

# Chapter 6

## Small Bowel Surgery

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### General Perspective and Overview

The relative risks and complications increase proportionately according to the site of resection and anastomosis within the small bowel and the underlying disease process. This is principally related to the surgical accessibility, ability to reduce tension, blood supply, risk of tissue injury, hematoma formation, and technical ease of achieving anastomosis. Risk of small bowel anastomotic leakage and failure is far less than that experienced with large bowel anastomoses, especially rectal.

Serosal tears may be recognized by the “stripe” sign indicating the exposure of the underlying smooth muscle, which should be repaired transversely with continuous monofilament absorbable suture to reduce risk of full-thickness perforation occurring. Excision of any necrotic or frayed tissue is usually prudent.

The main serious complication is **anastomotic leakage**, which can be minimized by adequate mobilization, reduction of tension, and ensuring satisfactory blood supply to the bowel. Avoidance of twisting or obstruction of bowel, either at the anastomosis or at the ileostomy, is imperative. Anastomotic leakage is associated with infection and may lead to **abscess formation, peritonitis, and systemic sepsis**. **Multisystem failure** and **death** remain serious potential complications of small bowel surgery and systemic infection. Multiple anastomoses, Crohn’s disease,

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established infection, and preexisting malnutrition are associated with increased risk of anastomotic leakage. **Hematoma formation** may arise from mesenteric vessel oozing, and this may predispose to infection.

Risk of inadvertent **small bowel perforation** is higher when division of multiple dense adhesions is performed, and is particularly increased with long, tedious operations where fatigue may occur and in laparoscopic division of adhesions in patients having had a previous laparotomy. If leakage of small bowel content is not noticed at the time of the initial surgery, infection and peritonitis will supervene, requiring early re-laparotomy, associated with increased risk of abscess formation and multisystem organ failure and mortality. In this setting resection of the injured bowel is recommended and stoma formation, either ileostomy or jejunostomy, rather than an anastomosis or suture repair. Established intraperitoneal infection, severe bowel edema from chronic obstruction, and attenuated, ischemic bowel are other examples where anastomosis may be less advisable. Stomas are associated with separate complications also.

Removal of a large length of small bowel may predispose to malabsorption and may be associated with more **frequent bowel actions and reduced control**, all of which may recover partially or completely over the months postoperatively: however, some patients are left with long-standing problems of the short bowel (gut) syndrome.

**Positioning on the operating table** has been associated with increased risk of **deep venous thrombosis** and **nerve palsies**, especially in prolonged procedures.

Possible reduction in the risk of misunderstandings over complications or consequences from small bowel surgery might be achieved by:

- Good explanation of the risks, aims, benefits, and limitations of the procedure(s)
- Useful planning considering the anatomy, approach, alternatives, and method
- Avoiding likely associated vessels and nerves
- Adequate clinical follow-up

With these factors and facts in mind, the information given in this chapter must be appropriately and discernibly interpreted and used.

### **Important Note**

It should be emphasized that the risks and frequencies that are given here *represent derived figures*. These figures are best estimates of relative frequencies across most institutions, not merely the highest-performing ones, and as such are often representative of a number of studies, which include different patients with differing comorbidities and different surgeons. In addition, the risks of complications in lower- or higher-risk patients may lie outside these estimated ranges, and individual clinical judgement is required as to the expected risks communicated to the patient and staff or for other purposes. The range of risks is also derived from experience and the literature; while risks outside this range may exist, certain risks may be reduced or absent due to variations of procedures or surgical approaches. It is recognized that different patients, practitioners, institutions, regions, and countries may vary in their requirements and recommendations.

For risks and complications associated with other procedures, see the relevant chapter.

## **Open (Feeding) Jejunostomy**

### *Description*

General anesthesia is usually used, but in high-risk patients, local anesthesia infiltration may sometimes be used. Jejunostomy is often performed for postoperative feeding as an intraoperative procedure. The aim is to establish a portal to the small bowel from the exterior. The most common procedure today is to make a small upper midline incision and identify a loop of the proximal small bowel that can easily be brought up to meet the anterior abdominal wall. A large-bore (20–24 FrG) Foley balloon catheter is inserted through a separate abdominal wall incision several centimeters lateral to the midline incision. A nonabsorbable purse-string suture is inserted into the anterior wall of the small bowel, and the Foley catheter is inserted into the bowel through a stab wound in the middle of the purse string. The balloon is inflated with about 5–10 ml of saline. The purse string is tightened and tied around the catheter. The small bowel is brought into apposition with the inside of the anterior abdominal wall by gentle traction on the catheter. Sutures are then placed to hold the bowel to the exit point of the catheter on the inside of the abdominal wall, and the Foley catheter is secured into position against the skin. Alternative catheters, with or without a balloon, can be used in different ways, but the principle is essentially the same.

### *Anatomical Points*

The colon, stomach, liver, and omentum may overlies the small bowel and make access difficult. Although these organs are at risk, generally these can be displaced to enable the procedure to be performed. Pectus excavatum or other deformities, including obesity, may also make the procedure more challenging.

### *Perspective*

See Table 6.1. Jejunostomy is used for feeding, drainage, or both. Open jejunostomies are frequently used today for enteral feeding as part of major abdominal surgical procedures, especially upper gastrointestinal or hepatobiliary procedures where oral feeding may be delayed.

**Table 6.1** Open (feeding) jejunostomy estimated frequency of complications, risks, and consequences

Complications, risks, and consequences	Estimated frequency
<i><b>Most significant/serious complications</b></i>	
Infection	
Wound <sup>a</sup>	5–20 %
Subcutaneous cellulitis; abscess <sup>a</sup>	1–5 %
Intraperitoneal	0.1–1 %
Systemic	0.1–1 %
Bleeding/hematoma formation	1–5 %
Jejunal leakage	1–5 %
Jejunal fistula (after removal of tube)	1–5 %
Tube dislodgement (internalization or extraction) <sup>a</sup>	1–5 %
Paralytic ileus	1–5 %
<i><b>Rare significant/serious problems</b></i>	
Discharging abscess sinus	0.1–1 %
Aspiration pneumonitis	0.1–1 %
<i><b>Less serious complications</b></i>	
Gastroesophageal reflux (feed induced)	5–20 %
Hernia formation (incisional)	0.1–1 %

<sup>a</sup>Dependent on underlying pathology, anatomy, surgical technique, and preferences

## ***Major Complications***

Occasionally, the balloon of a Foley catheter may migrate distally and can lead to **small bowel obstruction**. Separation of the small bowel from the anterior abdominal wall may result in **intraperitoneal leakage** of intestinal contents and peritonitis, with or without abscess formation or generalized sepsis. **Pressure necrosis** of the bowel against the catheter balloon and free **perforation** are rare. The most frequent complication, however, occurs around the exit of the catheter where **minor infection and excoriation** are very common. Associated **abscess formation** is not uncommon. **Systemic sepsis** is infrequent but may be severe, often related to the underlying condition(s), and can lead to death.

### **Consent and Risk Reduction**

#### **Main Points to Explain**

- Risk of leakage/fistula
- Infection
- Bleeding
- Further surgery

## **Small Bowel Adhesion Surgery (Without Resection) Division of Small Bowel Band Adhesion(s) (Including Division of Complex Adhesions)**

### ***Description***

General anesthesia is used. The patient may be positioned supine or in the modified Lloyd-Davies position, with a urinary catheter in the bladder.

The objective of the procedure is to divide the adhesion(s) responsible for the surgical indication, nearly always small bowel obstruction. Adhesions can vary from a *single band*, which is usually divided with either the scalpel, diathermy, or dissecting scissors, to *complex adhesions* encasing and joining the bowel and/or other organs.

Previous surgery, inflammation, abscess, irradiation damage, or the presence of mesh often adds complexity. Irrigation and blunt dissection can significantly aid the development of planes between the small bowel serosa and other tissues.

Irrigation using a drawing-up cannula connected to a standard I/V set or the “irrigating” scalpel aids in dissection by creating a plane of “edema” around the small bowel and washing away any blood or fluid, making the dissection of adhesions easier. Alternatively injection of saline with a hypodermic syringe has similar benefits. Judicious use of the diathermy at a low setting has a similar effect with heat and fumes generated, opening up the plane for dissection.

Peritoneal lavage with warm saline is performed to remove debris and contamination. Serosal tears may be recognized by the “stripe” sign indicating the exposure of the underlying smooth muscle bands, which should be repaired transversely with continuous monofilament absorbable suture before full-thickness perforation occurs. Excision any necrotic or frayed tissue is usually prudent.

### ***Anatomical Points***

There are few congenital abnormalities that change the anatomy of the small bowel except Merkel’s diverticulum, malrotation, and the presence of Ladd’s bands in the right upper quadrant. The major variation that is relevant in this operation is the site and extent of the adhesions.

