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Laparoscopic colon and rectal surgery at a VA hospital

Analysis of the first 50 cases

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Abstract
Background: Laparoscopic techniques were utilized for all colon and rectal procedures undertaken by a single surgeon at the West Haven VA Hospital beginning in August of 1991.
Methods: All patients were entered into a registry, and data was gathered prospectively. This report comprises the first 50 patients. These patients were compared with 34 consecutive patients undergoing open operations during the same time period.
Results: Overall, 33 patients (66%) were completed laparoscopically. This increased to 87% after the first 20 patients. Patients undergoing laparoscopic procedures showed significant improvement over the open and converted patients in several areas. Operative blood loss was decreased. They ate sooner (3.7 days) and required less postoperative pain medication. Major complications were less common after laparoscopic operations. Average length of stay was 8.3 days, compared with 13.9 days and 14.5 days in the converted and open groups, respectively. There was no difference in the operative time between laparoscopic and open cases; time for converted cases was significantly longer. There was no difference in lymph node counts among the three groups in patients with resections for cancer.
Conclusions: Laparoscopic colorectal surgery is safe and effective, although its efficacy in malignant disease is uncertain. Patients enjoy the same benefits derived from other laparoscopic procedures. Although there appears to be a longer learning curve associated with the procedure, minimally invasive techniques should become utilized more frequently for patients with colorectal disease.

Key words: Laparoscopic colorectal surgery — Learning curve — Lymph nodes

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Minimally invasive techniques have revolutionized the treatment of cholelithiasis since laparoscopic cholecystectomy was popularized in the late 1980s. Currently, the majority of cholecystectomies are performed laparoscopically, with improved results over traditional cholecystectomy in terms of length of stay, postoperative pain, and return to full activity [6, 14, 24]. The enthusiasm with which general surgeons embraced this new modality quickly spread to include other abdominal procedures, such as gastric, esophageal, and colorectal operations. It is evident that the same advantages enjoyed by patients after laparoscopic cholecystectomy can be obtained with these newer, more challenging procedures [14, 24]. A critical feature in determining the success of any laparoscopic operation is that the procedure should be technically identical to one performed with an open technique.

Initial application of minimally invasive techniques to colorectal procedures was hampered by the lack of proper instruments for handling, suturing, and stapling bowel. Thus initial procedures were limited to ''laparoscopically assisted'' procedures, whereby a small incision was made to deliver the bowel to be resected, with ligation of the mesentery and anastomosis carried out extracorporeally. The first such procedure to be undertaken was a right hemicolectomy performed by Jacobs in February, 1990 [8]. The introduction of a laparoscopic intestinal stapler, the Endo-GIA 30 (United States Surgical Corporation, Norwalk, CT), allowed the transection of the bowel to be accomplished inside the abdomen. Using this instrument for ligation of the mesentery and division of the colon, Fowler performed a sigmoid resection in October of 1990 [4], using a circular stapling device to construct the anastomosis. In a rapid succession thereafter, virtually all types of colorectal procedures were accomplished using minimally invasive techniques.

This report represents the experience of a single surgeon (G.H.B.), at the West Haven (Connecticut) Veterans Administration Medical Center. Laparoscopic colorectal pro-

Table 1. Diagnosis[a]

	Lap (n = 33)	Conv (n = 17)	Open (n = 34)
Cancer	17 (51.5%)	14 (82%)	19 (59%)
Diverticular disease	4 (12%)	2 (12%)	7 (20%)
Polyp	9 (27%)	0	2 (6%)
Crohn's	2 (6%)	0	2 (6%)
Other	1 (3%)	1 (6%)	3 (9%)

[a] Abbreviations: Lap = laparoscopic, Conv = converted

cedures were initiated in August 1991 and continued through December 1993. A laparoscopic registry was created and data was prospectively gathered on all patients since the inception of the cases. This report reviews the experience with these cases, comparing outcome data with a consecutive series of open cases performed during the same time period. Attempts were made to identify the potential advantages and disadvantages of the laparoscopic procedure in terms of length of stay, postoperative pain, morbidity, mortality, and operative blood loss.

