

Hand-Assisted Laparoscopic Colectomy: A Helping Hand?

Peter W. Marcello, M.D.¹

ABSTRACT

Adoption of laparoscopic colectomy to date has been slow because of its technical complexity and prolonged operative times. Most surgeons do not have the skill sets or colectomy volume to overcome the learning curve. The options for the future are limited. Either surgeons not skilled in laparoscopic colectomy will have to forfeit this procedure to expert laparoscopists as some have recommended or we need to find a way to simplify the procedure while maintaining the benefits of a minimally invasive approach. This article reviews the hurdles to laparoscopic colectomy and the potential benefits of the introduction of the hand to laparoscopic colectomy. In the end, the reader will have a clearer understanding of the controversy surrounding hand-assisted colectomy and why it should be expanded in its application if the majority of surgeons are to offer minimally invasive colectomy to their patients.

KEYWORDS: Laparoscopic colectomy, hand-assisted laparoscopy, hand-assisted colectomy

Objectives: Upon completion of this article, the reader should be able to: (1) summarize the causes of the learning curve associated with laparoscopic colectomy; (2) understand the controversy surrounding hand-assisted colectomy; and (3) list the potential advantages of hand-assisted laparoscopic colectomy.

With more than 10 years experience, a small minority of colon and rectal resections are performed laparoscopically across the United States. There are pockets in the nation where minimally invasive surgery has expanded to the colon, but widespread application has not been seen. The reasons for this are many, but in reality there are only a few that matter. Reported reasons that laparoscopic colectomy is not performed include the prolonged operative times, the need for specialized teams, the lack of quality laparoscopic instruments, the steep learning curve, the lack of data supporting improved results, the ability to perform open procedures through small incisions, the controversies surrounding

laparoscopic colectomy for cancer, and the lack of appropriate patients for the procedure.

In reality, I believe the reason laparoscopic colectomy has not had widespread acceptance is its technical complexity resulting in prolonged operative times and the lack of demand for the procedure by the general population. If a surgeon in practice has the choice of performing a procedure that is already known or a newer procedure that allows less to be done per day without patient demands or potential loss of revenue, a busy surgeon is unlikely to change his or her practice. This article looks at this issue and the fact that the introduction of the hand may allow broader application of

Intestinal Failure; Editor in Chief, David E. Beck, M.D.; Guest Editor, Alastair C. J. Windsor, M.B.B.S., M.D., F.R.C.S., F.R.C.S. (Ed). *Clinics in Colon and Rectal Surgery*, volume 17, number 2, 2004. Address for correspondence and reprint requests: Peter W. Marcello, M.D., Department of Colon and Rectal Surgery, Lahey Clinic, 41 Mall Rd., Burlington, MA 01805. E-mail: peter.w.marcello@lahey.org. ¹Department of Colon and Rectal Surgery, Lahey Clinic, Burlington, Massachusetts. Copyright © 2004 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA. Tel: +1(212) 584-4662. 1531-0043,p;2004,17,02,125,129,ftx,en;ccrs00172x.

minimally invasive surgery by the general population of operating surgeons.

LEARNING CURVE

After more than 10 years since its first description, there has not been widespread adoption of laparoscopic colectomy. This is in part related to its complexity. In comparison with the surgeon performing laparoscopic cholecystectomy, the surgeon performing laparoscopic colectomy has to work in multiple quadrants of the abdomen. This requires a better understanding of depth perception and proprioception. It is also necessary to have a coordinated team consisting of a surgeon, an assistant, and often a camera person. All three must work together along with the nursing and anesthesia teams. The surgeon may also need to work in reverse angles to the camera. All of these add to the complexity of the procedure and result in the need to perform several cases before the surgeon and surgical team becomes proficient. Numerous studies have evaluated the "learning curve" of laparoscopic colectomy.¹⁻³ It is estimated by conventional laparoscopic techniques that the learning curve for laparoscopic colectomy involves at least 20 cases and more likely 50 cases. Although most of these data are older, I believe that the numbers are relevant today. Our technique may have improved since the mid-1990s, but the basic instruments have not changed.

