

Laparoscopic Colectomy: A Critical Appraisal

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A multicenter retrospective study was undertaken to assess the efficacy and safety of laparoscopy in colon and rectal surgery. To minimize potential bias in interpretation of the results, all data were registered with an independent observer, who did not participate in any of the surgical procedures. Sixty-six patients underwent a laparoscopic procedure. Operations performed included sigmoid colectomy (19), right hemicolectomy (15), low anterior resection (6), colectomy with ileal pouch-anal anastomosis (IPAA) (5), and abdominoperineal resection (APR) (3). The conversion rate from laparoscopic colectomy to celiotomy was 41 percent. Major morbidity and mortality were 24 percent and 0 percent, respectively. Length of stay, hospital costs, and lymph node harvest were compared between the sigmoid resection and right hemicolectomy subgroups. Data from traditional sigmoid colectomies and right hemicolectomies were obtained from the same institutions for comparison. Mean postoperative stay for laparoscopically completed sigmoid and right colectomies was significantly less than that for either the converted or the traditional groups ($P < 0.02$). Total hospital cost for traditional right hemicolectomy was significantly less than that for the converted group ($P < 0.05$) but not the laparoscopic group. Laparoscopic sigmoid resection showed no significant total hospital cost difference among traditional, converted, and laparoscopic groups. Lymph node harvest in resections for carcinoma was comparable in all groups. These preliminary data suggest that laparoscopic colon and rectal surgery can be accomplished with acceptable morbidity and mortality when performed by trained surgeons. Length of stay is shorter, but there is no proven total hospital cost benefit. Appropriate registries will be necessary to adequately assess long-term outcome. [Key words: Laparoscopy; Laparoscopic colectomy; Colectomy; Colon resection; Colon and rectal surgery]

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The success of laparoscopic biliary surgery has resulted in the application of laparoscopic techniques to many abdominal and thoracic operations. Fewer pulmonary complications, more rapid return of gastrointestinal function, shorter postoperative stay, decreased cost, less postoperative pain and disability, better cosmesis, and more rapid return to work are only some of the benefits reported from laparoscopic cholecystectomy.¹⁻⁵

Recent advances in research and development have led to the rapid proliferation of specialized instrumentation designed for use by abdominal surgeons operating on the gastrointestinal tract below the biliary tree. However, the mere technical feasibility of laparoscopic colon and rectal surgery does not necessarily equate with the appropriateness of the decision to use the technique. As laparoscopic techniques are applied to colon and rectal surgery, a critical examination of the operative results is imperative.

This study was designed to examine several issues pertinent to laparoscopic colon and rectal surgery. Data from three institutions currently performing laparoscopic and laparoscopic-assisted colon and rectal surgery have been collated. Several aspects of laparoscopic surgery are addressed, including the types of operations attempted, the rate of conversion to celiotomy, operating time, hospital stay, cost, complications, and the extent of lymph node harvest.

MATERIALS AND METHODS

The hospital and clinic records of all patients who had colectomies involving laparoscopy from three institutions were retrospectively reviewed. The data extracted from these charts included 1) types of operations, 2) rate and reasons for conversion to celiotomy, 3) operating time and postop-

erative hospital stay, 4) complications, and 5) lymph node harvest in specimens resected for carcinoma. For the sigmoid resection and right hemicolectomy subgroups, billing information was obtained for analysis of operating room equipment and supplies charges as well as total hospital cost excluding professional fees. In addition, billing and postoperative stay data for concurrent traditional sigmoid and right colectomies were obtained from the participating institutions. The techniques of laparoscopic and laparoscopic-assisted colon resections have been described in detail elsewhere.⁶⁻⁸ Statistical analysis was done using the Kruskal-Wallis test and linear regression analysis.

RESULTS

Sixty-six patients underwent laparoscopic or laparoscopic-assisted colon resections between May 1991 and April 1992 (Table 1). There were 28 males with a mean age of 63 years (range, 19-88

years) and 38 females with a mean age of 58 years (range, 17-92 years).

Types of operations are included in Table 2. Conversion was defined as a deviation from the operative plan requiring a major abdominal incision to complete the proposed procedure. Twenty-seven of the 66 laparoscopic colorectal operations were converted to celiotomy, for a conversion rate of 41 percent. Reasons for conversion are given in Figure 1. A patient's past history of abdominal surgery did not seem to identify which cases required conversion (Fig. 2). Nearly 60 percent of both laparoscopically completed and converted cases had a history of an abdominal operation.

