Three-Step Ileal Pouch-Anal Anastomosis under Total Laparoscopic Approach for Acute or Severe Colitis Complicating Inflammatory Bowel Disease

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BACKGROUND: A two- or three-step procedure is mandatory for restorative proctocolectomy in patients presenting with severe or acute colitis complicating inflammatory bowel disease (IBD). The aim of this study was to analyze the feasibility of a total laparoscopic approach for consecutive subtotal colectomy (STC) and secondary ileal pouch-anal anastomosis (IPAA).

STUDY DESIGN: All patients underwent a three-step procedure that included first, a laparoscopic STC with ileostomy and sigmoidostomy; second, a laparoscopic proctectomy and IPAA, and third, closure of the temporary ileostomy.

RESULTS: Eighteen consecutive patients (7 women and 11 men), with a mean age of 39 ± 14 years (range 15 to 59 years) were included. Mean lengths of the procedures were 252 ± 59 minutes for STC, and 286 ± 46 minutes for IPAA, respectively. Two patients (11%) after laparoscopic IPAA required conversion into laparotomy. No patient died postoperatively. Four patients had reoperations after laparoscopic IPAA for intraperitoneal hemorrhage by laparotomy (n = 2) and by a transanal approach for anastomotic leakage (n = 2). The overall morbidity rate was 33% (12 of 36 procedures). Mean hospital stay was 8 ± 2 days after STC, and 10 ± 2 days after IPAA. After a mean follow up of 13 months, all patients underwent intestinal continuity restoration.

CONCLUSIONS: Our study suggests that a total laparoscopic approach is feasible and safe in inflammatory bowel disease patients with acute or severe colitis, not only for STC but also for IPAA after STC, with no mortality and an acceptable morbidity rate. (J Am Coll Surg 2006;202:637–642. © 2006 by the American College of Surgeons)

Laparoscopic colorectal resection in patients with inflammatory bowel disease (IBD) requires substantial experience working with IBD and advanced laparoscopic skills.[1] This is particularly true in patients with acute or severe colitis complicating IBD. In such cases, patients are often malnourished, anemic, and have received high doses of steroids.[1]

For most of us, subtotal colectomy (STC) in severe acute colitis (SAC) complicating IBD remains mandatory after failure of aggressive medical therapies (steroids, cyclosporin, or both) and in patients presenting with complications.[2] We have previously reported the safety of STC performed through laparotomy for patients with SAC, with a postoperative mortality rate < 1% and a postoperative morbidity rate of 33%.[3] We consider that a two- or three-step procedure beginning with STC remains the procedure of choice for patients with SAC. For us, the two main reasons for not performing ileal pouch-anal anastomosis (IPAA) as the first surgical step in patients with SAC are the risk of pelvis septic complications (which is increased after IPAA in patients taking high doses of steroids) and the possible existence of misdiagnosed Crohn's disease.[4]

To date, only four studies have reported on both feasibility and safety of laparoscopic STC for acute colitis. Although mean operating time was substantially longer after laparoscopic STC, the morbidity rate was lower and mean hospital stay was substantially reduced.[5-8] Concerning IPAA, five comparative retrospective studies suggested the feasibility of a laparoscopic approach.[9-12] Recently, a

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Abbreviations and Acronyms
IBD = inflammatory bowel disease
IPAA = ileal pouch-anal anastomosis
SAC = severe acute colitis
STC = subtotal colectomy

randomized study demonstrated that laparoscopic IPAA was associated, although not markedly, with reduced postoperative morbidity rate and hospital stay, compared with those for open IPAA.[13]

To our knowledge, no study has evaluated results of a total laparoscopic approach, including STC and IPAA, in patients with SAC complicating IBD. The aim of this study was to assess both the feasibility and safety of a total laparoscopic approach for STC and IPAA.

METHODS

Patients

Between 2000 and 2004, 18 consecutive patients with acute or severe colitis complicating IBD, operated on through a total laparoscopic approach, were enrolled in this study. All patients were operated on by a senior surgeon (YP) and underwent a three-step surgical treatment including an STC with ileostomy and sigmoidostomy; a proctectomy and IPAA, and closure of the temporary ileostomy.