Methods

Laparoscopic cases

All patients undergoing laparoscopic colon and rectal procedures were prospectively entered into a registry. Demographic and epidemiologic data were recorded at the time of admission. Information regarding the operative procedure, postoperative complications, and laboratory data were entered at the time of occurrence. Outcome data was updated for the purposes of this study.

All elective colorectal procedures by the author were attempted laparoscopically, with two exceptions. One patient who had undergone a radical cystectomy and ileal conduit was treated by an open technique because of the modified course of the left ureter. One patient underwent an open procedure because of equipment malfunction. Patients operated on for appendicitis and abdominal pain are not included in this study. Patients requiring urgent procedures are likewise excluded.

The first laparoscopic colorectal procedure was a low anterior resection attempted in August of 1991. This series includes patients operated on through December of 1993.

Open procedures

For purposes of comparison, a consecutive series of patients undergoing open procedures was retrospectively examined. Inclusion criteria were identical to those used for laparoscopic procedures, i.e., all elective colorectal procedures not including those for abdominal pain or appendicitis. These patients were operated on by a variety of surgeons between February of 1991 and December of 1993.

Patient preparation

All patients undergoing both open and laparoscopic procedures received a mechanical bowel preparation the afternoon prior to surgery with a polyethylene-glycol-based solution. Oral erythromycin and neomycin were given in three divided doses the day prior to surgery. A dose of broad-spectrum cephalosporin was given on call to the operating room and once in the recovery room.

Statistics

Statistical analysis was carried out using the Microsoft Excel 4.0 software package (Microsoft Corporation, Redmond WA). Data was analyzed for statistical significance using ANOVA or Student's t-test, where appropriate. A p value of <0.05 was considered significant.

Results

Patient characteristics

Demographics. A total of 50 patients underwent attempted laparoscopic procedures; 34 patients are included in the open series. All patients in the laparoscopic group and all but one in the open group were males. For purposes of comparison, the attempted laparoscopic group was divided into two: those patients undergoing complete laparoscopic procedures (33 patients) and those requiring conversion to an open operation (17 patients). The average age was 64.9 (standard deviation ±11.1) in the laparoscopic group, 71.6 (±9.5) in the converted group, and 65.9 (±12.0) in the open group. The differences were not significant (p = 0.14). Height and weight also did not significantly differ among the groups.

Diagnosis. The diagnoses of patients in the different groups are listed in Table 1. The majority of patients in each group had a diagnosis of cancer. Diverticular disease and benign neoplasms of the colon accounted for most of the remainder of patients.

Previous surgery. Eight of 33 patients (24%) in the laparoscopic group, five of 17 patients (29%) in the converted group, and nine of 34 (26%) of patients in the open group had undergone previous abdominal surgery. These differences were not significant.

ASA class. There was no significant difference in the American Society of Anesthesiology (ASA) class among the groups. The average class was 3.2 (±1.1) in the laparoscopic group, 2.9 (±1.5) in the converted group, and 3.3 (±1.5) in the open group.

Operative data (Table 2)

Procedures. The distribution of operative procedures among the three groups is shown in Table 2. In the laparoscopic group, five of eight right hemicolectomies had ex-

Table 2. Operative data[a]

	Lap (n = 33)	Conv (n = 17)	Open (n = 34)
Right hemi	8 (24%)	4 (24%)	12 (35%)
Sigmoidectomy	6 (18%)	4 (24%)	9 (26%)
LAR	3 (9%)	6 (34%)	6 (18%)
APR	3 (9%)	2 (12%)	3 (9%)
Polypectomy	5 (15%)	0	0
Colostomy (±)	7 (21%)	0	4 (12%)
Other	1 (3%)	1 (6%)	0

