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Malignant bowel obstructions

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ABSTRACT

Malignant large bowel obstructions (LBO) present a unique and often challenging problem that requires thoughtful consideration of both short and long-term outcomes. Presentations can vary, but the patient will often need urgent or emergent intervention. Primary colorectal cancer accounts for the majority of malignant LBOs making this topic particularly important for the colon and rectal surgeon. Currently there are 3 main treatment strategies for potentially curable disease: Fecal diversion, primary resection with or without diversion, or colonic stent placement followed by elective resection. Stenting is also being used in palliative circumstances. The following chapter outlines the latest literature in malignant LBOs and provides algorithms for both emergent and elective cases.

Introduction

Case

A 55 year-old male presented as a transfer from an outside facility with a large bowel obstruction from a rectosigmoid mass seen on CT (Fig. 1). Of note patient also had lesion in segment 6 of the liver concerning for metastatic disease. Patient had never undergone a colonoscopy and reported 20 lbs weight loss over the past 2–3 months. Upon arrival patient's vital signs were normal. Physical exam revealed a significantly distended and tympanic abdomen but no peritoneal signs. Given diffuse dilation of both large and small bowel, nasogastric tube was placed. Patient was taken to the endoscopy suite the following day and underwent successful placement of a self-expanding metallic stent (SEMS) (Fig. 2). The patient had immediate relief with flatus and stool. His nasogastric tube was removed the following day and he was able to tolerate a regular diet. After six days of decompression, patient was taken to the operating room and underwent a sigmoid colectomy with primary anastomosis and a wedge resection of the liver lesion. Final pathology was T3N2M1a. Patient recovered well and proceeded to adjuvant chemotherapy.

Malignant large bowel obstructions (LBO) present a unique and often challenging problem that requires thoughtful consideration of both short and long-term outcomes. Presentations vary, but the patient will often need urgent or emergent intervention. Currently there are 3 main treatment options for malignant large bowel obstructions: Primary resection with or without diversion, a diverting ostomy, or stent placement as "bridge to surgery" or palliation. This chapter will discuss the etiology, presentation, workup, and management of malignant LBOs.

Etiology

In cancers that affect both men and women, colon and rectal cancer is the second leading cause of cancer related death behind lung cancer.[1] Primary colorectal cancer accounts for greater than 50% all large bowel obstructions, with the most common site of obstruction found in the descending and rectosigmoid area (Fig. 3). These tumors are by nature more advanced, usually T3 or T4, and are more likely to present with positive lymph nodes and metastatic disease. They also have higher 5-year local recurrence and distant recurrence rates when presenting as an obstructing lesion.[2] Extrinsic compression from metastatic disease or other pelvic primary tumors accounts for roughly 6% of all LBO.[3] While extrinsic non-colorectal malignancies are commonly ovarian or pelvic in origin, they can also be seen in gastric, bladder, or kidney malignancies as well.[4]

Pathophysiology

Obstruction of the large bowel in the setting of malignancy is usually a slowly progressive process that ultimately causes complete or near complete mechanical obstruction of the bowel lumen. When a patient has a competent ileocecal valve this can cause a closed loop obstruction that is compounded by small bowel contents draining into the colon without reflux. The obstruction is hastened by bacterial overgrowth leading to worsening dilation, microvascular occlusion, hypoperfusion, and impending perforation. 70% of obstructions in the setting of colorectal cancer are left-sided in location and are more likely to perforate that right-sided lesions.[5]

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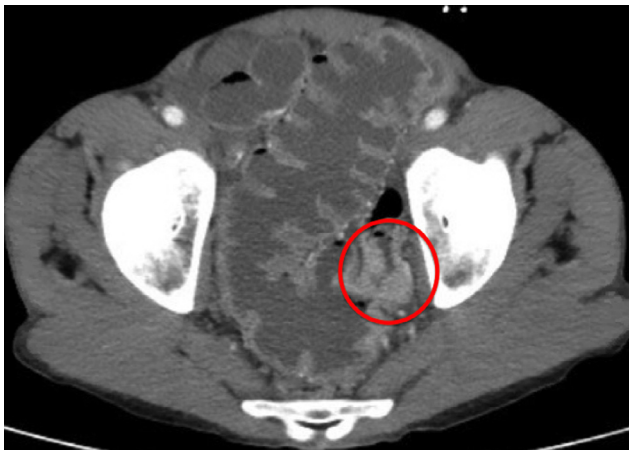

Fig. 1. Obstructing rectosigmoid mass seen on CT.

