

Avoiding and repairing bowel injury in gynecologic surgery

Tips for avoiding the pitfalls in at-risk patients and injury-prone procedures, plus techniques for adhesiolysis, repair of serosal and small bowel injuries, and inspection of the bowel to rule out perforations.

This dreaded complication requires vigilance and skill to avoid, and adequate training and experience to manage and repair. In a perfect world, every gynecologist would be trained in techniques to prevent and repair inadvertent bowel injuries. Unfortunately, residency programs often do not provide such training.

Gynecologists routinely operate on patients with risk factors for bowel injury—obesity, endometriosis, multiple abdominal procedures, pelvic inflammatory disease, history of malignancy, and advanced age. A general surgeon is often called, however, for bowel repairs that can be performed by a gynecologist with sufficient training and experience. (There are instances, however, in which a general surgical consultation may not be readily available—another reason to master repair of bowel injuries encountered during gynecologic surgery.)

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This article describes techniques to avert and manage intestinal injury. Topics include adhesiolysis, repair of bowel perforations, segmental bowel resection, and pre- and postoperative management. Vascular anatomy of the bowel is illustrated on page 21.

We emphasize the need for direct supervision by an experienced surgeon while mastering these techniques.

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KEY POINTS

- Although the optimal method is a matter of choice, preoperative bowel preparation is recommended to reduce bacteria, stool bulk, and infectious complications.
- When entering the peritoneal cavity in patients with prior surgery, watch for adhesions between a loop of bowel and the abdominal wall.
- In high-risk patients, enter the peritoneal cavity by extending the previous abdominal scar superiorly and inferiorly to minimize risk of injury.
- Close small perforations in 2 layers, with the suture line always perpendicular to the long axis of the bowel.
- For more extensive injury or compromised blood supply to the bowel wall, resection and anastomosis may be necessary. Obtain intraoperative general surgical consultation if not trained to perform this kind of repair.

Bowel preparation: A useful tool to reduce infection, leakage

Isolated reports have questioned the need for mechanical bowel preparation,^{1,2} and some experts point to the recent success of primary repairs of gunshot and stab wounds to the colon as evidence that bowel preparation and preoperative oral antibiotics are unnecessary.

Other studies indicate potential benefits, namely reducing infectious complications and anastomotic leakage following repair of inadvertent enterotomy. Indeed, the vast majority of North American surgeons continue to use some form of bowel preparation,^{3,4} and it is the standard of care for elective intestinal surgery. For these reasons, bowel preparation is strongly encouraged for the gynecologic surgeon operating on a pelvic mass,

Perforation and spillage of colon contents contaminates the peritoneal cavity with more than 400 species of bacteria.

endometriosis, or malignancy, or when difficult dissection is anticipated with the potential for inadvertent enterotomy and spillage of intestinal contents.

Bowel preparation consists of 2 phases: mechanical cleansing and antibiotic administration (TABLE). The postoperative infection rate can be reduced to well below 10% when these are properly performed.

Mechanical cleansing reduces the bulk of stool content within the lumen of the bowel, which also decreases the absolute amount of bacteria.⁵ Anaerobes are the predominant flora in the colon, with an estimated density of 10¹⁰ organisms per gram of stool. Perforation and spillage of colon contents contaminates the peritoneal cavity with more than 400 species of bacteria.

In the past, stool bulk was reduced via a low-residue or liquid diet combined with

cathartics, enemas, or other agents given over 2 to 3 days. This regimen was time-consuming, patient compliance was poor, and nutritional intake was severely restricted prior to major surgery.

Today, polyethylene glycol and sodium phosphate are the 2 most popular methods of bowel preparation.

▪ **Polyethylene glycol** (Golytely, *Braintree Labs, Braintree, Mass*) is a balanced electrolyte solution dispensed in a 4-L quantity that must be taken over 4 hours. Some patients find this volume difficult to consume; one option is administering the solution via a small nasogastric tube. Complications may include nausea/vomiting, abdominal cramping, and, rarely, fluid overload and electrolyte disturbances.