[a] Abbreviations: Hemi = hemicolectomy, LAR = low anterior resection, APR = abdominoperineal resection, Lap = laparoscopic group, Conv = Converted group

tracorporeal anastomoses; three had intracorporeal anastomoses. All sigmoid and left colectomies were done using intracorporeal anastomotic techniques. Colostomy construction or takedown represented 12% of the open cases and 21% of the laparoscopic cases. No laparoscopic colostomy creation or takedown required conversion to an open procedure. Fifteen percent (n = 5) of the laparoscopic cases were polypectomies. Two of these were laparoscopically assisted colonoscopic polypectomies, two were colotomies and polypectomies, and one was a laparoscopically assisted transanal excision. There were no polypectomies in the open group, and no laparoscopic polypectomies were converted to open procedures.

Time. Operative time averaged 215.7 (±122.4) min in the laparoscopic group, 321.4 (±145.2) min in the converted group, and 231.3 (±75.8) min in the open group. These differences approached statistical significance (p = 0.052, ANOVA). When examined in pairs, the time for the converted group was significantly longer than either of the other two. There was no significant difference between the laparoscopic and open groups. This apparent inconsistency may reflect different levels of resident staffing of cases and different degrees of attending experience in the open group.

Blood loss. The mean preoperative hematocrits in the laparoscopic, converted, and open groups were 39.3 (±15.0), 39.05 (±4.9), and 36.7 (±7.1), respectively. Postoperative hematocrit averaged 35.7 (±4.9), 33.1 (±3.3), and 33.2 (±9.5), respectively. The average drop in hematocrit was higher in the converted and open groups than in the laparoscopic groups.

One patient in the converted group who underwent a low anterior resection required reoperation for bleeding from a mesenteric artery which had been ligated during the open portion of the procedure. An additional patient was converted after sustaining a laceration to the inferior epigastric artery during trocar insertion (see below). There were no other bleeding complications.

Intraoperative complications. There were two enterotomies made during laparoscopy in the 50 patients undergoing laparoscopy (4%). One was able to be repaired laparoscopically; one required conversion to an open procedure. There was one enterotomy (2.9%) in the open group. These differences are not significant.

One patient in the laparoscopic group sustained an injury to the inferior epigastric vein near its insertion into the iliac vein during trocar insertion. This caused a large retroperitoneal hematoma, which was immediately explored and controlled with open techniques.

Postoperative course (Fig. 1)

Oral intake. Although there were minor differences in deciding when to allow patients to being oral intake between the open and laparoscopic groups, the majority of patients were offered liquids when they passed flatus. After successful laparoscopic procedures, patients tolerated p.o. liquids, on average, by postoperative day 3.7 (range 1–12 days). Patients requiring conversion took liquids on postoperative day 5.6 [1–13], and after open procedures on postoperative day 5.8 [2–26]. These groups are significantly different (p = 0.18, ANOVA). The time to oral intake was significantly shorter in the laparoscopic group than in the others when examined in pairs ($p < 0.05$). Differences in this variable may be related to the different management styles between the patients in the open and laparoscopic groups.

Pain medication. The mean number of doses of narcotics was 12.9 (±16.3) in the laparoscopic group, 21 (±15.5) in the converted group, and 16.0 (±13.9) in the open group. These differences were not significant (p = 0.41). The average in the laparoscopic group is somewhat misleading because of two patients who were on chronic narcotics and required many postoperative doses for pain control. The median number of narcotic doses required was 16 in both the converted and open groups and five in the laparoscopic group.

Length of stay. The mean postoperative length of stay was 8.3 days (range 3–33 days) in the laparoscopic group, 13.9 (±7.0) days in the converted group (range 8–33 days), and 14.5 (±9.6) days (range 5–44 days) in the open group (p = 0.01). The postoperative length of stay was significantly shorter in the laparoscopic group than in either of the other groups ($p < 0.05$). The median length of stay was 6, 11, and 10 days in the laparoscopic, converted, and open groups, respectively. The longer length of stay may be related to operative factors, such as increased complication rates, or longer time to recover bowel function in the open and con-