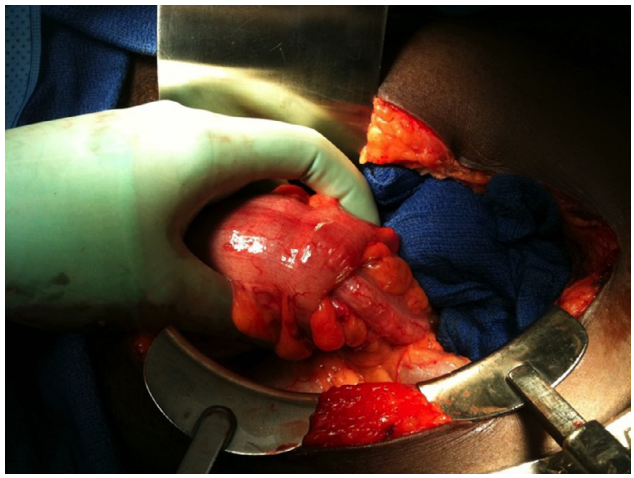

Fig. 3. Intraoperative findings of rectosigmoid mass.

Presentation

Patients with malignant LBO often present with progressive symptoms and somewhat insidious onset. Common presenting complaints include constipation, crampy abdominal pain, distention, rectal bleeding or change in stool caliber. In the malignant setting, patients can have weight loss, decreased appetite, and overall fatigue. Nausea and vomiting are sometimes absent due to a competent ileocecal valve and patients will only complain of obstipation, worsening distention and pain. The degree of stenosis usually determines the acuity and leads to different management strategies. Physical exam should be used to assess the patient's severity of illness and any evidence of peritonitis or compromised bowel that would lead to an urgent/emergent operation. Commonly, patients will present with abdominal distention and mild to moderate tenderness on exam. Distention can be fairly pronounced if the obstruction is distal in location, but in the absence of systemic sepsis and/or peritoneal signs further workup should be obtained.

Workup

Every patient that presents with concern for a malignant LBO should have complete blood work including lactic acid, CEA, and CA-125 in female patients if a cancer diagnosis is not already determined. Diagnostic imaging can vary depending on the patient's presentation, but it is the authors' opinion to start with upright and flat abdominal plain films. This test is quick, inexpensive, and can be performed at the bedside. Several findings can be seen that will help rule out an abdominal catastrophe or impending perforation including free air, pneumotosis, and impending perforation based on cecal diameter. Air fluid levels can suggest a more acute process as the colon has not had time to absorb the intraluminal fluid. Several factors should be weighed when assessing luminal diameter, including degree of distention, duration of distention, amount of tension on the wall, and baseline characteristics of systemic vasculature.[6] A cecal diameter of 12 cm has historically been the cutoff for increased risk of perforation and although absolute diameter is debatable, a 9–12 cm diameter should raise significant concern.[7]

While abdominal plain films are an excellent way to quickly assess for an abdominal catastrophe, they are often non-specific and require further imaging to determine etiology. In the past a common early test for evaluation of LBO was a contrast enema (CE). Sensitivity and specificity have been shown to be 96% and 98%, respectively, in determining the level of obstruction and occasionally can be therapeutic.[8] Water-soluble contrast is preferred as barium is associated with high mortality in the setting of perforation. With respect to malignant obstruction, CE can specify endoluminal caliber and length of the stenotic segment to aid in planning and feasibility of a possible stent. Keep in mind when making diagnostic choices, the utility of CE can be dependent on experience of the radiologist and patient body habitus.

