The Role of Laparoscopy in the Management of Bowel Obstruction

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Introduction and Rationale

Traditionally, laparotomy has been the approach of choice for small bowel obstruction even though laparoscopy may offer improved outcomes. Despite early adoption of laparoscopy for evaluation and treatment of a wide variety of abdominal pathology, acceptance of laparoscopy as an adequate approach to small bowel obstruction occurred late in the history of laparoscopy. Laparoscopic release of a single adhesive band was first described in 1991 by Bastug [1]. An estimated 300,000 patients are hospitalized and/or undergo surgery annually for adhesion-related SBO. Approximately 85% of small bowel obstructions in the Western world are caused by adhesions [2]. The overall risk of developing an adhesive SBO after abdominal surgery is approximately 5% historically, and after major abdominal surgery, the risk increases to between 15% and 42%. In a meta-analysis of over 440,000 patients who underwent abdominal surgery, the highest incidence of SBO occurred after open adnexal surgery or ileal pouch-anal anastomosis. With many procedures, laparoscopy resulted in fewer adhesions than an open approach, though this has not clearly translated to a lower incidence of SBO in colorectal surgery [3].

Although laparoscopic surgery is associated with early recovery, reduced length of hospital stay, and decreased morbidity compared with open surgery, the laparoscopic approach for treatment of small bowel obstruction has been slow to become established as the optimal approach, but laparoscopy is now considered an acceptable approach for cases of SBO in which it was previously felt to be contraindicated.

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Indications and Contraindications of Laparoscopy in SBO

The cause of a bowel obstruction frequently determines whether a laparoscopic approach is possible. Most commonly adhesions are the source of obstruction, but other causes including hernia (both internal hernias and abdominal wall defects), tumor, bezoar, intussusception, acute appendicitis, and terminal ileitis may be implicated. Preoperative imaging studies often point to a cause and assist with planning of the operative approach (Figs. 26.1a, b and 26.2a–c). Laparoscopy offers the advantage of a diagnostic opportunity in cases where preoperative imaging is ambiguous. Several predictors of successful laparoscopic lysis of adhesions have been reported, as well as relative contraindications to a laparoscopic approach (Table 26.1).

Principles and Quality Benchmarks

Principles of surgery for small bowel obstruction include identification of the cause of obstruction, relief of the obstruction, resection of nonviable bowel, and avoidance of inadvertent enterotomy. Laparoscopy can be a valuable tool in

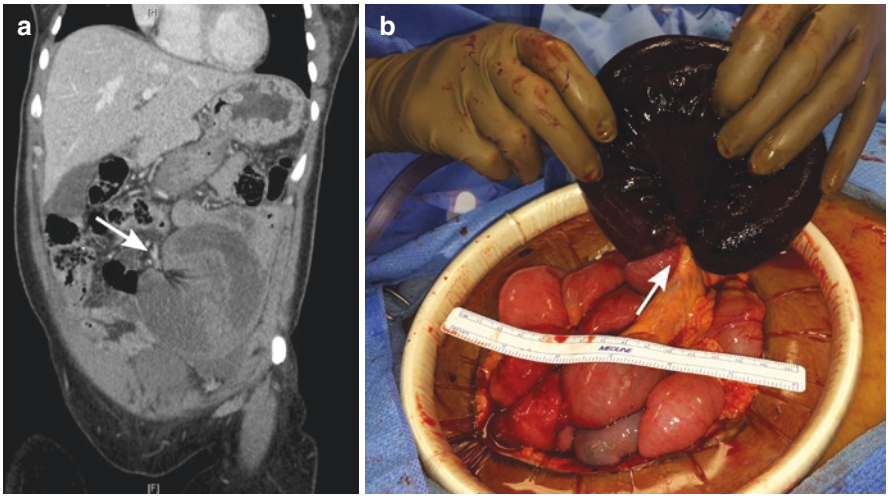

Fig. 26.1 (**a**, **b**) Abdominal CT scan images and operative findings in a woman with an adhesive closed loop small bowel obstruction after low-anterior resection for rectal cancer. Given the CT findings and peritonitis on exam, the patient was felt to be a poor candidate for laparoscopic exploration and underwent laparotomy and small bowel resection. **a** shows a coronal image with a class C-shaped closed loop obstruction with thickening and hypoenhancement of the bowel wall as well as edema and lack of perfusion in the associated mesentery. The arrow points to the location of both proximal and distal obstruction. **b** shows findings on exploratory laparotomy, with internal hernia through a short adhesive band causing closed loop obstruction and ischemia of a loop of small intestine