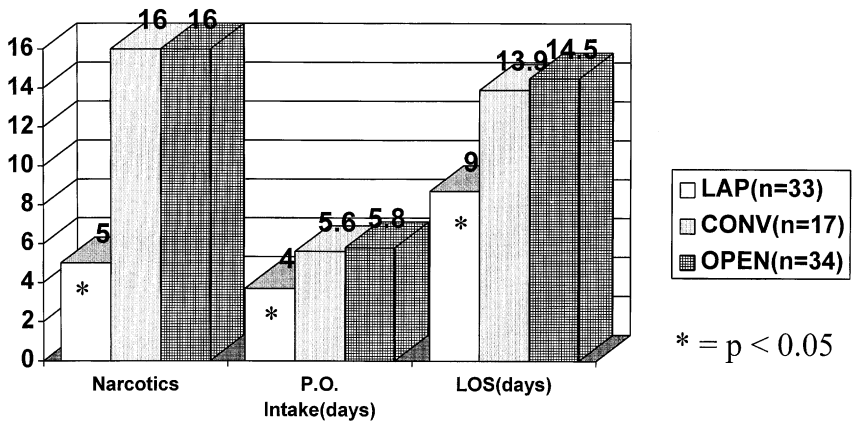

Fig. 1. Patient outcome in terms of narcotic doses, time to oral intake, and length of stay. The laparoscopic group was significantly lower than the other two groups in all three areas. Abbreviations: P.O. = oral, LOS = length of stay, lap = laparoscopic group, conv = converted group.

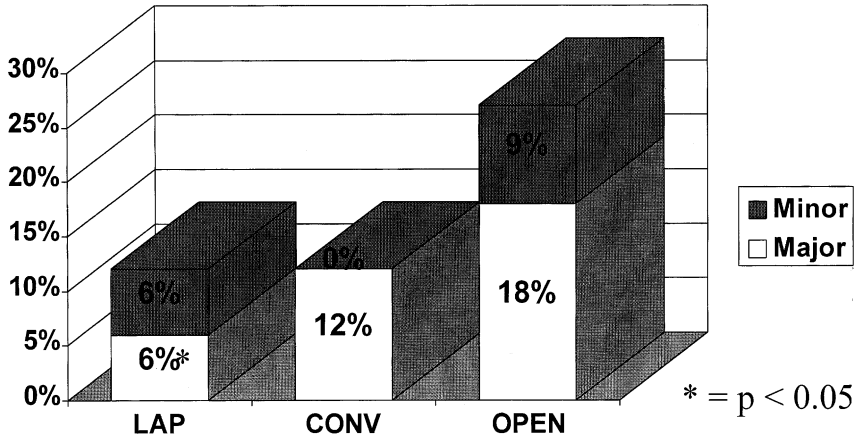

Fig. 2. Rates of complications in the three groups. The overall complication rate was not different among the groups. The laparoscopic group had a significantly lower rate of major complications. Abbreviations: lap = laparoscopic group, conv = converted group.

verted groups, or to bias in comparing two different groups retrospectively. While these stays may seem somewhat long, they are consistent with lengths of stay among similar groups at other VA hospitals.

Complications (Fig. 2). Overall complication rates were 12.1% in the laparoscopic group, 11.8% in the converted group, and 26.5% in the open group (p = ns). The major complication rate, however, was significantly higher in the open and converted groups than in patients in the laparoscopic group: laparoscopic group 6% (two patients), converted group 11.8% (two patients), and open group 17.6% (six patients) ($p < 0.05$). Major complications were defined as those which prolonged hospital stay, required readmission, or were potentially life-threatening.