Data, prospectively collected by reviewing the clinical files, included information on age, gender, body mass index, diagnosis, duration of disease, preoperative medical treatment, previous abdominal surgery, present indication for surgery, type of procedure performed, conversion to open surgery, operating time, morbidity, and length of hospital stay.

Surgical procedure

Subtotal colectomy with end ileostomy and sigmoidostomy

For both steps of laparoscopic STC and proctectomy with IPAA, the patients, under general anesthesia, were placed in a modified lithotomy position with closed arms, and with a nasogastric tube and bladder catheter. The supine position was changed during the procedure to facilitate retraction of the small bowel from the operating field, modifying the table position. Specifically, it was in steep Tredelenburg and tilted to the right for the left colon and the rectum, and in Tredelenburg and tilted to the left for the right colon. The surgeon stood on the patient's right or left side for the left or right colon dissection, respectively. The assistant stood in front of the operator, and camera driver and nurse were located on the same side as the operator. A 15-mmHg carbon dioxide pneumoperitoneum was established with a 10-mm laparoscopic port, placed through the umbilicus, using a direct open technique. A 0-degree laparoscope was positioned in the abdominal cavity and a diagnostic laparoscopy was performed. The remaining laparoscopic ports were placed under direct vision. Usually, four additional cannulas (5 to 12 mm) were used, generally one in each abdominal quadrant. An attempt was made to place the right lower quadrant trocar at the site of the previously marked ileostomy. Dissection of soft tissues, colorectal mesentery, serosal preparation, and vascular division were achieved with the use of a 5-mm blade harmonic scalpel device (Ultracision Shears Harmonic Scalpel LCS; Ethicon Endosurgery SA).

First, with the patient tilted to the right, incising the avascular plane between the structures, which subsequently facilitated mobilization of the splenic flexure, the operator separated the greater omentum and transverse colon. Second, the left colon was mobilized by incising the peritoneal reflection along the paracolic gutter; during this step, the left ureter was identified. Third, the mesocolic vessels were intracorporeally divided near the colon. Then, with patient tilted to the left, similar steps were performed on the right side, with complete mobilization of the right colon, and identification of the duodenum. A 5-cm incision was made on the right iliac fossa (at the exact location of the trocar orifice). The colon specimen was removed, and ligation of the main ileocolic artery was performed extracorporeally. Then, both sigmoid (above the rectosigmoid junction) and ileum (close to the ileocecal junction) were divided extracorporeally (with stapler). A double-end ileostomy and sigmoidostomy in the same orifice were fashioned in the right iliac fossa. Pneumoperitoneum was reestablished, and a laparoscope was reinserted to verify hemostasis and the absence of small bowel incarceration between both terminal ileum and sigmoid loops. Finally, the abdomen was deflated and all port incisions were closed. No abdominal drainage was left in place.

Total proctectomy with J-ileal pouch-anal anastomosis

Two to 3 months later, total proctectomy with IPAA was performed. The double-end ileostomy and sigmoidos-

tomy were closed and reintegrated intracorporeally. The right iliac fossa was temporarily closed cutaneously, and a 15-mmHg carbon dioxide pneumoperitoneum was established with a 10-mm laparoscopic port, placed through the umbilicus, using a direct open technique. The locations of the remaining laparoscopic ports were similar to those previously described. In women, the uterus was lifted up to the abdominal wall to expose the anterior face of the rectum. The posterior and lateral faces of the rectum were dissected along the rectal wall without performing total mesorectal excision. The distal rectum was mobilized up to the level of the levator ani muscles. Then, the upper part of the anal canal was divided with an endoscopic 45-mm stapler (EndoGIA, Ethicon Endosurgery SA). To be sure that rectal division was effectively made no higher than 1 to 2 cm above the levator ani muscles, transanal digital examination was systematically used to control the level of rectal division.