The difficulty with the broad application of laparoscopic colectomy is that most general surgeons perform fewer than 50 segmental colon resections per year. In a review of 2434 general surgeons who were taking the recertification examination for the American Board of Surgery, all of whom supplied their operative lists from the previous year, most surgeons performed fewer than 20 colon resections in 1 year.⁴ In fact, the mean number of colon resections performed by a surgeon was 11. Even at the 90th percentile, only 23 colectomies were performed a surgeon in a single year. If the average surgeon performs 11 resections and only one half are eligible for a laparoscopic approach, assuming a learning curve of 40 cases, it would take a surgeon 8 years to feel comfortable performing laparoscopic colectomy. Most surgeons cannot afford to go through such a learning curve. The solution, therefore, requires that not all surgeons can perform laparoscopic colectomy because of the high number of cases need to master these complex procedures or we have to find a way to lower the learning curve. Many expert laparoscopists suggest that we "raise the bar" and limit the number of surgeons who perform minimally invasive colon resection or have the novice laparoscopic surgeons perform these procedures with expert laparoscopists. I do not believe this is practical. We cannot expect to have enough experts available to assist other surgeons, especially in rural areas. I would prefer to "lower the bar" and

find a way to allow more surgeons, with fewer cases, to perform colon resection laparoscopically. I believe we already have plenty of data to suggest that this is feasible and efficacious.

WHAT IS A LAPAROSCOPIC COLECTOMY?

There is wide variability in the types of laparoscopic colorectal procedures performed, the reporting of results, and cultural variations in management of patients. Minimally invasive procedures may be described as laparoscopically "facilitated," "assisted," or "completed" procedures. These categories relate to whether the mobilization, devascularization, and resection of the bowel were completed laparoscopically and whether the anastomosis was performed intracorporeally or extracorporeally. In some centers, the colon is mobilized from the retroperitoneum and then an incision is made and the devascularization, colonic resection, and anastomosis are done extracorporeally. In other centers the mesenteric vessels are divided and the colon is mobilized intracorporeally. Then an incision is made for extraction, bowel resection, and anastomosis. This is typically done for a right colectomy at our institution.

For sigmoid resection and left colectomy, the vascular pedicles are divided, the colon attachments including the splenic flexure are mobilized, and the rectum and mesorectum are transected intracorporeally. The colon is then extracted through a 4- to 5-cm left lower quadrant incision and the diseased colon resected. The anvil for a circular staple is placed into the divided colon, and it is then placed back into the abdomen and a pneumoperitoneum is recreated. The anastomosis is completed intracorporeally. This has been our approach to left colon resection laparoscopically. At other institutions the vessels are ligated, the colon mobilized, and the rectum divided laparoscopically. Then a 6- to 8-cm lower midline or Pfannenstiel incision is made, the colon is transected, and the anastomosis is performed through the lower incision.

Both approaches, a 4-cm extraction through the left lower quadrant with an intracorporeal anastomosis or a 6- to 8-cm Pfannenstiel incision with extracorporeal anastomosis, would be considered a "laparoscopic colectomy." Is there a difference between these two approaches? Is one more cosmetically pleasing or less painful than the other? In essence, this is the difference between a straight laparoscopic resection and a hand-assisted sigmoid resection. For a hand-assisted laparoscopic colectomy, a 7- to 8-cm Pfannenstiel incision is made initially and three ports are placed (Fig. 1). The vascular pedicles are ligated and the colon is mobilized. The remainder of the procedure is done through the Pfannenstiel. In a traditional laparoscopic sigmoid resection, five trocars are placed and the 4-cm extraction

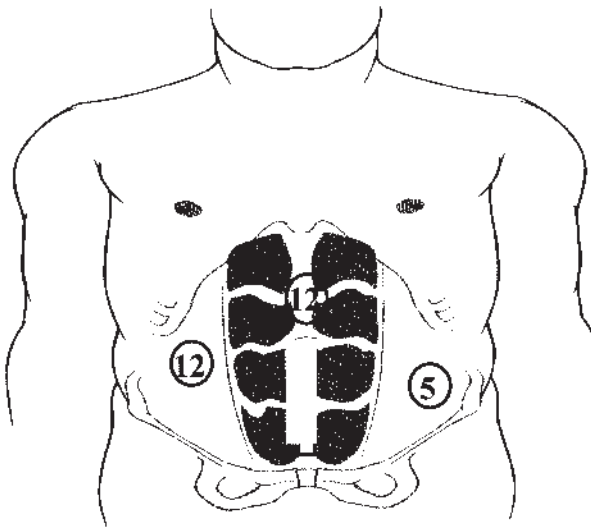


Figure 1 Port placement and extraction site for a hand-assisted laparoscopic left colectomy.

