectomy patients. During this period, laparoscopic surgery was offered to all patients presenting for elective or urgent primary ileocolic resection to the authors (D.W.L., R.R.C., T.Y.F., and E.J.D.). The only exceptions were patients with a known frozen abdomen (diagnosed at an earlier laparotomy or laparoscopy for other disease) and patients presenting with emergencies such as peritonitis or complete bowel obstruction. Patients with previous ileocolic resection were excluded from this study, whereas patients who had undergone other abdominal or pelvic surgery unrelated to Crohn's disease were not excluded. The protocol for the current study was approved by the institutional review board.

Preoperative evaluation

Due to the long study period, the methods of preoperative evaluations evolved during the study. As a minimum, all patients underwent colonoscopy and imaging of the small bowel before surgery, either by small bowel contrast radiography or by computed tomography (CT) enterography. Patients with a palpable mass were examined by CT or magnetic resonance imaging (MRI).

Surgical technique and perioperative care

Patients received oral bowel preparation except those who had obstruction. Pneumoperitoneum was established by Veress needle insufflation or by a direct supraumbilical cutdown Hassan technique. Through a supraumbilical 5- or 10-mm port, an initial exploratory laparoscopy was performed. Two 5-mm ports then were introduced in the suprapubic midline and in the left lower quadrant under direct visualization. The cecum and ascending colon were identified and mobilized by a lateral-to-medial dissection, with direct visualization and protection of the right ureter, inferior vena cava, and duodenum. In most cases, the hepatic flexure also was mobilized to facilitate exteriorization and construction of a side-to-side stapled anastomosis.

After mobilization of the right colon and any accompanying terminal ileal phlegmon, a vertical periumbilical incision measuring 5 cm or less was created through which the bowel was exteriorized. The ileocolic artery and vein were divided intra- or extracorporeally depending on the length and the degree of mesentery inflammation. The resection and anastomosis then were performed per surgeon preference. Stapled anastomoses typically were fashioned in a side-to-side configuration with two firings of a linear stapling instrument, with reinforcing sutures at the corners [7, 8]. Handsewn anastomoses typically were end-to-end and double-layered with a running subserosal layer (Vicryl or Monocryl) and an interrupted seromuscular layer (silk).

The entire small bowel was sequentially exteriorized through the periumbilical incision without extension of the incision (which overlay the root of the small bowel mesentery). The small bowel was inspected and palpated for synchronous disease, then returned to the peritoneal cavity. The incision was closed with fascial interrupted sutures (Vicryl) and a subcuticular continuous suture (Monocryl) after irrigation of the abdominal cavity. Abdominal drains were used only in cases of frank perforation. The decision to convert to laparotomy at any stage was made by the surgeon on a case-by-case basis, and the reasons for conversions were documented in the prospective database.

Postoperative analgesia was provided by intravenous patient-controlled analgesia (morphine or hydromorphone). This was replaced by oral narcotic analgesia (oxycodone/acetaminophen or propoxyphene/acetaminophen) on the morning of postoperative day (POD) 2. Nasogastric tubes were not used postoperatively. Diet was advanced as tolerated, with clear liquids introduced later in the day of the operation or on POD 1, and a soft diet was introduced on POD 2.

Collection and analysis of outcome parameters

Key clinical information such as demographic data, indication for surgery, operation performed, and length of hospital stay were collected in a prospective database. In addition, patient records were retrospectively studied for collection of additional information such as functional recovery parameters and morbidity up to 30 days. In-hospital complications were prospectively diagnosed by the primary surgical service. The decision to discharge patients was based on criteria developed for laparoscopically assisted colectomy, namely, passage of stools or flatus, tolerance of an oral soft diet, and appropriate pain control using oral narcotics.

Patients were assessed clinically approximately 30 days after surgery and any adverse events were recorded. They were assessed by their health care provider at either Mayo Clinic (81%) or their local hospital (19%). When they were followed locally, adverse events were reported to Mayo Clinic.

Data were analyzed according to the intention-to-treat principle so that cases converted to laparotomy remained in the analysis. Descriptive statistics instead of statistical tests form the basis of this case series report. Data are summarized in means ± standard deviation and/or medians (range) for continuous factors and in frequencies and percentages.

Results

Demographics

For the study, 109 patents were identified, including 35 men (32%). These patients had a mean age of 35 ± 14 years and body mass indexes (BMIs) of 35 ± 14 and 25 ± 6 kg/m^2, respectively. The most frequent indication for surgery was medically refractory disease (Fig. 1). A majority of patients had one or more preoperative risk factors (Table 1), such as steroid use (72%) or previous abdominal surgery (41%), and 19 patients (18%) had undergone two or more previous abdominal surgeries.

