Laparoscopic Total Abdominal Colectomy in the Acute Setting

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We report results from a single surgeon's 10-year team experience with laparoscopic total abdominal colectomy. We review our series, which includes a large subgroup of ill, high-risk patients with acute colitis requiring urgent surgery. From 1993 to 2003, we performed 65 laparoscopic total abdominal colectomies. All patients referred for total abdominal colectomy were offered the laparoscopic approach. We prospectively collected the following data on all patients: demographics, surgical indications, preoperative status, duration of surgery, intraoperative blood loss, operative complications, length of stay, subsequent operations, patient satisfaction, and lessons learned from our team experience. Preoperative diagnoses included ulcerative colitis (n = 55), Crohn's colitis (n = 3), colonic inertia (n = 4), and familial adenomatous polyposis (n = 3). Among the patients with inflammatory bowel disease, 70% of cases were performed on ill patients, refractory to medical management, requiring urgent surgery. This subgroup was managed with laparoscopic total abdominal colectomy and Brooke ileostomy, with ileoanal pouch anastomosis deferred. Operative times were long, ranging from 6 to 11 hours. Mean intraoperative blood loss was 200 ml. Mean length of stay was 4.3 days and ranged from 2 to 13 days. There were no conversions to open surgery and there were no deaths. Complications occurred in 12% of patients and included intra-abdominal abscess (n = 2), wound infection (n = 3), stoma stenosis (n = 1), and incisional hernia (n = 2). Postoperative patient satisfaction was high. Subsequent operations, including restorative proctectomy, were also performed laparoscopically. Laparoscopic total abdominal colectomy is technically challenging and requires a team approach but offers patients significant benefit in length of stay and surgical recovery. This operation can be effectively used with minimal morbidity in difficult, ill patients requiring urgent surgery. (J GASTROINTEST SURG 2005;9:881–887)

KEY WORDS: Laparoscopic colon surgery, total abdominal colectomy, ulcerative colitis, colectomy, laparoscopy

Reports of laparoscopic total abdominal colectomy as early as 1992 were mixed, concluding that although the laparoscopic approach is technically feasible, it did not appear to offer recognizable benefits to patients compared with standard laparotomy.[1] By the late 1990s, reports examined laparoscopic abdominal colectomy for quiescent pancolonic diseases, such as familial adenomatous polyposis and inactive inflammatory bowel disease, with promising outcomes. This suggested that as techniques and instrumentation

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were perfected, laparoscopic abdominal colectomy would become an appealing option.[2,3]

More recently, a few reports of laparoscopic total abdominal colectomy for acute colitis have been published. In 2000, Dunker et al.[4] retrospectively reported 42 inflammatory bowel disease patients requiring emergency colectomy with end-ileostomy, of which 32 patients had open colectomy and 10 patients had laparoscopic assisted colectomy. Operative times were longer in the laparoscopic group (271 versus 150 minutes; $P < 0.001$), but hospital stay was shorter (14.6 versus 18.0 days; $P = 0.05$). Complications were similar. They concluded that laparoscopic assisted colectomy in inflammatory bowel disease patients with acute colitis is feasible and as safe as open colectomy. In 2001, Marcello et al.[5] reported a case-control study investigating laparoscopic total colectomy for acute colitis. All patients underwent a total colectomy with creation of an end-ileostomy and buried mucous fistula. Patients with fulminant disease (tachycardia, fever, marked leukocytosis, peritonitis) were excluded, but all patients for whom medical treatment was failing were included. Reporting on 19 laparoscopic and 29 matched conventional patients, operative times were longer in the laparoscopic group (mean, 210 minutes; range, 150–270 minutes versus mean, 120 minutes; range, 60–180 minutes for conventional; $P < 0.001$), return of bowel function was shorter in the laparoscopic group (mean, 1 day; range, 1–3 days versus mean, 2 days; range, 1–4 days for conventional; $P = 0.003$). There were no inadvertent colostomies or conversions in the laparoscopic group. Complications occurred in three (16%) laparoscopic patients and in seven (24%) conventional patients. The authors concluded that laparoscopic total colectomy is feasible and safe in patients with acute nonfulminant colitis and may lead to faster recovery than conventional resection.

