Review Article

Palliative enteroscopic stent placement for malignant mid-gut obstruction

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ABSTRACT

Palliation of malignant small intestinal obstructions beyond the reach of conventional endoscopes for stent placement generally requires endoscopic decompression via a gastrostomy tube or a surgical bypass in patients who are operable candidates. With the advent of deep enteroscopy, palliative stent placement for mid-gut obstruction using currently available self-expandable metal stents may be feasible in selected cases. Proper patient selection and technical proficiency in deep enteroscopy and stent placement are key determinants for a successful outcome. Alternative means of stent delivery, including the percutaneous route, are also being developed, with the hope of expanding the use of stents in the mid small bowel beyond palliation.

Keywords: deep enteroscopy, palliation, small intestinal carcinoma, small intestinal obstruction, stent

Introduction

Placement of a self-expandable metal stent (SEMS) is an accepted therapeutic option for palliation of malignant obstruction involving the esophagus, gastroduodenum, and colon, and dedicated SEMS are available for over-the-wire or through-the-scope (TTS) insertion across obstructive lesions at these locations.1,2 Malignant small bowel obstruction is a dire complication of intrinsic disease or extrinsic compression from abdominopelvic tumors. However, endoscopic stent placement in the mid small bowel, defined as the segment between the ampulla of Vater and the ileocecal valve, can be technically challenging or infeasible owing to the anatomy of the small intestine, limitations of conventional endoscopes, and lack of TTS SEMS designed specifically for use in the mid gut.3

Palliation of malignant obstruction in the distal duodenum, and even the proximal jejunum, can generally be achieved using a therapeutic upper endoscope or an adult colonoscope whose large working channel can accommodate TTS placement of currently available enteral SEMS.4 In some cases, however, significant looping in the stomach and duodenal sweep limits endoscope insertion to more distal areas of obstruction and palliative surgical intervention, such as a bypass or diverting ostomy, is necessary. In poor surgical candidates, placement of a venting percutaneous endoscopic gastrostomy (PEG) or jejunoscopy tube may be required.5,6

The introduction of double balloon enteroscopy (DBE) and, subsequently, single balloon enteroscopy and spiral overtube-assisted enteroscopy (SE) have significantly impacted the diagnosis and therapy of diseases involving the small intestine.7,8 These techniques, collectively referred to as deep enteroscopy, can overcome looping, such as in a J-shaped stomach, and enable access to deeper segments of the small intestine for palliative stent placement. Balloon-assisted enteroscopy involves sequential push–pull maneuvers, whereas SE uses rotation of a specialized overtube with raised spirals at its tip to pleat the small bowel onto the overtube and enable enteroscope insertion deep into the small bowel.9 Although the working channel of deep enteroscopes (2.8 mm diameter) does not allow TTS passage of currently available SEMS and there are no dedicated stents for enteroscopic use, the deep enteroscopy techniques provide a stable platform via a fixed overtube for the non-TTS delivery of stents to the mid gut, as outlined below.

Indications and practical considerations

Although the major indication for mid-gut stent placement is palliation of malignant extrinsic or intrinsic obstructions, other potential indications include preoperative decompression as a bridge to surgery, closure of malignant chronic fistulae, and sealing of anastomotic leaks for which surgical revision is deemed too risky.3 Careful patient assessment remains an absolute prerequisite prior to considering stent placement for palliation of mid-gut stenosis. Radiological imaging, such as computed tomography of the abdomen and pelvis, is essential and may demonstrate multifocal sites of small bowel obstruction, which negate the benefit of placing a stent at a single point of obstruction (Fig. 1). This is
particularly true in patients with extensive peritoneal carcinomatosis, where a venting PEG may be the best palliative option. Imaging is not foolproof, however, and distal sites of obstruction may manifest themselves only after stent placement for a radiographically apparent isolated proximal stenotic segment has been performed.

The use of an adult colonoscope can be effective in delivering enteral stents for malignant obstructions of the distal duodenum and proximal jejunum, and should be given primary consideration for lesions at these locations. The technical success rate was 93% in one study of 16 patients with malignant distal duodenal or proximal jejunal obstruction. Of note, nine of the patients had undergone prior unsuccessful attempts at stent placement using a gastroscope.