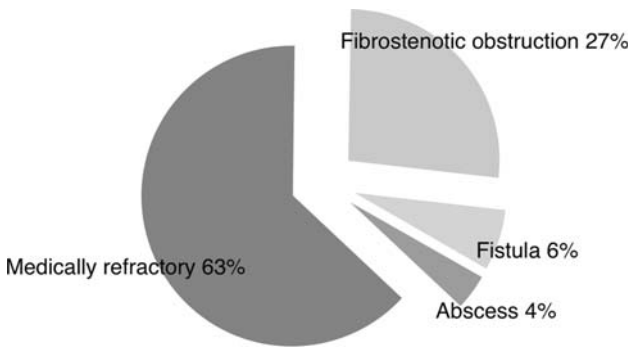

Fig. 1 Distribution of primary indications for surgery among 109 consecutive patients undergoing laparoscopically assisted ileocolic resection for Crohn's disease

Table 1 Preoperative factors that perhaps influenced the perioperative outcomes for 109 consecutive patients undergoing laparoscopically assisted ileocolic resection for Crohn's disease

Preoperative factors	*n* (%)
Previous abdominal surgery	45 (41)
Previous laparotomy	38 (35)
ASA class 1	7 (6)
ASA class 2	91 (83)
ASA class 3	11 (10)
Smokers	21 (19)
Prednisone <20 mg daily	52 (48)
Predisone 20–40 mg daily	19 (17)
Prednisone >40 mg daily	9 (8)
Azathioprine	43 (39)
6-Mercaptopurine	21 (19)
5-Acetosalicylic acid	23 (21)
Infliximab	23 (21)

ASA American Society of Anesthesiology

Surgery

The findings at surgery were active inflammation in 81 patients (74%), stricture in 36 patients (33%), phlegmon in 26 patients (24%), a fistula in another segment of bowel or another viscera in 20 patients (18%), and abscess in 8 patients (7%). Of the 20 intraabdominal fistulas, 14 were enteroenteric fistulas undiagnosed before surgery, and 6 were preoperatively diagnosed fistulas (3 interloop, 2 ileosigmoid, 1 enterovesicular). There was one enterocutaneous fistula.

Conversion to laparotomy was necessary during seven procedures (6%), due to technical difficulties during dissection in six cases and perforation of the bowel in one case. The six cases converted for technical reasons did not differ significantly from the nonconverted cases in terms of age (33 ± 10 years), BMI (25 ± 5 kg/m^2), previous surgery (1 of 6 had previous surgery), or presence of abscess (1 of 6 had abscess). Both patients with preoperatively diagnosed ileosigmoid fistulas in this series were among the converted cases (requiring synchronous colorectal resection), whereas the remaining 18 cases with fistulizing disease were not converted (including the case involving an enterovesicular fistula).

The mean duration of surgery was 150 ± 45 min. In all cases, an ileocolic resection was performed. Additional procedures were performed for several patients (1 left

Table 2 Postoperative 30-day morbidity for 109 consecutive patients undergoing laparoscopically assisted ileocolic resection for Crohn's disease

Complication	*n* (%)
Any complication	12 (11)
Prolonged postoperative ileus	4 (4)
Wound infection	2 (2)
Urinary retention	2 (2)
Sigmoid colon perforation	1 (1)
Thrombosis in superior mesenteric vein	1 (1)
Hemorrhage	1 (1)
Wound hematoma	1 (1)
Wound seroma	1 (1)

hemicolectomy, 1 low anterior resection, 3 additional small bowel resections, and 2 or 3 stricturoplasties for 4 patients). The ileocolic anastomosis was stapled in 85 cases (78%).

Morbidity

Postoperative complications occurred within 30 days for 12 patients (11%). Prolonged gastrointestinal ileus was the most common complication (Table 2). In the current series, no anastomotic dehiscence and no deaths occurred. Postoperative morbidity was not more common among patients with previous laparotomy (3/38 vs. 9/71).

One patient underwent reoperation within 30 days after surgery: This patient had a perforation of the sigmoid colon while still in the hospital. During the primary operation, an adhesion between the ileum and the sigmoid colon was divided, with no evidence of an ileosigmoid fistula at the time. On POD 3, a sigmoid leak was evident, and emergency laparotomy was undertaken. A loop transverse colostomy was fashioned, after which the patient's recovery was uneventful.

Postoperative recovery

Patients tolerated a soft diet on POD 3 (range, 1–13 days) and passed stool on POD 3 (range, 1–7 days). The median postoperative length of hospital stay was 4 days (mean, 4.1 $\pm$ 1.9 days; range, 2–15 days). There were no readmissions within 30 days of surgery.

Discussion

This series included all the patients ($n = 109$) who underwent attempted laparoscopically assisted primary ileocolic resection for Crohn's disease during a 12-year period at our institution. The only exclusion criteria were a known frozen abdomen, an emergent presentation, and previous abdominal or pelvic surgery for Crohn's disease. This series is therefore representative of the unselected patient population requiring primary ileocolic resection for Crohn's disease and demonstrates that this operation can be performed laparoscopically with low rates of conversion (6%) and overall 30-day morbidity (11%). Furthermore, gastrointestinal function returned for more than half of the patients by 3 days after surgery, with discharge from the hospital the following day.

