

Laparoscopic Surgery is Useful for Preventing Recurrence of Small Bowel Obstruction After Surgery for Postoperative Small Bowel Obstruction

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Introduction: Risk factors for recurrence postoperative small bowel obstruction in patients who have postoperative abdominal surgery remain unclear.

Materials and Methods: The study group comprised 123 patients who underwent surgery for ileus that developed after abdominal surgery from 1999 through 2013. There were 58 men (47%) and 65 women (53%), with a mean age of 63 years (range, 17 to 92 y). The following surgical procedures were performed: lower gastrointestinal surgery in 47 patients (39%), gynecologic surgery in 39 (32%), upper gastrointestinal surgery in 15 (12%), appendectomy in 9 (7%), cholecystectomy in 5 (4%), urologic surgery in 5 (4%), and repair of injuries caused by traffic accidents in 3 (2%). Laparoscopic surgery was performed in 75 patients (61%), and open surgery was done in 48 (39%). We examined the following 11 potential risk factors for recurrence of small bowel obstruction after surgery for ileus: sex, age, body mass index, the number of episodes of ileus, the number of previously performed operations, the presence or absence of radiotherapy, the previously used surgical technique, the current surgical technique (laparoscopic surgery, open surgery), operation time, bleeding volume, and the presence or absence of enterectomy.

Results: The median follow-up was 57 months (range, 7 to 185 mo). Laparoscopic surgery was switched to open surgery in 11 patients (18%). The reason for surgery for postoperative small bowel obstruction was adhesion to the midline incision in 36 patients (29%), band formation in 30 (24%), intrapelvic adhesion in 23 (19%), internal hernia in 13 (11%), small bowel adhesion in 20 (16%), and others in 1 (1%). Postoperative complications developed in 35 patients (28%): wound infection in 12 (10%), recurrence of postoperative small bowel obstruction in 12 (10%), paralytic ileus in 4 (3%), intra-abdominal abscess in 3 (2%), suture failure in 1 (1%), anastomotic bleeding in 1 (1%), enteritis in 1 (1%), and dysuria in 1 (1%). Enterectomy was performed in 42 patients (38%). On univariate analysis, 2 risk factors were significantly related to the recurrence of small bowel obstruction: open surgery

($P = 0.017$) and bleeding volume ($P = 0.031$). On multivariate analysis, open surgery was an independent risk factor for the recurrence of small bowel obstruction (odds ratio, 5.621; $P = 0.015$).

Conclusions: Open surgery was an independent risk factor for the recurrence of small bowel obstruction after abdominal surgery. In the future, laparoscopic surgery should be performed to prevent the recurrence of small bowel obstruction.

Key Words: postoperative small bowel obstruction, recurrence, laparoscopic surgery

(*Surg Laparosc Endosc Percutan Tech* 2016;26:e1–e4)

Endoscopic surgery for gastrointestinal disease has rapidly become more popular because of several advantages over open surgery, such as minimal invasiveness and esthetic maintenance. As compared with open surgery, laparoscopic surgery is associated with less intraoperative blood loss and prompter recovery of gastrointestinal function after surgery.^{1–3} The response to surgical stress has also been reported to be milder.⁴ However, in patients with a history of open surgery, the presence of small bowel adhesions can interfere with trocar insertion for laparoscopic surgery, and the dissection of strong adhesions carries the risk of injuring the intestine and other structures. Laparoscopic surgery is therefore extremely difficult and has been contraindicated in such patients.⁵ Recently, owing to dramatic progress in laparoscopic surgery and its increasing popularity, the indication range has gradually been broadened to include patients with small bowel obstruction. However, the indication criteria, preoperative diagnosis, timing of surgery, indications for surgery, and risk factors for the postoperative recurrence of small bowel obstruction remain controversial. Our study was designed to delineate risk factors for postoperative recurrence of small bowel obstruction in patients who underwent abdominal surgery.

MATERIALS AND METHODS

The study group comprised 123 patients who underwent surgery for adhesive small bowel obstructions that were diagnosed from January 1999 through May 2013. Table 1 shows the demographic characteristics of the 123 patients with postoperative small bowel obstructions. There were 58 males (47%) and 65 females (53%), with a mean age of 63 years (range, 17 to 92 y). Open surgery was

Received for publication April 20, 2015; accepted November 23, 2015. From the Department of Surgery, Kitasato University, School of Medicine, Sagamihara, Japan.

None declared, including any from National Institutes of Health (NIH); Wellcome Trust; Howard Hughes Medical Institute (HHMI); and others.