### ***Perspective***

See Table 6.2. This operation can be one of the most demanding in general surgery, particularly when dealing with multiple adhesions, especially those associated with

**Table 6.2** Small bowel adhesion surgery (without resection) and division of small bowel band adhesion(s) (including division of complex adhesions) estimated frequency of complications, risks, and consequences

Complications, risks, and consequences	Estimated frequency
<b><i>Most significant/serious complications</i></b>	
Infection <sup>a</sup> overall	1–5 %
Subcutaneous	1–5 %
Intra-abdominal/pelvic	0.1–1 %
Systemic	0.1–1 %
Bleeding/hematoma formation <sup>a</sup>	
Wound	1–5 %
Intra-abdominal	0.1–1 %
Paralytic ileus <sup>a</sup>	50–80 %
Bowel perforation (sometimes multiple) <sup>a</sup>	1–5 %
Small bowel fistulae <sup>a</sup>	1–5 %
Intolerance of large meals (necessity for small frequent meals) <sup>a</sup>	20–50 %
<b><i>Rare significant/serious problems</i></b>	
Possibility of ileostomy/colostomy <sup>a</sup>	0.1–1 %
Recurrent small bowel obstruction (early or late) <sup>a</sup> [ischemic stenosis/ adhesion re-formation]	0.1–1 %
Diarrhea	0.1–1 %
Nutritional deficiency <sup>a</sup> – anemia, B12 malabsorption <sup>a</sup>	0.1–1 %
Multisystem organ failure <sup>a</sup> (renal, pulmonary, cardiac failure)	0.1–1 %
Death <sup>a</sup>	0.1–1 %
<b><i>Less serious complications</i></b>	
Pain/tenderness [rib pain (sternal retractor), wound pain]	
Acute (<4 weeks)	>80 %
Chronic (>12 weeks)	1–5 %
Seroma formation	0.1–1 %
Wound dehiscence <sup>a</sup>	0.1–1 %
Incisional hernia formation (delayed heavy lifting/straining)	0.1–1 %
Wound scarring (poor cosmesis/wound deformity)	1–5 %
Nasogastric tube <sup>a</sup>	1–5 %
Wound drain tube(s) <sup>a</sup>	1–5 %

<sup>a</sup>Dependent on underlying pathology, anatomy, surgical technique, and preferences

irradiation, abscesses, or mesh. The ultimate objective is to divide all adhesions without sustaining injury to the small bowel or other organs. Breaches of the serosa are not uncommon, and full thickness (enterotomy) may occur in up to 40 % of cases with dense adhesions. Serosal tears may be repaired with interrupted monofilament absorbable material. Resection of a damaged small bowel segment may be necessary. The operation notes should include a diagram of the sites of enterotomies and resection lengths measured from the duodenal-jejunal (DJ) flexure. The consequences of enterotomy are significant and include wound infection, wound dehiscence, small bowel obstruction, intra-abdominal abscess, intra-abdominal leak, perforation of small bowel content with generalized peritonitis, and enterocutaneous fistula.

## *Major Complications*

The main complications arise from **perforation**, either concealed or revealed, occurring during division of adhesions. **Infection**, including **abscess** formation, **wound infection**, and **peritonitis**, may occur and be serious sometimes leading to **multisystem organ failure**. **Bleeding** is rarely serious, but oozing can be problematic and may cause mesenteric hematoma(s) that can become infected. **Wound dehiscence** and **enterocutaneous fistula** formation are serious but less common problems. **Small bowel obstruction** can recur and may be a repetitive, monotonous problem, requiring much hospitalization and surgery.

### **Consent and Risk Reduction**

#### **Main Points to Explain**

- Risk of leakage/fistula
- Infection
- Bleeding
- Risk of ileostomy
- Risk of organ injury
- Risk of further surgery

## **Resection of Small Bowel (with Primary Anastomosis)**

### *Description*

General anesthesia is used. Patient may be positioned, with a urinary catheter, supine or in the modified Lloyd-Davies position to provide better access for the scrub nurse or for the surgeon in accessing the left upper quadrant of the stomach. If irrigation is being used to aid in the dissection, then a plastic incise drape combined with adhesive irrigation bags is useful.

If this is “redo” or reentry surgery, access is best achieved by also extending the incision above/below the existing scar into the “virgin” abdominal wall. The old scar should be excised. Entry to the abdominal cavity should be by careful dissection with combination of sharp dissection and irrigation or diathermy.

The objective of the operation is to perform a resection of the small bowel with end-to-end anastomosis. A good arterial blood supply in both bowel ends is essential before attempting an anastomosis. Single- or double-layer continuous techniques using monofilament absorbable suture material are usually used. Stapling techniques have become popular using a combination of the GIA stapler and linear cutter performing a functional end-to-end (or end-side or side-side) anastomosis.

The most common indications are for multiple adhesions and for ischemic segments from band adhesions. The position(s) of small bowel anastomosis from the DJ flexure and/or ileocecal valve should be measured with a sterile ruler and clearly documented in the operation notes with a diagram.

Contraindications to anastomosis such as intra-abdominal sepsis, significant medical comorbidities, or risk factors reducing wound healing make an ileostomy and mucous fistula preferable, often through the same stomal aperture. Serosal tears may be recognized by the “stripe” sign indicating the exposure of the underlying smooth muscle bands, which should be repaired transversely with continuous monofilament absorbable suture before full-thickness perforation occurs. Excision of any necrotic or frayed tissue is usually prudent.

### *Anatomical Points*

There are a few anatomical points that affect the small bowel except for Meckel’s diverticulum, malrotation of the cecum, and Ladd’s bands. Situs abdominus inversus is very rare.

### *Perspective*

See Table 6.3. The complications of this operation often depend on the initial pathology for which the procedure was performed. The most serious complication being anastomotic leakage, the risk of which is increased by distal obstruction, often caused by distal adhesions, hence the need to dissect all adhesions from the DJ flexure to the ileocecal valve. The consequence of an anastomotic leakage is contamination of the peritoneal cavity, leading to generalized peritonitis or intra-abdominal abscess formation, typically in the paracolic gutters, pelvis, or the subphrenic spaces. Anastomotic leakages are reduced, by ensuring good blood supply to the bowel ends, no tension, and no factors contraindicating an anastomosis. Wound infection, small bowel obstruction, and enterocutaneous fistula are significant but fortunately uncommon complications.

### *Major Complications*

The main complications arise from **perforation**, either concealed or revealed, occurring during division of adhesions/bowel resection. Anastomotic leakage is a serious complication and may lead to generalized or localized sepsis. **Infection**, including **abscess** formation, **wound infection**, and **peritonitis**, may occur and be serious sometimes leading to **multisystem organ failure** and is the main cause of



**Table 6.3** Resection of small bowel (with primary anastomosis) estimated frequency of complications, risks, and consequences

Complications, risks, and consequences	Estimated frequency
<b><i>Most significant/serious complications</i></b>	
Infection <sup>a</sup> overall	1–5 %
Subcutaneous	1–5 %
Intra-abdominal/pelvic	0.1–1 %
Systemic	0.1–1 %
Bleeding/hematoma formation <sup>a</sup>	
Wound	1–5 %
Intra-abdominal	0.1–1 %
Paralytic ileus <sup>a</sup>	50–80 %
Bowel perforation (sometimes multiple) <sup>a</sup>	1–5 %
Intolerance of large meals (necessity for small frequent meals)	20–50 %
<b><i>Rare significant/serious problems</i></b>	
Possibility of ileostomy/colostomy (rare) <sup>a</sup>	0.1–1 %
Anastomotic breakdown/leakage	0.1–1 %
Recurrent small bowel obstruction (early or late) <sup>a</sup> [anastomotic stenosis/ischemic stenosis/adhesion re-formation]	0.1–1 %
Diarrhea	0.1–1 %
Nutritional deficiency – anemia, B12 malabsorption <sup>a</sup>	0.1–1 %
Short gut syndrome (extensive small bowel resection) <sup>a</sup>	<0.1 %
Pancreatitis/pancreatic injury/pancreatic cyst/leakage/pancreatic fistula	
Unresectability of ischemic/pathological segment	0.1–1 %
Small bowel fistulae <sup>a</sup>	1–5 %
Colonic injury/ischemia/fistula (middle colic arterial injury) <sup>a</sup>	0.1–1 %
Gastric/small bowel ischemia <sup>a</sup> (gastroepiploic, mesenteric arterial injury)	0.1–1 %
Vascular injury	0.1–1 %
Multisystem organ failure (renal, pulmonary, cardiac failure)	0.1–1 %
Death <sup>a</sup>	0.1–1 %
<b><i>Less serious complications</i></b>	
Pain/tenderness [rib pain (sternal retractor), wound pain]	
Acute (<4 weeks)	>80 %
Chronic (>12 weeks)	1–5 %
Seroma formation	0.1–1 %
Wound dehiscence	0.1–1 %
Incisional hernia formation (delayed heavy lifting/straining)	0.1–1 %
Wound scarring (poor cosmesis/wound deformity)	1–5 %
Nasogastric tube <sup>a</sup>	1–5 %
Wound drain tube(s) <sup>a</sup>	1–5 %

<sup>a</sup>Dependent on underlying pathology, anatomy, surgical technique, and preferences

**death** when it occurs. **Bleeding** is rarely serious, but oozing can be problematic and may cause mesenteric hematoma(s) that can become infected. **Wound dehiscence** and **enterocutaneous fistula** formation are serious but less common problems. **Small bowel obstruction** can recur and may be a repetitive, monotonous problem, requiring much hospitalization and surgery.