A weakness of the current series is that it was uncontrolled. During the study period, laparoscopy was adopted as the standard of care for this patient population based on safety data from a concurrent study on colon cancer surgery [9, 10] and early experiences with Crohn's disease [11, 12]. A prospective comparative trial or even a retrospective case-matched study was impossible to perform at this institution due to the increasingly low number of patients undergoing planned ileocolic resection using an open approach since the adoption of laparoscopic colectomy and the introduction of tumor necrosis factor alpha receptor blockers. However, the current outcomes can be compared qualitatively with the published experience. The most updated metaanalysis included 881 patients from 14 controlled studies [6]. The largest single-center case series published to date included 69 patients [13].

The current data compare favorably with the previously published data, suggesting that results improve as this operation is implemented as the standard of care during several years in a single institution. In the cumulative literature review, the conversion rate was found to be 11% [6], higher than the current rate of 6%. In the largest previously published case series, collected over a 6-year period, the rate of conversion was 30% [13]. In the current data, it is difficult to predict conversion on the basis of BMI, previous surgery, or presence of abscess. However, both patients with a preoperative diagnosis of an ileosigmoid fistula required conversion, suggesting that this may be an indication of higher risk.

The overall morbidity rate was 11%, similar to the overall perioperative morbidity rate of 13% associated with the cumulative experience of laparoscopically assisted ileocolic resection [6], whereas the rate for the open surgery arms in that metaanalysis was significantly higher at 20%. In the single-center experience, overall morbidity was 19% [13].

One difficulty comparing morbidity between trials is that even minor differences in nuances of definitions for complications significantly alter recorded complication rates [14]. Reoperation rates are an outcome parameter that represents "harder data." In the current series, the 1% reoperation rate within 30 days compares well with the 3% for the laparoscopic arm and the 4% for the open arm of the study in the cumulative analysis [6] and with the 9% for the

single-center experience [13]. Taken together, the lower rates for reoperations and overall morbidity in the current series again indicate that results may improve over the years as laparoscopic surgery is adopted as standard practice.

In terms of recovery, the mean length of hospital stay (4.1 days) likewise compares well with that reported for cumulative laparoscopic experience (5.7–8.3 days) [6] and the single-center series (7.6 days) [13].

In summary, the short-term outcomes in this consecutive unselected series analyzed by the intention-to-treat principle compare favorably with the published experience of both laparoscopic and open surgery, demonstrating that laparoscopy can be applied safely to the surgical treatment of primary ileocolic Crohn's disease.

Perioperative care is a strong determinant of postoperative recovery and morbidity [15], perhaps even stronger than the mode of surgery (laparoscopy vs laparotomy). Recent developments in colon surgery have demonstrated that very rapid physiologic recovery and discharge is possible after both open and laparoscopic segmental colectomy by optimizing anesthesia, analgesia, fluid therapy, and other aspects of perioperative care [16, 17]. Such so-called enhanced-recovery protocols also have been shown to reduce morbidity [15].

Some aspects of enhanced-recovery protocols (e.g., early oral diet and early mobilization) were implemented during the course of the current study. Adopting all the physiologic stress-reducing elements of enhanced-recovery protocols for laparoscopic ileocolic resection may improve recovery and morbidity further.

Other potential benefits, such as an earlier return to work with resulting overall economical benefits and improved cosmesis, remain to be studied. Furthermore, it remains to be seen how the long-term results of laparoscopically assisted primary ileocolic resection for Crohn's disease compare with those for open surgery. Population-based data demonstrate that this patient group frequently requires reoperation, with cumulative relapse rates of 28% and 36%, respectively, 5 and 10 years after open primary ileocolic resection [18]. Data comparing laparoscopic and open surgery show that the minimally invasive approach is associated with fewer intraabdominal adhesions than laparotomy, which may reduce the need for adhesion-related reoperation [19, 20]. In addition, the incidence of incisional hernias may be lower, further reducing the need for reoperations as well as their complexity [20].

In conclusion, the current series demonstrates that in experienced hands, laparoscopic colectomy can be routinely offered to patients with Crohn's disease requiring primary ileocolic resection. Furthermore, this series supports the cumulative evidence from previous studies that laparoscopically assisted ileocolic resection is associated with better short-term outcomes than open surgery and should therefore be considered the operation of choice for this indication. The laparoscopic approach currently is the standard approach offered at our institutions for primary resection of ileocolic Crohn's disease. Outcomes in terms of societal and health care costs, cosmesis, and long-term wound morbidity and reoperation rates remain to be elucidated for this cohort.

Acknowledgments The authors thank Dr. Rui Qin and Ms. Rachel Gullerud at the Division of Biostatistics, Mayo Clinic for their valuable contributions to the manuscript.

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