▪ **Sodium phosphate** (Fleet Phospho-soda, *C.B. Fleet Co, Lynchburg, Va*) is administered in two 45-mL increments several hours apart. There is no consensus on which bowel-prep method is superior^{3,4}; most surgeons prefer one or the other. Due to potential electrolyte abnormalities with the use of sodium phosphate, polyethylene glycol is favored for patients with significant renal, cardiac, or hepatic disease.

Antibiotics decrease bacterial concentration within the bowel lumen and are thought to reduce contamination and the likelihood of intra-abdominal abscess and wound infections.

▪ **We recommend** minimally absorbed oral antibiotics (1 g each of neomycin and erythromycin, given at 1 PM, 2 PM, and 11 PM the day before surgery) in combination with an intravenous second-generation cephalosporin (1 g if using cefotetan, 2 g if using cefoxitin; given immediately before surgery and continued postoperatively for 3 doses).

▪ **Timing** of antibiotic administration is important, since postoperative antibiotics alone do not appear to be effective. If significant spillage occurs intraoperatively, parenteral antibiotics should be continued for 5 days.

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TABLE

Bowel prep regimen

DAY BEFORE SURGERY	
Morning	Light breakfast
Noon	Clear liquids Polyethylene glycol, 4L, to be consumed over 4 to 6 hours
1 PM	Neomycin, 1 g orally Erythromycin, 1 g orally
2 PM	Neomycin, 1 g orally Erythromycin, 1 g orally
Evening	Clear liquids
11 PM	Neomycin, 1 g orally Erythromycin, 1 g orally
DAY OF SURGERY	
Morning	Intravenous cephalosporin (1 g cefotetan or 2 g cefoxitin); 1 hour before incision, continued postoperatively for 3 doses

Thermal injury due to unipolar cautery is particularly ominous because the extent of injury exceeds what is grossly observed.

When injuries are most likely

Intestinal injuries during gynecologic surgery usually involve the small bowel and can be minor, such as a serosal tear or a small, full-thickness laceration—or major, involving a devitalized bowel loop or its mesentery.

Bowel injury may occur during a variety of surgical procedures. One study showed that most injuries occur during adhesiolysis or entry into the peritoneal cavity. A smaller but substantial number of cases occur during “less extensive” procedures such as uterine curettage and laparoscopy.⁶

Upon entering the peritoneal cavity, keep in mind the possibility of injuring an

adherent loop of bowel. Because of its anatomical relationships to the pelvic viscera, portions of the bowel may become involved in adhesions, which can lead to extremely challenging pelvic dissections in conditions such as endometriosis or severe pelvic infection. Dissection of pelvic adhesions is a common cause of bowel injury, because bowel loops are retracted deeply downward by adhesive bands, and the limited pelvic space hampers visualization and gentle adhesiolysis.

At special risk for bowel injury are women who have undergone prior abdominal operations or who are obese. In a series of 270 general surgery patients undergoing reoperation,⁷ 52 (19%) sustained inadvertent enterotomy. These patients had undergone a mean of 3.3 previous laparotomies and had a higher body mass index (mean of 25.5 versus 21.9).

Age may be another risk factor, since patients with enterotomies were 60 years or older.⁷

Injury during laparoscopy. Inadvertent bowel injuries may occur during laparoscopic procedures, especially at the time of trocar insertion or manipulation of pelvic structures.⁵ One device that helps prevent these injuries is the optical trocar (Visiport, *US Surgical, Norwalk, Conn*), which allows physicians to visualize the layers of the abdominal wall as penetration occurs.

We also routinely direct anesthesia personnel to insert a nasogastric tube at the beginning of laparoscopic procedures to facilitate decompression of the stomach and small bowel.

The risks of electrocautery. Electrocautery used for tubal ligation, pelvic dissection, or hemostasis may injure the bowel if the surgeon is not careful. Thermal injury due to unipolar cautery is particularly ominous because the extent of injury is greater than what can be grossly observed. The incidence of this type of injury can be reduced using bipolar cautery devices, as well as clips or bands for tubal ligation.