Surgical bypass should be considered preferentially for patients with a reasonable performance status and a longer life expectancy, as it is associated with better long-term outcomes, fewer adverse events, and a lesser rate of intervention relative to stent placement. Although the data pertain primarily to gastric outlet obstruction, the findings can likely be extrapolated to malignant mid-gut obstruction.

Deep enteroscopy for stent placement in the mid gut

Although the depth of insertion and rate of complete enteroscopy is greater with DBE, clinical comparative trials have shown similar diagnostic and therapeutic yields among the deep enteroscopy instruments. All three modalities appear to be equally safe and effective for the evaluation of the small intestine. Thus, the selection of a particular device is influenced primarily by device availability and operator preference.

A deep enteroscopy approach for the palliative stenting of mid-gut obstructions represents an attractive option over surgical intervention because of its minimally invasive nature and expected lower rate of procedure-related morbidity, particularly in terminally ill patients with a poor performance status. Deep enteroscopy, however, may not be suitable or feasible in patients with bowel encasement from widespread peritoneal carcinomatosis and in those with severe small bowel fixation and angulation from surgical adhesions that hinder advancement of the enteroscope. Therefore, the decision to proceed with deep enteroscopy-assisted stent placement for palliating mid gut obstruction should be individualized. Two methods of mid-gut stent insertion using deep enteroscopy instruments and commercially available SEMS have been described: the withdrawal–reinsertion technique and the through-the-overtube technique.

Withdrawal–reinsertion technique

Lee et al described the use of the withdrawal–reinsertion technique that involves the advancement of DBE and balloon-assisted reduction maneuvers, as needed, to reach the site of obstruction, the insertion of a long guide-wire through the stricture, and instrument removal while leaving the guide-wire in place. The guide-wire is then back-fed into the working channel of a conventional therapeutic endoscope, which is advanced as far as technically feasible into the gut lumen. A TTS SEMS is subsequently inserted over the guide-wire and placed across the stricture, followed by stent deployment under both endoscopic and fluoroscopic view. The length of the selected stent is based on the estimated length of the stricture at endoscopy or following fluoroscopic contrast assessment.

In the series by Lee et al, 19 patients underwent the withdrawal–reinsertion technique as a rescue procedure for failed conventional palliative stent placement for malignant small bowel obstruction. Small intestinal obstruction was due to metastatic gastric (n = 15), colorectal (n = 2), and primary small bowel cancer (n = 2), and the obstruction sites were in the efferent jejunal limb (53%), proximal jejunum (32%), or third portion of the duodenum (15%). The technical success rate was 95%, and the clinical success rate, defined as relief of obstructive symptoms after stent placement, was 84%. No major procedure-related adverse events occurred. Stent migration and restenosis occurred in 11% and 21% of patients, respectively, with median stent patency duration of 67 days. Potential drawbacks of this technique include the risk of losing the guide-wire with the unfolding of small bowel pleats during the removal of the deep enteroscope or during the insertion of the second endoscope, as well as looping of the conventional endoscope in the stomach despite its advancement over the guidewire. This technique may be more suited for proximally situated small bowel lesions, but not likely to succeed for obstructing lesions located in the mid-distal jejunum and beyond.

Through-the-overtube technique

The through-the-overtube technique for placement of stents in the mid gut has been described for all three deep enteroscopy instruments. Data regarding this technique are currently limited to case reports and small series (Table 1). The technique involves the use of the dedicated balloon-assisted or spiral overtubes as conduits for placement of esophageal or enteral SEMS through malignant mid-gut obstruction under fluoroscopic guidance (Fig. 2). The procedure is relatively similar for all three enteroscopic systems, albeit with technical nuances to compensate for length discordance between overtubes and stent delivery catheters.