We reviewed results from a single surgeon's team 10-year experience with laparoscopic total abdominal colectomy, including a large subgroup of patients with acute colitis requiring urgent surgery. Our objective was to assess the feasibility and safety of laparoscopic total abdominal colectomy in the acute setting. Furthermore, we examined our experience for lessons learned in an effort to delineate why adoption of laparoscopy for colonic disease has been so slow compared with other minimally invasive surgery procedures. While greater than 95% of the 700,000 cholecystectomies performed in the United States are performed with a laparoscope, less than 10% of the 250,000 colon resections are performed laparoscopically.

MATERIAL AND METHODS

Surgery Team

Our report retrospectively describes laparoscopic total abdominal colectomies performed by a single surgeon's team in a U.S. military medical treatment facility between 1993 and 2003. Our group recognized early in our laparoscopic colon surgery experience, dating from 1991, that laparoscopic colon surgery was demanding, time consuming, and controversial for the most common colon surgery indication: cancer. We also recognized, however, potential patient benefits from laparoscopic colon surgery, particularly for total abdominal colectomy. We established prospective guidelines for our laparoscopic total abdominal colon surgery program. We recognized laparoscopic colon surgery as requiring advanced laparoscopic surgery skills—laparoscopic colon surgery is multiquadrant; requires extensive dissection, control of major blood vessels, and specimen removal; and can require either ostomy or anastomosis. Recognizing the importance of a core laparoscopic team, we dedicated two surgeons with advanced laparoscopic skills for all laparoscopic total abdominal colectomies. Our lead surgeon was a pioneer in laparoscopic surgery for the U.S. military and provided continuity for the team throughout the 10-year period. During the 10-year period, the second team member included several general surgery attendings who were intermittently involved and colorectal surgeons from sister facilities, but the majority of the cases involved one of two sequentially assigned colorectal attending surgeons. The significant impact of surgeon experience on the outcome of advanced laparoscopic cases has been demonstrated in numerous studies. Therefore, all surgeons involved in this series had completed hands-on courses in basic and advanced laparoscopic surgery and had completed at least 30 laparoscopic cholecystectomies prior to participating in the laparoscopic colectomy cases. We established regular access to a laparoscopic skills lab with at least quarterly laboratory sessions to sharpen surgeon skill sets.

In addition, because we worked in a federal facility, we were able to minimize concerns regarding time constraints, being aware that laparoscopic colon surgery required longer operating times than conventional procedures.

Patients

Patients referred for total abdominal colectomy for benign disease during the 10-year period between 1993 and 2003 were offered a laparoscopic total abdominal colectomy. Because of the lack of data 10 years ago from a prospective randomized trial examining the efficacy, safety, and equivalency of laparoscopy for colon cancer, we excluded colon cancer from

our laparoscopic total abdominal colectomy procedures. However, we did not exclude patients on the basis of prior abdominal surgery, and we did not exclude patients with acute colitis, although we did exclude patients with peritonitis.

Procedures

Patients with nonacute disease underwent laparoscopic total abdominal colectomy, proctectomy if indicated, and then ileoanal pouch anastomosis with diverting loop ileostomy, or ileorectal anastomosis, depending on the extent of their disease process. All patients with acute colitis underwent total abdominal colectomy, end-ileostomy, and creation of Hartmann's pouch.

Careful attention was given to patient positioning. For the nonacute group where restoration of gastrointestinal continuity was planned, we used low lithotomy, with the thighs projecting horizontally from the torso. For the acute group, patients were placed supine with a footboard. Both arms were tucked to maximize physician access to work from any location. A beanbag was used in most cases to stabilize the patient with bed movements during surgery.