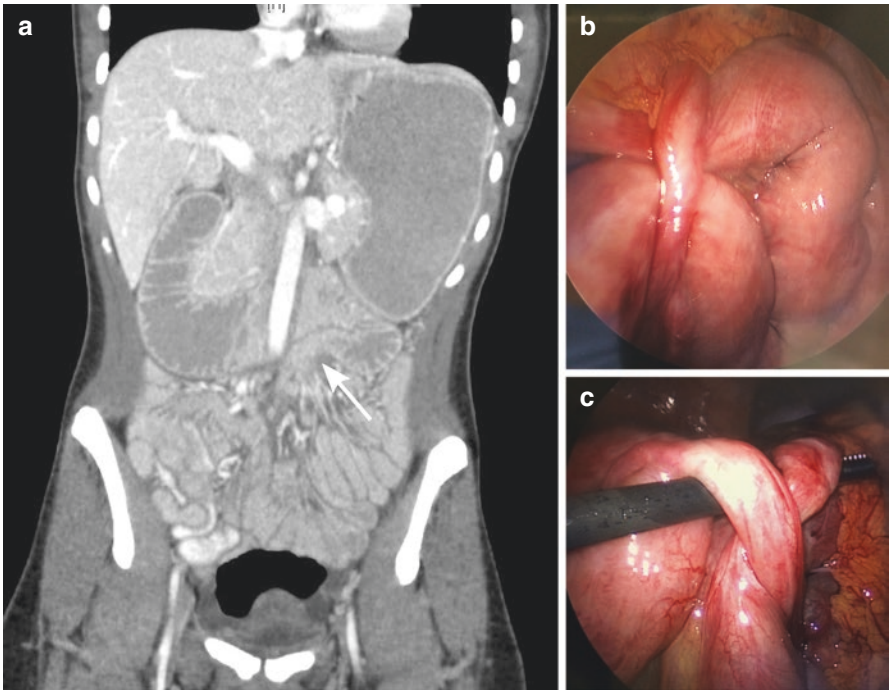

Fig. 26.2 (**a**–**c**) Abdominal CT scan images and operative findings in a woman with adhesive small bowel obstruction of the proximal jejunum after laparoscopic total proctocolectomy and ileal pouch-anal anastomosis for familial adenomatous polyposis. Given the proximal point of obstruction and prior laparoscopic approach, the patient was felt to be a good candidate for laparoscopic exploration and lysis of adhesions, which successfully resolved her obstruction. **a** shows a coronal image with dilated stomach, duodenum, and proximal jejunum. The arrow points to the point of obstruction from the adhesive band. Note the distal decompressed loops of small intestine in the pelvis. **b** and **c** show laparoscopic findings, with a broad adhesive band compressing the proximal jejunum

Table 26.1 Predictors for success and contraindications to laparoscopy for small bowel obstruction

Predictors of successful laparoscopic lysis of adhesions	Contraindications to laparoscopic approach for SBO
Two or fewer prior abdominal operations Previous upper abdominal incision Appendectomy as only prior operation Transition point outside of the pelvis Bowel dilation less than 4 cm Partial bowel obstruction Surgeon training in advanced laparoscopic techniques	Massive abdominal distension that prevents safe entry into the peritoneal space and limits working space Peritonitis with the need for bowel resection Hemodynamic instability Inability to tolerate pneumoperitoneum due to comorbid disease

accomplishing these goals, but conversion to open surgery should be undertaken without delay if any of these goals cannot be accomplished via laparoscopic approach.

Preoperative Planning, Patient Workup, and Optimization

Initial evaluation of the patient should address early stabilization with nasogastric decompression, fluid resuscitation, and correction of electrolyte abnormalities. Nasogastric decompression should be performed prior to induction of general anesthesia to minimize risk of aspiration.

Early attention to the urgency of surgery is critical in avoiding complications of strangulated bowel. Severe pain, incarcerated hernia, overlying skin changes, significant leukocytosis, free peritoneal fluid or air, or suggestion of compromised perfusion on imaging warrants consideration of emergent surgery. It is important to remember that with a closed loop obstruction, fluid-filled loops are often not seen on abdominal x-ray. If a patient is felt to be stable without impending strangulation, observation with nasogastric decompression is appropriate, but if an obstructed patient does not improve in 24–48 hours, the abdomen should be explored.