In brief, a deep enteroscope with balloon-assisted or spiral overtube is advanced to the stricture site. With the tip of the

Fig. 1. Multifocal areas of obstruction with dilation and focalization of the small bowel due to extensive peritoneal carcinomatosis.
overtube anchored closely to the site of obstruction, pull maneuvers are performed to reduce loop formation proximal to the stenotic site and to maintain an overtube configuration in the straightest and shortest path possible to facilitate passage of the stent’s delivery catheters, which are relatively stiff and inflexible. Although SE has a lower insertion depth than DBE, it may provide better anchoring and a more stable platform than balloon overtubes, which can slip.20

Once in position at the obstruction site, the length of the stricture can be assessed endoscopically or by fluoroscopic contrast instillation if the enteroscope cannot traverse the stricture. A fluoroscopic marker (endoscopic clip or intramural contrast injection) can be placed to identify the proximal and/or distal end (if traversed) of the stricture. Thereafter, a long guide-wire is advanced as far as feasible beyond the stricture, followed by withdrawal of the enteroscope while leaving the guide-wire and overtube in place. For DBE, withdrawal of the enteroscope through its overtube can be problematic and may result in loss of the overtube position owing to the traction force required to disrupt the manufacturer’s rubber band used to affix the enteroscope’s balloon at its tip. As an alternative, the enteroscope’s balloon can be affixed with a suture instead of the rubber band, enabling the retraction of the enteroscope into the overtube while preserving the double-balloon maneuvers unique to DBE (Fig. 3). Another caveat is that the stent’s delivery catheter (e.g., esophageal SEMS) may not be long enough to pass through the entire length of the overtube, in addition to the stricture site. One solution is to make an incision with a scalpel through the lining of the overtube close to the mouth and transfer the guide-wire so it exits through the incision site. Of note, caution is warranted to make the incision.

Table 1 Deep Enteroscopy Overtube-Assisted Stent Placement for Malignant Small Bowel Obstruction

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Location of malignant obstruction</th>
<th>Stent</th>
<th>Endoscope</th>
<th>Route of insertion</th>
<th>Clinical success</th>
<th>AE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yamamoto et al 200413</td>
<td>2</td>
<td>NR</td>
<td>Esophageal</td>
<td>DBE</td>
<td>NR</td>
<td>NR</td>
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<tr>
<td>Ross et al 200615</td>
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<td>Distal duodenum</td>
<td>Esophageal Ultraflex</td>
<td>DBE</td>
<td>Oral</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Kita et al 200714</td>
<td>6</td>
<td>NR</td>
<td>NR</td>
<td>DBE</td>
<td>Oral/Anal</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Pérez-Cuadrado et al 201318</td>
<td>1</td>
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<td>DBE</td>
<td>Oral</td>
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<td>No</td>
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<tr>
<td>Popa et al 201417</td>
<td>1</td>
<td>Proximal jejunum</td>
<td>Taewoong Niti-S</td>
<td>DBE</td>
<td>Oral</td>
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<td>No</td>
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<tr>
<td>Espinel and Pinedo 201119</td>
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<td>Enteral Wallflex</td>
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<tr>
<td>Lennon et al 201020</td>
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<td>Enteral Wallflex</td>
<td>SE</td>
<td>Oral</td>
<td>Yes</td>
<td>No</td>
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</tbody>
</table>

AE, adverse events; DBE, double balloon enteroscope, NR, not reported; SBE, single balloon enteroscope; SE, spiral enteroscope.

* Defined as ability to tolerate at least a liquid diet.

Fig. 2. Schematic layout of mid-gut stent placement using double balloon enteroscopy. (A) Instrument advancement to the site of obstruction with balloon anchoring of overtube. (B) Guide-wire advancement beyond the obstruction. (C) Enteroscope removal leaving overtube and guide-wire in place. (D) Through-the-overtube and over-the-wire insertion of the stent’s delivery system across the obstruction. (E) Stent deployment under fluoroscopic view.
away from the internal tubing that supplies air insufflation to the overtube balloon. This maneuver can significantly truncate the distance from the mouth to the obstruction site and enable the selection of a shorter stent delivery system to reach its target (Fig. 4). Another alternative is to use the short DBE instrument, if available, which has an overtube length of 105 cm as opposed to 145 cm for the standard DBE overtube.

Under fluoroscopic view, the selected stent’s delivery catheter is advanced over the guide-wire and through the overtube for placement across the stricture. To avoid inadvertent deployment of the proximal flange of the stent in the overtube, distal-release esophageal or enteral SEMS is used and partially deployed. The overtube is subsequently retracted at a safe distance from the proximal aspect of the stent and the stent is then completely released.

After stent deployment, the enteroscope can be reintroduced through the overtube to confirm satisfactory positioning (Fig. 5). Contrast flush can also be administered to confirm free flow and patency of the stent.