site is created later in the case (Fig. 2). Regardless of whether a hand is utilized or not for the procedure, both approaches for extraction and anastomosis have appeared in the laparoscopic literature. In fact, there have been randomized and nonrandomized studies evaluating intracorporeal versus extracorporeal anastomosis by Bergamaschi et al.^{5,6}

In a nonrandomized comparison of intracorporeal versus extracorporeal anastomosis during elective laparoscopic sigmoid resection for diverticulitis, the authors noted a reduction in mean operative time in the group undergoing extracorporeal anastomosis (180 versus 244 minutes, $p < .001$). Despite no differences in the return of flatus (3.1 versus 3.8 days), patients undergoing an intracorporeal anastomosis had a shorter length of stay

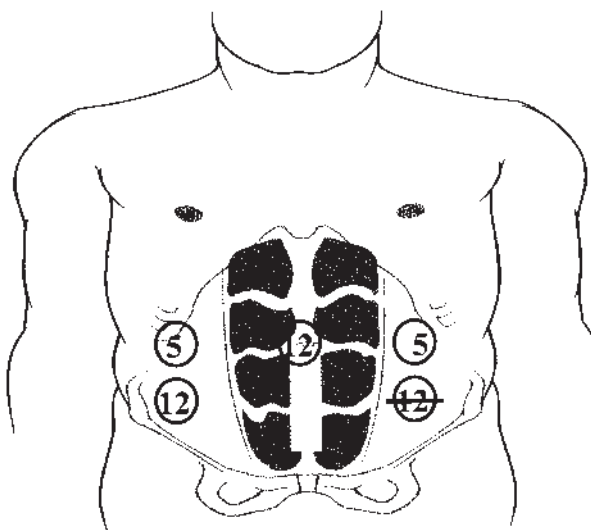


Figure 2 Port placement and extraction site for a standard laparoscopic left colectomy.

(4.6 versus 9.9 days, $p < .001$). However, the technique was different in both groups, and the surgeries were performed at two different sites over two different time intervals, which may have introduced bias.

The authors then performed a single-institution prospective randomized trial comparing intracorporeal (16 patients) and extracorporeal (15 patients) anastomosis through a 5- to 7-cm Pfannenstiel incision during elective laparoscopic sigmoid diverticular resection. There were no differences in incision size, blood loss, anastomotic complications, return of bowel function, or length of stay between the two groups. In patients undergoing an extracorporeal anastomosis there was a significant reduction in mean operative time (190 versus 295 minutes, $p < .01$) without any obvious disadvantage. I believe this study can be used as a basis to explore hand-assisted laparoscopic colectomy because it embodies the same principles and technical steps as a hand-assisted laparoscopic sigmoid resection as currently performed at my institution today.

HAND-ASSISTED COLECTOMY

Most expert laparoscopists view hand-assisted surgery as a step backward. I shared the same views until the summer of 2001, when the advancement of sleeveless hand-assisted devices came along. Up until that time I had performed more than 300 laparoscopic colorectal procedures with dozens of surgical residents and had also taught laparoscopic colectomy to hundreds of surgeons in animal and cadaver courses. And although I could routinely perform laparoscopic colon resections without the use of the hand, I realized that many residents and nonlaparoscopic surgeons struggled with even the simplest of laparoscopic tasks. Up until that time, I had placed more hand assist devices into cadavers and animals than I had into patients. I was a skilled laparoscopist and, therefore, I did not need a hand. At that time, before sleeveless technology, all hand devices required a sleeve to achieve a pneumoperitoneum and the company provided only a single sleeve in the kits. Therefore, if I wanted to teach a surgical resident a particular step, I had to stop the case, lose pneumoperitoneum, remove the sleeve, have the resident place the sleeve on, and regain pneumoperitoneum. This was not at all practical and often frustrating.

However, with the next generation of hand devices such as the GelportTM (Applied Medical Resources, Rancho Santa Margarita, CA) and to a lesser degree the LapDisk (Ethicon Endosurgery, Cincinnati, OH), I could teach residents with little downtime. Hand exchanges could be performed with little or no loss of pneumoperitoneum. And although I still do not need the hand, I have found that my residents and nonlaparoscopic partners can perform more portions of a laparoscopic colectomy with greater ease and a shorter learning