The mesentery was then totally mobilized up to the fourth duodenum, and a Kocher's maneuver was sometimes used in patients with short mesentery. The right iliac fossa was then reopened, and the rectum specimen was removed. An 18-cm ileal J-pouch was mechanically made extracorporeally using two or three shots by a 90-mm GIA stapler (GIA, Ethicon Endosurgery SA). If the top of the reservoir easily reaches just the lower margin of the symphisis pubis, stapled IPAA can be performed without excessive tension. The J-pouch was then transposed into the pelvis and the right iliac fossa was again temporarily closed. Then, the pneumoperitoneum was reestablished. The IPAA was created laparoscopically, by using an endoluminal-stapling device through the anus (PCEAA, Ethicon Endosurgery SA), using the double-stapling technique. A closed suction drain was left in the pelvis, and a temporary ileostomy was performed at the same site of the former double-end ileostomy and sigmoidostomy.

Ileostomy closure

Two months after operation, before ileostomy closure, the absence of anastomotic leak and stenosis was always confirmed by contrast enema. Under general anesthesia, an end-to-end manual anastomosis was performed for stoma closure.

Study criteria

Conversion to open surgery was defined as any unplanned incision or a planned incision $>$ 6 cm, which was necessary for simple exteriorization of the resected specimen and fashioning of the anastomosis.

Mortality was defined as death occurring in the hospital or within 30 days. Complications were defined as major if they resulted in an increase in hospital stay greater than the average length of stay, or if they posed a potential threat to the patient's vital functions. Complications were considered minor when they did not influence the average postoperative length of stay.

RESULTS

Eighteen consecutive patients (7 women and 11 men), with a mean age of 39 $\pm$ 14 years (range 15 to 59 years) (SD) underwent this three-step laparoscopic procedure. Laparoscopic STC was indicated because of severe (n = 14) or acute colitis (n = 4). Pathologic examination revealed ulcerative colitis (n = 15), Crohn's disease (n = 2), and indeterminate colitis (n = 1). Mean duration of the disease before operation was 100 $\pm$ 97 months (range 0 to 312 months). American Society of Anesthesiology scores were I (n = 2), and II (n = 16). Ten patients (83%) were receiving corticosteroids, immunosuppressive therapy, or both at the time of operation. Mean body mass index was 23 $\pm$ 3 kg/m^2 (range 17 to 29 kg/m^2).

Subtotal colectomy with both-end ileostomy and sigmoidostomy

No patient required conversion to laparotomy. Mean length of the procedure was 253 $\pm$ 59 minutes (range 180 to 420 minutes). One patient (6%) required postoperative blood transfusion. There was no postoperative death. Minor postoperative complications included wound hematoma and ileosigmoidostomy prolapse. Mean hospital stay averaged 8 $\pm$ 2 days (range 4 to 12 days, Table 1). One patient was readmitted on postoperative day 8 because of a small bowel obstruction and treated successfully without reoperation; one patient was readmitted to another institution on postoperative day 30 for a pulmonary embolism (Table 2).

Total proctectomy with ileal pouch-anal anastomosis

Laparoscopic proctectomy with IPAA was performed a mean of 81 $\pm$ 18 days (range 59 to 119 days) after STC. Two patients (11%) required conversion to laparotomy because of intraoperative bleeding. Mean length of the procedure was 286 $\pm$ 47 minutes (range 220 to

Table 1. Mean Length of Procedures and Length of Stay after Laparoscopic Three-Step Ileal Pouch-Anal Anastomosis in 18 Consecutive Patients with Acute or Severe Colitis Complicating Inflammatory Bowel Disease

Phase of procedure	Mean length of procedure, min, (range)	Mean length of stay, d, (range)
Subtotal colectomy (first step)	253 ± 59 (180–420)	8 ± 2 (4–12)
Proctectomy with ileal pouch-anal anastomosis (second step)	286 ± 47 (220–370)	10 ± 2 (8–15)
Stoma closure (final step)	93 ± 29 (60–160)	5 ± 1 (3–7)
Overall procedure	633 ± 70 (520–780)	24 ± 3 (19–33)

±, standard deviation.

370 minutes, Table 1). Three patients (17%) required postoperative blood transfusion. There were no deaths. Two patients (11%) required reoperation through laparotomy for intraabdominal bleeding. The postoperative course was, for both, uneventful. Five patients suffered from a clinical anastomotic leakage, requiring transanal drainage (n = 2) or antibiotics only (n = 3). All five symptomatic patients were successfully treated with conservative measures. Mean hospital stay was 10 ± 2 days (range 8 to 15 days) for the 18 patients. Five patients were readmitted for peristomial abscess (n = 1), ileostomy prolapse (n = 1), small bowel obstruction (n = 1), or postoperative hematoma or abscess (n = 2). Two patients were treated successfully by percutaneous drainage under CT-scan guidance (Table 2).