We used four or five laparoscopic ports, all 10–11 mm to allow use of any instrument through any port, given the multiquadrant nature of the required dissection. We did not use hand-assist devices. Commercially available small wound protectors became readily available in the late 1990s, and we began using these devices at the extraction incision during the externalized portion of the procedures (colon transection and anvil placement). If the colon has been divided at the top of the rectum, completely mobilized, and mesentery divided, the entire colon can be delivered through a wound protector at an ileostomy site.

We used a 30- or 45-degree angled 10-mm laparoscope for all procedures. One challenge of laparoscopic colon surgery is retraction. The first assistant often works opposite the camera, making spatial orientation challenging. In addition, laparoscopic bowel graspers remain potentially traumatic. We endeavored to manipulate the bowel as little as possible, favoring retraction of the pericolic fat or mesentery.

Colon mesentery management can be tedious and challenging. Technology has advanced significantly in 10 years. Individual vessel dissection and ligation with endoloops or endoclips were required early in our experience. Later, we used sequential firings of the endo-GIA stapling device to divide the colon mesentery, with resultant exorbitant expense. The advent of the Harmonic Scalpel (Ethicon, Cincinnati, OH) facilitated mesenteric dissection. Introduction of the Ligasure (Valley Lab, Boulder, CO) device dramatically accelerated the time required for mesentery division.

Tactically, surgeons have debated the best approach to the colon mesentery: lateral to medial, or medial to lateral. Because we were dealing with benign disease, our initial experience favored the lateral-to-medial approach, particularly because the blood supply of the colon, once mobilized, is in the midline. In some cases, we were able to mobilize the entire colon and then divide the mesentery extracorporeally using traditional ligatures. More recently, particularly as we apply oncologic principles to laparoscopic colon surgery, we have adopted the medial-to-lateral approach, dividing the named vessels at the root of the mesentery, identifying ureters early, and leaving lateral attachments as suspensory aides during mesentery dissection.

Restoration of gastrointestinal continuity was not an issue for our acute colitis patients, who all underwent laparoscopic total abdominal colectomy, creation of a Hartmann's pouch, and end-ileostomy. For the nonacute patients, we used standard reconstruction techniques, including both double-stapled and hand-sewn anastomoses. As will be discussed, later in our experience, we expanded laparoscopic applications to ileostomy takedown, pouch creation, and completion proctectomy.

Database

We prospectively maintained a laparoscopic total abdominal colectomy database including patient demographics, surgical indications, preoperative status, operative times, operative blood loss, complications, length of stay, subsequent surgeries, patient satisfaction, and lessons learned from our experience.

RESULTS

Patients

Between 1993 and 2003, our group performed 65 laparoscopic total abdominal colectomies. The median age was 47 years (range, 21–68 years). There were 39 women and 26 men.

Diagnoses

Of the 65 patients, preoperative diagnoses included 55 (84.6%) patients with ulcerative colitis, 4 (6.2%) patients with colonic inertia, 3 (4.6%) patients with Crohn's colitis, and 3 (4.6%) patients with familial adenomatous polyposis (FAP).

Acute Colitis

Within the large subgroup of 58 (89% of the total) patients with inflammatory bowel disease (IBD), including the ulcerative colitis and Crohn's colitis patients, 40 (70% of the IBD group, 62% of the total) had acute colitis, with varying degrees of severity. One patient with Crohn's colitis had intramural abscesses of his left colon. Most of these patients were receiving intravenous steroids and antibiotics; many were receiving total parenteral nutrition. All of these patients were failing to respond to medical management.