curve when their hand was reintroduced into the abdomen. I have also found this to be true when teaching general surgeons at several recent cadaver courses. By allowing a surgeon to place a single hand back into the abdomen, tactile sensation and proprioception are restored and the surgeon has access to one of the most useful tools in performing colectomy, the hand! Take-down of the splenic flexure is greatly facilitated with the use of the hand. The colon is more easily mobilized from the retroperitoneum with the hand, and separation of the omentum from the colon proceeds in a manner similar to open surgery. Recent colorectal residents completing their training at our institution are performing more complex cases early in their careers. A year ago, the first laparoscopic procedures performed in clinical practice by our two graduating residents were a hand-assisted total colectomy and proctocolectomy. In all my prior years of teaching, I have never had residents begin their careers performing such complex procedures. Although I would like to believe that this relates to an advancement in my teaching skills, I know that the primary reason is the addition of the hand for advanced laparoscopic colorectal procedures. In August 2001, I also began to offer my patients undergoing elective sigmoid resection the choice of a 4-cm left lower quadrant extraction site or an 8-cm Pfannenstiel incision and did not mention that if the Pfannenstiel incision was used, a hand would be placed through the wound. My female patients have almost universally chosen the Pfannenstiel incision, whereas the men either have no preference or have left it to my discretion.

STUDIES

Several studies have evaluated hand-assisted laparoscopic colectomy. Ou in 1995 reported his initial experience in 12 patients undergoing colectomy by hand-assisted methods and compared it with the experience in 12 patients undergoing a conventional open method.⁷ He demonstrated that the hand-assisted procedures required on average 135 minutes as compared with 100 minutes for the standard open method. Length of stay was reduced in the hand-assisted group with an average of 5.6 days as compared with 8.3 days for open patients. Ou concluded that compared with traditional open surgery, hand-assisted laparoscopic colectomy offered reduction in analgesics, better cosmetic results, earlier intake of food, and shorter hospital stay. The only disadvantage of the hand-assisted method by his account was the longer operative time, but Ou thought that this would be reduced with more experience. Similarly, O'Reilly et al reported 38 colon resections using the hand-assisted method and reported a mean length of stay of 2.7 days.⁸

In a prospective multicenter randomized study involving 40 patients by the Hand-Assisted Laparoscopic

Surgery (HALS) group, 22 patients underwent hand-assisted laparoscopic colectomy using the Handport™ (Smith & Nephew, Andover, MA) and 18 underwent standard laparoscopic-assisted colectomy (standard laparoscopic surgery [SLS]).⁹ Operative time was comparable for hand-assisted laparoscopy (152 ± 66 minutes) and standard laparoscopy (141 ± 54 minutes) ($p = .58$). Mean incision length for specimen extraction–bowel anastomosis was similar (HALS 7.4 cm versus SLS 7.0 cm). Three of 22 HALS cases (14%) were converted, as compared with 4 of 18 (22%) in the laparoscopy group ($p = .68$). Return of bowel function occurred by the third postoperative day for the majority of patients in both groups (HALS 77%, SLS 78%). There was no difference in length of stay (HALS 7.0 days [range, 2–12] versus SLS 6.0 days [range, 2–10], $p = .25$). Severity of postoperative pain and rate of functional recovery were equivalent. One major complication occurred in each group. In a subsequent evaluation in which the group was expanded to 73 patients, the results were similar, although now there was a difference in the rate of conversion favoring the HALS group (11% versus 29%, $p = .05$).¹⁰ A lower conversion rate was also seen in a prospective single-institution randomized trial involving 54 patients (27 SLS versus 27 HALS).¹¹ The operative times were similar, but HALS was associated with a far lower conversion rate (7% versus 23%, $p < .05$).

We have recently presented two case-control studies of hand-assisted laparoscopic colectomy compared with standard laparoscopic techniques. The first was a comparative study of patients undergoing elective sigmoid resection for diverticulitis.¹² There were 20 patients who underwent resection by hand-assisted methods with the Gelpport™ device and 33 patients treated with conventional laparoscopic resections. Patients were well matched for age, sex, body mass index, and severity of inflammation. There was no difference in operative time, complications, or length of stay, and seven patients (21%) in the standard laparoscopy group required conversion but none of the hand-assisted patients required conversion ($p = .01$). Four patients were converted to a smaller Pfannenstiel incision and three required a larger midline incision. The majority of conversions were necessary because of the inflammation and adherence of the sigmoid colon to the left pelvis. In the hand-assisted group, this challenging portion of the procedure was accomplished through the open Pfannenstiel incision. This finding is constant in the recent laparoscopic literature. In addition, although there was no difference in the operative times between the two groups, more of the procedural steps were done by my residents or nonlaparoscopic partners in the hand-assisted group.

