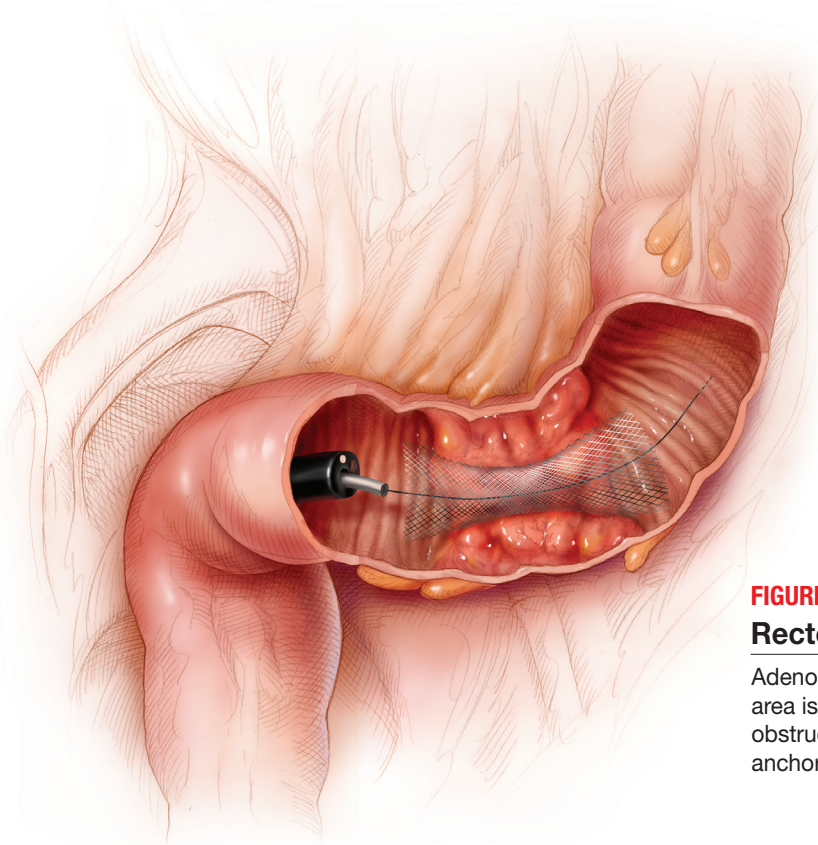


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FIGURE

Rectosigmoid placement

Adenocarcinoma in the rectosigmoid area is the leading cause of colonic obstruction. Tumor ingrowth helps anchor the stent after it is deployed.

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How to use stents for colorectal obstruction

This nonoperative alternative can avoid emergency surgery and improve survival.

The colorectal cancer patient with acute colonic obstruction poses a surgical emergency. Failing expeditious treatment, the patient can end up with intestinal ischemia, perforation, and sepsis. Yet, emergency colectomy in this patient carries high morbidity and mortality.

So surgeons have devised various nonoperative approaches to managing malignant or benign colonic obstruction. However, these approaches have limited applications because of the risk of perforation and tumor seeding, higher costs of repeat treatments, limited efficacy, rapid

tumor regrowth, and technical difficulties accessing the tumor.¹⁻⁶

One alternative nonoperative approach, especially for the patient with unresectable or widely metastatic disease, is to implant a self-expanding metallic stent (SEMS) in the obstructed segment.

Avoid emergency surgery

Nonoperative treatment of acute colonic obstruction aims to avoid an emergency laparotomy on an unprepared colon in the debilitated patient. SEMS were first used for esophageal, tracheobronchial, and

biliary tree obstructions.^{1,7} Since the first reports in the late 1990s, multiple authors have evaluated the use of SEMS for managing large-bowel obstruction.^{1-4,8,9} Success rates typically improve with experience.³

SEMS can deliver the potential for a single-stage procedure to reduce the risks and costs of a multistage operation. Fewer patients having temporary or permanent colostomies further reduce costs. Patients without colostomies are more likely to return to work earlier.³

Studies have attributed the lower cost of stenting procedures to a combination of reasons: shorter hospitalization, fewer operations, lower anesthesia cost (SEMS is placed under sedation and not general anesthesia), and shorter ICU stay.^{3,7,10,11}

We present the indications, contraindications, potential complications, and techniques for SEMS placement.