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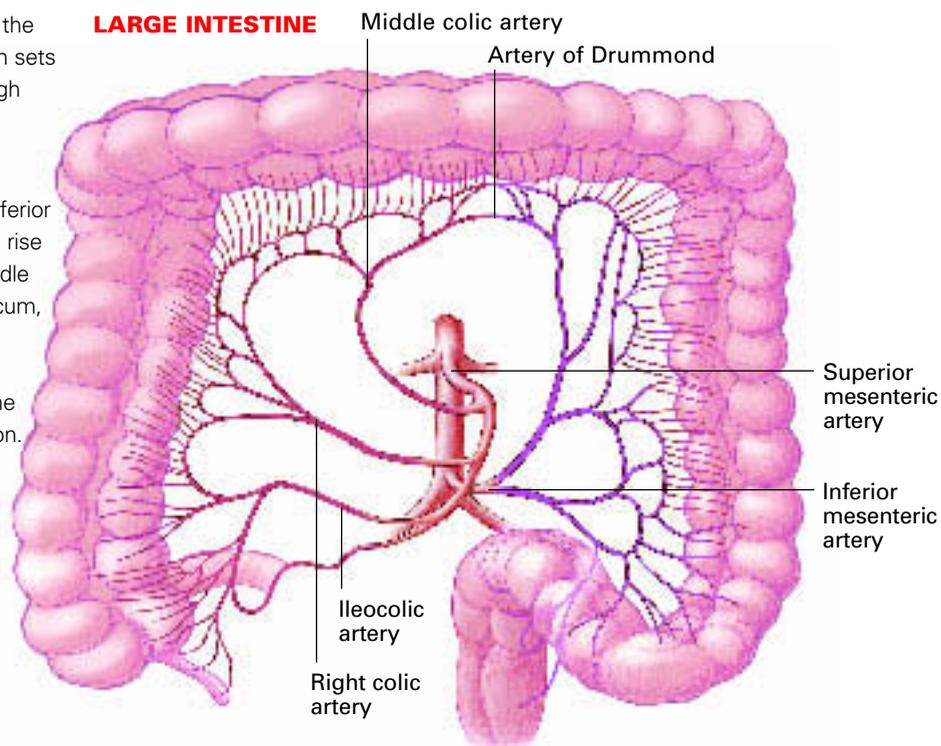
Vascular anatomy of the gastrointestinal tract

An intricate, but orderly, system of arteries

The large intestine is attached to the posterior abdominal wall by its own sets of mesentery or mesocolon, through which its blood supply courses.

The colon's dual blood supply emanates from the superior and inferior mesenteric arteries. The first gives rise to the ileocolic, right colic, and middle colic arteries, which supply the cecum, right colon, and transverse colon, respectively. The branches of the inferior mesenteric artery supply the descending colon and sigmoid colon.

All major arterial branches to the colon anastomose with one another to form the artery of Drummond (marginal, juxtacolic), ensuring collateral circulation to the large intestine.



The small intestine extends from the pylorus to the ileocecal junction and consists of 3 segments: duodenum, jejunum, and ileum. It is attached to the posterior abdominal wall by the mesentery, which extends from the ligament of Treitz to the ileocecal junction.

The blood supply derives from the superior mesenteric artery, which originates at the aorta at the level of the first lumbar vertebra and courses diagonally downward and to the right.

The superior mesenteric artery gives off large branches—the jejunal and ileal arteries—which course through the mesentery and divide into multiple anastomosing secondary branches to form vascular arcades. In turn, the arcades give off straight branches—the vasa rectae—which perfuse the bowel wall. Between the terminal vasa rectae are avascular spaces known as windows of Deaver.