Ileostomy closure

Stoma closure was performed in all 18 patients. Mean delay for ileostomy closure was 92 ± 49 days (range 9 to 197 days). Mean hospital stay was 5 ± 1 days (range 3 to 7 days). No patient experienced major postoperative complications requiring specific treatment.

Followup

Followup was 13 ± 15 months (range 1 to 43 months). Stoma closure was performed in all patients. Mean stool frequency per 24 hours was 7 ± 2 (range 4 to 13) and during the night was 1 ± 1 (range 0 to 4). Eight patients (44%) used medication for diminished frequency of stool, three occasionally, and five patients (27%) regularly.

DISCUSSION

We report here the feasibility and safety of a total laparoscopic approach for both STC and IPAA in IBD patients presenting with severe or acute colitis. No patient died during these two laparoscopic procedures, and the overall morbidity rate was 33% (12 of 36 procedures).

Table 2. Postoperative Morbidity after Laparoscopic Three-Step Ileal Pouch-Anal Anastomosis in 18 Consecutive Patients with Acute or Severe Colitis Complicating Inflammatory Bowel Disease

Complications	Subtotal colectomy, n	Ileal pouch-anal anastomosis, n
Medical	1 (6%)*	1 (6%)†
Minor surgical	3 (17%)	3 (17%)
Wound infection	0	0
Hematoma wound	1	0
Bowel obstruction (treated conservatively)	1	1
Peristomial abscess	0	1
Stoma prolapse	1	1
Major surgical	0 (0%)	4 (22%)‡§
Radiologic drainage	0	2
Transanal drainage	0	2
Laparotomy	0	2

*Pulmonary embolism requiring medical treatment.
†Urinary tract infection.
‡One laparotomy was performed for hemorrhage and transanal drainage for fistula in the same patient.
§Laparotomy for hemorrhage and radiologic drainage for parietal abscess were performed in the same patient.
±, standard deviation.

No patient required conversion into laparotomy after laparoscopic STC. That compared favorably with the literature, which reported a conversion rate ranging between 0% and 8%.[5-8] All patients were operated on by a senior surgeon who has performed more than 400 laparoscopic colorectal resections. No selection of the patients was performed. So, all consecutive patients presenting with acute or severe colitis complicating IBD were proposed for a laparoscopic approach, except those with complications (ie, toxic megacolon, peritonitis, and hemorrhage). Both laparoscopic and colorectal experience may explain this low conversion rate. In addition, no patients required reoperation after laparoscopic STC, and small bowel obstruction developed in only one patient (6%). Our postoperative morbidity (24%) compared favorably with other studies in which morbidity rate ranged between 16% and 50%.[5-8] Although not pronounced, laparoscopic STC was associated with a reduced postoperative morbidity rate in three retrospectives studies.[5,7,8]

In addition, laparoscopic STC was associated in these three studies with a marked reduction in wound com-

Table 3. Reported Series of Laparoscopic Subtotal Colectomy for Severe or Acute Colitis Complicating Inflammatory Bowel Disease

First author	Patients	Mean operating time, min	Conversion rate		Major morbidity*		Minor morbidity		Mortality		Length of stay, d
			n	%	n	%	n	%	n	%	
Bell[6]	18	260	0	0	1	6	5	28	0	0	5 ± 3
Marcello[8]	19	210	0	0	0	0	3	16	0	0	4
Dunker[7]	10	271	0	0	5	50	1	10	0	0	15 ± 13
Seshadri[5]	37	270	3	8	—		—		1	3	6
Present study	18	253 ± 59	0	0	0	0	3	16	0	0	8 ± 3

*Major morbidity: complication requiring specific treatment (ie, laparotomy, transanal drainage, or radiologic drainage).
±, standard deviation.

plication rate, delay to return of bowel function, and mean hospital stay.[5,7,8] This result, and our study, demonstrated the feasibility and safety of laparoscopic STC.