Types of obstruction

The leading cause of colonic obstruction in adults is adenocarcinoma, mostly in the rectosigmoid area (**FIGURE**).^{3,5} Authors have used stents in other areas, such as the ascending or transverse colon. They have agreed stents can be used on most lesions regardless of location.²

Strictures from diverticulitis represent the most common cause of benign colonic obstruction.¹¹ Anastomotic and inflammatory strictures may also cause obstruction.¹² Radiation enteritis, especially in the lower pelvis for treatment of prostate or cervical cancers, can result in late strictures and subsequent obstruction.

Half of all patients undergoing emergency exploratory laparotomy for acute malignant colonic obstruction are candidates for curative resection. Their mortality and morbidity following surgery approaches 25%–50%, respectively, compared with 1%–6% for patients undergoing elective surgery for colorectal cancer.^{3,8,10,13,14}

Resection and primary anastomosis is the treatment of choice for most right-colon obstructions. SEMS is an option for left-side malignant colonic obstruction.¹⁵

Stents for use in colonic obstruction

Available in the United States:

- Cook Colonic-Z (Cook Medical, Spender, IN).
- Enteral Wallstent (Microvasive Corporation/Boston Scientific, Natick, MA).
- BARD Memotherm stent (BARD, Billerica, MA).

Available outside the United States:

1. TTS Niti-S Colorectal Stent (Taewoong-Medical Co, Ltd, Seoul, South Korea).
2. Hanarostent Colorectal (MI Tech Co, Ltd, Seoul, South Korea).²²

Types of stents

The first stents were made of plastic and yielded varying degrees of success.^{1,7} Today, flexible metal stents, approved by the US Food and Drug Administration, are mostly made of nitinol (titanium/nickel alloys). Metallic stents retain and maintain their shape after placement, a critical property in the tortuous rectosigmoid area. All manufacturers offer SEMS with guidewires and delivery catheters (**BOX**).

SEMS have small hooks on both ends that anchor to the colonic wall to minimize the risk of migration. The stents achieve complete expansion over 3 to 5 days, gradually exerting minimal shearing force and decreasing the risk of perforation. Stent walls have multiple interstices to facilitate tumor ingrowth and further minimize the risk of migration.

Tumor ingrowth, however, may cause recurrent obstruction. Surgeons have used either endoscopic laser photocoagulation of the tumor, new stent placement, or an operation to manage this problem.^{4,6,8,13,15}

As the stent gradually expands, scar tissue forms to help the stent stay in place.^{2,9,16} Tumor growth through the sidewall openings further anchors the stent.

Indications for SEMS

Stenting has been shown to be safe and efficient for relieving acute colonic obstruction due to benign or malignant disease in two clinical scenarios (**TABLE 1**).³

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SEMS can deliver the potential for a single-stage procedure to reduce the additional risks and costs of a two- or three-stage operation.

TABLE 1
Results and efficacy of SEMS

Authors	N / Study type	Success rate	Complication rates	Conclusions
Watson ²²	107 / Retrospective cohort study	Technical: 93% Clinical: 97%	Overall: 9% Perforation: 1.9% Migration: 3.7% Re-occlusion: 2.8%	Perforation rates higher for balloon dilatation.
Carne ¹⁷	336 / Retrospective cohort study	Technical: 92% Clinical: 90%	Perforation: 2% Migration: 10% Re-occlusion: 16%	Survival rates similar, but SEMS yielded shorter hospital stays.
Athreya ⁸	102 / Retrospective review	Technical: 86%	Perforation: 1-17% Migration: 6% Re-occlusion: 30%	
Choi ¹	72 / NA	Technical: 89% Clinical: 92%	Similar	
Tilney ¹⁰	451 / Meta-analysis; SEMS vs palliative surgery	Technical: 92.6%	Mortality: 5.7% vs 12.1% for emergency surgery	Emergency surgery mortality: 12.1% Survival rates similar, but SEMS yielded shorter hospital stay and less need for stomas. Large heterogeneity.
Law ¹⁶	30 / SEMS vs emergency palliative surgery	NA	NA	SEMS yielded shorter hospital stay and lower cost. Morbidity, mortality, and long-term survival rates similar
Khot ^{3,7,8,16}	598 / Literature review	Technical: 92% Clinical: 95%	Perforation: 4% Migration: 10% Re-occlusion: 62% Fecal impaction: 25% Bleeding: 5% Mortality: 1% Pain: 5%	Technical failure: 8% Clinical failure: 5%
Sebastian ^{7,8}	1198 / Pooled series analysis	Technical: 92% Clinical: 88.6%	Perforation: 3.8% Migration: 11.8 % Re-occlusion: 7.3 % Mortality: 0.6%	
Camunez ¹⁴	80 / Case series	Technical: 88% Clinical: 96%	NA	Clinical failure: 16%

A “bridge” for colonic decompression

This approach can potentially convert an emergency decompression procedure to a single-stage, elective resection in the patient who is otherwise a poor candidate for surgery.

