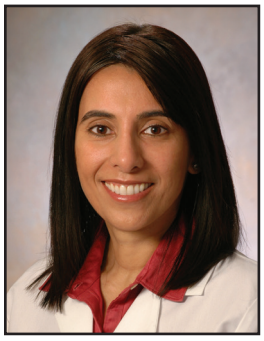
Douglas G. Adler MD, FACG, AGAF, FASGE, Series Editor

Endoscopic Ultrasound Guided Gastroenterostomy for the Treatment of Gastroduodenal Outlet Obstruction

Emmanuel Coronel



Uzma D. Siddiqui

BACKGROUND

The term gastric outlet obstruction has been used broadly to define any mechanical obstruction impairing gastric emptying into the small bowel. The area of obstruction can be in the distal stomach or proximal duodenum, and can be due to an intraluminal lesion or from extrinsic compression, most commonly from malignancy. Patients often present with early satiety, nausea, vomiting (usually undigested food contents) and weight loss. Upper endoscopy and cross-sectional imaging, such as an upper gastrointestinal series with oral contrast or a contrast-enhanced computerized tomography (CT), are necessary not just to confirm the diagnosis but also to evaluate the location and severity of the obstruction. Interestingly, until the 1970's, the most common cause of gastric outlet obstruction was pyloric stenosis associated with peptic ulcer disease. Since the introduction of effective acid suppressive medications and the identification of *Helicobacter pylori* as one of the main drivers of peptic ulcer disease, severe peptic stricture has become rare. Currently, the most common etiology of gastric outlet obstruction has become pancreatic cancer.[1] However, although less common, gastric outlet obstruction can arise from duodenal compression caused by chronic pancreatitis.

Many patients with gastric outlet obstruction are not ideal candidates for surgical resection of the obstructing

Emmanuel Coronel, MD Uzma D. Siddiqui, MD, FASGE, Center for Endoscopic Research and Therapeutics (CERT), Chicago, IL

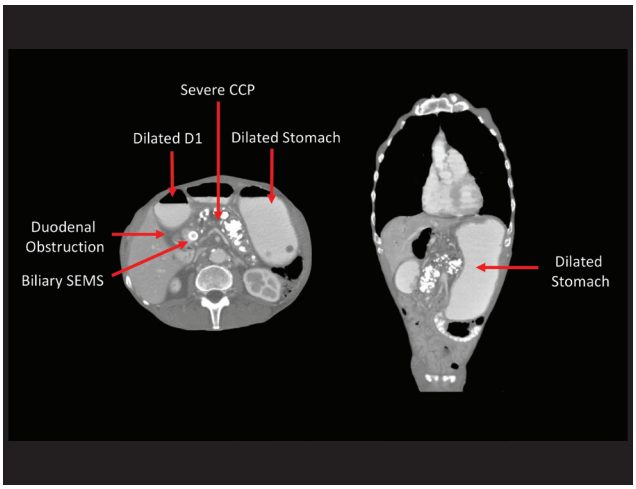


Figure 1.

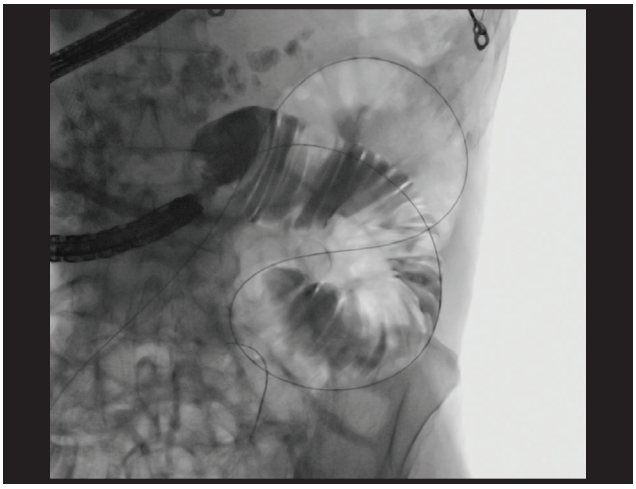


Figure 2.