In the laparoscopic group, the major complications included a pelvic abscess and a prolonged ileus. The abscess occurred 17 days after a low anterior resection for rectal cancer (the patient had been discharged). It was treated by percutaneous drainage and intravenous antibiotics. The prolonged ileus (12 days) occurred after a right colectomy for a cecal polyp using a laparoscopic-assisted technique. Minor complications (two patients, 6%) included one episode each of urinary tract infection and a retained perineal Jackson-Pratt drain after an abdominoperineal resection. Major complications in the converted group included one episode of wound dehiscence (after a wound infection) in a patient who underwent an elective sigmoid resection for diverticulitis and one episode of postoperative bleeding from a mesenteric artery which had been inadequately ligated. In the open group, the major complications consisted of one episode each of wound dehiscence, pelvic abscess, multisystem organ failure, stomal suture line disruption, prolonged ileus (17 days), and deep venous thrombosis. There were one wound infection and two urinary tract infections.

The wound infection rates were zero in the laparoscopic group, 2.9% in the open group, and 5.8% in the converted group. These differences are not significant.

Mortality. There was only one death in the series, which occurred in the open group (2.9%), in a patient who developed multisystem organ failure after becoming ventilator dependent. He had significant comorbid cardiopulmonary disease and underwent a low anterior resection for rectosigmoid cancer. He died on postoperative day 33.

Cancer resection

The most common indication for surgery in all groups was for colorectal cancer (Table 1).

The average lymph node count did not differ among the groups and varied widely within each group. The laparoscopic, converted, and open groups had mean lymph node counts of 10.9 (±10.0), 13.1 (±6.8), and 11.9 (±8.4), respectively (Fig. 4). There was also no difference in the number of nodes which contained metastatic disease (Fig. 4).

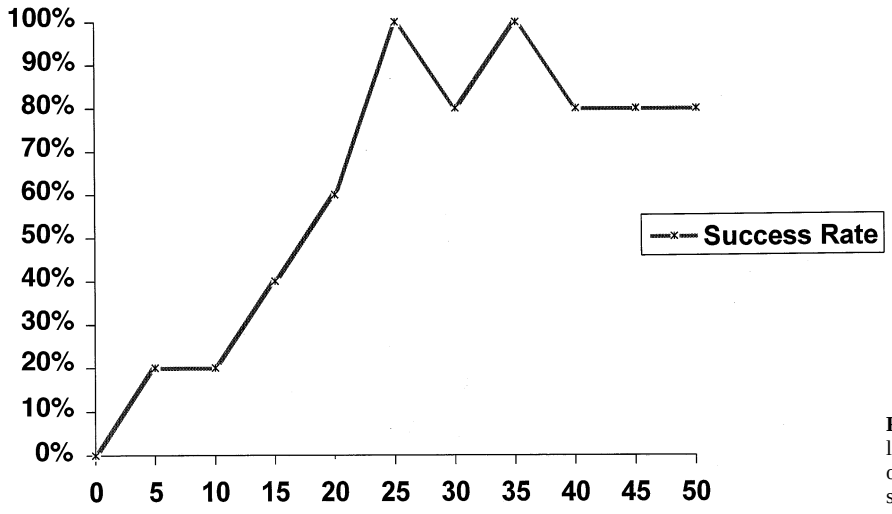

Fig. 3. Rate of successful completion of laparoscopic procedures by groups of five operations. There was a sustained increase in success after the first 20 procedures.

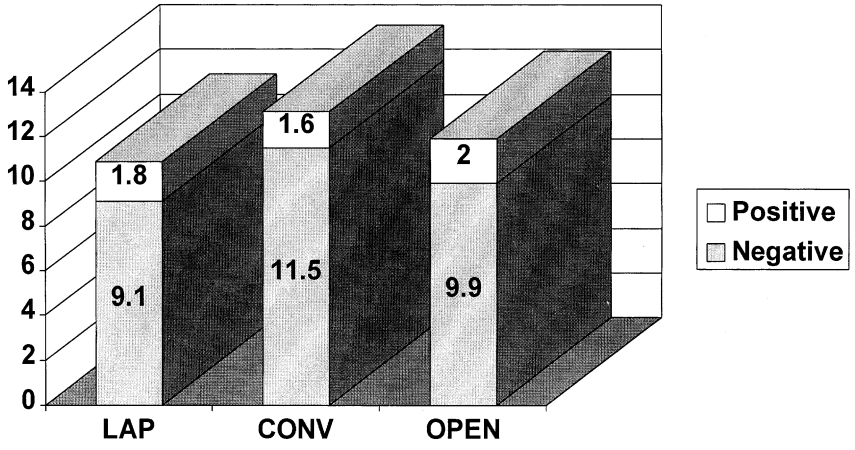

Fig. 4. Lymph node counts in the three groups. There was no significant difference in the number of total or positive nodes among the three groups. Abbreviations: lap = laparoscopic group, conv = converted group.