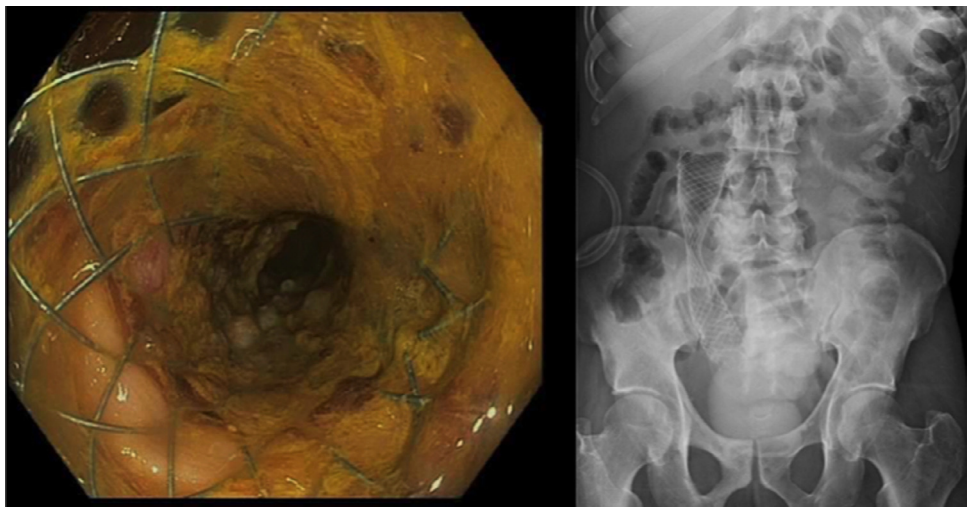

Fig. 2. Successful endoluminal stent placement across rectosigmoid mass (left). Stent position seen on abdominal radiograph post-procedure (right).

CT scan has become the imaging modality of choice in many centers because it can determine location of obstruction, show signs of perforation, and help determine underlying etiology. CT can also provide information on intrinsic versus extrinsic compression, colon diameter, and evaluate for distant disease.[9] Multiple studies have shown CT to be superior to CE in the assessment of LBO including better availability of CT and easier to obtain in most practices.[10–12] It is the authors' preference to obtain a CT with PO, IV, and rectal contrast when a malignant large bowel obstruction is suspected.

Management

Management of a LBO in the malignant setting can be one of the more challenging and difficult decision processes for a surgeon. Multiple factors add to the complexity of the treatment algorithm including etiology, tumor location, metastatic disease, signs of perforation, contamination, patient's clinical status, and hospital resources such as ability to emergently place a colonic stent. Decisions about a 1, 2, or 3 stage procedure and possible stenting all require careful consideration. Regardless of etiology, initial management of a malignant LBO should focus on volume resuscitation and repletion of electrolytes. NGT insertion should be considered if patient is nauseated and/or vomiting. The next step is determining whether the patient has signs of perforation or closed loop obstruction leading to emergent surgical intervention.

In the setting of diffuse peritonitis, systemic signs of perforation, or evidence of ischemia the patient should undergo immediate surgical intervention. If time and circumstances permit, mark the patient for a potential colostomy or ileostomy. Patients should be placed in the lithotomy position and it is the authors' opinion these cases should be performed via a midline laparotomy. Since the colon is usually significantly dilated, a minimally invasive approach can be very difficult from both an entry and visualization standpoint. If bowel distention causes a substantial impediment to resection a 12-gauge needle can be placed obliquely through the tenia and connected to suction for decompression.[3]

After exploration of the abdomen, assessment is made for resectability of the obstructing lesion, evidence of metastatic disease, and the viability of the remaining colon (Fig. 4). The "unresectable" lesions are usually pelvic in location and often invading other structures. These lesions can be gynecologic in nature and frequently the patient has evidence of metastatic disease/carcinomatosis. These patients are best treated with proximal diversion with a loop colostomy. Obstructing rectal tumors are the other scenario where only performing proximal diversion is warranted. Although a rectal mass may be "resectable", a loop colostomy can provide time for neoadjuvant chemoradiation and improves the opportunity for an R0 resection.

Once a lesion has been identified, assessment of the remaining colon is paramount with specific attention to the cecum as this is the most likely area to experience necrosis and perforation. The Law of Laplace (Pressure=Tension/Radius) dictates that the largest diameter of tube requires the least amount of pressure to distend, thereby placing the cecum at greatest risk.[13] Evidence of cecal vascular compromise from distention or perforation in the setting of a left-sided obstruction is most commonly best treated by subtotal colectomy with end ileostomy.

If the colon appears viable and the lesion is distal to the splenic flexure, primary resection should be performed if technically possible. The decision to perform an anastomosis versus a colostomy is dependent on multiple factors. Patients with significant dilation or bowel edema, presence of contamination, patient factors such as hemodynamic instability or significant comorbidities should not undergo an anastomosis. A systematic review by Amelung et al. analyzed eight comparative studies investigating acute resection versus diverting colostomy as a bridge to surgery for left sided colonic obstruction and found there was no significant difference in 30-day morbidity or mortality.[14] However, patients that underwent a colostomy with subsequent elective resections were less likely to have a permanent stoma and more likely to have a primary anastomosis.

