Laparoscopic-Assisted Colectomy: A Comparison of Dissection Techniques

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ABSTRACT

Background and Objectives: Mobilization of the colon and dissection of the mesentery are difficult laparoscopic techniques. Traditional methods have been used for this dissection, but often with great difficulty. The ultrasonically activated shears, when introduced in 1993, had the possibility to make this dissection less technically difficult. This is a retrospective review of the use of these shears for these techniques during laparoscopic-assisted colectomy.

Materials and Methods: Eighty-five patients underwent a laparoscopic-assisted right hemicolectomy or sigmoid resection. Colon mobilization and mesenteric dissection were completed intracorporeally. Complications, operative time, estimated blood loss, and length of stay were compared for resections completed with and without the ultrasonically activated shears.

Results: Thirty-six patients had laparoscopic-assisted colectomy without the shears, and 49 patients had the procedure with the shears. There were no complications due to the ultrasonic energy. Use of the shears resulted in shorter operative times (170 min. vs. 187 min., p=0.1989), similar median blood loss (98 mL vs. 95 mL, p=0.7620), and shorter lengths of stay (4.3 days vs. 6.9 days, p=0.0018).

Conclusions: The ultrasonically activated shears are safe and effective for colon mobilization and mesenteric division. The use of the shears may result in shorter operative times and shorter lengths of stay.

Key Words: Laparoscopic-assisted colectomy, Ultrasonic energy.

INTRODUCTION

Minimally invasive surgical techniques have revolutionized the treatment of many of the problems seen by the general surgeon. Although the impact has been greatest in the treatment of cholelithiasis, many of the same advantages achieved with laparoscopic cholecystectomy can be realized with advanced laparoscopic procedures. Since the first initial reports of laparoscopic right hemicolectomy in February 1990 and sigmoid resection in October 1990, laparoscopic-assisted colectomy (LAC) has been found to have numerous advantages when compared to open colectomy. Among these advantages are less blood loss, fewer wound complications, more rapid return of intestinal function, less pain, shorter hospitalization and quicker return to work. But LAC has not been widely accepted as the surgical treatment of choice for patients requiring colon resection. There are two main factors which have prevented the widespread use of LAC techniques. First, the procedure is technically much more difficult and, second, although some have reported good results, LAC has not yet been proven to yield equal or better results for the treatment of colon cancer when compared with open colectomy. Indeed, much concern has been raised about the possibility of increased recurrence rates, port site metastasis, and the possibility that LAC will not prove to be an adequate resection for cure of cancer. Prospective randomized multicenter trials are currently investigating these concerns. Even though LAC for benign disease has yielded good results, only a small percentage of surgeons offer LAC for the treatment of benign disease when discussing options with their patients.

Overall, the biggest impediment to the widespread adoption of LAC for benign disease remains the difficulty of the procedure. In our experience, colon mobilization and division of the mesentery have been the most difficult parts of the procedure for the surgeon to learn.

The anastomosis is usually completed extracorporeally or with the transanal circular stapler, much as would be done during open surgery. The development of the ultrasonically activated shears (Laparoscopic Coagulating Shears [LCS], Ethicon Endo-Surgery/Ultracision, Smithfield, RI) has provided an alternative technology for...
mobilization of the colon and division of the mesentery. To evaluate the efficacy, safety, and efficiency of this new energy source, we retrospectively reviewed a portion of our series of LAC cases.

MATERIALS AND METHODS

From October 1990, to May 1997, 118 laparoscopic colon resections were completed for a variety of indications. Thirty-three of these patients had a colectomy other than a right hemicolectomy or a sigmoid resection and were eliminated from the study. The charts of the remaining 85 patients who underwent either laparoscopic-assisted right hemicolectomy or laparoscopic-assisted sigmoidectomy were reviewed retrospectively by the authors. Fifty patients had benign disease, and 35 had malignant disease. Patients who underwent curative resection for carcinoma of the colon were entered in an Institutional Review Board (IRB) approved prospective study.

The operative notes were reviewed to determine the method in which the colon was mobilized and the mesentery divided. From this review, two groups were identified: one in which this dissection was done without the LCS (no LCS group), and one in which this dissection was done with the LCS (LCS group). The age, sex, indication for surgery, operative times, estimated blood loss (EBL), and length of stay (LOS) were documented for each group.