## **Consent and Risk Reduction**

### **Main Points to Explain**

- Risk of leakage/fistula
- Infection
- Bleeding
- Risk of ileostomy
- Risk of organ injury
- Risk of further surgery

## **Resection of Small Bowel (Without Primary Anastomosis) Ileostomy and Mucous Fistula**

### *Description*

General anesthesia is used. Preoperative counselling and siting with a stomal therapist is desirable. Positioning may be supine or in the modified Lloyd-Davies position with a urinary catheter to provide better access for the scrub nurse or for the surgeon in accessing the left upper abdominal quadrant.

If irrigation is being used to aid in the dissection, then a plastic incise drape combined with adhesive irrigation bags is useful.

If this is “redo” or “reentry” surgery, access is best achieved by also extending the incision above/below the existing scar into the “virgin” abdominal wall. The old scar should be excised. Entry to the abdominal cavity should be by careful dissection with combination of sharp dissection and irrigation or diathermy.

This procedure is often performed where it is unsafe to perform a small bowel anastomosis because of the presence of intra-abdominal sepsis, past irradiation, or mesh or in a patient who has medical comorbidities or other risk factors that reduce wound healing capacity, e.g., diabetes, renal failure, or malnutrition.

The aim therefore is to create a stoma using the proximal end of the small bowel that has been resected and create a mucous fistula of the distal end. This procedure is often performed in the emergency setting. Ideally the stoma should be properly sited preoperatively. In the emergency setting, this is in the horizontal plane 3–4 cm to the right of the umbilicus. The aperture in the skin and the abdominal wall should be adequate so that the proximal small bowel and the distal small bowel can easily be passed through the aperture with their associated mesentery (2–3 finger widths). An end ileostomy with a “spout” of at least 2 cm fashioned using a Brooke technique aids skin protection and bag entry. The distal bowel mucous fistula can be brought out adjacent to the end ileostomy through the same aperture. Stapling the distal end after confirming that it is distal using a linear stapler and suturing the end of the staple line with a monofilament nonabsorbable suture material to the rectus

sheath removes the mucous fistula and allows the whole aperture for the end ileostomy. The site of the stoma and distal bowel length should be measured by sterile ruler and clearly documented using a diagram in the operation notes. The abdominal wall and skin should be closed before fashioning/maturing the stoma to reduce contamination.

### *Anatomical Points*

There are a few anatomical points that affect the small bowel except for Meckel's diverticulum, malrotation of the cecum, and Ladd's bands. A shortened mesentery or severe obesity may make obtaining sufficient SB length difficult for stoma formation. Situs abdominus inversus is very rare.

### *Perspective*

See Table 6.4. Major complications of this operation often relate to complications of the ileostomy. Most serious in the initial postoperative period is ischemia of the stoma, avoided by ensuring good blood supply to the bowel ends, no tension, an adequate aperture, and no factors contraindicating ileostomy. Ischemia and retraction may lead to intraperitoneal leakage and generalized or localized peritonitis and sepsis. The initial pathology for which the procedure was performed and comorbidities often determine complications experienced. Fistula formation occurring in the small bowel proximal to the stoma may create a peristomal abscess, and leakage of small bowel contents into the subcutaneous tissue can be severely problematic.

Longer-term stoma complications include retraction, prolapse, peristomal hernia, and stenosis. Almost all stomas formed eventually develop some form of complication. Persistent proximal or even distal obstruction can be problematic in ensuring stomal function and distal SB drainage, respectively. Stomal skin problems and bag adherence are common issues that are troublesome.

Wound infection, small bowel obstruction, and enterocutaneous fistula are significant but fortunately uncommon complications. Later reversal of the ileostomy may be considered and is usually straightforward, but can be challenging in some situations.

### *Major Complications*

The main complications arise from **perforation**, either concealed or revealed, occurring during division of adhesions/bowel resection. **Stomal ischemia, retraction, and leakage** are serious complications and may lead to generalized or

**Table 6.4** Resection of small bowel (without primary anastomosis), ileostomy, and mucous fistula estimated frequency of complications, risks, and consequences

Complications, risks, and consequences	Estimated frequency
<b><i>Most significant/serious complications</i></b>	
Infection <sup>a</sup> overall	5–20 %
Subcutaneous	5–20 %
Intra-abdominal/pelvic	0.1–1 %
Systemic	0.1–1 %
Bleeding/hematoma formation <sup>a</sup>	
Wound	1–5 %
Intra-abdominal	0.1–1 %
Paralytic ileus <sup>a</sup>	50–80 %
Bowel perforation (sometimes multiple) <sup>a</sup>	1–5 %
Stomal ulceration	1–5 %
Para-stomal hernia formation	1–5 %
Small bowel fistulae <sup>a</sup>	1–5 %
Intolerance of large meals (necessity for small frequent meals)	20–50 %
<b><i>Rare significant/serious problems</i></b>	
Stomal retraction	0.1–1 %
Stomal prolapse	0.1–1 %
Para-stomal fistula formation	0.1–1 %
Stomal stenosis	0.1–1 %
Recurrent small bowel obstruction (early or late) <sup>a</sup> [ischemic stenosis/adhesion formation]	0.1–1 %
Diarrhea	0.1–1 %
Nutritional deficiency – anemia, B12 malabsorption <sup>a</sup>	0.1–1 %
Short gut syndrome (extensive small bowel resection) <sup>a</sup>	<0.1 %
Pancreatitis/pancreatic injury/pancreatic cyst/pancreatic fistula	<0.1 %
Seroma formation	0.1–1 %
Colonic injury/ischemia/fistula (middle colic arterial injury) <sup>a</sup>	0.1–1 %
Gastric/small bowel ischemia <sup>a</sup> (gastroepiploic, mesenteric arterial injury)	0.1–1 %
Vascular injury	0.1–1 %
Multisystem organ failure <sup>a</sup> (renal, pulmonary, cardiac failure)	0.1–1 %
Death <sup>a</sup>	0.1–1 %
<b><i>Less serious complications</i></b>	
Pain/tenderness [rib pain (sternal retractor), wound pain]	
Acute (<4 weeks)	>80 %
Chronic (>12 weeks)	1–5 %
Wound dehiscence	0.1–1 %
Incisional hernia formation (delayed heavy lifting/straining for 6–8 weeks)	0.1–1 %
Wound scarring (poor cosmesis/wound deformity)	1–5 %
Nasogastric tube <sup>a</sup>	1–5 %
Wound drain tube(s) <sup>a</sup>	1–5 %

<sup>a</sup>Dependent on underlying pathology, anatomy, surgical technique, and preferences

localized sepsis. **Infection**, including **abscess** formation, **wound infection**, and **peritonitis**, may occur and be serious sometimes leading to **multisystem organ failure** and is the main cause of **death** when it occurs. **Bleeding** is rarely serious, but oozing can be problematic and may cause mesenteric hematoma(s) that can become infected. **Wound dehiscence** and **enterocutaneous fistula** formation are serious but less common problems. **Small bowel obstruction** can recur and may be a repetitive, monotonous problem, requiring much hospitalization and surgery. Later ileostomy reversal is associated with risk of obstruction, leakage, and sepsis.