Procedures

All of the 40 (62%) patients in this subgroup with acute colitis were managed with laparoscopic total abdominal colectomy, creation of a Hartmann's pouch, and end-ileostomy. Of the 40 IBD patients from the acute colitis group left with an end-ileostomy and Hartmann's pouch, 39 had ulcerative colitis and 1 had Crohn's colitis. The Crohn's patient eventually underwent elective ileostomy takedown and ileoproctostomy. Of the 39 ulcerative colitis patients, 37 eventually underwent elective ileostomy takedown, completion proctectomy, and ileoanal pouch anastomosis with diverting loop ileostomy; two patients declined proctectomy and retain their end-ileostomies.

As our laparoscopic team skills evolved, the last 10 of these patients underwent elective laparoscopic ileostomy takedown, completion proctectomy, and ileoanal pouch anastomosis with diverting loop ileostomy. For three of these patients, the only incisions were their ileostomy site and three laparoscopic port sites. At their urgent operation, their colon was removed through their eventual ileostomy site. At their elective surgery, after laparoscopic completion proctectomy and mobilization of the terminal ileal blood supply to the superior mesenteric artery, their ileostomy was taken down and exteriorized, their pouch was created and reintroduced into the abdomen, and then ileoanal anastomosis was performed, followed by diverting loop ileostomy. When their loop ileostomy was closed 6 weeks later, they had completed the three-stage total abdominal proctocolectomy with ileoanal pouch anastomosis with only an ileostomy and three port site scars.

Of the remaining 25 (38%) patients, 18 patients were nonacute IBD patients. Of these 18 patients, two were Crohn's colitis patients managed with laparoscopic total abdominal colectomy with ileoproctostomy. Of the 16 nonacute IBD patients with ulcerative colitis, 13 patients underwent laparoscopic total abdominal colectomy and "open" proctocolectomy with ileoanal pouch anastomosis with diverting loop ileostomy; and 3 patients, who were over 65 years old, underwent laparoscopic total abdominal colectomy with ileoproctostomy. Of the remaining 7 (11%) non-IBD patients, the four patients with colonic inertia underwent laparoscopic total colectomy with ileoproctostomy, whereas the three patients with FAP underwent laparoscopic total abdominal colectomy and "open" mucosal proctectomy with ileoanal pouch anastomosis and diverting loop ileostomy.

Operative Data

Operative times were long, averaging 7.4 hours and ranging from 6 to 11 hours. Blood loss averaged 200 ml, ranging from 100 to 700 ml. There were no conversions to "open" surgery, although early on, proctectomy and ileoanal pouches were performed through lower midline or pfannenstiel incisions. Two patients in the acute colitis group sustained inadvertent colotomies.

Complications

There were no deaths (mortality = 0%). Complications occurred in 8 (12%) of patients, including 2 (3%) intra-abdominal abscesses, 3 (5%) wound infections, 1 (2%) stomal stenosis, and 2 (3%) incisional hernias. The two intra-abdominal abscesses were percutaneously drained under computed tomography guidance. One of these two intra-abdominal abscesses occurred in the acute Crohn's colitis patient with left colon intramural abscesses; the other occurred in one of the acute patients who sustained an inadvertent colotomy. The single patient who developed stomal stenosis required operative revision. Of the two incisional hernias, one was repaired primarily at "open" surgery, and the other was repaired laparoscopically with mesh.

Length of Stay and Patient Satisfaction

Bowel function returned by day 1.5 (range, 1–4 days). Length of stay averaged 4.3 days, ranging from 2 to 13 days. Patient satisfaction was only informally surveyed but was subjectively high. We were particularly impressed by patients' reports of rapid at-home recovery to normal activities of daily living.