Statistical analysis was performed on all variables utilizing t-test methodology.

Operative Technique

All surgical procedures were performed in a similar fashion by the senior author or by the laparoscopic surgery fellow under the direct supervision of the senior author. In all patients the colon was mobilized and the mesentery divided. From this review, two groups were identified: one in which this dissection was done without the LCS (no LCS group), and one in which this dissection was done with the LCS (LCS group). The age, sex, indication for surgery, operative times, estimated blood loss (EBL), and length of stay (LOS) were documented for each group.

RESULTS

Demographics

Of the 85 patients, 36 had their procedures completed without the LCS and were in the no LCS group, while 49 had use of the LCS and were in the LCS group. The female:male ratio was 2:1 in the no LCS group and 1.6:1 in the LCS group. The average age was 67.9 years (range 28-101) in the no LCS group and 62.6 years (range 25-91) in the LCS group. These small sex and age differences were not significant.

Indications

Right hemicolectomy was indicated for carcinoma 74% of the time in both groups (Table 1). Large adenomas, arteriovenous malformations, and, in one case, lymphoma were the other indications. Sigmoid colectomy was indicated for diverticulitis in 58% of the no LCS group and 79% of the LCS group (Table 2). Carcinoma was the indication in 28% and 21% of the groups, respectively. The other indications for sigmoid colectomy in the no LCS group were sigmoid stricture and sigmoid volvulus. Hence, the majority of the sigmoid resections were completed for diverticulitis, and the majority of the right hemicolectomies were for carcinoma.

Previous Surgery

Fifteen of 36 patients (42%) in the no LCS group and 22 of 49 patients (45%) in the LCS group had previous abdominal or pelvic surgery. These differences were not statistically significant.
Table 1. Indications for Laparoscopic-Assisted Sigmoid Colectomy (LASC).

| Indication   | LASC without LCS | LASC with LCS |
|--------------|------------------|---------------|
| Diverticulitis | 12 (58%)        | 27 (79%)      |
| Carcinoma    | 6 (28%)          | 7 (21%)       |
| Other        | 3 (14%)          | 0             |

Table 2. Indications for Laparoscopic-Assisted Right Hemicolectomy (LARHC).

| Indication      | LARHC without LCS | LARHC with LCS |
|-----------------|------------------|---------------|
| Carcinoma       | 11 (74%)         | 11 (74%)      |
| Large Adenoma   | 2 (13%)          | 4 (26%)       |
| Other           | 2 (13%)          | 0             |

Table 3. Outcome parameters.

| Parameter    | without LCS | with LCS | p-value |
|--------------|-------------|---------|---------|
| OR time (min)| 187         | 170     | 0.1989 (N.S.) |
| Blood loss (mL)| 95         | 98      | 0.7621 (N.S.) |
| LOS (days)   | 6.9         | 4.3     | 0.0018  |

Outcome Parameters

Average operating room time was less when the LCS was used (170 min. vs. 187 min., p=0.1989) but did not reach statistical significance. Average blood loss was nearly the same whether the LCS was used or not (95 mL vs. 98 mL, p=0.7620) (Table 3). The LOS was less for the LCS group (4.3 days vs. 6.9 days, p=0.0018), and this did reach statistical significance.

Bleeding Complications

One patient developed postoperative intra-abdominal bleeding in the no LCS group. No intra-abdominal bleeding complications occurred in the LCS group. Yet, three patients overall had postoperative bleeding from a stapled anastomosis, for an incidence of 3.5%. One patient had the bleeding controlled by colonoscopic cauterization at the circular staple line. Another patient after sigmoidectomy had an unsuccessful colonoscopic attempt to control the bleeding and required transanatal suture of the staple line after 3 units of blood were transfused. A third patient bled from a stapled ileocolic anastomosis after heparin therapy was started to treat a postoperative pulmonary embolus. The bleeding stopped when the heparin was discontinued. However, when heparin was again started, the patient re-bled, and, therefore, a vena caval filter was placed. Of note was that none of these patients who bled, bled from the area of dissection with the LCS, even when heparin therapy caused anastomotic bleeding. There were no patients who required readmission for delayed bleeding. Hence, there were no early or late bleeding complications in the areas of dissection with the LCS. Additionally, there were no other early or late complications which could be related to the use of the shears.

