Does Means of Access Affect the Incidence of Small Bowel Obstruction and Ventral Hernia After Bowel Resection? Laparoscopy Versus Laparotomy

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BACKGROUND: Laparotomy for bowel resection is causally related to the development of small bowel obstruction (SBO) and ventral hernia, with incidences approaching 12% to 15% each. This report attempts to define the incidence of these access-related complications in a large group of patients undergoing laparoscopic-assisted bowel resection (LABR) and open bowel operation (OPEN).

STUDY DESIGN: A retrospective cohort of 716 consecutive patients undergoing either LABR (n = 211) or OPEN (n = 505) procedures between January 1995 and July 2000 was identified and selected from a prospective registry.

RESULTS: Index LABR (n = 211) and OPEN (n = 505) cases included segmental colectomy in 146 LABR and 408 OPEN patients; subtotal colectomy with or without stoma in 18 LABR and 6 OPEN patients; ileocolectomy in 37 LABR and 85 OPEN patients; and small bowel resection in 10 LABR and 6 OPEN patients. The mean followup periods in the LABR and OPEN groups were 2.71 years and 2.42 years, respectively. The incidence of wound hernia was significantly higher in OPEN cases (n = 65) compared with LABR (n = 5) (p < 0.05). The incidence of surgical repair of ventral hernia was also significantly higher in the OPEN group (28) compared with LABR (4) (p < 0.05). Postoperative SBO requiring hospitalization with conservative management occurred significantly less frequently in LABR patients (n = 4) compared with OPEN patients (n = 31) (p = 0.016). The need for surgical release of SBO was similar between the OPEN and LABR groups (n = 4 versus n = 11). The overall reoperation rate for these two complications was two times higher in the OPEN group than in the LABR group (7.7% versus 3.8%).

CONCLUSIONS: The data demonstrate that laparoscopic access for bowel operation significantly reduces the incidence of ventral hernia and SBO rates compared with laparotomy. This reduces the need for readmission to the hospital and additional surgical procedures, providing a potential source of decreased morbidity. It should be considered as a means of cost savings associated with laparoscopic bowel operations. (J Am Coll Surg 2003;197:177–181. © 2003 by the American College of Surgeons)

Both ventral hernia and small bowel obstruction (SBO) are accepted as complications directly related to the performance of bowel operation through laparotomy. Adhesions are frequent findings after previous abdominal operation. In a prospective trial, 93% of patients were found to have adhesions attributable to the previous operation.[1] Intraabdominal adhesions are the most common cause of bowel obstructions in the United States, with an estimated frequency up to 70%.[2-5] Incisional hernias are reported to have an incidence of between 2% and 11% in patients undergoing abdominal surgical procedures, and after surgical repair, a remarkable recurrence rate of about 20% to 46% is to be expected.[6-8] These access-related complications are associated with increased expense, morbidity, and mortality because of rehospitalization and additional surgical procedures.[3,5] Even initial reoperation for either SBO or ventral hernia

Table 1. Age, Gender, and Pathology Distribution of the Patients

	LABR (n = 211)	OPEN (n = 505)	p Value
Mean age y (range)	50.8 (10–85)	57.7 (11–92)	<0.001*
Gender (male/female)	91:120	255:250	<0.07[†]
Inflammatory disease, n (%)	123 (58.3%)	222 (44.0%)	0.0005[†]
Benign diseases, n (%)	61 (28.9%)	64 (12.7%)	<0.0001[†]
Malignancy, n (%)	27 (12.8%)	219 (43.3%)	<0.0001[†]

*Mann-Whitney $p < 0.001$.
[†]Chi-square test $p < 0.07$.
LABR, laparoscopic-assisted bowel resection; OPEN, open bowel surgery.

carries a significant risk of recurrence despite excellent surgical technique.[2-9] The incidence of either SBO or ventral hernia complicating laparoscopic bowel resection is not well defined, although both appear to be lower than rates after laparotomy.[10-12] The purpose of this study was to define the relative incidence of ventral hernia formation and SBO in two large cohorts of patients undergoing open or laparoscopic bowel operation at a single institution. The incidence of hospital readmission and surgical intervention for these complications was also assessed for both groups.