### **Consent and Risk Reduction**

#### **Main Points to Explain**

- Risk of leakage/fistula
- Infection
- Bleeding
- Stomal complications
- Risk of organ injury
- Risk of further surgery

## **Open Enteroenterostomy (Including Small Bowel Open Palliative Bypass)**

### *Description*

General anesthesia is used. Positioning is in the supine or in the modified Lloyd-Davies position with a urinary catheter to provide better access for the scrub nurse or for the surgeon in accessing the left upper abdominal quadrant. If irrigation is being used to aid in the dissection, then a plastic incisional drape combined with adhesive irrigation bags is useful. Often this is “redo” surgery and access is best achieved by also extending the incision above/below the existing scar into the “virgin” abdominal wall. The old scar should be excised. Entry to the abdominal cavity should be by careful dissection with combination of sharp dissection and irrigation or diathermy. The objective of this operation is to perform a bypass usually for a malignant or inflammatory obstruction that is not resectable. For this reason, the proximal bowel is typically dilated and the distal small bowel collapsed. The anastomosis is almost always side to side using longitudinal enterotomies in the proximal and distal bowel, using a single-layer continuous monofilament absorbable suture material alone or with a GIA stapler. It is usual to perform some form of

decompression of the proximal bowel to relieve pressure and allow better approximation – the authors favor either an intercostal thoracic catheter attached to suction with a side hole cut in the catheter to allow decompression with lower pressure suction or a large-bore (16G) needle attached to a 5 ml syringe with plunger removed to take the end of the suction tubing. The tube/needle is moved around to extract gas and fluid and the insertion hole(s) closed with 3/0 monofilament absorbable sutures. Serosal tears may be recognized by the “stripe” sign indicating the exposure of the underlying smooth muscle bands, which should be repaired transversely with continuous monofilament absorbable suture before full-thickness perforation occurs. Excision any necrotic or frayed tissue is usually prudent.

### *Anatomical Points*

There are a few anatomical points that affect the small bowel except for Meckel’s diverticulum, malrotation of the cecum, and Ladd’s bands. Situs abdominus inversus is very rare. Previous surgery and the underlying pathology, causing acquired anatomical distortion or modification, largely determine the technical difficulties encountered.

### *Perspective*

See Table 6.5. The aim of this operation is often palliative to relieve small bowel obstruction in a patient who has disseminated intra-abdominal malignancy and a poor prognosis, usually with an expected median survival of some 3–9 months. The patients are often malnourished or have other medical comorbidities that mitigate against good wound healing. Consequently wound infection, wound dehiscence, small bowel obstruction, anastomotic leakage, and enterocutaneous fistula are more common than in healthier patients. Sometimes the procedure does not alleviate the obstructive problem. Occasionally, the palliation is remarkably good with return of good levels of functioning and improved quality of life. Sometimes the procedure is therapeutic, especially in the high-anesthetic-risk patient with benign very dense adhesions or indeterminate mass, where an expedient operation may assist. Repeat surgery is sometimes indicated in some settings.

### *Major Complications*

The main complications arise from **perforation**, either concealed or revealed, occurring during division of adhesions/bowel resection or from the anastomosis. **Anastomotic leakage** is a serious complication and may lead to generalized or

**Table 6.5** Open enteroenterostomy (including small bowel open palliative bypass) estimated frequency of complications, risks, and consequences

Complications, risks, and consequences	Estimated frequency
<i><b>Most significant/serious complications</b></i>	
Infection <sup>a</sup> overall	1–5 %
Subcutaneous	1–5 %
Intra-abdominal/pelvic	0.1–1 %
Systemic	0.1–1 %
Bleeding/hematoma formation <sup>a</sup>	
Wound	1–5 %
Intra-abdominal	0.1–1 %
Paralytic ileus <sup>a</sup>	50–80 %
Bowel perforation (sometimes multiple) <sup>a</sup>	1–5 %
Small bowel fistulae <sup>a</sup>	1–5 %
Intolerance of large meals (necessity for small frequent meals)	20–50 %
<i><b>Rare significant/serious problems</b></i>	
Small bowel obstruction (early or late) <sup>a</sup> [anastomotic stenosis/ischemic stenosis/adhesion formation]	0.1–1 %
Anastomotic breakdown/leakage	0.1–1 %
Possibility of colostomy/ileostomy (rare) <sup>a</sup>	0.1–1 %
Nutritional deficiency – anemia, B12 malabsorption <sup>a</sup>	0.1–1 %
Pancreatitis/pancreatic injury/pancreatic cyst/leakage/pancreatic fistula	
Diarrhea	0.1–1 %
Seroma formation	0.1–1 %
Colonic injury/ischemia/fistula (middle colic arterial injury) <sup>a</sup>	0.1–1 %
Gastric/small bowel ischemia <sup>a</sup> (gastroepiploic, mesenteric arterial injury)	0.1–1 %
Vascular injury	0.1–1 %
Multisystem organ failure <sup>a</sup> (renal, pulmonary, cardiac failure)	0.1–1 %
Death <sup>a</sup>	0.1–1 %
<i><b>Less serious complications</b></i>	
Pain/tenderness [rib pain (sternal retractor), wound pain]	
Acute (<4 weeks)	>80 %
Chronic (>12 weeks)	1–5 %
Wound dehiscence	0.1–1 %
Incisional hernia formation (delayed heavy lifting/straining)	0.1–1 %
Wound scarring (poor cosmesis/wound deformity)	1–5 %
Nasogastric tube <sup>a</sup>	1–5 %
Wound drain tube(s) <sup>a</sup>	1–5 %

<sup>a</sup>Dependent on underlying pathology, anatomy, surgical technique, and preferences

localized sepsis. **Infection**, including **abscess** formation, **wound infection**, and **peritonitis**, may occur and be serious sometimes leading to **multisystem organ failure** and is the main cause of **death** when it occurs. **Bleeding** is rarely serious, but oozing can be problematic and may cause mesenteric hematoma(s) that can become infected. **Wound dehiscence** and **enterocutaneous fistula** formation are serious but less common problems. **Small bowel obstruction** can recur and may be a repetitive, monotonous problem, requiring much hospitalization and even further surgery.

## **Consent and Risk Reduction**

### **Main Points to Explain**

- Risk of leakage/fistula
- Infection
- Bleeding
- Risk of ileostomy
- Risk of organ injury
- Risk of further surgery

## **Laparoscopic Enteroenterostomy**

### *Description*

General anesthesia is used. Laparoscopic procedures have assumed an important place in intestinal bypass and are being developed continually. Positioning is in the supine or in the modified Lloyd-Davies position with a urinary catheter to provide better access for the scrub nurse or for the surgeon in accessing the left upper abdominal quadrant. Entry to the abdominal cavity should be by careful open cut-down to avoid vascular or bowel injury. The objective of this operation is to perform a bypass for either malignant or inflammatory obstruction that is not resectable. For this reason, the proximal bowel is typically dilated and the distal small bowel collapsed. The anastomosis is almost always side to side using longitudinal enterotomies in the proximal and distal bowel, using a single-layer continuous monofilament absorbable suture material alone or with a stapler. It is usual to perform some form of decompression of the proximal bowel to relieve pressure and allow better approximation which can be by preoperative suction and/or intraoperative needle puncture. Serosal tears may be recognized by the “stripe” sign indicating the exposure of the underlying smooth muscle bands, which should be repaired transversely with continuous monofilament absorbable suture before full-thickness perforation occurs. Excision any necrotic or frayed tissue is usually prudent.

### *Anatomical Points*

There are a few anatomical points that affect the small bowel except for Meckel’s diverticulum, malrotation of the cecum, and Ladd’s bands. Situs abdominus inversus is very rare. Previous surgery and the underlying pathology, causing acquired anatomical distortion or modification, largely determine the technical difficulties encountered.



## Perspective

See Table 6.6. The aim of this operation is often palliative to relieve small bowel obstruction in a patient who has disseminated intra-abdominal malignancy and a poor prognosis, usually with an expected median survival of some 3–9 months.

**Table 6.6** Laparoscopic enteroenterostomy estimated frequency of complications, risks, and consequences

Complications, risks, and consequences	Estimated frequency
<b><i>Most significant/serious complications</i></b>	
Infection <sup>a</sup> overall	1–5 %
Subcutaneous	1–5 %
Intra-abdominal/pelvic	0.1–1 %
Systemic	0.1–1 %
Port site	0.1–1 %
Bleeding/hematoma formation <sup>a</sup>	
Wound	1–5 %
Intra-abdominal	0.1–1 %
Conversion to open operation	1–5 %
Paralytic ileus <sup>a</sup>	50–80 %
Small bowel fistulae <sup>a</sup>	1–5 %
Intolerance of large meals (necessity for small frequent meals)	20–50 %
<b><i>Rare significant/serious problems</i></b>	
Injury to the bowel or blood vessels (trochar or diathermy)	0.1–1 %
Gas embolus	0.1–1 %
Port site hernia formation	0.1–1 %
Small bowel obstruction (early or late) <sup>a</sup> [anastomotic stenosis/ ischemic stenosis/adhesion formation]	0.1–1 %
Possibility of colostomy/ileostomy (rare) <sup>a</sup>	0.1–1 %
Anastomotic breakdown/leakage	0.1–1 %
Diarrhea	0.1–1 %
Nutritional deficiency – anemia, B12 malabsorption <sup>a</sup>	0.1–1 %
Pancreatitis/pancreatic injury/pancreatic cyst/leakage/pancreatic fistula	
Seroma formation	0.1–1 %
Colonic injury/ischemia/fistula (middle colic arterial injury) <sup>a</sup>	0.1–1 %
Gastric/small bowel ischemia <sup>a</sup> (Gastroepiploic, mesenteric arterial injury)	0.1–1 %
Multisystem organ failure <sup>a</sup> (renal, pulmonary, cardiac failure)	0.1–1 %
Death <sup>a</sup>	0.1–1 %
<b><i>Less serious complications</i></b>	
Pain/tenderness [rib pain (sternal retractor), wound pain]	
Acute (<4 weeks)	>80 %
Chronic (>12 weeks)	1–5 %
Wound dehiscence	0.1–1 %
Wound scarring (poor cosmesis/wound deformity)	1–5 %
Nasogastric tube <sup>a</sup>	1–5 %
Wound drain tube(s) <sup>a</sup>	1–5 %