The skill level and experience of the surgeon are important in operative planning, both in terms of technical skill and ability to judge if and when it is appropriate to convert to laparotomy. Absolute contraindications for laparoscopy include pulmonary or cardiac status that cannot tolerate abdominal insufflation. Relative contraindications include diffuse abdominal distension, which risks bowel injury both during initial access to the abdomen and in dissection and visualization of the anatomy due to limited exposure. A history of previous abdominal surgery is a relative contraindication to a laparoscopic approach, with prior laparotomy or prior diffuse peritonitis yielding lower probability of success than a prior laparoscopic operation.

Operative Setup and Technique

The patient should be positioned on the operating room table with the entire abdomen exposed and sterilized. The patient's torso and all extremities should be secured to the operating table such that the table can be tilted in different directions for best visualization. In cases where intraoperative lower endoscopy may be useful (e.g., SBO after ileal pouch-anal anastomosis), a split-leg table or lithotomy position should be considered.

Pneumoperitoneum can be established using either Hasson technique or Veress needle depending on surgeon's preference, but ideally initial access should be gained away from prior surgical sites. Initial use of an optical viewing trocar can facilitate safe peritoneal entry as it allows direct visualization of the layers of the abdominal wall. Insertion of subsequent trocars under direct laparoscopic visualization is critical. Surgeons should not shy away from using several additional 5 mm trocars in

order to improve access and exposure. Using a 5 mm rather than 10 mm 30 degree scope allows for frequent change in camera port position during the case. This is particularly helpful in keeping the camera in line with the surgeon's instruments when running the bowel from distal to proximal. Using a pair of atraumatic laparoscopic forceps, the surgeon follows the loops of bowel, attempting to find a transition point between distended and collapsed bowel. Careful attention to gentle manipulation of the bowel, especially dilated segments, is critical to avoid creating enterotomies. Adhesive bands are lysed with sharp laparoscopic scissors, and blunt dissection of adhesions is minimized in order to avoid tearing of tissue in planes out of direct view. As in reoperative surgery, the use of energy, either monopolar cautery or bipolar energy, should be minimized in order to avoid the risk of inadvertent burn injury and delayed enterotomy. Endo peanuts can be particularly helpful during blunt dissection of soft adhesions. Hemostasis can be achieved with suction and sponges.

Laparoscopy is a very good option to evaluate bowel obstruction in the virgin abdomen, as it allows for diagnosis and, if tumor or other reasons for minilaparotomy are found, helps optimize incision placement.

Pitfalls and Troubleshooting

The decision to convert to open surgery should be made expediently if any of the goals of surgery for SBO cannot be accomplished (identification of the cause of obstruction, relief of the obstruction, resection of nonviable bowel, and avoidance of inadvertent enterotomy). Frequently laparoscopy provides improved visualization over open surgery, but with obstruction, dilated bowel may preclude adequate visualization. Changing camera ports, adding working ports, and tilting the operating table may allow for identification of the transition point. Often after prior open surgery, adhesions to the prior abdominal incision can be divided via lateral laparoscopic ports, and laparoscopic approach is successful.

Ideally, all adhesions should be lysed to allow for running of the entire small bowel. It is necessary, however, to balance the advantage of complete visualization with the risk of bowel injury and causing bleeding by dividing further adhesions. The surgeon should maintain a low threshold for conversion if severely distended bowel or matted adhesions are present, especially in the deep pelvis. If enterotomy with minor contamination occurs and the bowel is minimally distended and otherwise healthy, laparoscopic repair can be considered, but unfortunately these conditions are rarely met, and at least minilaparotomy is typically advisable after iatrogenic bowel injury.

If the cause of obstruction is corrected but question of bowel strangulation exists, the loop of bowel should be observed for at least 5 minutes in the operating room. Return of normal color and peristalsis suggests viability, but with uncertainty the loop of bowel should be resected or at minimum the patient should be closely observed after surgery with a low threshold for second-look laparoscopy. If nonviable bowel is identified, resection should be performed through at least a minilaparotomy to minimize peritoneal contamination.

Laparoscopy can be a safe and effective first-line approach to small bowel obstruction, but maintaining a low threshold to convert to laparotomy is imperative for patient safety.

Outcomes

Logic would suggest that a laparoscopic approach for adhesive small bowel obstruction would confer the same benefits to patients as laparoscopy for other conditions, but the data are not so clear. An important consideration is that the retrospective, nonrandomized nature of nearly all publications on surgery for adhesive SBO heavily biases open surgery toward patients with more comorbidities or worse clinical presentation. As a result, outcomes will tend to favor laparoscopy despite attempts to mediate these confounders with multivariate analysis and case matching. However, it is unlikely that a randomized controlled trial large enough to provide useful results will ever be completed, and so best analysis of the available data is important. Several single institution retrospective reviews, some of which utilize propensity score matching, have been published on the topic. In addition, several authors have pooled analyses of case-matched control or comparative studies, and nationwide databases have been queried on the topic.