In the patient with potentially resectable malignant obstruction, stent decompression can enable adequate pre-operative staging and multimodal neoadjuvant chemoradiation for rectal cancer.

An option for palliation

In the patient with unresectable locally advanced or disseminated metastatic disease and a life expectancy of less than 6 months, SEMS can be palliative for long-term colonic decompression.⁷ Stenting can provide better quality of life than a permanent colostomy.^{2,12,17} Short lesions in the rectosigmoid area are much easier to stent.¹⁸ Stable patients with resectable limited metastatic disease or multiple

obstructions are best treated surgically.

In benign disease, authors have reported the best results for short anastomotic strictures.^{12,19,20}

Contraindications

Stent placement is not an option in the following situations.

Preventive therapy

Prophylaxis is a controversial application. Endoscopy can locate a near obstruction before clinical signs manifest, and stenting with elective resection may seem appropriate. However, stents placed in this scenario are prone to migrate because of the laxity of the colonic lumen. Although stent migration is easy to manage, no clinical evidence supports prophylactic stenting.²

Colonic pathology

Perforation is an absolute contraindication for stenting. Inability to pass the guidewire across a tight stenosis and colonic ischemia have also been reported as contraindications.^{7,14,18,20} Safe decompression of long, kinked, or proximal tumors is not a given.

Lesions and diverticulitis

A technically proficient surgeon can stent multiple or very proximal lesions,¹⁶ but stenting is contraindicated in this setting.^{7,18-20} Significant coagulopathy, acute angle of the obstructed area, presence of a fistula, and stenosis within 3 cm of the anal sphincter are also contraindications.^{4,13}

Complications and failure

Early complications

Most early complications (TABLE 2) of stent placement are self-limiting and can be managed with supportive and expectant care. Early complications include:

- **Stent failure.** This can ensue from inadequate stent length, proximal fecal impaction, stent migration or fracture, or the presence of a synchronous lesion. Laxatives and enemas can successfully treat fecal

TABLE 2
Complications
of SEMS placement^{2,3,5,11,16,22}

Early
Perforation, 3.76%–4%
Anorectal pain, 5%
Tenesmus, 5%
Fecal impaction, 25%
Stent failure, 8%
Incontinence, 11%
Bleeding, 5%
Death, 0.6%–1%
Late
Recurrent obstruction, 7.3%–10%
Stent migration, 10%–11.8%

impaction.²¹ SEMS fracture, a rare occurrence,⁹ can be treated with stent removal or replacement.^{1,9}

- **Perforation.** Authors have reported perforation at the stent site and proximally in the cecum due to overdistension. Treatments include either observation with IV fluids and antibiotics for the stable patient, or Hartmann's resection for the patient with peritoneal signs.^{4,6,14,21} Balloon dilatation has been associated with higher perforation rates.^{1,3,6,8,10,14,16,17,22}
- **Tenesmus and anorectal pain.** These complications are more likely with low-rectal cancers. The problems are usually self-limiting and best avoided if stents are placed above the level of the sphincter muscle. Treatment is observation or oral pain control.^{3,5,13,14,19,21} A few cases will merit IV pain control or SEMS removal.³
- **Bleeding.** This self-limiting complication is best treated with observation and supportive care. It rarely requires resection.^{3,13,19,21}

Alternatives such as cryotherapy or laser photocoagulation for relieving low-rectal obstructions require multiple treatments for optimal results.^{6,15}

Long-term complications

- **Recurrent obstruction.** Tumor in-

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Alternatives such as cryotherapy or laser photocoagulation for relieving low rectal obstructions require multiple treatments for optimal results.