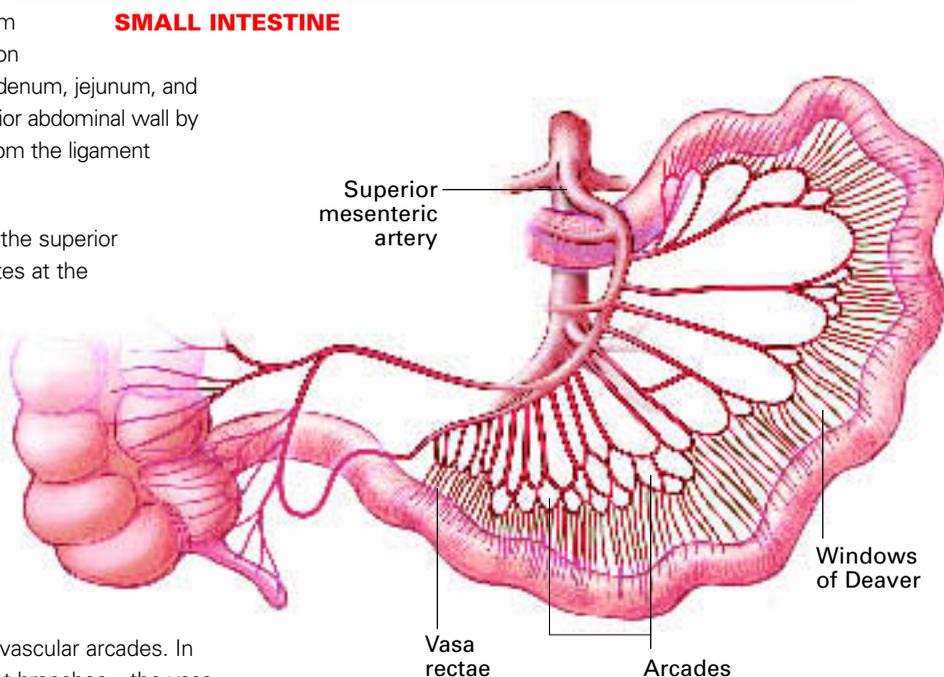


Image: Birek Cox

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Injury as a result of uterine perforation is unlikely, but can occur. If perforation occurs during dilation and curettage, bowel laceration may result, particularly adhesions are present between the uterus and bowel loops. In extremely rare instances, a loop of bowel may be pulled through a perforation into the uterine cavity or vagina, requiring laparotomy for reduction and repair. Caution is advised during curettage, especially in a gravid uterus, to prevent this potentially catastrophic event.

Avoid the temptation to lyse opaque adhesions using blunt dissection, as serosal tears and enterotomies may occur.

Adhesiolysis: Plan on a lengthy, meticulous procedure

Adhesions are a common cause of pelvic pain, infertility, and bowel obstruction, and their presence may make it difficult to carry out the intended surgical procedure. Adhesiolysis may be necessary to mobilize loops of bowel tightly adherent to pelvic structures, to provide sufficient exposure of the surgical field and prevent subsequent bowel obstruction.

The extent of adhesions does not necessarily correlate with clinical symptoms.

Adhesions may be of the thin, filmy, “friendly” variety or dense, thick bands.

How adhesions occur. When tissue is injured, fibrin is deposited on the peritoneal and serosal surfaces. The extent to which this fibrin is infiltrated with fibroblasts and the degree of subsequent fibrosis determine adhesion density. Any process that impairs fibrinolysis tends to delay resolution of adhesions.

Contributing factors. Adhesions are commonly encountered in pelvic surgery and may be observed in 50% to 90% of patients who have undergone previous surgery.⁸

Obese patients also are more susceptible to adhesions. Other contributing factors include

pelvic infection, bleeding, irradiation, chemical irritants, and conditions such as endometriosis.

Lysis technique. Apply gentle, controlled traction—as well as countertraction—on the bowel loops to facilitate isolation and dissection with sharp Metzenbaum scissors or a scalpel. (Forceful traction or rough handling of bowel loops may cause a breach in the bowel wall with subsequent spillage of intestinal contents.)

Avoid the temptation to lyse adhesions using blunt dissection (serosal tears and enterotomies may occur)—except in the case of translucent adhesions. These may be lysed via gentle, blunt dissection by rubbing the index finger and thumb back and forth over tissue. They also may be sharply cut using the tip of the scissors to form a “window” in a portion of the adhesion and cutting the adhesive segments in increments.

A characteristic line of demarcation often appears between adhesions and their peritoneal attachment, denoting a safe dissection plane.

Technique for special challenges: Chronic pelvic disease, prior laparotomies. When operating on these patients, be prepared for a long, meticulous procedure. A hasty approach in such cases is perilous and increases the likelihood of postoperative complications.