This laparoscopic experience compared favorably with our previous results of STC performed through laparotomy for the same acute conditions in IBD patients.[3] Similar mortality (0.6%) and morbidity (33%) rates were observed after open STC.[3] Mean operating times for both laparoscopic STC and IPAA were similar to those observed after open STC and IPAA in our unit (data not shown). Although complicated forms of acute colitis (ie, toxic megacolon, bleeding, perforation) remain for us a contraindication to a laparoscopic approach, we believe that most patients with acute or severe colitis can now be operated on laparoscopically, with a low expected morbidity rate (Table 3). Our three-step laparoscopic procedure for acute or severe colitis complicating IBD was similar to what we proposed before (through laparotomy) for the same kind of patients—experience that we recently published.[3,14] Among our patients with ulcerative colitis and Crohn's disease undergoing IPAA, approximately 25% underwent a three-step approach, 70% had a two-step approach, and < 5% had a one-step IPAA. This ratio was not modified by the laparoscopic approach.

Concerning the choice between a two- versus a three-step approach for IPAA, we prefer a three-step IPAA in most patients with an acute or severe condition. Because of the potentially disastrous consequences of pelvic sepsis after IPAA, even with a temporary stoma, and the very low morbidity rate observed after laparoscopic STC, we believe that temporary ileostomy and sigmoidostomy are preferable to a two-step IPAA, especially in malnourished patients on high doses of steroids. It has been previously demonstrated that steroids are associated with a higher risk of sepsis after IPAA.[4] For us, longterm functional results of IPAA (which can be substantially altered by anastomotic leakage) are much more important for the patient than a two-step instead of a three-step IPAA.

In our study, two patients (12%) required conversion to laparotomy during laparoscopic IPAA. This rate compares favorably with the 0% to 25% rate observed in the literature (Table 4).[9,10,12,13,15,16]

We recently demonstrated in another study of laparoscopic resection for Crohn's disease,[17] that postoperative morbidity was not increased in converted patients. In some series "laparoscopic IPAA" means, in fact, either laparoscopic-assisted IPAA with a Pfannenstiel incision or hand-assisted IPAA, probably making the conversion rate lower than that in the total laparoscopic approach we chose in our study. But we believe that the benefit of

Table 4. Reported Series of Laparoscopic Ileal Pouch-Anal Anastomosis

Study and number of patients	Previous subtotal colectomy, n	Inflammatory bowel disease patients, n	Mean operative time, min	Conversion rate, n (%)	Major morbidity,* n (%)	Minor morbidity, n (%)	Mortality, n	Mean length of stay, d (range)
Maartense (n = 30)[13]	0	20	214	0 (0)	5 (16)	1 (3)	0	10 (5–31)
Ky (n = 32)[15]	0	29	315	0 (0)	3 (9)	8 (25)	0	6 (4–23)
Kienle (n = 50) [16]	0	23	320	4 (8)	9 (18)	11 (22)	0	12 (7–49)
Our study (n = 18)	18	18	286 ± 47	2 (11)	4 (22)	3 (17)	0	10 (8–15)

*Major morbidity was defined as a complication requiring specific treatment (laparotomy, transanal drainage, or radiologic drainage).
±, standard deviation.

laparoscopy is probably greater with a total laparoscopic approach than that with a laparoscopic-assisted operation.[16] It is particularly true for cosmetic results, but probably also for postoperative pain and the risk of wound dehiscence during followup. In our study, 22% of our patients presented major postoperative complications requiring surgical treatment. Although this morbidity rate remains high, it is close to the 23% rate observed recently by Heuschen and colleagues[4] in a large series of more than 450 open IPAAs performed for ulcerative colitis. Very few studies have been reported so far concerning the results of laparoscopic IPAA (Table 4).[1,4,13,16] Recently, the first randomized study (comparing hand-assisted IPAA versus laparotomy in 60 patients) and a large comparative study (including 50 patients) demonstrated the feasibility and safety of the laparoscopic approach for IPAA.[13] Although mean operative time remains longer than that for laparotomy, even in experienced centers, some authors have reported marked reductions of ileus, delay to oral intake, and hospital stay.[9,10,11,13,18] But in our experience, mean operating time was shorter after laparoscopic than open IPAA (data not shown). In addition, satisfaction with cosmetic results of the scar and the body image score were considerably better after laparoscopic IPAA.[9]

In conclusion, our data and other recent reports suggest that IPAA under a total laparoscopic approach can be offered safely in experienced centers to patients with IBD.