DISCUSSION

Adoption of laparoscopy for colonic disease has been slow compared with other minimally invasive surgical procedures. The timing of our report coincides with the publication of the Clinical Outcomes of

Surgical Therapy (COST) Study Group, comparing laparoscopically assisted with "open" surgery for colon cancer.[6] This trial involved 863 patients, 66 surgeons, and 48 hospitals, and reports rates of cancer recurrence, operative complications, and survival at 4.4 years to be similar between the two groups. This landmark study is, as the accompanying editorial described, "the end of the beginning."[7] We agree with their prediction that resistance to laparoscopic colon surgery will diminish. Cancer remains the number two leading cause of death in the United States, and colon cancer remains the leading gastrointestinal cancer, with 146,940 new colorectal cancers, and 56,730 deaths, projected for 2004.[8]

However, compared with the swift domination of laparoscopic cholecystectomy, rapid expansion of laparoscopic colon surgery may prove more challenging. Why has the progress of laparoscopic colon surgery been so divergent from laparoscopic cholecystectomy? The first laparoscopic cholecystectomy, performed by Philippe Mouret on March 17, 1987, in Lyons, France, triggered what many described as the "Nintendo surgery revolution." By 1992, use of laparoscopy to treat gallbladder disease was embraced as "standard of care."[9,10] More than 90% of the 700,000 cholecystectomies performed annually in the United States were performed with a laparoscope. By 1994, laparoscopy had been tried for surgeries ranging from solid organ removal (e.g., nephrectomy, adrenalectomy) to pancreatic resection to total colectomy. By the late 1990s, laparoscopy became the preferred approach for obesity and gastroesophageal reflux surgery.

The story for laparoscopic colon surgery is different. Use of laparoscopy for colorectal disease dates as early as 1990, when Jacobs reported laparoscopic right colectomy. The minimally invasive surgery promises of smaller incisions, reduced pain, shorter hospitalization, and shorter recovery, even if the cost is greater, have been reported for laparoscopic colon procedures by numerous surgeons, but many reports were equivocal. In 2004, most colon operations are still performed by "open," conventional techniques described before Halsted. Laparoscopic colon surgery accounts for less than 10% of the 250,000 colon resections performed in the United States. How does laparoscopic colon surgery differ from other laparoscopic procedures?

First, and most obvious, laparoscopic colon surgery is difficult. Basic laparoscopic surgery skills are one-handed skills and the surgeon can accomplish simple organ removal with limited vascular control and no reconstruction. Fortunately for the explosive growth of laparoscopic cholecystectomy, basic laparoscopic skills can be achieved by any surgeon.[11,12] Advanced laparoscopic surgery requires two-handed skills for bimanual manipulation, complex dissection, suturing, and knot tying. Laparoscopic colon surgery is technically demanding. In 1996, Steve Wexner detailed technical factors unique to laparoscopic colorectal surgery.[13] These difficulty factors can be expanded to include the following: multiquadrant surgery, requires two-handed "advanced" laparoscopic skills, labor intensive and may require two advanced laparoscopic surgeons, time consuming, requires control of named vascular structures, requires solutions for retrieval of specimens that may be large and/or contaminated with infections or cancerous tissue, usually requires bowel anastomosis, and often performed for malignancy.

Second, concerns about adequacy of laparoscopy for colon cancer have slowed the adoption of laparoscopy for colon disease. Colon cancer is the most common gastrointestinal cancer and is the most common indication for colon resection. Early reports of cancer at port sites following laparoscopy raised concerns about the role of laparoscopy for cancer.[14–17] Even though Beart published a reflective review finding that wound recurrence rates appear to be low, concerns about port site recurrences persisted.[18] Basic science data favor the impact of laparoscopy versus open surgery on the immune system, with implications for colon cancer surgery.[19] Still, controversy about the safety, efficacy, and equivalency of laparoscopy to "open," conventional colon surgery with respect to adequacy of staging, resection, lymphadenectomy, and specimen handling has led many surgeons and cancer centers to call for a moratorium on laparoscopy for colon cancer until a prospective double-blinded clinical trial has directly examined the safety, efficacy, and equivalency of the two approaches.[20–23] The moratorium was embraced by many practicing surgeons, relieved to delay adopting what was already recognized as a challenging arena for laparoscopic surgery.