<sup>a</sup>Dependent on underlying pathology, anatomy, surgical technique, and preferences

The patients are often malnourished or have other medical comorbidities that mitigate against good wound healing. Consequently wound infection, wound dehiscence, small bowel obstruction, anastomotic leakage, and enterocutaneous fistula are more common than in healthier patients. Sometimes the procedure does not alleviate the obstructive problem. Occasionally, the palliation is remarkably good with return of good levels of functioning and improved quality of life. Sometimes the procedure is therapeutic, especially in the high-anesthetic-risk patient with benign very dense adhesions or indeterminate mass, where an expedient operation may assist. Repeat surgery is sometimes indicated in some settings. Laparoscopic methods carry a range of specific attendant advantages and risks over open techniques.

### *Major Complications*

The main complications arise from **perforation**, either concealed or revealed, occurring during division of adhesions/bowel resection or from the anastomosis. **Anastomotic leakage** is a serious complication and may lead to generalized or localized sepsis. **Infection**, including **abscess** formation, **wound infection**, and **peritonitis**, may occur and be serious sometimes leading to **multisystem organ failure** and is the main cause of **death** when it occurs. **Bleeding** is rarely serious, but oozing can be problematic and may cause mesenteric hematoma(s) that can become infected. **Wound dehiscence** and **enterocutaneous fistula** formation are serious but less common problems. **Small bowel obstruction** can recur and may be a repetitive, monotonous problem, requiring much hospitalization and even further surgery. **Gas embolus** and **major vascular or bowel injury** are additional serious, although very rare, complications of the laparoscopic approach.

#### **Consent and Risk Reduction**

##### **Main Points to Explain**

- Risk of leakage/fistula
- Infection
- Bleeding
- Risk of ileostomy
- Risk of organ injury
- Gas embolism
- Risk of open operation
- Risk of further surgery

## Small Bowel Tumor Resection Surgery

### *Description*

General anesthesia is used. Positioning in the supine or modified Lloyd-Davies position with a urinary catheter may provide better access for the scrub nurse or for the surgeon in accessing the left upper abdominal quadrant. If irrigation is being used to aid in the dissection, then a plastic incise drape combined with adhesive irrigation bags is useful. If this is “redo” surgery, access is best achieved by also extending the incision above/below the existing scar into the “virgin” abdominal wall. The old scar should be excised. Entry to the abdominal cavity should be by careful dissection with combination of sharp dissection and irrigation or diathermy. The objective of this operation is to perform a resection of the small bowel tumor (usually malignant), the mesentery, and lymph glands and perform an end-to-end anastomosis. Because small bowel tumors often present late with bowel obstruction, there are often many lymph glands involved in the mesentery and the resection often therefore is palliative. In some circumstances a palliative enterenterostomy may be more appropriate. The length of SB resection depends on mesenteric lymph gland involvement and local invasion. Wedge resection of the tumor and mesentery is sometimes achievable. A good arterial blood supply in both bowel ends is essential before attempting an anastomosis. Single- or double-layer continuous techniques using monofilament absorbable suture material are usually used. Absence of tumor at the margins is imperative. Stapling techniques have become popular using a combination of the GIA stapler and linear cutter performing a functional end-to-end (or end-side or side-side) anastomosis. Good hemostasis, especially of the mesenteric and omental vessels, is essential.

### *Anatomical Points*

There are a few anatomical points that affect the small bowel except for Meckel’s diverticulum, malrotation of the cecum, and Ladd’s bands. Situs abdominus inversus is very rare. Previous surgery and the underlying pathology, causing acquired anatomical distortion or modification, largely determine the technical difficulties encountered.

### *Perspective*

See Table 6.7. The most serious complication is anastomotic leakage, and this will occur in two situations: the first is where there has been a technical problem, either inadequate blood supply or poor technical anastomotic technique; and the second

**Table 6.7** Small bowel tumor resection surgery estimated frequency of complications, risks, and consequences

Complications, risks, and consequences	Estimated frequency
<b><i>Most significant/serious complications</i></b>	
Infection <sup>a</sup> overall	1–5 %
Subcutaneous	1–5 %
Intra-abdominal/pelvic	0.1–1 %
Systemic	0.1–1 %
Bleeding/hematoma formation <sup>a</sup>	
Wound	1–5 %
Intra-abdominal	0.1–1 %
Unresectability of malignancy/involved resection margins <sup>a</sup>	Individual
Tumor recurrence <sup>a</sup>	Individual
Paralytic ileus <sup>a</sup>	50–80 %
Bowel perforation (sometimes multiple) <sup>a</sup>	1–5 %
Small bowel fistulae <sup>a</sup>	1–5 %
Intolerance of large meals (necessity for small frequent meals)	20–50 %
Deep venous thrombosis	1–5 %
<b><i>Rare significant/serious problems</i></b>	
Anastomotic breakdown/leakage	0.1–1 %
Possibility of colostomy/ileostomy (rare) <sup>a</sup>	0.1–1 %
Nutritional deficiency – anemia, B12 malabsorption <sup>a</sup>	0.1–1 %
Short gut syndrome (extensive small bowel resection) <sup>a</sup>	<0.1
Liver/biliary/bowel/renal/adrenal/diaphragmatic injury <sup>a</sup>	0.1–1 %
Thoracic duct injury (chylous leak, fistula) <sup>a</sup>	<0.1
Diarrhea	0.1–1 %
Splenic injury <sup>a</sup>	0.1–1 %
Conservation (consequent limitation to activity; late rupture)	
Splenectomy	
Pancreatitis/pancreatic injury/pancreatic cyst/leakage/pancreatic fistula	
Seroma formation	0.1–1 %
Colonic injury/ischemia/fistula (middle colic arterial injury) <sup>a</sup>	0.1–1 %
Gastric/small bowel ischemia <sup>a</sup> (gastroepiploic, mesenteric arterial injury)	0.1–1 %
Vascular injury	0.1–1 %
Small bowel obstruction (early or late) <sup>a</sup> [anastomotic stenosis/ischemic stenosis/adhesion formation]	0.1–1 %
Multisystem organ failure <sup>a</sup> (renal, pulmonary, cardiac failure)	0.1–1 %
Death <sup>a</sup>	0.1–1 %
<b><i>Less serious complications</i></b>	
Pain/tenderness [rib pain (sternal retractor), wound pain]	
Acute (<4 weeks)	>80
Chronic (>12 weeks)	1–5 %
Wound dehiscence	0.1–1 %
Incisional hernia formation (delayed heavy lifting/straining)	0.1–1 %
Wound scarring (poor cosmesis/wound deformity)	1–5 %
Nasogastric tube <sup>a</sup>	1–5 %
Wound drain tube(s) <sup>a</sup>	1–5 %

<sup>a</sup>Dependent on underlying pathology, anatomy, surgical technique, and preferences

situation is where the patient has an increased risk of poor wound healing because of either coexisting medical morbidities, e.g., diabetes and/or malnutrition and the patient's other treatment(s), or underlying disease process causing immunosuppression and/or poor wound healing. Wound infection is the most common complication, followed by wound dehiscence or long-term incisional hernia formation. Breakdown of the anastomosis may lead to generalized peritonitis or localized intra-abdominal abscess in either the pericolic gutter, pelvis, or subphrenic space. Severe sepsis may result. Enterocutaneous fistula may also occur.

### *Major Complications*

The main complications arise from **perforation**, either concealed or revealed, occurring during division of adhesions/bowel resection. **Stomal ischemia, retraction, and leakage** are serious complications and may lead to generalized or localized sepsis. **Infection**, including **abscess** formation, **wound infection**, and **peritonitis**, may occur and be serious sometimes leading to **multisystem organ failure** and is the main cause of **death** when it occurs. **Bleeding** is rarely serious, but oozing can be problematic and may cause mesenteric hematoma(s) that can become infected. **Wound dehiscence** and **enterocutaneous fistula** formation are serious but less common problems. **Small bowel obstruction** can recur and may be a repetitive, monotonous problem, requiring much hospitalization and surgery. Later ileostomy reversal is associated with risk of obstruction, leakage, and sepsis.