Bowel preparation is not recommended in malignant obstructions due to the risk of proximal perforation. Although, the senior author has, on rare occasion, had patients perform a "slow prep" over several

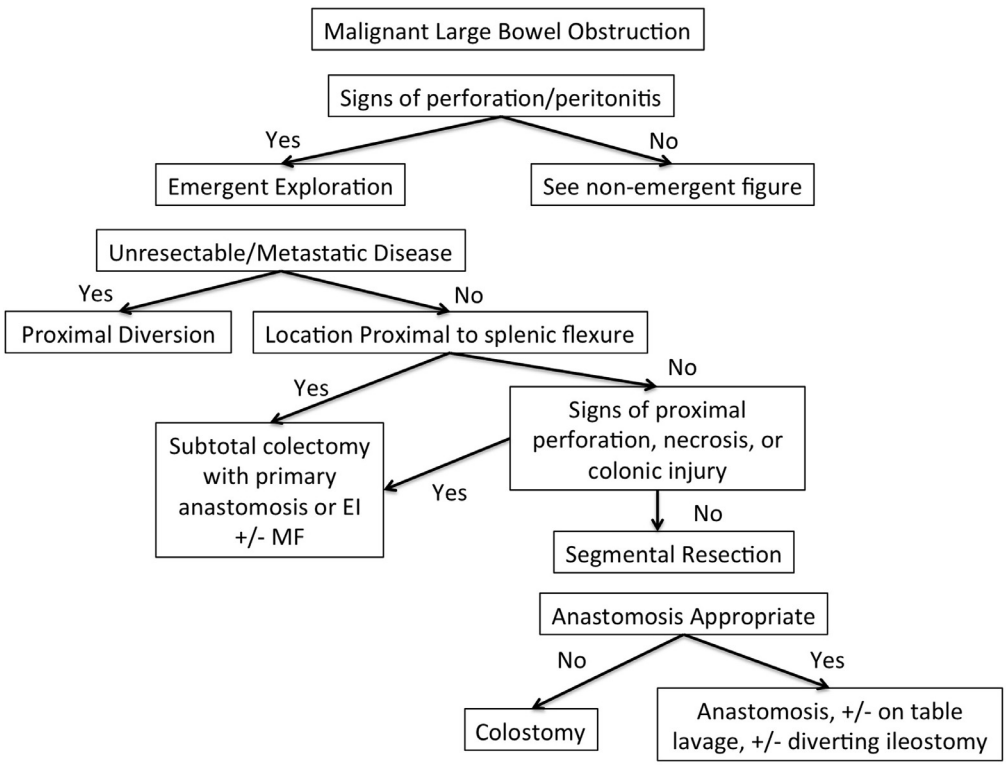

Fig. 4. Algorithm for management of a malignant large bowel obstruction in the emergent setting with signs of perforation or peritonitis.

days. This is performed on minimally symptomatic patients (who are incompletely obstructed based on ongoing passage of stool and flatus), using Miralax (17 g in 8 ounces of liquid every 4–6 h) with frequent reassessment of the patient for evidence of worsening distention or peritonitis.

Intraoperative colonic lavage or on table lavage (OTL) has been proposed to facilitate primary anastomosis in left-sided obstructions.[15,16] This technique involves antegrade irrigation through an appedicostomy, cecostomy, or enterotomy on the terminal ileum with evacuation through the distal transected colon. More recently, an alternative technique has been proposed using a long tube inserted proximal to the obstruction retrograde to the cecum. This tube is attached to a Y-shaped connector and the colon is irrigated and drained through its respective side of the connector. This removes the need to make a proximal cecotomy or enterotomy.[17] Once the bowel is cleansed and decompressed the patient can ideally undergo a primary anastomosis. OTL is not without complications and risk including increased operative time, need for surgical expertise, and possible increased risk of spillage leading to potential organ space and wound infections.[18,19] One small randomized trial comparing OTL versus manual decompression showed no significant differences between the two groups and the authors deemed manual decompression as safe as OTL.[20] Others have concluded that OTL is not necessary in left sided colonic emergencies showing increased rates of postoperative complications, specifically increased rate of wound infections.[19] It is the authors' opinion that OTL is beneficial in selected distal obstructions with substantial intraluminal fecal burden – especially if it is located in the proximal colonic segment that is going to be used in the anastomosis.

In the patient that does not to have peritonitis, hemodynamic instability, or signs of impending perforation (such as massive cecal diameter on imaging) the decision algorithm becomes based on tumor location. If the tumor is located proximal to the splenic flexure, these patients are treated with a subtotal colectomy with primary anastomosis. For tumors located distal to the splenic flexure the management becomes much more challenging and controversial.