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performed in 48 patients (39%), and laparoscopic surgery was performed in 75 (61%). Recurrent postoperative small bowel obstruction was defined as small bowel obstruction that developed within 30 days after surgery and required decompression therapy. The diagnostic methods included abdominal examination, abdominal plain radiography, abdominal ultrasonography, contrast-enhanced computed tomography, and abdominal magnetic resonance imaging. Small bowel obstruction associated with transient paralysis after surgery that responded to fasting and infusion therapy was regarded to be paralytic small bowel obstruction and was excluded from the study. As for the surgical procedures, open surgery was mainly performed from January 1999 through December 2013, and laparoscopic surgery was increasingly used since January 2004, after techniques for laparoscopic surgery had stabilized. The history of surgery was as follows (Table 2): lower gastrointestinal surgery in 47 patients (39%), gynecologic surgery in 39 patients (32%), upper gastrointestinal surgery in 15 patients (12%), appendectomy in 9 patients (7%), cholecystectomy in 5 patients (4%), urinary tract surgery in 5 patients (4%), traffic injury repair in 3 patients (2%), adhesiotomy in 73 patients (60%), adhesiotomy with partial small bowel resection in 46 patients (37%), bypass surgery in 3 patients (2%), and bypass surgery with partial small bowel resection in 1 patient (1%). Laparoscopic surgery was converted to open surgery in 11 (18%) of 62 patients. The reasons for conversion to open surgery were peritoneal adhesions in 6 patients, adhesions to the midline incision in 4 patients, adhesions between loops of the small intestine in 3 patients, and band formation and small bowel adhesions in 1 patient.

Indications for Surgery

Surgery was indicated for patients with repeated episodes of adhesive small bowel obstruction after surgery, small bowel obstruction that did not respond to conservative therapy, small bowel obstruction associated with strictures on enterography, and patients in whom preoperative decompression therapy was feasible and strictures could be identified on radiographic examination performed by an ileus tube. Patients who had strangulated obstruction associated with unstable vital signs and those with distinct evidence of peritoneal dissemination of cancer cells were excluded from the study. In patients in whom our surgical procedure was difficult to perform, such as those with a history of radiotherapy, intraperitoneal administration of anticancer agents, or polysurgery, the intraperitoneal cavity was examined laparoscopically to decide the port locations and surgical procedures.

TABLE 1. Preoperative Characteristics of the Patients

Sex (male:female)	58:65
Age (range)	60.6 (17-92)
BMI (kg/m ²)	19 (13-29)
Previous obstruction	3.0 (± 5.0)
Previous operations	1.4 (± 0.7)
Presence of decompression before operation	97:26
Surgical procedure (laparoscopic surgery:open surgery)	75:48

BMI indicates body mass index.

TABLE 2. Etiology of Small Bowel Obstruction

Surgical Procedure	Laparoscopic Surgery	Open Surgery	Total
Upper digestive surgery	0	15	15
Colorectal surgery	8	39	47
Appendectomy	0	9	9
Cholecystectomy	0	5	5
Gynecologic surgery	0	39	39
Urological surgery	0	5	5
Traffic injury	0	3	3

Laparoscopic Surgery

A 12-mm first port was placed diagonally to the base of the culprit lesion with the use of an open laparoscopy technique; the site of the previous surgical wound was avoided. After inducing pneumoperitoneum, the peritoneal cavity was examined, and 5-mm ports (for 2-mm forceps, etc.) were placed bilaterally in a triangular manner, with the base of the triangle situated along a line connecting the site of the culprit lesion with the first port. The number of ports was increased if necessary. If procedures such as partial resection of the small bowel or repair of intestinal injury were required, a camera port was placed through a mini-laparotomy incision (5 cm or less). If strong bowel adhesions developed in the pelvic cavity after abdominoperineal resection or radiotherapy, the adhesions were dissected by the mini-laparotomy.

Statistical Analysis

Statistical analyses were performed with the χ^2 test and Mann-Whitney *U* test. *P* values of <0.05 were considered to indicate significant difference. Multivariate analysis was performed with a logistic regression model, using SPSS version 8.0 software (JCSPP Inc., Chicago, IL).

RESULTS

The median follow-up was 57 months (range, 7 to 185 mo). The reasons for performing surgery for small bowel obstruction were adhesions to the midline wound in 36 patients (29%), bands in 30 (24%), intrapelvic adhesions in 23 (19%), small bowel adhesions in 20 (16%), internal hernias in 13 (11%), and others in 1 (1%). Laparoscopic surgery was converted to open surgery in 11 patients (18%).