METHODS

All patients, with or without previous abdominal operation, undergoing primary open (OPEN) or elective laparoscopic-assisted bowel resection (LABR) between January 1995 and July 2000 were eligible for the study. Patients undergoing segmental (group I) or subtotal (group II) colectomy, ileocolectomy (group III), or small bowel resection (group IV) were included. Exclusion criteria included pouch procedures as index operation, open reoperation within 30 days after LABR index operation for reasons other than those that are the focus of this study, obstruction caused by malignancy, and death of patients without questionnaires sent back by any relatives. Virtually all OPEN patients had vertical midline incisions for operative access. The LABR patients had two to four lateral abdominal trocar sites ranging from 5 to 12 mm in size and incisions for specimen extraction ranging from 3 to 7 cm either in the infraumbilical midline or left or right lower quadrants. Any LABR patients who required conversion to a vertical midline incision (n = 26) were counted as OPEN cases for the purpose of data analysis. Data collected included age, gender, index bowel resection, index pathology, development of wound/port hernia with or without hernia repair, and hospitalization for SBO with or without operation for SBO. Chart review, mail questionnaire, or telephone

contact were used to perform followup of patient data. Data analysis included all patients whose questionnaires were received by February 1, 2001.

Data were analyzed using the Mann-Whitney test for nonparametric data and either the chi-square test or Fisher's exact test. Results were considered significant at $p < 0.05$.

RESULTS

In the period from January 1995 to July 2000, a total of 716 patients, 505 in the OPEN group and 211 in the LABR group, were analyzed for the incidence of incisional hernias and small bowel obstructions. The mean age in the LABR patients (50.8 years, range 10 to 85) was lower than in the OPEN group (57.7 years, range 11 to 92) (p < 0.001). In the LABR group, there were more females, in contrast to a slight majority of males in the OPEN group (p = 0.007) (Table 1). The median followup periods in this series were similar in the two groups (LABR, 2.71 years; OPEN, 2.42 years; p = 0.93). The distribution of the underlying pathology is presented in Table 1. A significantly greater percentage of patients with colon cancer were in the OPEN group because of the restriction of LABR procedures to study protocols. Conversely, relatively more patients with benign bowel diseases were treated laparoscopically.

Table 2 demonstrates the distribution of index operations in the two groups. The predominant procedures in both groups were segmental colectomy, which represented 69.2% of the LABR and 80.8% of the OPEN procedures, and ileocolic resections (17.6% of LABR and 16.8% of OPEN procedures). A higher percentage of patients in the LABR group underwent an index subtotal colectomy (8.5% versus 1.2%, p < 0.0001).

Table 3 demonstrates the statistically and clinically significant higher incidence of both ventral hernia and SBO in the OPEN group. The location of the hernias was port site in four patients and extraction site in one

Table 2. Index Surgical Procedures

	LABR (n = 211)		OPEN (n = 505)		
Surgical procedure	n	%	n	%	p Value*
Segmental colectomy	146	69.2	408	80.8	0.0007
Subtotal colectomy	18	8.5	6	1.2	<0.0001
Ileocolectomy	37	17.6	85	16.8	0.82
Small bowel resection	10	4.7	6	1.2	0.003

*Chi-square test.
LABR, laparoscopic-assisted bowel resection; OPEN, open bowel surgery.

patient in the LABR group; all hernias in the OPEN group were in the midline wounds. The need for reoperation for SBO was similar between the two groups. Interestingly, if a clinically evident hernia developed in a patient, a patient in the LABR group was more likely to undergo surgical repair (LABR, 80%; OPEN, 37.3%). Patients with inflammatory disease of the bowel had the highest overall rates of SBO and hernia formation (LABR, 8.1%; OPEN, 24.3%). The incidence of SBO and hernia was 23.3% in the OPEN patients with malignant pathologies at index operation versus 3.7% in the LABR group, and this was highly significant (p < 0.05, chi-square test). The highest rates of postoperative hernias occurred in patients with inflammatory diseases (LABR, 3.3%; OPEN, 14.0%). In LABR patients with malignancies, no hernias were seen, although 13.7% of the OPEN cancer patients developed hernias.

Analysis of the overall reoperation rates for the two groups demonstrated that the need for surgical repair of incisional hernias is markedly reduced in patients undergoing LABR (1.9% versus 5.5%, p = 0.03). This would be even more dramatic except for the fact that 80% of LABR patients had their hernias repaired compared with 37.3% of the OPEN patients. The overall reoperation rate for either SBO or ventral hernia was almost twice as high in the OPEN group (7.7% versus 3.8%, p = 0.03).