Navigating the endoscope in SEMS placement

When the endoscope passes through the obstruction, identify the cephalad extent of the lesion and follow these steps^{3,13,20}:

- Pass a guidewire through the operating channel of the endoscope across the obstruction and above its cephalad margin.
- Remove the endoscope.
- Insert the stent-delivery catheter and advance it over the guidewire above the cephalad margin of the obstruction.
- Reinsert the endoscope and advance it alongside the stent catheter until the caudad margin of the obstruction comes into view.
- Deploy the SEMS under endoscopic guidance to ensure that it overlaps the stricture at least 1–1.5 cm on both ends.^{3,13}

If the obstruction blocks the endoscope, follow this approach after you have identified the caudad point of the obstruction^{3,13}:

- Insert a flexible hydrophilic radio-opaque biliary guidewire, preloaded with a biliary catheter, through the operating channel of the endoscope and carefully advance it through the obstruction under fluoroscopic or endoscopic guidance, or both.
- Use fluoroscopy with water-soluble contrast to verify guidewire placement above the cephalad point of obstruction.
- Remove the biliary catheter; insert the stent-delivery catheter and advance it over the guidewire.
- Evaluate the stricture length and anatomy under fluoroscopy with water-soluble contrast.
- Position the stent and deploy it with fluoroscopy and water-soluble contrast.

When one stent is too short, a second stent is an option. As long as the initial stent traverses the cephalad end of the obstruction, deploying a second stent into the lumen of the first and across the caudad margin of the obstruction is fairly easy.

GZ, EMH

growth has caused reobstruction in up to 62% of cases. Most authors have preferred repeat stenting.^{4,6,8,13,14} Some have used lasers for reobstruction from tumor ingrowth.^{4,13} Most patients who receive SEMS for palliation die from metastatic disease before obstruction can recur.

- **Shrinkage and migration.** Chemoradiation after the initial stenting may cause the carcinoma to shrink and thus the stent to migrate.¹⁴ Stents migrate more frequently in benign disease, as the inflammatory process subsides.^{2,3,6,7} This patient usually needs no further treatment and pass-

es the stent.^{1,3} Removal or restenting after migration has been reported in 19% and 20% of recipients, respectively.³ Using a stent at least 20 mm in diameter further reduces the risk of migration. Early high rates of migration involved 10-mm stents, which are no longer used.^{3,6,13,15}

- **Pain.** SEMS placement near the levators can cause significant pain in the patient with mid- or low-obstructing rectal cancer. Stenting followed by neoadjuvant chemoradiation therapy can be an appealing option. However, low-lying stents can make a sphincter-sparing procedure more difficult, especially in the deep male pelvis during a total mesorectal excision and coloanal anastomosis.

How to place a stent

Gastroenterologists and colorectal surgeons tend toward endoscopy to place stents, whereas interventional radiologists favor fluoroscopy. Two critical rules apply for successful colonic stenting:

- Stents should overlap the lesion by 1–1.5 cm on each end.
- The caudad end of the stent should be above the sphincter complex to avoid severe pain and tenesmus.

Avoid placing stents within 5 cm of the anal verge. Colonic lesions less than 3 cm are easier to stent. Longer lesions require additional stents, and stent overlap can be technically challenging. Stenting multiple lesions is controversial. Some authors recommend resection in that setting.^{3,13}

Role of endoscopy

Endoscopy allows the surgeon to take biopsies during stenting. Endoscopy also makes it easier to traverse the stricture with the guidewire under direct vision, avoiding injury to a friable and inflamed bowel (**BOX**).¹⁰ Although most studies have reported SEMS placement under fluoroscopy, some authors have advocated combining endoscopy and fluoroscopy.

Work-up and patient preparation

Plain upright abdominal films will exclude the presence of free air. An enema with water-soluble contrast can assess the length and degree of obstruction while excluding a perforation at the same time.¹⁵ The sedation and patient positioning is comparable to that for routine lower endoscopy.

SEMS placement requires a procedure room with fluoroscopy. The surgeon's choice of endoscope is an important consideration. We prefer the ease of use and short operating channel of a gastroscope for a lesion in the rectosigmoid. A pediatric endoscope also may be useful, but most stents will not fit through its operating channel and must be passed adjacent to the scope.^{15,16}

We begin with lower endoscopy to localize the lesion, perform biopsy as indicated, and irrigate the lumen for adequate visualization. The technique then depends on whether the endoscope can safely traverse the lesion.^{2,4,15} Balloon dilatation and ND-YAG laser coagulation under endoscopic guidance may facilitate canalization,⁴ but they bear a considerable risk of perforation and should be avoided.^{4,6,9,20}

Postprocedure considerations

We prefer to perform a water-soluble contrast enema to exclude perforation and confirm successful stent placement. Most patients will have a complete resolution of the obstruction within 24 hours. We keep patients on clear liquids and obtain plain abdominal upright films the following morning. If the obstructing symptoms are resolving, we proceed with a soft, low-residue diet and stool softeners. ■

Disclosure

The authors did not disclose any relationships.

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Most patients who receive SEMS for palliation die from metastatic disease before obstruction can recur.

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