There have been no trocar-site recurrences of tumor. There is one incisional recurrence in a patient who was converted from a laparoscopic to an open low anterior resection for a rectal adenocarcinoma in January of 1993. This patient had tumor invading into the serosal fat, and no lymph node metastases. The proximal and distal margins were free of tumor. Conversion was undertaken for poor exposure due to excessive mesenteric fat. He developed recurrent tumor in his midline incision in December of 1993, 11 months after the initial resection. He has subsequently been diagnosed with an anastomotic recurrence and liver metastases within 4 months of the incisional recurrence.

Conversion to open procedures

The operation was considered to be converted to an open procedure if an abdominal incision was made that was larger than required for specimen retrieval. Of the 50 patients undergoing attempted laparoscopic colorectal procedures, 33 (66%) were successfully completed. Of the 17 patients requiring conversion, five were converted because they exceeded a predetermined time limitation of 90 min. This was imposed early on in the series until sufficient experience with minimally invasive techniques was gained. Four patients were converted because of intraperitoneal fat (mesenteric, omental, or both) obscuring visualization, two were converted because of enlarged para-aortic lymph nodes deemed too risky for laparoscopic removal, and one each was converted because of inability to adequately expose the ureter, extensive adhesions, anastomotic tension, enterotomy unable to be repaired laparoscopically, unexpected large bowel obstruction, and vascular injury during trocar insertion (see Intraoperative Complications).

The conversion rate was 65% during the initial 20 cases in this series. In the latter 30 patients, the conversion rate has been consistently low, with a success rate of 86.7%. The learning curve is displayed in Fig. 3.

Discussion

This report represents a single-surgeon, single-institution, consecutive series of 50 patients undergoing laparoscopic colon and rectal surgical procedures. It represents another link in a growing chain of evidence which supports and legitimizes minimally invasive colon and rectal surgery. Numerous studies have documented the efficacy of these procedures [3, 10, 11, 13, 15–17, 19–21, 23, 25, 26, 29]. These studies report on results obtained with series of 11–240 patients. The results of these studies mostly support the

conclusion that patients after laparoscopic procedures enjoy a decreased length of stay and wound infection rates, earlier return of bowel function, decreased postoperative pain, and shorter convalescence. Senagore and colleagues [23] have quantified the subjective opinion that patients feel better after laparoscopic colon surgery by documenting an improved Karnofsky performance score in this group of patients as compared with patients undergoing open procedures. Not all series have been as supportive of minimally invasive colon surgery; however, Wexner and colleagues have not shown any advantage for minimally invasive procedures in terms of postoperative ileus or length of stay [2, 28]. In fact, good results with early postoperative feeding after laparoscopic procedures may have led to a trend in shortening length of stay after open procedures.

The current study confirms the findings in the majority of other studies—patients in our series had significantly less postoperative pain, shorter ileus, and were discharged sooner than patients after open or converted cases. Our conclusions are necessarily limited by the retrospective nature of the comparison and by the fact that the open cases were performed by a variety of surgeons with various levels of training.

It is important to note that patients in the converted group did not differ significantly from the open group in terms of any of the above parameters. Thus it appears that patients converted to open operations did not suffer an adverse outcome because of the attempt at a laparoscopic procedure. The overall complication rates among the groups was likewise not significantly different, and is in line with other reports for laparoscopic and open techniques. Major complications, however, were significantly lower in the laparoscopic group than in the other two groups.