Obstructing left sided lesions present a unique clinical situation with various treatment options for which the literature is lacking in consistent conclusive evidence. Our management strategy is based around the algorithm in Fig. 5. This algorithm assumes no evidence of unresectable metastatic disease and is primarily based on whether a lesion is amenable to a colonic stent to "bridge to surgery". This allows the bowel to decompress over a short time period and ideally undergo a minimally invasive operation with primary anastomosis. Most would conclude that stenting as a bridge to surgery has equivalent or improved surgical outcomes with respect to stoma creation and complications, but there are varying results with respect to disease recurrence and survival.[21,22]

Self-expanding metallic stents (SEMS) were introduced as an option for colonic and rectal obstructions in the early 1990s because of the high morbidity and mortality associated with open resection and ostomy creation.[23,24] Subsequent studies showed promising results in both palliation and as a method to bridge to surgery with median technical (ability to place the stent in the desired location) and clinical success (improvement of obstructive symptoms so that no additional treatment is required) rates of 96% and 92%, respectively[25] (Fig. 6). The data, however, remained poor with respect to characterization and the definition of obstruction and clinical success. Also, colonic stenting is not without significant complications, including migration, occlusion, bleeding, pain, and most notably perforation. Contraindications to stenting include suspected ischemia, impending perforation, intra-abdominal abscess, inability to pass a guidewire, and low rectal tumors. Patient selection remains paramount in determining the right clinical picture to place a stent.

Placement of a SEMS can be challenging and requires expertise of both the endoscopist and support staff. Stent placement can be achieved through several techniques including endoscopic guidance alone, fluoroscopic guidance alone, or a combination of both. It is the authors' preference to use both endoscopic and fluoroscopic guidance.

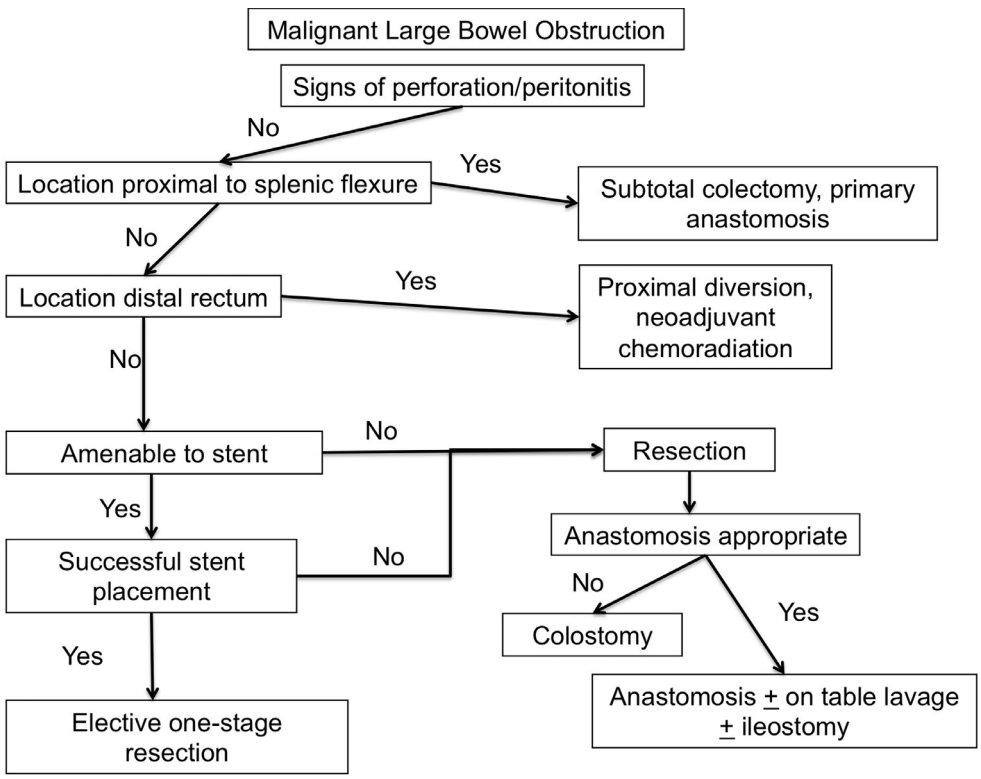

Fig. 5. Algorithm for management of a malignant large bowel obstruction without signs of perforation or peritonitis.