First, dissect the anterior abdominal wall from the adherent bowel on either side of the incision. Then extend the dissection laterally on both sides until the ascending and descending colon are identified. Next, dissect the small bowel free and mobilize it out of the pelvis.

It often is helpful to move to another area when dissection becomes too difficult; dissection through easier planes often will clarify the relationship of pelvic structures and adherent bowel loops.

Once the small bowel has been mobilized from the pelvis, lyse adhesions between loops of bowel that are causing kinking or narrowing of the lumen, to reduce the risk of postoperative bowel obstruction. Next, carefully dissect pelvic structures from the sigmoid colon and rectum.

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How and when to repair serosal injury

Serosal injury is a breach of integrity of the visceral peritoneum, the outermost covering of the bowel wall. This may occur when the serosa is cut during entry into the abdomen or when it is torn during blunt dissection of dense adhesions.

If the underlying muscular and mucosal layers remain intact, these small areas of “denuded” serosa need not be repaired, since most experts believe that suture placement increases the likelihood of future adhesions. The serosal and muscular layers should be repaired if the mucosa is exposed, however. Otherwise the bowel wall will weaken at the site, making it vulnerable to perforation.

The seromuscular layers can be approximated easily using interrupted 4-0 silk on a small tapered needle. Be careful to avoid placing the stitch through the mucosa, which would violate the bowel lumen.

When the defect of the seromuscular layer is large (when a more extensive area is denuded during dissection of densely adherent bowel away from a tumor or endometriotic lesion), repair becomes more involved. This may require resection of the injured area with primary anastomosis.

Intestinal perforations: Early recognition is essential

This critical serious complication can become disastrous if not immediately recognized and repaired. Perforation of the small intestine (enterotomy) or large bowel (colotomy) often occurs upon entry into the peritoneal cavity or during a difficult dissection, particularly when extensive adhesions are present.

Exercise special caution when operating on patients who have undergone prior surgery, who are advanced in age, or both.

Reoperation technique. When entering the abdomen through an old scar, reduce the likelihood of bowel injury by extending the

new incision to either side of the old scar. Then enter the peritoneal cavity in a virgin area of the abdominal wall, where adherent loops of bowel are less likely.

Carefully open the fascia and dissect the preperitoneal fat down to the peritoneum. Before entering the abdominal cavity, retract the peritoneum upward with smooth forceps and palpate it between the thumb and index finger to ensure that a bowel loop is not in harm's way.

If the underlying muscular and mucosal layers remain intact, small areas of “denuded” serosa need not be repaired.

Examine the entire small and large bowel carefully after surgery, to rule out injury. It is not uncommon for more than 1 perforation to occur in a bowel segment during a difficult dissection.

Begin at the ligament of Treitz and continue to the ileocecal junction. This is “running” the bowel—ie, inspecting in hand-over-hand fashion.

In the small bowel, the division between the jejunum and ileum is arbitrary, with no sharply defined line of demarcation. However, the diameter of the lumen decreases as one moves from jejunum to ileum, the number of vascular arcades increases, and the number of windows of Deaver diminishes. Also, the wall of the jejunum is generally thicker than that of the ileum.

In addition, inspect the colon in its entirety, with special emphasis on the sigmoid and rectum. Besides its larger lumen, the large bowel is distinguished by 3 longitudinal muscular bands called taenia coli, out-pouching of the wall (sacculations), and epiploic appendages.

Also examine the mesentery to exclude vascular compromise to the bowel wall.

Repair perforations immediately to limit contamination of the peritoneal cavity. Prior

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to closure, inspect wound edges for devitalized tissue and, if found, promptly debride it.

If colotomy occurs in the setting of an unprepared bowel with significant spillage, follow closure with copious irrigation.

Small perforations can usually be closed in 2 layers, with an inner layer of 3-0 delayed synthetic absorbable suture (Dexon, Vicryl) through the full thickness of the bowel wall, ensuring mucosal approximation. It is vital that this layer be “waterproof,” allowing no leakage of intestinal contents. Then place a second row of suture in the seromuscular layer using 4-0 silk to imbricate the first suture line.