One apparent drawback of minimally invasive colorectal surgery appears to be increased operative time [3, 15, 16, 19, 23, 25]. We did not find this to be the case in our series, although comparison between the groups is again necessarily tempered by the retrospective nature of the analysis, and varying level of attending surgeon and resident involvement with the cases. Regardless of the apparent increase in operative time, it is evident that operative times can be significantly shortened as a surgeon's experience grows [3, 15, 19, 21].

The learning curve for laparoscopic colorectal procedures is longer than that observed in laparoscopic cholecystectomy [12], and for this reason it has not been as widely employed by the general surgical community as has laparoscopic cholecystectomy. There are several apparent reasons for this. Laparoscopic colon resection is technically very demanding and requires skills not routinely utilized or learned during laparoscopic cholecystectomy, such as intracorporeal knot-tying and suturing and the use of two-handed dissection. Thus it is not a simple extension of rudimentary techniques, but rather an entirely new procedure. This makes the learning curve longer and steeper than that for laparoscopic cholecystectomy. Additionally, most general surgeons do not have a sufficient volume of colon and rectal cases to rapidly become proficient at minimally invasive resection. Thus laparoscopic colorectal surgery has, justifiably, been practiced at relatively few centers, by surgeons with a large volume of cases. In the current series, it is apparent that a level of proficiency is obtained after completing approximately 20 cases. This is evidenced by the fact that the rate of conversion decreased from 65% to 13% after the first 20 cases. Other authors [10] have found the learning curve to last as long as 6 months in these procedures. Conversion rates in other large series range widely, from a low of 6% [17] to a high of 41% [3], with most other reports in the 15–25% range [15, 16, 19, 21]. The overall conversion rate in this series was 34%, which is somewhat higher because of a policy to convert procedures which lasted longer than 90 min in the early part of the series. It is important to recognize that conversion to an open procedure is not a complication or a failure but rather represents sound surgical judgment in proceeding in the safest possible fashion.

Patient selection is critical in successful completion of laparoscopic procedures. No attempt was made in this series to exclude patients: All patients referred to the senior author for elective colorectal procedures were attempted laparoscopically, except for the two patients described above (Methods). While it is impossible to predict with certainty which patients will require conversion, some guidelines do exist. Obese patients and those with prior abdominal surgery generally prove more difficult. Previous gynecologic procedures may obscure pelvic dissection planes. The pattern of fat deposition in women appears to facilitate laparoscopic procedures. Women tend to deposit much of their fat in the abdominal wall, as opposed to men who deposit it largely intraperitoneally, in the mesentery, omentum, and retroperitoneum. This often obscures landmarks and makes dissection difficult. Thus the ideal patient for laparoscopic surgery is a thin woman who had not undergone previous abdominal operations.

An area which is of considerable interest is the utility of minimally invasive techniques in curative colorectal cancer resections. There have been a number of reports of early trocar site recurrence in both colorectal cancer and other abdominal malignancies [1, 5, 9, 18, 27]. These reports arouse concern; however, they represent only isolated instances. Careful assessment of overall survival and the true incidence of wound recurrence can only be assessed in large studies, which are currently underway. Wound recurrence has been reported to be approximately 1% in one series of over 1,600 patients undergoing open colon resection for colon carcinoma [7] and 0.6% in 1,711 patients enrolled in current prospective trials of colorectal cancer [22]. What is essential for an adequate laparoscopic cancer operation is that the same procedure be performed as one would perform traditionally. Thus there should be no compromise in terms of high vessel ligation, radial margins, and lymph node harvests in minimally invasive procedures. The current series shows no difference in lymph node counts after open or laparoscopic surgery. Similar results have been obtained in other series in terms of lymph node counts [3, 10, 15, 16, 19, 25, 26], as well as with margins of resection [10, 15, 25, 26].

Minimally invasive colon and rectal surgery, therefore, remains a vital and necessary tool in the armamentarium of general surgeons. As instrumentation, techniques, and experience continue to improve and expand, its role in treating all types of intestinal pathology will undoubtedly increase.

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