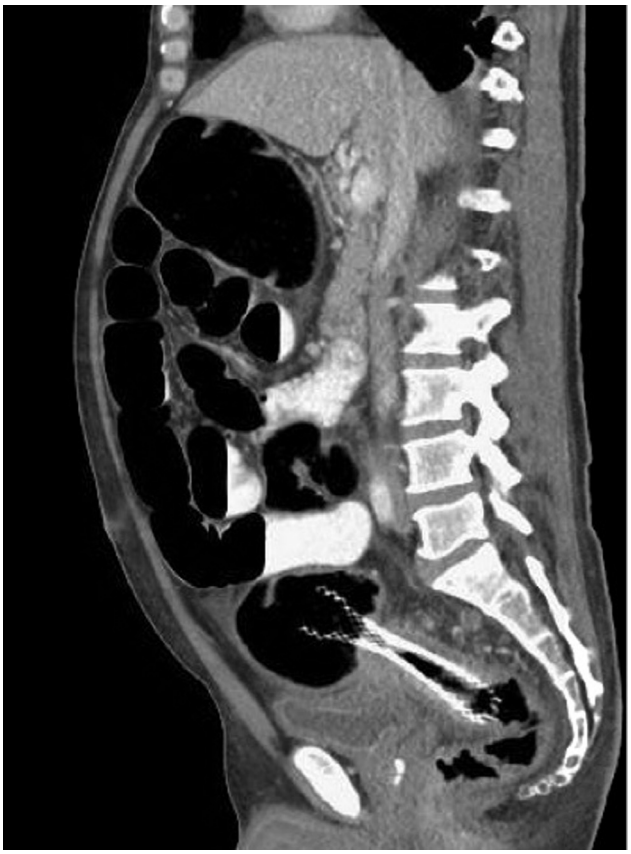

Fig. 6. Sagittal CT view of a stent placed across an obstructing rectosigmoid lesion.

Carbon dioxide insufflation is also preferred. If the patient does not already have a nasogastric tube, placing one is recommended prior to the procedure. SEMS placement can be done under moderate sedation with the patient in the lateral decubitus position, although patients with substantial small bowel or gastric distention should be considered for elective intubation to protect against aspiration. Next the colonoscope is used to locate the lesion. A catheter is placed proximal to the lesion and water soluble contrast injected under fluoroscopy to identify location, length, and caliber of the lesion. A guidewire is then placed across the lesion, and a 5 mm endoclip placed 5 cm distal to the lesion. An appropriately sized stent is then placed over the wire and deployed. Dilation is not recommended and is associated with increased risk of perforation. A post-procedure abdominal radiograph is obtained to document stent position.

The first randomized trial by Cheung et al. compared 48 patients with left sided lesions between the splenic flexure and rectosigmoid junction undergoing an endolaparoscopic approach versus emergent open surgery. Overall technical and clinical success rate was 83% with 67% undergoing a single stage procedure in the endolaparoscopic arm while only 38% in the conventional arm.[26] Interestingly, no stent related complications were reported. However, two multicenter, prospective randomized control trials (RCT) from France and the Netherlands called into question the safety of stenting.[27,28] Pirlet et al. randomized 60 patients to emergency surgery or SEMS placement. 53% of the SEMS group had a technical failure and 2 colonic perforations were directly attributed to stent placement. They also found 8 "silent" perforations on pathologic specimens increasing the overall perforation rate to 26%. van Hooft et al. performed another RCT revealing a high perforation rate (6 stent related and 3 silent) of almost 20% and a low technical success rate of 70%. Both of these trials were prematurely stopped for safety concerns. These findings certainly give pause to stenting as a safe pathway. The authors do note several shortcomings of their studies that warrant mention. First, their patient populations had a higher rate, 70%, of "complete" obstruction than previous studies and this may have contributed to their high complications rate. Second, specifically the Netherlands study enrolled patients across a large number of centers with various expertise.[28] These findings stress the importance of performing these procedures at high volume, tertiary facilities with experienced physicians. Nevertheless, these results showed the need for further investigation into safety, efficacy, and patient selection in stenting as a bridge to surgery.