Adhesive SBO is approached laparoscopically in about one third of cases [4, 5] with conversion to laparotomy in 25–39% of these [2, 4, 5]. The number of prior operations did not correlate with need for conversion to open surgery in all studies, but a documented history of dense adhesions was associated with a higher rate of conversion to open surgery. In addition, emergency operations resulted in twice the rate of conversion to laparotomy [6]. The most commonly cited reasons for conversion are dense adhesions (29–70%), ischemic bowel with need for resection (16–24%), iatrogenic injury (10–16%), and inadequate exposure (9–16%) [2, 4, 5]. Enterotomy rates ranged from 6.6 to 25% [2, 4, 6] (Table 26.2). It is unclear whether laparoscopic or open surgery poses a higher risk for enterotomy, with conflicting results showing higher rates of enterotomy in open surgery [4], some showing higher rates in laparoscopy [7], and some equivocal [8]. Importantly, Dindo and colleagues found in their review of a prospective Swiss nationwide database of

Table 26.2 Outcomes in laparoscopy for small bowel obstruction

Reasons for conversion to open surgery during laparoscopic approach to small bowel obstruction	Incidence
Dense adhesions	29–70%
Ischemic bowel, need for resection	16–24%
Iatrogenic injury	10–16%
Inadequate exposure	9–16%
Laparoscopic approach to small bowel obstruction is associated with: Enterotomy rates of 6.6–25% Reduced rates of mortality, morbidity, pneumonia, length of stay compared to open approach Possibly increased long-term incidence of reoperation for recurrent obstruction compared to open approach	

laparoscopic approach for SBO that reactive conversions forced by intra-abdominal complications almost doubled the morbidity rate compared to early preemptive conversions [6].

Laparoscopic surgery for adhesive SBO has been associated with a significant reduction in mortality [2, 8], morbidity [2, 4, 8–10], rates of pneumonia [8], and length of stay [4, 5, 8–11] (Table 26.2). Most [4, 9] but not all [8] studies showed early return of bowel function with laparoscopy compared to open surgery. No difference has been found between laparoscopy and laparotomy in need for early return to the OR [8, 9, 11].

With introduction and wider adoption of laparoscopy for intestinal surgery, comfort levels with more challenging cases have risen. Pei et al. used the ACS NSQIP database to evaluate trends in use of laparoscopy for SBO and found that the proportion of SBO cases treated laparoscopically increased by 1.6% per year from 17.2% in 2006 to 28.7% in 2013 [10]. Behman and colleagues showed a threefold increase in laparoscopic approach over a 10-year period, from 4.3% to 14.3% in 2014 [7]. In a separate study, patient outcomes did not differ when the operating surgeon was fellowship-trained in minimally invasive surgery [5].

One argument for the use of laparoscopy is the attractive logic that long-term recurrence of adhesive small bowel obstruction might be less if the index obstruction is treated laparoscopically, resulting in fewer future adhesions. Yao and colleagues [9] followed 156 patients for 3 years after laparoscopic and open adhesiolysis and evaluated incidence of recurrent obstructive symptoms and reoperation for obstruction. Laparoscopy yielded good short-term outcomes including early return of bowel function, reduced incidence of complications, and shorter hospital stay. At 1 and 3 years postoperatively, etiology of previous SBO, surgical approach (laparoscopic vs. open), and postoperative clinical course had no impact on recurrence of obstructive symptoms. At 1 and 3 years, however, the incidence of reoperation for recurrence was significantly higher in the laparoscopically treated group (7.7% vs. 0%), though only four patients in total required reoperation (Table 26.2). Overall the authors were unable to show a long-term benefit of laparoscopy over open surgery, especially in terms of recurrent symptoms. The authors speculate that in laparoscopy, insufficient exposure of the entire small bowel can contribute to recurrence.

Conclusions

Relative to the open approach, laparoscopic management of small bowel obstruction is feasible in selected patients with reduced morbidity and mortality among surgeons experienced in laparoscopy but with a significant conversion rate. It is important to keep in mind that a low threshold for conversion may decrease postoperative morbidity. Laparoscopy may reduce the risk of adhesions compared to laparotomy, though further long-term studies are needed to determine whether laparoscopic treatment of adhesive SBO can help reduce the risk of recurrent episodes of SBO.

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