#### **Consent and Risk Reduction**

##### **Main Points to Explain**

- Risk of leakage/fistula
- Infection
- Bleeding
- Risk of ileostomy
- Risk of organ injury
- Risk of unresectability
- Risk of tumor recurrence
- Risk of further surgery

### **Open Ileostomy (End/Loop Ileostomy, Without Resection)**

#### *Description*

General anesthesia is used. Preoperative counselling and siting with a stomal therapist is desirable. Positioning may be supine or in the modified Lloyd-Davies position with a urinary catheter to provide better access for the scrub nurse or for the surgeon

in accessing the left upper abdominal quadrant. If this is “redo” surgery, access is best achieved by also extending the incision above/below the existing scar into the “virgin” abdominal wall. The old scar should be excised. Entry to the abdominal cavity should be by careful dissection with combination of sharp dissection and irrigation or diathermy. This procedure is relatively rarely performed alone where the small bowel needs to be defunctioned to rest the distal SB or colon or for perianal trauma/sepsis. End ileostomy is more usually performed during colonic/rectal anastomosis for diversion of the fecal stream to reduce stress on the anastomosis. The aim therefore is to create a stoma using a loop of SB or an end ileostomy (+/- a mucous fistula). This procedure may be performed in the emergency setting for local external anal/rectal trauma. Ideally the stoma should be properly sited preoperatively. In the emergency setting this is in the horizontal plane 3–4 cm to the right of the umbilicus. The aperture in the skin and the abdominal wall should be adequate so that the proximal small bowel and the distal small bowel can easily be passed through the aperture with their associated mesentery (2–3 finger widths). An end ileostomy with a “spout” of least 2 cm fashioned using a “Brooke” technique aids skin protection and bag entry. The distal bowel mucous fistula can be brought out adjacent to the end ileostomy through the same aperture. Stapling the distal end after confirming that it is distal using a linear stapler and suturing the end of the staple line with a monofilament nonabsorbable suture material to the rectus sheath removes the mucous fistula and allows the whole aperture for the end ileostomy. The site of the stoma and distal bowel length should be measured by sterile ruler and clearly documented using a diagram in the operation notes. The abdominal wall and skin should be closed before fashioning/maturing the stoma, to reduce contamination. The presence of intra-abdominal sepsis, past irradiation, mesh or in a patient who has medical comorbidities or other risk factors that reduce wound healing capacity, e.g., diabetes, renal failure, or malnutrition is associated with higher risk of complications with the stoma.

### *Anatomical Points*

There are a few anatomical points that affect the small bowel except for Meckel’s diverticulum, malrotation of the cecum, and Ladd’s bands. A shortened mesentery or severe obesity may make obtaining sufficient SB length difficult for stoma formation. Situs abdominus inversus is very rare.

### *Perspective*

See Table 6.8. Major complications of this operation often relate to complications of the ileostomy. The most serious in the initial postoperative period is ischemia of the stoma, avoided by ensuring good blood supply to the bowel ends, no tension, an adequate aperture, and no factors contraindicating ileostomy. Ischemia and

**Table 6.8** Open ileostomy (end/loop ileostomy, without resection) estimated frequency of complications, risks, and consequences

Complications, risks, and consequences	Estimated frequency
<b><i>Most significant/serious complications</i></b>	
Infection <sup>a</sup> overall	1–5 %
Subcutaneous	1–5 %
Intra-abdominal/pelvic	0.1–1 %
Systemic	0.1–1 %
Bleeding/hematoma formation <sup>a</sup>	
Wound	1–5 %
Intra-abdominal	0.1–1 %
Stomal ulceration	1–5 %
Para-stomal hernia formation	1–5 %
Electrolyte/fluid disturbance	5–20 %
Diarrhea (longer term)	1–5 %
Nutritional deficiency – anemia, B12 malabsorption <sup>a</sup>	1–5 %
Paralytic ileus <sup>a</sup>	50–80 %
Bowel perforation (sometimes multiple) <sup>a</sup>	1–5 %
Small bowel fistulae <sup>a</sup>	1–5 %
Intolerance of large meals (necessity for small frequent meals) (gastroepiploic, mesenteric arterial injury)	20–50 %
Vascular injury	0.1–1 %
<b><i>Rare significant/serious problems</i></b>	
Stomal stenosis/obstruction	0.1–1 %
Stomal retraction	0.1–1 %
Stomal prolapse	0.1–1 %
Para-stomal fistula formation	0.1–1 %
Malpositioning of ileostomy	0.1–1 %
Selection of incorrect limb of loop as distal end <sup>b</sup>	<0.1 %
Pancreatitis/pancreatic injury/pancreatic cyst/leakage/fistula	0.1–1 %
Seroma formation	0.1–1 %
Colonic injury/ischemia/fistula (middle colic arterial injury) <sup>a</sup>	0.1–1 %
Gastric/small bowel ischemia <sup>a</sup>	0.1–1 %
Small bowel obstruction (early or late) <sup>a</sup> [anastomotic stenosis/ischemic stenosis/adhesion formation]	0.1–1 %
Multisystem organ failure <sup>a</sup> (renal, pulmonary, cardiac failure) <sup>a</sup>	0.1–1 %
Death <sup>a</sup>	0.1–1 %
<b><i>Less serious complications</i></b>	
Pain/tenderness [rib pain (sternal retractor), wound pain]	
Acute (<4 weeks)	>80 %
Chronic (>12 weeks)	1–5 %
Wound dehiscence	0.1–1 %
Incisional hernia formation (delayed heavy lifting/straining)	0.1–1 %
Wound scarring (poor cosmesis/wound deformity)	1–5 %
Nasogastric tube <sup>a</sup>	1–5 %
Wound drain tube(s) <sup>a</sup>	1–5 %

<sup>a</sup>Dependent on underlying pathology, anatomy, surgical technique, and preferences<sup>b</sup>Failure to ensure correct orientation of bowel; surgeon error

retraction may lead to intraperitoneal leakage and generalized or localized peritonitis and sepsis. Tension can be a serious problem in patients with a shorter mesentery or abdominal obesity where obtaining sufficient tension-free length may be difficult. The initial pathology for which the procedure was performed and comorbidities often determine complications experienced.

Fistula formation occurring in the small bowel proximal to the stoma may create a peristomal abscess, and leakage of small bowel contents into the subcutaneous tissue can be severely problematic. Longer-term stoma complications include retraction, prolapse, peristomal hernia, and stenosis. Almost all stomas formed eventually develop some form of complication. Persistent proximal or even distal obstruction can be problematic in ensuring stomal function and distal SB drainage, respectively. Stomal skin problems and bag adherence are common issues that are troublesome. Wound infection, small bowel obstruction, and enterocutaneous fistula are significant but fortunately uncommon complications. Later reversal of the ileostomy may be considered and is usually straightforward, but can be challenging in some situations.

### *Major Complications*

The main complications arise from **perforation**, either concealed or revealed, occurring during division of adhesions/bowel resection/bowel mobilization. **Stomal ischemia, retraction, and leakage** are serious complications and may lead to generalized or localized sepsis. **Infection**, including **abscess** formation, **wound infection**, and **peritonitis**, may occur and be serious sometimes leading to **multisystem organ failure**. **Bleeding** is rarely serious, but oozing can be problematic and may cause mesenteric hematoma(s) that can become infected. **Wound dehiscence** and **enterocutaneous fistula** formation are serious but less common problems. **Small bowel obstruction** can occur and may be a repetitive, monotonous problem, requiring much hospitalization and surgery. Later ileostomy reversal is associated with risk of obstruction, leakage, and sepsis.