Morbidity was classified as major or minor. Major complications were those that prolonged the hospital stay or required unplanned repair or removal of an organ. The converse was true for minor morbidity. There were a total of 16 major complications (24 percent) in 13 patients (Table 3). Fourteen of these 16 major complications were in the converted group. Minor morbidity occurred in 19 of the 66 cases (29 percent) (Table 4).

There were four injuries directly related to the laparoscopic procedure (Table 5). Three of these injuries were the cause for conversion to celiotomy. One unrecognized enterotomy was noted only after the laparoscopic procedure was con-

Table 1.
Case Contribution by Institution

Institution	Number of Patients
A	35
B	16
C	15

Table 2.
Procedures Involving Laparoscopy

Operation	Laparoscopic Assisted	Converted	Total	Conversion Rate (%)
Sigmoid resection	9	10	19	53
Right hemicolectomy	10	5	15	33
Stoma formation or closure	6	2	8	25
Low anterior resection	3	3	6	50
IPAA	5	0	5	0
APR	2	1	3	33
Left hemicolectomy	1	1	2	50
Abdominal colectomy, IRA*	1	1	2	50
Proctectomy	1	1	2	50
Rectosigmoidectomy with Hartmann's pouch and repair hernias	0	1	1	100
Total proctocolectomy with ileostomy	0	1	1	100
Resection of perforated Crohn's, ileostomy, Hartmann's pouch, pelvic drainage	0	1	1	100
Ileocecal resection	1	0	1	0
Total	39	27	66	41

* IRA = ileorectal anastomosis.

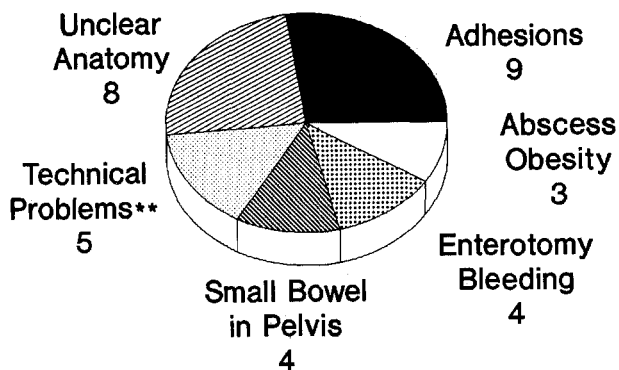


Figure 1. Reasons given for conversion to open procedures. * Some cases had multiple reasons. ** Lesion not in resected specimen; instrumentation not available; etc.

verted for another reason. An iliac artery laceration occurred during laparoscopic dissection. There was no mortality.

Sigmoid resection and right hemicolectomy

Laparoscopic (n=39) 59%

Converted (n=27) 41%

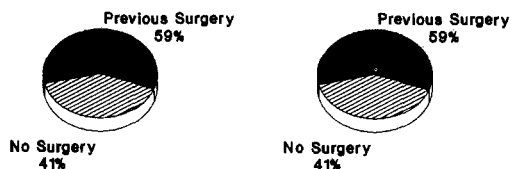


Figure 2. Forty-one percent of all laparoscopic cases were converted. Previous surgery did not influence the conversion rate.

Table 3.
Major Complications

	Converted	Laparoscopic Assisted
Enterotomy*	4	
Ileus	3	1
Splenic injury requiring splenectomy†	2	
Major arterial laceration	1	
Persistent bleeding requiring reoperation	1	
Anastomotic dehiscence‡	1	
Atrial fibrillation‡	1	
CVA‡§	1	
Heart block requiring pacemaker		1
Total	14 in 11 patients (21%)	2 in 2 patients (3%)

* One enterotomy occurred after conversion.

† Occurred after conversion.

‡ Same patient.

§ CVA = cerebrovascular accident.

Table 4.
Minor Complications

	Converted	Laparoscopic Assisted
Urinary tract	4	3
Diarrhea	3	3
Wound infection or hematoma	2	2
Minor soiling*	1	1
Peristomal irritation		1
Perianal irritation	1	
URI†	1	
Narrow anus with redundant mucosa*		1
Total	12 in 9 patients (44%)	11 in 10 patients (28%)
Total all cases	23 in 19 patients (29%)	

* Same patient.