**Alternative methods for stent placement in the mid gut**

Oral or rectal routes of endoscopic stent delivery in the mid gut are not always feasible, particularly in the setting of altered gut anatomy. Percutaneous insertion of enteral SEMS in the mid gut has been described in such cases, usually after a failed endoscopic attempt at stent placement. Percutaneous routes utilized for enteral SEMS placement have included percutaneous endoscopic duodenostomy, percutaneous tube enterostomy, and percutaneous transhepatic cholangiostomy. In a review by Zhang et al., an estimated 10.5% and 9.3% of enteral stents were deployed using percutaneous endoscopic duodenostomy/percutaneous tube enterostomy and percutaneous transhepatic cholangiostomy, respectively. The major indication for percutaneous placement of an enteral stent was for palliation of malignant obstructions in patients with surgically altered gut anatomy, particularly at an afferent loop.

Other radiological interventions include percutaneous radiological jejunostomy long tube placement following jejunopexy to decompress the small bowel proximal to the obstruction and to provide a route via the percutaneous radiological jejunostomy for subsequent SEMS placement to palliate one or more small bowel obstructions. In one study, clinical success using this technique was achieved in 18 of 21 patients (85.7%), although major (peritonitis) and minor procedure-related adverse events occurred in 4.8% and 28.6% of patients, respectively.

Percutaneous stent placement requires a matured fistulized tract, a process that typically takes 1 month on average. This delay is not suitable for acutely ill patients. Furthermore, endoscope passage through the percutaneous tract is limited by the diameter of the tract, greatly restricting the size of endoscopes that can be used. To circumvent the need for a matured tract and subsequent delay in stenting, a percutaneous assisted transprosthetic endoscopic therapy (PATENT) procedure has been proposed, whereby a covered SEMS is deployed through a freshly created enterocutaneous tract secured by T-tags. The secured expansion of the tract with the SEMS allows a one-step transprosthetic procedure and the possibility for repeated interventions using therapeutic endoscopes. The PATENT procedure has been described in proof-of-concept studies, including single-session antegrade endoscopic retrograde cholangiopancreatography (ERCP) through a fresh PEG tract in patients with a Roux-en-Y gastric bypass, drainage of the gallbladder through an SEMS-secured cholescystostomy tract, and transprosthetic access through a PEG tract to control a bleeding ulcer at a gastrojejunal anastomosis using a standard upper endoscope. The PATENT technique may not only be applicable for palliation of malignant mid-gut obstruction, but also for a variety of benign small intestinal

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**Fig. 3.** Modification of balloon fixation at the tip of the endoscope. (A) Replacement of the standard rubber band with silk suture to affix the balloon at the tip of the endoscope. (B) This allows retraction of the balloon-loaded enteroscope through the overtube and (C) preserves the double balloon maneuvers unique to double balloon enteroscopy.

**Fig. 4.** Technique for passage of shorter length stent’s delivery catheter through overtube of double balloon endoscope. (A) Incision through overtube close to the mouth using a scalpel. (B) Transfer of the guide-wire (arrow) so it exits through the incision site. (C) Shortened over-the-wire travel distance for the stent’s delivery catheter from the mouth (rather than the proximal end of the overtube) to the obstruction site.
conditions, including placement of biodegradable or drug-eluting stents to manage Crohn’s strictures not accessible by standard enteroscopes.

Future directions

Deep enteroscopic stent placement for malignant mid-gut obstruction beyond the reach of conventional endoscopes is an appealing option in patients who are deemed poor surgical candidates. Relative to surgery, stent placement allows for a more rapid return to functional bowel status, with shorter hospital stay and a lower rate of early adverse events. However, stent insertion deep in the mid gut is a technically challenging and complex procedure, requiring the inventive use of currently available deep enteroscopy instruments and SEMS not specifically suited for that purpose. Stent placement for deep small bowel obstruction represents the last frontier for gastrointestinal endoscopic stenting. The development of new enteroscopes that allow TTS stent placement and/or novel highly flexible stent designs compatible with current enteroscopes will facilitate endoscopic stenting of the mid gut, with the application extending beyond palliation in the foreseeable future.18

Conflicts of interest

The authors declare no conflicts of interest.

References