Since that time, at least 5 other randomized trials have been published.[29–32] Foo et al. performed a meta-analysis comparing all current randomized control trials and found the stent group had a significantly lower risk of overall complications, including stoma rates ($R = 0.605$, $p = 0.032$). However they found that the stent group had a significantly increased risk of systemic recurrence (RR = 1.627, $p = 0.046$), yet this did not translate into a difference in 3-year disease-free survival or overall survival.[21] Another systematic review and meta-analysis concluded long-term oncologic outcomes were similar with less permanent stoma rates in the stent group. However, when evaluating only RCTs (randomized control trials) there was a trend toward worse survival in the stent group. Overall, the authors concluded that stenting appears to be oncologically safe when done in experienced hands.[33]

Given these cumulative findings, we believe stenting should still be considered when evaluating malignant obstructing left sided lesions and the algorithm outlined in Fig. 5 is the management strategy used at our institution. Not included in this outline are patients that present with a LBO secondary to extracolonic cancers such as gynecologic malignancies. Patients in these scenarios can undergo stenting, but they are at a higher risk for stent migration and other complications. Additionally, they may have multiple synchronous or metachronous points of obstruction, which markedly decreases the efficacy of stenting.

Palliation is the other scenario that stents can provide at least adequate short-term relief for malignant obstructions. Studies have demonstrated good technical success, but stents are more likely to reobstruct and migrate when used in the palliative setting.[34] Park et al., evaluated their outcomes over 10 years after stenting for stage IV obstructive colorectal cancer. They showed a decrease in early complication rate and an increase in survival duration without any change to mortality rates.[35] Recently, Abelson et al., concluded stenting to be safe and improves efficiency of care with improved quality of life benefits among those patients in the palliative setting.[36]

Malignant large bowel obstructions can be a challenging clinical scenario that necessitates consideration of several pathways in order to provide the patient with the best possible outcome. Surgical intervention is dependent on multiple factors including the patient's clinical condition, location of the obstruction, and evidence of metastatic disease. For the non-emergent cases, stenting can be a viable option as a bridge to surgery in the appropriate setting. Continued research is required to understand the long-term implications of stenting and the best practice guidelines for malignant obstructions.

References

1. Group, USCSW, *U.S. Cancer Statistics Data Visualizations Tool, Based On November 2017 Submission Data (1999-2015): U.S. Department of Health and Human Services.* Centers for Disease Control and Prevention and National Cancer Institute; 2018.
2. Cortet M, et al. Patterns of recurrence of obstructing colon cancers after surgery for cure: a population-based study. *Colorectal Dis.* 2013;15(9):1100–1106.
3. Lopez-Kostner F, Hool GR, Lavery IC. Management and causes of acute large-bowel obstruction. *Surg Clin North Am.* 1997;77(6):1265–1290.
4. Lee YM, et al. Emergency surgery for obstructing colorectal cancers: a comparison between right-sided and left-sided lesions. *J Am Coll Surg.* 2001;192(6):719–725.
5. Aslar AK, et al. Analysis of 230 cases of emergent surgery for obstructing colon cancer–lessons learned. *J Gastrointest Surg.* 2011;15(1):110–119.
6. Boley SJ, et al. Pathophysiologic effects of bowel distention on intestinal blood flow. *Am J Surg.* 1969;117(2):228–234.