#### **Consent and Risk Reduction**

##### **Main Points to Explain**

- Risk of leakage/fistula
- Infection
- Bleeding
- Stomal complications
- Risk of organ injury
- Risk of further surgery



## Laparoscopic Ileostomy (Loop or End Ileostomy)

### *Description*

General anesthesia is used. Preoperative counselling and siting with a stomal therapist is desirable. Laparoscopic procedures have assumed an important place in intestinal surgery and are being developed continually. Positioning is in the supine or in the modified Lloyd-Davies position with a urinary catheter to provide better access for the scrub nurse or for the surgeon in accessing the left upper abdominal quadrant. Entry to the abdominal cavity should be by careful open cutdown to avoid vascular or bowel injury. This procedure is relatively rarely performed alone, usually for benign diseases, where the small bowel needs to be defunctioned to rest the distal SB or colon or for perianal trauma/sepsis. End ileostomy is more usually performed during laparoscopic colonic/rectal anastomosis for diversion of the fecal stream to reduce stress on the anastomosis. The aim therefore is to create a stoma using a loop of SB or an end ileostomy (+/- a mucous fistula). This procedure may be performed in the emergency setting for local external anal/rectal trauma. Ideally the stoma should be properly sited preoperatively. In the emergency setting this is in the horizontal plane 3–4 cm to the right of the umbilicus. The aperture in the skin and the abdominal wall should be adequate so that the proximal small bowel and the distal small bowel can easily be passed through the aperture with their associated mesentery (2–3 finger widths). An end ileostomy with a “spout” of least 2 cm fashioned using a Brooke technique aids skin protection and bag entry. The distal bowel mucous fistula can be brought out adjacent to the end ileostomy through the same aperture. Stapling the distal end after confirming that it is distal using a linear stapler and suturing the end of the staple line with a monofilament nonabsorbable suture material to the rectus sheath removes the mucous fistula and allows the whole aperture for the end ileostomy. The site of the stoma and distal bowel length should be measured by sterile ruler and clearly documented using a diagram in the operation notes. The abdominal wall and skin should be closed before fashioning/maturing the stoma, to reduce contamination. The presence of intra-abdominal sepsis, past irradiation, mesh or in a patient who has medical comorbidities or other risk factors that reduce wound healing capacity, e.g., diabetes, renal failure, or malnutrition is associated with higher risk of complications with the stoma.

### *Anatomical Points*

There are a few anatomical points that affect the small bowel except for Meckel’s diverticulum, malrotation of the cecum, and Ladd’s bands. A shortened mesentery or severe obesity may make obtaining sufficient SB length difficult for stoma formation. Adhesions can dictate the ability to perform or difficulty of the laparoscopic approach. Situs abdominus inversus is very rare.

## *Perspective*

See Table 6.9. The procedure is usually easily performed with few complications of note. Major complications of this operation relate primarily to complications of the ileostomy. The most serious in the initial postoperative period is ischemia of the stoma, avoided by ensuring good blood supply to the bowel ends, no tension, an adequate aperture, and no factors contraindicating ileostomy. Ischemia and retraction may lead to intraperitoneal leakage and generalized or localized peritonitis and sepsis. Tension can be a serious problem in patients with a shorter mesentery or abdominal obesity where obtaining sufficient tension-free length may be difficult. The initial pathology for which the procedure was performed and comorbidities often determine complications experienced. Fistula formation occurring in the small bowel proximal to the stoma may create a peristomal abscess and leakage of small bowel contents into the subcutaneous tissue can be severely problematic. Longer-term stoma complications include retraction, prolapse, peristomal hernia, and stenosis. Almost all stomas formed eventually develop some form of complication. Persistent proximal or even distal obstruction can be problematic in ensuring stomal function and distal SB drainage, respectively. Stomal skin problems and bag adherence are common issues that are troublesome. Wound infection, small bowel obstruction, and enterocutaneous fistula are significant but fortunately uncommon complications. Later reversal of the ileostomy may be considered and is usually straightforward, but can be challenging in some situations. Laparoscopic methods carry a range of specific attendant advantages and risks over open techniques.

## *Major Complications*

The main complications arise from **perforation**, either concealed or revealed, occurring during division of adhesions/bowel resection/bowel mobilization. **Stomal ischemia, retraction, and leakage** are serious complications and may lead to generalized or localized sepsis. **Infection**, including **abscess** formation, **wound infection**, and **peritonitis**, may occur and be serious sometimes leading to **multisystem organ failure** and is the main cause of **death** when it occurs. **Bleeding** is rarely serious, but oozing can be problematic and may cause mesenteric hematoma(s) that can become infected. **Wound dehiscence** and **enterocutaneous fistula** formation are serious but less common problems. **Small bowel obstruction** can occur and may be a repetitive, monotonous problem, requiring much hospitalization and even further surgery. Later ileostomy reversal is associated with risk of obstruction, leakage, and sepsis. **Gas embolus** and **major vascular or bowel injury** are additional serious, although very rare, complications of the laparoscopic approach.

**Table 6.9** Laparoscopic ileostomy (loop or end ileostomy) estimated frequency of complications, risks, and consequences

Complications, risks, and consequences	Estimated frequency
<b><i>Most significant/serious complications</i></b>	
Infection <sup>a</sup> overall	1–5 %
Subcutaneous	1–5 %
Intra-abdominal/pelvic	0.1–1 %
Systemic	0.1–1 %
Port site	0.1–1 %
Bleeding/hematoma formation <sup>a</sup>	
Wound	1–5 %
Intra-abdominal	0.1–1 %
Conversion to open operation	1–5 %
Stomal ulceration	1–5 %
Para-stomal hernia formation	1–5 %
Electrolyte/fluid disturbance	5–20 %
Paralytic ileus <sup>a</sup>	50–80 %
Small bowel fistulae <sup>a</sup>	1–5 %
<b><i>Rare significant/serious problems</i></b>	
Stomal retraction	0.1–1 %
Stomal prolapse	0.1–1 %
Para-stomal fistula formation	0.1–1 %
Injury to the bowel or blood vessels (trochar or diathermy)	0.1–1 %
Gas embolus	0.1–1 %
Stomal stenosis/obstruction	0.1–1 %
Malpositioning of ileostomy	0.1–1 %
Selection of incorrect limb of loop as distal end <sup>b</sup>	<0.1 %
Small bowel obstruction (early or late) <sup>a</sup> [anastomotic stenosis/ischemic stenosis/adhesion formation]	0.1–1 %
Diarrhea	0.1–1 %
Nutritional deficiency – anemia, B12 malabsorption <sup>a</sup>	0.1–1 %
Pancreatitis/pancreatic injury/pancreatic cyst/fistula	0.1–1 %
Seroma formation	0.1–1 %
Colonic injury/ischemia/fistula (middle colic arterial injury) <sup>a</sup>	0.1–1 %
Gastric/small bowel ischemia <sup>a</sup> (gastroepiploic, mesenteric arterial injury)	0.1–1 %
Multisystem organ failure <sup>a</sup> (renal, pulmonary, cardiac failure)	0.1–1 %
Death <sup>a</sup>	0.1–1 %
<b><i>Less serious complications</i></b>	
Pain/tenderness [rib pain (sternal retractor), wound pain]	
Acute (<4 weeks)	>80 %
Chronic (>12 weeks)	1–5 %
Intolerance of large meals (necessity for small frequent meals)	20–50 %
Wound dehiscence	0.1–1 %
Wound scarring (poor cosmesis/wound deformity)	1–5 %
Nasogastric tube <sup>a</sup>	1–5 %
Port site hernia formation	0.1–1 %
Wound drain tube(s) <sup>a</sup>	1–5 %

<sup>a</sup>Dependent on underlying pathology, anatomy, surgical technique, and preferences

<sup>b</sup>Failure to ensure correct orientation of bowel, surgeon error

## **Consent and Risk Reduction**

### **Main Points to Explain**

- Risk of leakage/fistula
- Infection
- Bleeding
- Stomal complications
- Risk of organ injury
- Risk of open surgery
- Risk of further surgery

## **Open Reversal of Previous Loop or End Ileostomy**

### *Description*

General anesthesia is used. Positioning is in the supine or in the modified Lloyd-Davies position with a urinary catheter to provide better access for the scrub nurse or for the surgeon in accessing the left upper abdominal quadrant. Entry to the abdominal cavity should be by careful open cutdown around the stoma (+/- mucous fistula) site to reduce risk of vascular or bowel injury. This procedure is usually relatively straightforward and performed alone where the small bowel continuity can be restored safely. The aim therefore is to join the stomal and mucous fistula limbs by end-to-end anastomosis using a sutured or stapled technique. The stomal end is usually excised. The laparotomy used is generally small and localized to the stomal region; however, a separate midline approach is sometimes required. The aperture in the abdominal wall is usually closed directly with several heavy monofilament sutures. Delayed primary skin closure may be used to reduce infection as contamination is common. The procedure may be more difficult if the distal end has been returned to the abdomen in the initial end-ileostomy procedure. Infection risk is increased for the patient with past irradiation or mesh or when medical comorbidities or other risk factors that reduce wound healing capacity (e.g., diabetes, renal failure, or malnutrition) are present.

### *Anatomical Points*

The main anatomical points that affect this procedure are acquired through previous surgery and/or complications such as abscess or fistula/sinus formation. A shortened mesentery or severe obesity increases difficulty and risk of complications. Excessive scarring may make definition of anatomical planes challenging.