A total of 35 patients (28%) had postoperative complications: wound infection in 12 (10%), small bowel obstruction in 12 (10%), paralytic ileus in 4 (3%), intra-abdominal abscess in 3 (2%), suture failure in 1 (1%), anastomosis-site bleeding in 1 (1%), enteritis in 1 (1%), and urinary tract infection in 1 (1%). On univariate analysis, open surgery (*P* = 0.017) and intraoperative bleeding volume (*P* = 0.031) were risk factors for postoperative recurrence of small bowel obstruction (Table 3). On multivariate analysis, open surgery was the only independent risk factor for recurrence of small bowel obstruction (odds ratio, 5.621; *P* = 0.015) (Table 4). As compared with open surgery, laparoscopic surgery was associated with a higher preoperative number of small bowel obstructions (*P* = 0.003), a lower intraoperative bleeding volume (*P* = 0.001), a smaller number of reoperations for small bowel obstruction (*P* = 0.038), and a shorter postoperative hospital stay (*P* < 0.001) (Table 5).

TABLE 3. Risk Factors of Post Overall Complication Univariate Analysis

	SBO + (n = 12)	SBO - (n = 111)	P
Sex (male:female)	7:5	51:60	0.607
Age (range)	55.8 (± 16.8)	61.1 (± 15.9)	0.172
BMI (kg/m ²) (range)	19.5 (± 3.3)	19.3 (± 3.0)	0.506
No. SBO (range)	1.9 (± 1.3)	3.2 (± 5.3)	0.943
Previous operations (range)	1.3 (± 0.7)	1.4 (± 0.7)	0.739
Preoperative surgery (laparoscopic:open)	1:11	8:103	0.889
Radiation (+ : -)	5:7	20:91	0.119
Decompression therapy (+ : -)	11:1	86:25	0.169
Surgical procedure (laparoscopic:open)	3:9	72:39	0.017
Operation times (min) (range)	160.4 (± 87.2)	156.9 (± 84.7)	0.959
Bleeding (mL) (range)	179.6 (± 230.7)	118.2 (± 291.4)	0.031
Intestinal resection (+ : -)	4:8	42:69	0.758

BMI indicates body mass index; SBO, small bowel obstruction.

DISCUSSION

Our study showed that open surgery was an independent risk factor for postoperative intestinal obstruction. Laparoscopic surgery for postoperative small bowel obstruction allows earlier discharge after surgery and return to social activities because of its minimal invasiveness. In the early 1990s, laparoscopy was first used to examine sites of small bowel obstruction.⁶ A subsequent study reported that the incidence of recurrent postoperative small bowel obstruction increased in parallel to the number of years after surgery in patients who had undergone surgery for postoperative small bowel obstruction.⁷ Younger age, lumpy adhesions, and postoperative complications have been reported to be risk factors for recurrence of postoperative small bowel obstructions.⁸ Surgery for adhesive small bowel obstruction is associated with many procedural accidents and postoperative complications, as well as particularly high mortality among patients who are elderly or in poor general condition. Recently, many studies have reported that laparoscopic surgery is a useful procedure for the management of small bowel obstruction.⁹ A study comparing laparoscopic surgery with open surgery for the treatment of acute adhesive small bowel obstructions reported that laparoscopic surgery is associated with earlier recovery of intestinal motility and a shorter hospital stay, as well as with low rates of conversion to open surgery and postoperative complications when performed by experienced endoscopic surgeons. Laparoscopic surgery can thus be used as an alternative to open surgery.¹⁰ In our study, despite the fact that laparoscopic surgery was associated

TABLE 4. Risk Factors of Postoperative Overall Complication Multivariate Analysis

	Odds Ratio	95%CI	P
Surgical procedure			
Open surgery	5.621	1.393-22.684	0.015
Bleeding (150 mL ≤)	1.075	0.249-4.628	0.922

CI indicates confidence interval.

with a higher preoperative number of small bowel obstructions than was open surgery, laparoscopic surgery had a lower bleeding volume and a shorter hospital stay than open surgery, without prolonging the operation time and was thus minimally invasive.