7. Jain A, Vargas HD. Advances and challenges in the management of acute colonic pseudo-obstruction (ogilvie syndrome). *Clin Colon Rectal Surg*. 2012;25(1):37–45.
8. Chapman AH, McNamara M, Porter G. The acute contrast enema in suspected large bowel obstruction: value and technique. *Clin Radiol*. 1992;46(4):273–278.
9. Godfrey EM, Addley HC, Shaw AS. The use of computed tomography in the detection and characterisation of large bowel obstruction. *N Z Med J*. 2009;122(1305):57–73.
10. Beattie GC, et al. Computed tomography in the assessment of suspected large bowel obstruction. *ANZ J Surg*. 2007;77(3):160–165.
11. Jacob SE, Lee SH, Hill J. The demise of the instant/unprepared contrast enema in large bowel obstruction. *Colorectal Dis*. 2008;10(7):729–731.
12. Frager D, et al. Prospective evaluation of colonic obstruction with computed tomography. *Abdom Imaging*. 1998;23(2):141–146.
13. Saegesser F, et al. Intestinal distension and colonic ischemia: occlusive complications and perforations of colo-rectal cancers. A clinical application of Laplace's law. *Chirurgie*. 1974;100(7):502–516.
14. Amelung FJ, et al. Acute resection versus bridge to surgery with diverting colostomy for patients with acute malignant left sided colonic obstruction: systematic review and meta-analysis. *Surg Oncol*. 2015;24(4):313–321.
15. Dudley HA, Racliffe AG, McGeehan D. Intraoperative irrigation of the colon to permit primary anastomosis. *Br J Surg*. 1980;67(2):80–81.
16. Evans RO, et al. Single-stage treatment for malignant left-sided colonic obstruction: a prospective randomized clinical trial comparing subtotal colectomy with segmental resection following intraoperative irrigation. *Br J Surg*. 1996;83(4):572.
17. Sasaki K, et al. One-stage segmental colectomy and primary anastomosis after intraoperative colonic irrigation and total colonoscopy for patients with obstruction due to left-sided colorectal cancer. *Dis Colon Rectum*. 2012;55(1):72–78.
18. Park UC, et al. Single-stage procedure with intraoperative colonoscopy and colonic irrigation in patients with obstructing left-sided colonic cancer. *Int J Colorectal Dis*. 2004;19(5):487–492.
19. Ortiz H, et al. Comparative study to determine the need for intraoperative colonic irrigation for primary anastomosis in left-sided colonic emergencies. *Colorectal Dis*. 2009;11(6):648–652.
20. Lim JF, et al. Prospective, randomized trial comparing intraoperative colonic irrigation with manual decompression only for obstructed left-sided colorectal cancer. *Dis Colon Rectum*. 2005;48(2):205–209.
21. Foo CC, et al. Is bridge to surgery stenting a safe alternative to emergency surgery in malignant colonic obstruction: a meta-analysis of randomized control trials. *Surg Endosc*. 2019;33(1):293–302.
22. Mege D, et al. What is the best option between primary diverting stoma or endoscopic stent as a bridge to surgery with a curative intent for obstructed left colon Cancer? Results from a propensity score analysis of the french surgical association multicenter cohort of 518 patients. *Ann Surg Oncol*. 2019;26(3):756–764. Epub 2019 Jan 8.
23. Dohmoto M, Hunerbein M, Schlag PM. Palliative endoscopic therapy of rectal carcinoma. *Eur J Cancer*. 1996;32A(1):25–29.
24. Tejero E, et al. New procedure for the treatment of colorectal neoplastic obstructions. *Dis Colon Rectum*. 1994;37(11):1158–1159.
25. Watt AM, et al. Self-expanding metallic stents for relieving malignant colorectal obstruction: a systematic review. *Ann Surg*. 2007;246(1):24–30.
26. Cheung HY, et al. Endolaparoscopic approach vs conventional open surgery in the treatment of obstructing left-sided colon cancer: a randomized controlled trial. *Arch Surg*. 2009;144(12):1127–1132.
27. Pirlet IA, et al. Emergency preoperative stenting versus surgery for acute left-sided malignant colonic obstruction: a multicenter randomized controlled trial. *Surg Endosc*. 2011;25(6):1814–1821.
28. van Hooft JE, et al. Colonic stenting versus emergency surgery for acute left-sided malignant colonic obstruction: a multicentre randomised trial. *Lancet Oncol*. 2011;12(4):344–352.
29. Alcantara M, et al. Prospective, controlled, randomized study of intraoperative colonic lavage versus stent placement in obstructive left-sided colonic cancer. *World J Surg*. 2011;35(8):1904–1910.
30. Ho KS, et al. Endoscopic stenting and elective surgery versus emergency surgery for left-sided malignant colonic obstruction: a prospective randomized trial. *Int J Colorectal Dis*. 2012;27(3):355–362.
31. Ghazal AH, et al. Colonic endolumenal stenting devices and elective surgery versus emergency subtotal/total colectomy in the management of malignant obstructed left colon carcinoma. *J Gastrointest Surg*. 2013;17(6):1123–1129.
32. Arezzo A, et al. Colonic stenting as a bridge to surgery versus emergency surgery for malignant colonic obstruction: results of a multicentre randomised controlled trial (ESCO trial). *Surg Endosc*. 2017;31(8):3297–3305.
33. Amelung FJ, et al. Critical appraisal of oncological safety of stent as bridge to surgery in left-sided obstructing colon cancer; a systematic review and meta-analysis. *Crit Rev Oncol Hematol*. 2018;131:66–75.
34. Choi JH, et al. Covered self-expandable metal stents are more associated with complications in the management of malignant colorectal obstruction. *Surg Endosc*. 2013;27(9):3220–3227.
35. Park YE, et al. Outcomes of stent insertion and mortality in obstructive stage IV colorectal cancer patients through 10 year duration. *Surg Endosc*. 2019;33(4):1225–1234. Epub 2018 Aug 27.
36. Abelson JS, et al. Long-term postprocedural outcomes of palliative emergency stenting vs stoma in malignant large-bowel obstruction. *JAMA Surg*. 2017;152(5):429–435.