We have also reported the use of hand-assisted techniques for restorative proctocolectomy.¹³ This represents the first study to evaluate the effectiveness of

hand-assisted laparoscopic approach in comparison with a conventional laparoscopic method in patients undergoing laparoscopic proctocolectomy. Both groups (10 hand-assisted laparoscopy [HAL] versus 13 standard laparoscopy [SL]) were well matched, with no differences in age, sex, American Society of Anesthesiology (ASA) score, operative indication, steroid usage, or diagnosis. The results demonstrated no differences in incision size (mean 8 cm), operative blood loss, rate of conversion (HAL 10% versus SL 0%) or complications (HAL 40% versus SL 31%). The operative times progressively decreased in the HAL group (mean 247 minutes) while remaining constant in the CL group (mean 300 minutes, $p < .05$) over the period of study. This 1 hour reduction in operative time is significant to the busy practicing surgeon and may open the door to more surgeons in performing laparoscopic restorative proctocolectomy. Hand-assisted restorative proctocolectomy can be accomplished without detriment to bowel function, length of stay, or patient's outcome.

CONCLUSIONS

The adoption of laparoscopic colectomy to date has been poor. Although the cause of this is multifactorial, the primary reason is its technical complexity and prolong operative times. The options for the future are limited. Either surgeons not skilled in laparoscopic colectomy will have to forfeit this procedure to expert laparoscopists, as some have recommended, or we need to find a way to simplify the procedure while maintaining the benefits of a minimally invasive approach. I would prefer to lower the bar and have the widespread adoption of hand-assisted laparoscopy by all surgeons than to limit the number of surgeons who perform laparoscopic colectomy (and thereby the number of patients). The results to date suggest that one can maintain all the benefits of a minimally invasive approach, with shorter operative times and a shorter learning curve, by the introduction of the hand to laparoscopic colectomy. I

believe the hand is helpful and not a hindrance to the performance of laparoscopic colectomy.

REFERENCES

1. Simons AJ, Anthonie GJ, Ortega AE, et al. Laparoscopic-assisted colectomy learning curve. *Dis Colon Rectum* 1995; 38:600-603
2. Senagore AJ, Luchtefeld MA, Mackeigan JM. What is the learning curve for laparoscopic colectomy? *Am Surg* 1995;61: 681-685
3. Wishner JD, Baker JWJ, Hoffman GC, et al. Laparoscopic-assisted colectomy. The learning curve. *Surg Endosc* 1995; 9:1179-1183
4. Hyman N. How much colorectal surgery do general surgeons do? *J Am Coll Surg* 2002;194:37-39
5. Bergamaschi R, Tuetch JJ, Pessaux P, Arnaud JP. Intracorporeal vs laparoscopic-assisted resection for uncomplicated diverticulitis of the sigmoid. *Surg Endosc* 2000;14:520-523
6. Bergamaschi R, Tuetch JJ, Cervi C, Arnaud JP. Re-establish pneumoperitoneum in laparoscopic-assisted sigmoid resection? Randomized trial. *Dis Colon Rectum* 2000;43:771-774
7. Ou H. Laparoscopic-assisted mini laparotomy with colectomy. *Dis Colon Rectum* 1995;38:324-326
8. O'Reilly MJ, Saye WB, Mullins SG, et al. Techniques of hand-assisted laparoscopic surgery. *J Laparoendosc Surg* 1996;6:239-244
9. HALS Study Group. Hand-assisted laparoscopic surgery vs standard laparoscopic surgery for colorectal disease: a prospective randomized trial. *Surg Endosc* 2000;14:896-901
10. HALS Study Group. Hand-assisted laparoscopy versus standard laparoscopy for colorectal resection. *Dis Colon Rectum* 2000;43:A20-A21
11. Targarona EM, Gracia E, Garriga J, et al. Prospective randomized trial comparing conventional laparoscopic colectomy with hand-assisted laparoscopic colectomy. *Surg Endosc* 2002;16:234-239
12. Braveman JM, Marcello PW, Rusin LC, Roberts PL, Schoetz DJ. Hand assisted laparoscopic sigmoid resection for diverticulitis: a comparison with laparoscopic resection. *Surg Endosc* 2003;17:S234
13. Rivadeneira DE, Marcello PW, Roberts PL, et al. Benefits of hand-assisted laparoscopic restorative proctocolectomy: a comparative study. *Dis Colon Rectum* 2003;46:A32