## Perspective

See Table 6.10. Major complications of this operation often relate to complications of the anastomosis. The most serious in the initial postoperative period are ischemia and leakage. Intraperitoneal leakage and generalized or localized peritonitis and sepsis may lead to systemic sepsis and multiorgan failure. Local infection, cellulitis, and abscess formation are not uncommon. The underlying pathology for which the procedure was performed and comorbidities often determine complications experienced. Fistula or sinus formation can also occur but is rare. Hernia formation is

**Table 6.10** Open reversal of previous loop or end ileostomy estimated frequency of complications, risks, and consequences

Complications, risks, and consequences	Estimated frequency
<b>Most significant/serious complications</b>	
Infection <sup>a</sup> overall	1–5 %
Subcutaneous	1–5 %
Intra-abdominal/pelvic	0.1–1 %
Systemic	0.1–1 %
Bleeding/hematoma formation <sup>a</sup>	
Wound	1–5 %
Intra-abdominal	0.1–1 %
Paralytic ileus <sup>a</sup>	50–80 %
Bowel perforation (sometimes multiple) <sup>a</sup>	1–5 %
Small bowel fistulae <sup>a</sup>	1–5 %
<b>Rare significant/serious problems</b>	
Anastomotic breakdown/leakage	0.1–1 %
Small bowel obstruction (early or late) <sup>a</sup> [anastomotic stenosis/ischemic stenosis/adhesion formation]	0.1–1 %
Diarrhea	0.1–1 %
Nutritional deficiency – anemia, B12 malabsorption <sup>a</sup>	0.1–1 %
Colonic injury/ischemia/fistula <sup>a</sup>	0.1–1 %
Vascular injury	0.1–1 %
Multisystem organ failure <sup>a</sup> (renal, pulmonary, cardiac failure)	0.1–1 %
Death <sup>a</sup>	<0.1 %
<b>Less serious complications</b>	
Pain/tenderness [rib pain (sternal retractor), wound pain]	
Acute (<4 weeks)	>80 %
Chronic (>12 weeks)	1–5 %
Intolerance of large meals (necessity for small frequent meals)	20–50 %
Wound dehiscence	0.1–1 %
Incisional hernia formation (delayed heavy lifting/straining)	0.1–1 %
Wound scarring (poor cosmesis/wound deformity)	1–5 %
Nasogastric tube <sup>a</sup>	1–5 %
Wound drain tube(s) <sup>a</sup>	1–5 %

<sup>a</sup>Dependent on underlying pathology, anatomy, surgical technique, and preferences

more common after infection, and small bowel obstruction at the anastomosis or from adhesions is also possible.

## *Major Complications*

The main complications arise from **anastomotic leakage** and **perforation**, either concealed or revealed. Leakage is a serious complication and may lead to generalized or localized sepsis. **Infection**, including **abscess** formation, **wound infection**, and **peritonitis**, may occur and be sometimes serious leading to **multisystem organ failure** and is the main cause of **death** when it occurs. **Bleeding** is rarely serious, but oozing can be problematic and may cause mesenteric hematoma(s) that can become infected. **Wound dehiscence** and **enterocutaneous fistula** formation are serious but less common problems. **Small bowel obstruction** can occur and may be a repetitive, monotonous problem, requiring much hospitalization and even further surgery.

### **Consent and Risk Reduction**

#### **Main Points to Explain**

- Risk of leakage/fistula
- Infection
- Bleeding
- Risk of repeat ileostomy
- Risk of organ injury
- Risk of further surgery

## **Crohn's Stricturoplasty (Open)**

### *Description*

General anesthesia is used. Positioning is in the supine or in the modified Lloyd-Davies position with a urinary catheter to provide better access for the scrub nurse or for the surgeon in accessing the left upper abdominal quadrant. If this is “redo” surgery, access is best achieved by also extending the incision above/below the existing scar into the “virgin” abdominal wall. The old scar should be excised. Entry to the abdominal cavity should be by careful dissection with combination of sharp dissection and irrigation or diathermy. The objective of this operation is to relieve SB obstruction due to the wall thickening from Crohn's ileitis. The usual method relies on longitudinal enterotomies through the thickened zones with transverse closure (so called Crohn's stricturoplasty), using interrupted monofilament

sutures. This procedure is often relatively straightforward, and multiple areas can be treated in this way, with or without SB resection and direct end-to-end anastomosis in some cases. Infection risk is increased for the patient with past irradiation, on immunosuppressive therapy, or with mesh or when medical comorbidities or other risk factors that may reduce wound healing capacity, e.g., diabetes, renal failure, active inflammation, or malnutrition, are present. Good hemostasis, especially of the mesenteric and omental vessels, is essential to avoid bleeding or hematoma formation.

### *Anatomical Points*

The main anatomical points that affect this procedure are acquired through previous surgery and/or complications such as abscess or fistula/sinus formation and excessive SB thickening. Crohn's disease typically has areas on normal appearing bowel between the affected segments. The extent of the affected bowel modifies the surgical anatomy. The existence of fistulae, sinuses, and adhesions to other structures usually increases the risks of surgical complications. A shortened mesentery or severe obesity increases the difficulty and complication risk. Excessive scarring may make definition of anatomical planes challenging.

### *Perspective*

See Table 6.11. Major complications of this operation often relate to complications of the anastomosis. The most serious in the initial postoperative period are ischemia and leakage. Intraperitoneal leakage and generalized or localized peritonitis and sepsis may lead to systemic sepsis and multiorgan failure. Local infection, cellulitis, and abscess formation are not uncommon. The Heineke-Mikulicz-type stricturoplasty is the most common (81 %), followed by the Finney type (10 %). The underlying Crohn's pathology for which the procedure was performed and comorbidities often determine complications experienced. Fistula or sinus formation can also occur but is rare, either pre- or postoperatively. If present preoperatively, the risk is increased postoperatively. Hernia formation is more common after infection, and small bowel obstruction at the anastomosis or from adhesions is also possible. Recurrence of Crohn's strictures is common; although not an operative complication per se, these usually occur at sites other than at the stricturoplasty site(s).

### *Major Complications*

The main complications arise from **anastomotic leakage** and **perforation**, either concealed or revealed. Leakage is a serious complication and may lead to

**Table 6.11** Crohn's stricturoplasty (open) estimated frequency of complications, risks, and consequences

Complications, risks, and consequences	Estimated frequency
<i><b>Most significant/serious complications</b></i>	
Infection <sup>a</sup> overall	1–5 %
Subcutaneous	1–5 %
Intra-abdominal/pelvic	0.1–1 %
Systemic	0.1–1 %
Bleeding/hematoma formation <sup>a</sup>	
Wound	1–5 %
Intra-abdominal	1–5 %
Recurrence of stricture(s) (all sites, previous and new)	20–50 %
Paralytic ileus <sup>a</sup>	50–80 %
Anastomotic breakdown/leakage	1–5 %
<i><b>Rare significant/serious problems</b></i>	
Small bowel obstruction (early or late) <sup>a</sup> [anastomotic stenosis/ischemic stenosis/adhesion formation]	0.1–1 %
Bowel perforation (sometimes multiple) <sup>a</sup>	0.1–1 %
Small bowel fistulae <sup>a</sup>	0.1–1 %
Vascular injury	0.1–1 %
Carcinoma at stricturoplasty	<0.1 %
Multisystem organ failure <sup>a</sup> (renal, pulmonary, cardiac failure)	0.1–1 %
Death <sup>a</sup>	<0.1 %
<i><b>Less serious complications</b></i>	
Pain/tenderness [wound pain]	
Acute (<4 weeks)	>80 %
Chronic (>12 weeks)	1–5 %
Intolerance of large meals (necessity for small frequent meals)	1–5 %
Wound dehiscence	0.1–1 %
Incisional hernia formation (delayed heavy lifting/straining)	0.1–1 %
Wound scarring (poor cosmesis/wound deformity)	1–5 %
Nasogastric tube <sup>a</sup>	1–5 %
Wound drain tube(s) <sup>a</sup>	1–5 %

<sup>a</sup>Dependent on underlying pathology, anatomy, surgical technique, and preferences

generalized or localized sepsis. **Infection**, including **abscess** formation, **wound infection**, and **peritonitis**, may occur and be sometimes serious leading to **multi-system organ failure** and is the main cause of **death** when it rarely occurs. **Local infection** is relatively common and sometimes a chronic problem. **Bleeding** is rarely serious, but oozing can be problematic and may cause mesenteric hematoma(s) that can become infected. **Wound dehiscence** and **enterocutaneous fistula/sinus** formation are serious but less common problems. **Small bowel obstruction** can occur and may be a repetitive, monotonous problem, requiring much hospitalization and even further surgery. The creation of a **stoma** (ileostomy and/or colostomy) may be required in specific circumstances.



## Consent and Risk Reduction

### Main Points to Explain

- Risk of leakage/fistula
- Infection
- Bleeding
- Risk of stoma
- Risk of organ injury
- Recurrent strictures
- Risk of further surgery

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