DISCUSSION

Postoperative adhesions occur in 67% to 93% of patients, based on autopsy studies by Weibel and Majno[13] and a prospective clinical trial by Menzies and Ellis.[1] Postoperative adhesions account for 49% to 74% of SBOs.[1,2,14] The National Inpatient Profile reported that more than 400,000 laparotomies for lysis of adhesions were performed in 1993 in the United States.[15] The amount of resources consumed by these activities is similarly impressive, with more than $1.1 billion spent in the United States for adhesiolysis in 1988 and an average length of stay of 11.24 days.[5]

The type of surgical procedure plays some role in the risk for adhesion-related SBO. The incidence of SBO is particularly high after abdominal hysterectomy because of closure of the pelvic peritoneum and because this is a common surgical procedure requiring laparotomy.[16,17] Even after resection of colorectal cancer, adhesions are almost as frequent a cause of SBO as recurrent malignancy.[18] The locations of the obstructive adhesions involving the small intestine are most commonly between small bowel and the scar (20%) and the surgical site (15.7%), or between loops of small bowel (8.1%).[1] Over 80% of the patients in this study had adhesions from the omentum to the back of their abdominal wound, and these were found to be attributable to the previous operation.[1] A prospective randomized trial by Beck and colleagues[3] found an involvement of about 63% of the incision length in adhesion formation to the abdominal wall.[19] The time to onset of SBO is highly variable after an index operative procedure.[1] In 472 patients with previously resected colorectal cancer, Edna and Bjerkeset[18]

Table 3. Incidence of Postoperative Hernias and Small Bowel Obstructions

	LABR (n = 211)		OPEN (n =505)		
	n	%	n	%	p Value*
Hernia	5	2.4	65	12.9	0.00002
SBO (nonsurgical treatment)	4	1.9	31	6.1	0.016
SBO (surgical treatment)	3	1.4	8	1.6	0.87

*Chi-square test.
LABR, laparoscopic-assisted bowel resection; OPEN, open bowel surgery; SBO, small bowel obstructions.

found a median time interval of 1.3 years between the primary cancer operation and the relaparotomy for secondary SBO, and 70% to 80% of the SBOs were clinically manifest within 2 to 3 years. This time frame is similar to the followup of these two patient cohorts. These facts support the contention that the method of access to the abdominal cavity is of some significance, and it logically follows that smaller incisions should diminish the risk of postoperative adhesions to the abdominal wall. In addition, the overall significantly lower rate of readmission for SBO presented in this report lends credence to the possible reduction of interloop adhesions as a result of less manipulation of the viscera laparoscopically. The risk of adhesion formation is obviously not completely eradicated by a laparoscopic approach, as demonstrated by the similar need for operative release of SBO in the LABR and OPEN patients. Avoidance of SBO is very important because of the substantial recurrence rates after either nonoperative (33% to 40%) or operative treatment (20% to 27%) after surgical adhesiolysis.[19-21]

The risk of ventral hernia formation after laparotomy ranges from 11% to 20% depending on the indications, urgency, and type of surgical procedure evaluated.[22,23] Risk factors for the development of ventral hernia include obesity, steroid use, vascular disease, previous operation for abdominal aortic aneurysm, prostatism (in men), intraabdominal infection, and postoperative septic complications.[22-24] The use of monofilament, nonabsorbable sutures applied in a continuous manner has been associated with reductions in the incidence of ventral hernia formation to approximately 4%.[24] Even more discouraging is the fact that longterm studies have demonstrated a high rate of ventral hernia recurrence after repair, ranging from 4% to 54%.[22,23]

Although there are few data defining the incidence of hernia formation after laparoscopic bowel operation, it is intuitive that the risk should be lower when there are smaller wounds. A number of case reports after various laparoscopic procedures have demonstrated that both the unclosed trocar sites (regardless of port size) and the extraction site are at risk for developing hernias.[25-27] The former can result in a Richter's hernia, which carries a higher risk for ischemic necrosis of the affected bowel segment. The port site incisions have demonstrated a very low rate of hernia formation of 0.02% in a large survey of gynecologic procedures.[28]

We have demonstrated a significantly lower risk of ventral hernia formation after LABR (LABR, 2.4% versus OPEN, 12.9%). This difference is further magnified by the fact that the vast majority of the LABR hernias were repaired, but only 37% of the OPEN patients had their hernias repaired. This might reflect the perception that repair of a larger midline hernia is more complex than repair of either a trocar-site hernia or the small extraction site wound. The majority of our trocar-site hernias occurred early in our experience, and we currently close all port sites larger than 5 mm. We believe this accounts for the absence of port-site hernias in patients who underwent operation during the last 22 months of this study. We experienced only one hernia at an extraction site. The extraction incision appears to be at lower risk of hernia formation, possibly because of easier access to the fascial edges, a predominance of muscle-splitting incisions, and the multilayer fascial closure used.

Conclusion

The data of this large series demonstrate that laparoscopic bowel operation is associated with a significant reduction in readmission rates for SBO and a significant reduction in the development of ventral hernias. These results demonstrate additional advantages of laparoscopic bowel procedures, which can reduce morbidity, mortality, and the overall cost of care of small bowel and colonic pathology.

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