† URI = upper respiratory infection.

Table 5.
Injuries Directly Related to the Laparoscopic Procedure

Enterotomy	3
Major arterial laceration	1
Total	4 (6%)

were the most frequently performed operations and therefore were used for comparing specific data. Postoperative hospital stay was shorter for completed laparoscopic sigmoid colectomy and right hemicolectomy than for converted and traditional sigmoid colectomy and right hemicolectomy ($P < 0.02$) (Fig. 3).

When comparing length of operation for sigmoid resection and right hemicolectomy, there was no difference in the time required for a converted sigmoid or right colectomy than for a laparoscopic sigmoid or right colectomy. Data regarding length of operation for traditional sigmoid resection and right hemicolectomy were not reviewed. In one surgeon's laparoscopic sigmoid resection experience, linear regression analysis showed a 50 percent relative decrease in operating room time over a 10-month period (Fig. 4).

Operating room costs for traditional sigmoid and right colectomies were significantly less than for those involving laparoscopy ($P < 0.001$) (Fig. 5). This was before newly released and costly stapling instruments were available.

When comparing total hospital cost, traditional right colectomy was significantly less costly than converted right colectomy ($P < 0.05$) but not laparoscopic right colectomy. There was no significant total hospital cost difference among any of the sigmoid colectomy groups (Fig. 6).

The number of lymph nodes obtained from spec-

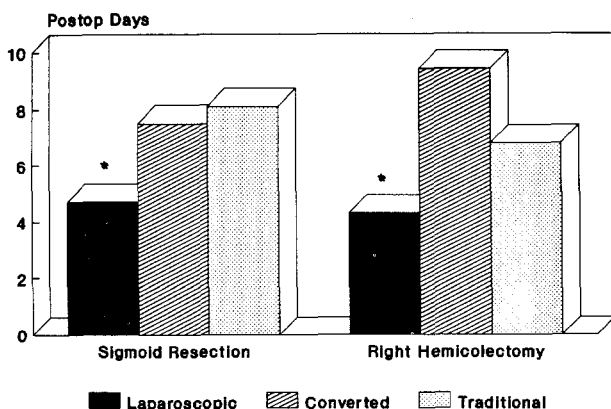


Figure 3. Postoperative stay was significantly shorter for laparoscopic sigmoid resection and right hemicolectomy. * $P < 0.02$, laparoscopic vs. converted vs. traditional.

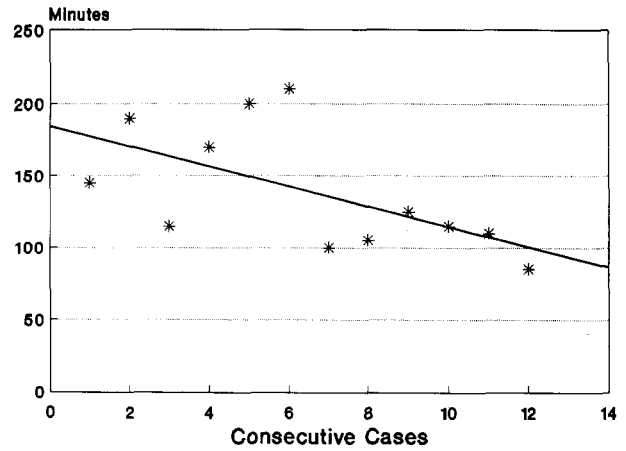


Figure 4. One surgeon's experience demonstrating a 50 percent decrease in operating time for a laparoscopic sigmoid resection over the study period. * Single surgeon.

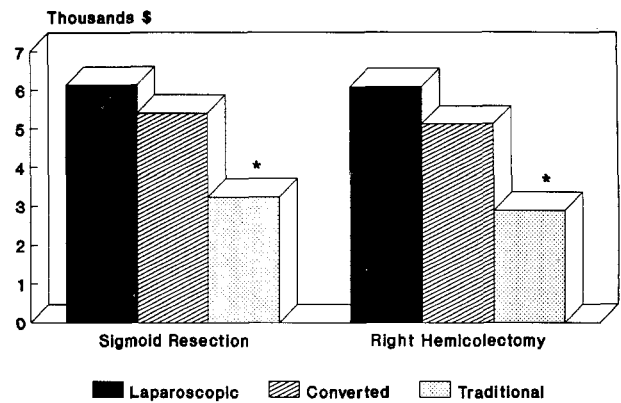


Figure 5. Operating room cost was significantly less for traditional colectomies. * $P < 0.001$, traditional vs. laparoscopic and converted.