Author Contributions

Study conception and design: Alves, Panis
Acquisition of data: Ouaïssi
Analysis and interpretation of data: Ouaïssi, Panis
Drafting of manuscript: Ouaïssi, Alves, Panis
Critical revision: Alves, Panis
Statistical expertise: Panis
Supervision: Panis

REFERENCES

1. Gurland BH, Wexner SD. Laparoscopic surgery for inflammatory bowel disease: results of the past decade. Clinical review. Inflamm Bowel Dis 2002;8:46–54.
2. Katz JA. Medical and surgical management of severe colitis. Semin Gastrointest Dis 2000;11:18–32.
3. Alves A, Panis Y, Bouhnik Y, et al. Subtotal colectomy for acute colitis: A 20-year experience of a tertiary care center with an aggressive and early surgical policy. J Am Coll Surg 2003; 197:379–385.
4. Heuschen UA, Hinz U, Allemeyer EH, et al. Risk factors for ileoanal J pouch-related septic complications in ulcerative colitis and familial adenomatous polyposis. Ann Surg 2002;235:207–216.
5. Seshadri PA, Poulin EC, Schlachta CM, et al. Does a laparoscopic approach to total abdominal colectomy and proctocolectomy offer advantages? Surg Endosc 2001;15:837–842.
6. Bell RL, Seymour NE. Laparoscopic treatment of fulminant ulcerative colitis. Surg Endosc 2002;16:1778–1782.
7. Dunker MS, Bemelman WA, Slors JFM, et al. Laparoscopic-assisted vs open colectomy for severe acute colitis in patients with inflammatory bowel disease. Surg Endosc 2000;14:911–914.
8. Marcello PW, Milsom JW, Wong SK, et al. Laparoscopic total colectomy for acute colitis. Dis Colon Rectum 2001;44:1441–1445.
9. Dunker MS, Bemelman WA, Slors JFM, et al. Functional outcome, quality of life, body image, and cosmesis in patients after laparoscopic-assisted and conventional restorative proctocolectomy. Dis Colon Rectum 2001;44:1800–1807.
10. Berdah SV, Barthet M, Emungania O, et al. Two stage video-assisted restorative proctocolectomy. Ann Chir 2004;129:332–336.
11. Hashimoto A, Funayama Y, Naito H, et al. Laparoscope-assisted versus conventional restorative proctocolectomy with rectal mucosectomy. Surg Today 2004;31:210–214.
12. Rivadeneia DE, Marcello PW, Robert PL, et al. Benefit of hand-assisted laparoscopic restorative proctocolectomy: A comparative study. Dis Colon Rectum 2004;47:1371–1376.
13. Maartense S, Dunker MS, Slors FJ, et al. Hand-assisted laparoscopic versus open restorative proctocolectomy with ileal pouch anal anastomosis. A randomised trial. Ann Surg 2004;240:984–992.
14. Regimbeau JM, Panis Y, Pocard M, et al. Handsewn ileal pouch-anal anastomosis on the dentate line after total proctectomy: technique to avoid incomplete mucosectomy and the need for long-term follow-up of the anal transition zone. Dis Colon Rectum 2001;44:43–50.
15. Ky AJ, Sonoda T, Milsom JW. One-stage laparoscopic restorative proctocolectomy. Dis Colon Rectum 2002;45:207–211.
16. Kienle P, Z'graggen K, Schmidt J, et al. Laparoscopic restorative proctocolectomy. Br J Surg 2005;92:88–93.
17. Alves A, Panis Y, Bouhnik Y, et al. Factors that predict conversion in 69 consecutive patients undergoing laparoscopic ileocecal resection for Crohn's disease: A prospective study. Dis Colon Rectum 2005;48:2302–2308.
18. Marcello PW, Milsom JW, Wong SK, et al. Laparoscopic restorative proctocolectomy. Case-matched comparative study with open restorative proctocolectomy. Dis Colon Rectum 2000;43: 604–608.