Schippers and colleagues reported that adhesion formation between the wound and small bowel occurred more frequently after open surgery than laparoscopic surgery in a canine model. This finding was attributed to the difference in the size of the surgical wound.¹¹ However, when laparoscopic surgery was converted to open surgery because of intraoperative small bowel injury, the rate of postoperative complications such as wound infection rose to 45.9% as compared with patients who underwent early conversion to open surgery because of poor surgical field visualization.¹² It is therefore important to switch to open surgery when necessary, without needlessly adhering to laparoscopic surgery. In 1 study, 10.3% of patients were switched to open surgery because of intestinal injuries.¹³ Patients who have undergone bowel resection or repair of serosal injury are at risk for the formation of recurrent adhesions at the sites of anastomoses or serosal sutures in the small bowel. Adequate care should therefore be exercised when using forceps. Previous studies reported that intraoperative small bowel injury occurred in 4.6% to 17.6% of patients^{14,15} and delayed small bowel injury occurring in 8.5% of patients.¹⁶ In our hospital, 46 patients (37%), including those with mild intraoperative small bowel injuries, underwent small bowel resection because of severe adhesions or strictures of the small bowel, indicating a high rate of small bowel resection. However, no patient had delayed small bowel injury.

In a review study conducted by O'Connor et al,¹³ the rate of conversion from laparoscopic surgery to open surgery in patients with small bowel obstruction was 29%, the incidence of postoperative complications was 14.8%, and the mortality rate was 1.5%. In our hospital, the rate of conversion to open surgery was 19%, and the incidence of complications was 28%. There were no deaths. Although the rate of conversion to open surgery was low, the rate of

TABLE 5. Patients and Operative Characteristics by Surgical Approach

	LS (n = 75)	OS (n = 48)	P
Sex (male:female)	31:44	27:21	0.152
Age (range)	58.5 (± 16.5)	63.8 (± 14.8)	0.097
BMI (kg/m ²)	19.1 (± 3.3)	19.8 (± 2.5)	0.141
No. SBO	4.0 (± 6.2)	1.5 (± 1.1)	0.003
Previous operations	1.4 (± 0.8)	1.38 (± 0.7)	0.873
Prior surgery (LS:OS)	9:66	0:48	0.032
Radiation (+ : -)	15:60	10:38	0.919
Decompression therapy (+ : -)	56:19	41:7	0.230
Operation times (min) (range)	169.0 (± 95.5)	139.0 (± 60.5)	0.161
Bleeding (mL) (range)	76.9 (± 266.0)	198.1 (± 302.5)	0.001
Intestinal resection (+ : -)	25:50	21:27	0.329
SBO	3:72	9:39	0.018
Reoperation SBO	3:72	8:40	0.038
Hospital stay (d)	16.2 (± 13.1)	29.8 (± 25.0)	< 0.001

BMI indicates body mass index; LS, laparoscopic surgery; OS, open surgery; SBO, small bowel obstruction.

postoperative complications tended to be high. There is an urgent need to decrease the rates of wound infection and recurrent small bowel obstruction.

In patients in whom adequate decompression is not achieved before laparoscopic surgery, it is difficult to secure a surgical field because of poor visibility, and it is extremely difficult to perform procedures with the use of forceps. In addition, serosal or small bowel injuries are liable to occur in the presence of marked edema of the small bowel; forceps must therefore be used with extreme care. In patients found to have strangulation ileus associated with bloody ascites or extensive intestinal necrosis on examination of the colon, laparoscopic surgery should be promptly converted to open surgery.¹⁷

As for countermeasures for preventing recurrence of small bowel obstruction after surgery, Fazio et al¹⁸ conducted a large, randomized, controlled study and reported that the use of Seprafilm after abdominal surgery reduced the incidence of adhesive small obstruction by 47% as compared with a control group. Mohri et al¹⁹ reported that the use of Seprafilm decreased the incidence of early postoperative small bowel obstruction occurring within 30 days after abdominal surgery. In a meta-analysis of 7 clinical trials (n = 630), patients in whom an adhesion prevention sheet was used during open surgery had fewer adhesions at reoperation.²⁰ However, the incidence of small bowel obstruction did not differ significantly according to whether or not an adhesion prevention sheet was used, and the incidences of postoperative complications and ileus (intestinal paralysis) were higher among patients in whom an adhesion prevention sheet was used.²¹ In our hospital, Seprafilm is not used in patients who undergo laparoscopic surgery, but is used in all patients who undergo mini-laparotomy or open surgery.

Open surgery was an independent risk factor for postoperative adhesive small bowel obstruction. Therefore, laparoscopic surgery was confirmed to be a useful countermeasure against this postoperative complication. It is thus important to initially use a laparoscopic approach and to continue surgery provided that an adequate working space can be secured. If decompression is inadequate and safety cannot be secured, a tailor-made approach method best suited for the individual patient should be used without persisting on laparoscopic surgery.

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