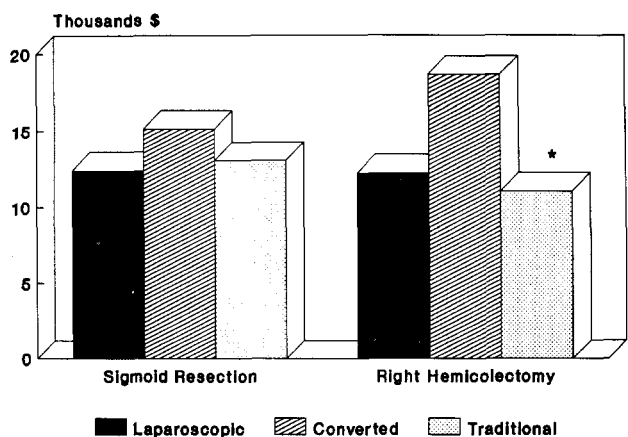


Figure 6. Total hospital cost was significantly higher only for converted right hemicolectomy. * $P < 0.05$, traditional vs. converted.

imens resected for carcinoma was reviewed. Sigmoid and right colectomy specimens showed no difference among laparoscopic, converted, and a historic traditional group (Fig. 7).

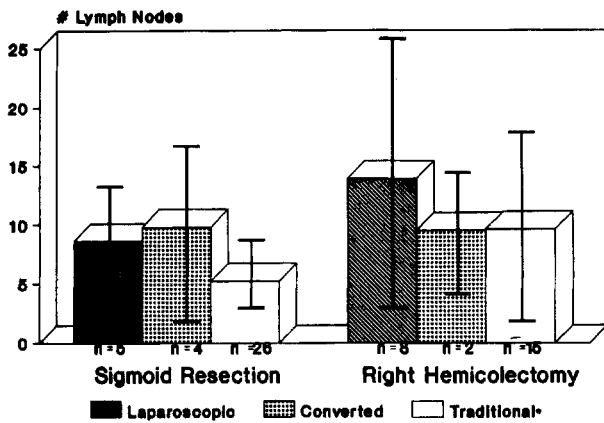


Figure 7. Lymph node harvest was comparable in all groups. * Br J Surg 1989;76:1166.

DISCUSSION

Initial reports concerning the use of laparoscopy in colon and rectal surgery have been encouraging.⁹ Other reports have tempered enthusiasm with cautious optimism.^{7, 8} However, the majority of information regarding laparoscopic colon surgery is presented through industry-supported media presentations, videotapes, and mailings. Key questions remain to be answered as to the safety and efficacy of laparoscopy in this setting.

This study appears to answer the question of feasibility. Laparoscopy may be used in many types of colon and rectal operations. Operations particularly suited for these techniques, based on a conversion rate of <50 percent, are ileal pouch-anal anastomosis (IPAA), stoma procedures, right hemicolectomy, and abdominoperineal resection (APR).

Technical variations and instrument availability make comparisons using multiple institutions difficult. In this study, technique varied as to the amount of the procedure done laparoscopically. In the vast majority of cases, mobilization of the colon and mesenteric vascular ligation were done laparoscopically. In some, however, the colon was mobilized laparoscopically but vascular ligation was performed extracorporeally. The length and orientation (midline or transverse) of the counter incision used to make the anastomosis also varied in the operative reports. In some instances, specialized instruments were not available. Better comparisons of perioperative data will be made when laparoscopic colectomy techniques become more standardized and specialized equipment is uniformly available.

The number of procedures converted owing to

injuries directly related to laparoscopy was small (6 percent). The remaining operations were converted to celiotomy usually because of problems with exposure. Prior abdominal surgery did not impact the conversion rate.