General surgical consultation is needed whenever the gynecologist is inexperienced with bowel resection and anastomosis.

It also is essential that the suture line be perpendicular to the long axis of the bowel, rather than parallel; otherwise, the bowel lumen would narrow. Even perforations extending along the longitudinal axis for several centimeters should be repaired in transverse fashion to provide a lumen of adequate diameter.

**Resecting the small bowel:
If inexperienced, obtain
general surgery consultation**

Bowel resection and anastomosis require a greater degree of skill than is attained in a typical gynecologic training program. For that reason, resection is addressed here only superficially. Our primary caveat: A general surgical consultation should be obtained whenever the gynecologist is inexperienced with bowel resection and anastomosis.

Indications for resection. Strongly consider resection and anastomosis if the perforation involves more than 50% of the circumference of the bowel wall, if multiple perforations occur in a short segment of bowel, or if there is vascular compromise to a segment of

bowel. Adequate perfusion to the bowel usually is indicated by a pink serosal surface. If the serosa remains dark or dusky and fails to become pink after several minutes of observation, vascular compromise is likely and resection is preferred.

If there is doubt about the blood supply to the bowel, give 1 g fluorescein intravenously and inspect the bowel under ultraviolet light (Wood’s lamp). Normal vascularized bowel will have a homogenous yellow-green appearance. Patchy fluorescence or areas without any fluorescence are evidence of ischemia.

To drain or not to drain

Because perforation and resection both involve entry into the bowel lumen, some degree of spillage is inevitable. This is of greater concern when the large bowel is involved, because of the increased likelihood of bacterial contamination. Immediate copious irrigation of the peritoneal cavity is indicated. Also consider a pelvic drain, especially when dissection has been extensive or raw surfaces are oozing.

The combination of bacterial contamination and free peritoneal blood in the pelvis increases the risk for infection. A strategically placed, half-inch Jackson Pratt drain (or a similar device) may help prevent abscess. In the event of anastomotic leakage, a drain often allows for a controlled enterocutaneous fistula to be managed without reoperation.

Some surgeons have satisfactory results without these drainage techniques.

**When to begin postop feeding:
Depends on type of repair**

Opinion varies about the appropriate time to commence feeding after major abdominal surgery, particularly bowel surgery. Over the past decade, with the pressure to discharge patients earlier, many physicians have opted for earlier timing.

Traditionally, feeding was withheld until

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bowel sounds were auscultated; then it progressed slowly. Today many surgeons advance the diet much more quickly, with little or no delay in recovery. Fanning and Andrews⁹ demonstrated that early feeding does not increase the incidence of anastomotic leakage, dehiscence, or aspiration pneumonia—although it is associated with increased emesis.

Patients undergoing surgery for relatively minor injuries can have their diet advanced as if there were no intestinal involvement.

Feeding after minor repairs. When the surgery has involved relatively minor injuries, such as isolated serosal tears and adhesiolysis, nasogastric tube placement is not required. These patients can have their diet advanced as if there were no intestinal involvement. Give clear liquids when bowel sounds are heard and, if tolerated, advance to solids. It is probably not necessary to await a bowel movement before discharging the patient; she can be released once flatus is passed.

Substantial repairs. When major injuries have been repaired, such as with a large perforation repair or bowel resection, it is prudent to proceed more slowly.

Place a nasogastric tube to minimize bowel distention and subsequent leakage from the repair site. Give the patient nothing by mouth until bowel sounds are clearly present and flatus is passed. Then clamp the nasogastric tube for 24 hours, remove it, and institute clear liquids, provided there is no nausea, vomiting, or distension. Advance to full liquids and then solids, tailoring this process to the patient. When she can tolerate a regular diet, with substantial passage of flatus or bowel movement, recovery is signaled.

Need for additional training

The techniques necessary to manage simple bowel injury are not difficult to master. However, Ob/Gyn residency programs need to extend training in this area. Additional rotations on the general surgery or trauma services as second- or third-year residents would be ideal, but the use of animal laboratories is a good alternative. ■

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