Third, laparoscopic colon surgery exposes the limitations of current minimally invasive surgery technology, skills, and training. Although basic laparoscopic skills are achievable by any surgeon, as proved with laparoscopic cholecystectomy,[8,9] not only are advanced laparoscopic surgery skills more difficult, but their acquisition is more challenging. The average general surgery resident finishing training in the United States has performed fewer than one laparoscopic colon procedure. Currently, 90% of advanced complex laparoscopic surgeries are performed by less than 20% of surgeons. What is the future of surgery? A few laparoscopic wizards? Better training? Better technology?

The use of plastic wound protectors remains controversial. Kercher's group recently reported no significant reduction in wound infection using wound protectors for laparoscopic assisted colon surgery.[24] Wound infection rates are higher for inflammatory versus noninflammatory resections.

Watershed events, such as the publication of the COST trial, amplify needs in general surgery and colon and rectal surgery training to expand emphasis on minimally invasive surgery and enable educational technologies. Overcoming learning curves will remain challenging, but we can leverage skills acquisition in nonpatient venues to accelerate use of new skills in patient care.

CONCLUSIONS

Laparoscopic total abdominal colectomy is technically challenging and requires a team approach, but offers patients benefits in length of stay and surgical recovery and can be effectively used with minimal morbidity and no mortality, not only for elective pancolonic disease, but also for patients with acute colitis requiring urgent surgery.

Lessons learned from our 10-year experience with laparoscopic total abdominal colectomy are coincident with the recent publication of the COST Study Group data. There will be increased interest in expanding use of the laparoscope for colonic disease, particularly for colon cancer. Our 10-year experience with laparoscopic total abdominal colectomy has taught us that, unlike laparoscopic cholecystectomy, laparoscopic colon surgery is difficult and team based and requires advanced skill sets that are not easily acquired. Pressures to expand laparoscopic colon surgery will be challenging. Solutions lie in expanded simulator-based skills training, increased videoendoscopic surgery training, and collaboration among general and colorectal surgeons. Technology is needed to move laparoscopy from a transition technology to true computer-assisted surgery for better patient imaging, simulation, and enhanced surgeon education and performance.

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Discussion

Dr. B. Schirmer (Charlottesville, VA): I want to thank Dr. Marohn for providing a copy of the manuscript, and I want to congratulate him on a very nice paper. This is an important study that shows that it doesn't matter if you take a long time in the operating room; if you do good surgery, your patients can still have good outcomes. It is noteworthy also that removing the colon seems to eliminate postoperative ileus in these patients, whereas when we do partial colectomies, we still see an ileus.

My real question for you, Mike, is perhaps taking a lesson from bariatric surgery. I personally found in bariatric surgery that even though I was a skilled surgeon, I needed a single dedicated team that didn't change to be able to decrease operating times and have a better experience. You did 65 cases over 10 years, six-and-a-half cases per year. Do you think it was the limitation of volume that led to persistently long OR times? It took me about 100 to 200 cases to be able to do a gastric bypass laparoscopically with an unskilled assistant. What volume would it take to get you to that point, or how many of these cases did you do with a varying first assistant, and how much was the variability in the team responsible for the long OR times?

Dr. Marohn: Thank you for an insightful question. The transient nature of our operating room team was a major limiting step. My continuity for well over ten years at one institution in the US Military was atypical, but my teammates were transient, which contributed to our lengthy OR times. Three other factors are worth comment regarding OR times. First, I share your view that laparoscopic colon surgery benefits with a two-surgeon approach, at least, for laparoscopic total colectomies. Second, our reported operative times included set-up times, because set-up times, particularly with a variable team, are increased in an equipment-intensive advanced laparoscopic setting. Third, technology advances have impacted laparoscopic surgery. In ten years, we have moved from electrocautery and laparoscopic clips or pre-tied suture loops to the ultrasonic coagulating shears or high-current bipolar vessel sealers; each accelerating operative management for advanced laparoscopy, particularly mesenteric division.