Much of the increased cost of laparoscopy comes from the disposable items used as soon as the procedure is undertaken. These costs, added to the increased length of stay, make converted procedures especially costly. To reduce these costs, preoperative selection criteria are needed to identify patients who are likely to require a celiotomy. Such criteria might help to decrease conversion rates. In procedures initiated laparoscopically, guidelines for a rapid initial assessment are needed to assist in the decision to proceed laparoscopically or immediately convert. When exposure is limited, there should be a low threshold for conversion. Correct decisions at this juncture will minimize laparoscopic time and material costs that would be lost owing to a late decision to convert. Importantly, a preoperative or early intraoperative decision to convert should not be considered a failure.

Laparoscopic procedures must prove safe if they are to become a standard of care. A high complication rate will quickly offset any alleged cost savings. In this series, all perioperative complications were included. It appears that laparoscopic techniques can be safely used in colon and rectal surgery. However, increased morbidity might be expected in the converted group. With the enthusiasm of industry to develop new instrumentation and establish training courses, the surgical community must independently report morbidity and mortality and evaluate clinical efficacy.

The sigmoid and right colectomy subgroups of this heterogeneous series were used to evaluate specific elements such as postoperative stay and cost. Laparoscopically completed sigmoid and right colectomies had a shorter postoperative stay, but operating room costs were higher. Total hospital cost was significantly higher only for converted right hemicolectomies. Converted procedures incurred additional costs from a combination of a failed laparoscopic procedure and a prolonged hospital stay. If the procedure was completed laparoscopically, total hospital cost was similar to traditional colectomy. As surgeons become more proficient with laparoscopic colectomy, the operating room time should be expected to decrease and lower costs. Additional reductions could be

expected as techniques improve and the cost of instrumentation decreases.

The appropriateness of this technology for the treatment of colorectal carcinoma is a legitimate concern. In the short term, it is reasonable to make some assessment of the effectiveness of laparoscopy by evaluating for completeness of resection. Since a generous excision of lymph node-bearing tissue is the current standard of care for colorectal cancer, one reasonable assessment may be to compare lymph node yield between laparoscopic and nonlaparoscopic cancer operations. Unfortunately, the quantity of lymph nodes identified in each specimen is highly variable from institution to institution.¹⁰ Therefore, this may be considered at best a very crude criterion by which to judge the adequacy of resection.

In this study, sigmoid resection and right hemicolectomy for carcinoma showed no difference in the number of lymph nodes obtained between the laparoscopic and converted groups. These data were compared with a historic group of harvested lymph nodes from traditional sigmoid and right colectomies used by Scott and Grace¹¹ to compare lymph node detection after a fat clearance technique. The laparoscopically completed, converted, and historic groups showed no statistically significant difference in the number of harvested lymph nodes. It should be noted that these are small groups with large standard deviations. More rational comparisons for the purpose of evaluating the effectiveness of laparoscopic colon resection for large bowel cancer are needed. Long-term clinical studies, including stage-for-stage survival data, will ultimately be needed to make this determination.

The American Society of Colon and Rectal Surgeons has established a data base that can rapidly gather and analyze the perioperative information sent from surgeons who perform laparoscopic colon and rectal operations (available from The American Society of Colon and Rectal Surgeons, 800 East Northwest Highway, #1080, Palatine, IL 60067). Out of this data base, the Society hopes to critically and scientifically analyze the therapeutic and cost effectiveness of laparoscopy in colon and rectal surgery.

Current data are based on a small volume of cases and a wide variation in technique from institution to institution. However, this preliminary evidence suggests that laparoscopic colon and rectal

surgery does not significantly increase morbidity. Although costs are not decreased, laparoscopic colectomy probably does not increase total costs over traditional operations. This fact, along with potential savings in posthospital costs due to anticipated decreased disability and recovery times, suggests the need for continued development and application of this technology. Despite these theoretic advantages, however, larger series are needed to establish its precise role.

SUMMARY AND CONCLUSIONS

A wide variety of laparoscopic colon and rectal operations are technically feasible. Operating room time decreases with experience. The rate of conversion to celiotomy is high but appears appropriate for these complicated procedures. A timely decision to convert should not be considered a failure. It appears that comparable lymph node harvest can be accomplished laparoscopically. Although laparoscopically completed colectomy reduces postoperative stay, the total hospital costs are similar to traditional colectomy. Morbidity directly related to the laparoscopic procedure is infrequent. Overall morbidity may appear high, but this will likely decrease with an increase in experience of the operating surgeon. This preliminary series indicates that laparoscopic colectomy can be performed in a safe and effective manner in selected patients.

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