DISCUSSION

This report is a single-institution, single-surgeon's experience with LAC, and dates from the first reported cases of LAC.¹² Although many new instruments and technologies have been introduced since then, the fundamental surgical techniques and principles described then have not changed. The most difficult steps in LAC are intracorporeal mobilization of the colon and division of the mesentery. The learning curve for these techniques is much longer than for the techniques required for laparoscopic cholecystectomy, and this has slowed the widespread use of LAC for patients needing colon resection. This study was done to assess the use of a new technology, the ultrasonically activated shears, for mobilization of the colon and division of the mesentery.

The ultrasonically activated shears were developed to apply ultrasonic energy to unsupported tissue.¹⁵ The jaws of the shears consist of an active blade and an opposing passive (not ultrasonically activated), movable tissue pad. This allows the surgeon to grasp tissue and vessels within the jaws of the shears, and coapt the endothelium of any vessels in the tissue. The ultrasonic energy is then transmitted to this tissue and can seal blood vessels and divide what has been grasped. The shears have been shown to facilitate completion of other advanced laparoscopic procedures such as division of...
the short gastric arteries during Nissen fundoplication\textsuperscript{16,17} and division of the infundibulopelvic ligament during laparoscopic-assisted vaginal hysterectomy.\textsuperscript{18}

The active blade of the shears vibrates longitudinally at 55,500 Hz. Depending on the power setting of the generator, the active blade will move 50-100 microns with each oscillation. Touching the active blade to tissue transfers mechanical energy from the blade to the tissue. This mechanical energy breaks Hydrogen bonds in the protein of the tissue, resulting in a sticky coagulum which seals blood vessels. This will allow blood vessels up to 3 mm to be sealed with the shears, without the need for any other method to achieve hemostasis.\textsuperscript{19}

Relatively little heat is generated compared to other energy sources, since most of the energy delivered is mechanical energy. The relatively low level of heat generated increases the safety with which the instrument can be used adjacent to other viscera, such as the small intestine or great vessels. The largest or named arteries in the mesentery may need to be controlled by other means, such as clips, ligatures, or the endoscopic linear cutting stapler.

We found that when the ultrasonically activated shears were utilized, the need for scissors, pre-tied loops, clips, and linear cutting staplers was markedly reduced. In situations in which blood vessels were less than 3 mm (as in colon resections for benign disease when high vascular pedicle division was not necessary) these were no longer needed, and the entire dissection could be completed with the shears. When we compared LAC done with and without the shears, the overall operative times and blood loss were similar. Although the operative times with the shears were a little bit shorter, this could have been due to an increase in our skills as we progressed along our learning curve. However, as our skills improved, and partly due to the availability of the shears, we attempted and completed many more difficult procedures than we would have tried without the shears, as documented by the 20% higher incidence of diverticulitis in the LCS group. These more difficult cases inevitably would have taken more time than most of the cases we tried initially if we had not had the shears. Therefore, the shorter length of time in the group in which the shears were used, although not great, is probably significant since we were often doing more difficult cases with the shears. It is our opinion that use of the shears greatly facilitated successful completion of these more complex cases.

The literature documents a decreased length of stay following LAC.\textsuperscript{3-11} In the present study, a similar LOS of 5-6 days is noted. Although the LOS for the group in whom we used the shears was less, this difference is probably due to changes in our postoperative management as we became more comfortable and familiar with the recovery of patients after LAC. Since the patients treated without the shears were all treated early in our experience (before the shears were available), the decrease in length of stay was probably related to our experience. With experience we learned that early advancement of the diet and earlier discharge are possible because the patient has less pain and a shorter ileus following LAC. We do not see a reason why the use of the ultrasonically activated shears would reduce pain and shorten ileus, nor do we see a reason why the use of the LCS would explain the shorter length of stay.

**CONCLUSIONS**

The ultrasonically activated shears are a safe and effective device for mobilizing the colon and dividing the mesentery during LAC. For the experienced laparoscopic surgeon, use of the shears can reduce the time required for routine cases of LAC and can facilitate the completion of more difficult cases. For the inexperienced laparoscopic surgeon, there is no substitute for appropriate training, but the shears have the potential to shorten the learning curve for the inexperienced surgeon by facilitating the two most difficult technical parts of LAC.

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