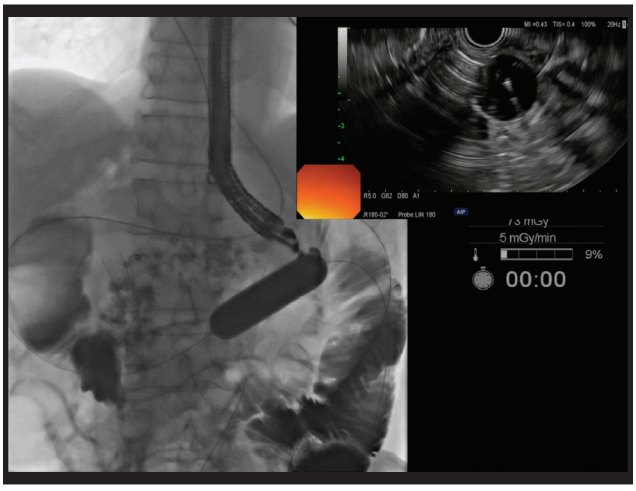


Figure 3.

tumor due to the presence of advanced malignancy. Therefore, these patients are managed with palliative interventions such as surgery (open or laparoscopic gastroenterostomy) or endoscopy, traditionally via enteric stent placement. These patients are frequently debilitated and have a poor performance status and while surgery, when successful, offers better long term outcomes it is associated with much higher rates of morbidity and mortality when compared to minimally invasive interventions such as endoscopic stenting. Endoscopic stenting is safe and effective for symptom palliation in gastroduodenal outlet obstruction. In a retrospective study comparing its outcomes against surgery, endoscopic stenting had significantly less complications and patients had shorter hospitals stays but had a higher re-intervention rate and overall charges.[2] Enteral stents are designed for patients with malignancy and may not be ideal for use in benign conditions.[3]

Endoscopic ultrasound (EUS) was initially utilized as a diagnostic modality in pancreatic diseases dating back to the 1980's where a radial echoendoscope allowed detailed imaging to be obtained due to scope proximity to the pancreas while sitting in the gastrointestinal tract. In the 1990's, the linear echoendoscope with an accessory channel was developed which allowed for therapeutic interventions. This included pancreatic sampling (fine needle aspiration and fine needle biopsy) and drainage of multiple types of lesions (pseudocysts, bile ducts, and pancreatic ducts).

More recently, with the advent of lumen apposing metal stents (LAMS), EUS guided placement has been used in the creation of luminal anastomoses. The idea of creating a luminal anastomosis between the stomach and small bowel (EUS-guided gastroenterostomy) using a stent was initially developed in animals. In 2012, Binmoeller and Shah showcased the results of this technique using a porcine model.[4] The procedure was performed using an anchor wire to appose the lumen of the small bowel to the stomach and a biflanged lumen apposing metal stent (LAMS) was deployed under ultrasound guidance to create the anastomosis. The procedure was technically successful in all four animals without complications. Another animal study from Japan performed by Itoi et al.[5] showed similar results with a successful creation of a gastroenteric anastomosis and no adverse events. In this study, the authors used different devices such as a novel double

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balloon enteric tube to access the small bowel and a different lumen apposing metal stent.

In the United States, a cautery-enhanced (CE) LAMS system allows for direct puncture through the stomach and into the small bowel and obviates the need for tract dilation prior to stent deployment. Furthermore, the single-step access to the small bowel may minimize the chance for separation between the stomach and small bowel. The biphalanged design of the stent reduces the risk of migration and we would advocate using the 15mm diameter size. However, the use of CE-LAMS for gastroenterostomy is an off-label indication.

Endoscopic Technique

EUS-guided gastroenterostomy (EUS-GE) using LAMS was developed as a way to bypass the obstructed proximal duodenum with direct placement of the stent between the stomach and more distal duodenum or proximal jejunum. This new endoscopic technique continues to evolve as endosonographers gain more clinical experience and as more devices are developed for the creation of endoscopic anastomosis. There is no "ideal method" of how to perform this procedure and the technique itself has multiple steps that require an expert operator when performing this procedure.

The basic principles include filling the small bowel with contrast to distend it for better apposition with the gastric wall, puncture into the small bowel, and then stent deployment with the distal flange in the small bowel and the proximal flange in the stomach. This can be performed using different approaches.

The initial access can be performed by using a 19-gauge needle and advancing a guidewire into the small intestine or can be performed directly "freestyle" using the cautery enhanced (CE) LAMS delivery system.

It is of utmost importance to ensure adequate visualization and distention of the small bowel prior to puncture. Depending on the degree of lumen obstruction, every effort should be made to infuse a large volume of dilute contrast into the small bowel. Small amounts of methylene blue can be added to the diluted contrast to help confirm appropriate access after stent deployment. A case series from Japan used a double balloon enteric tube to access the small bowel and distend the bowel distal to the ligament of treitz.[6] In two other case series the visualization of the small

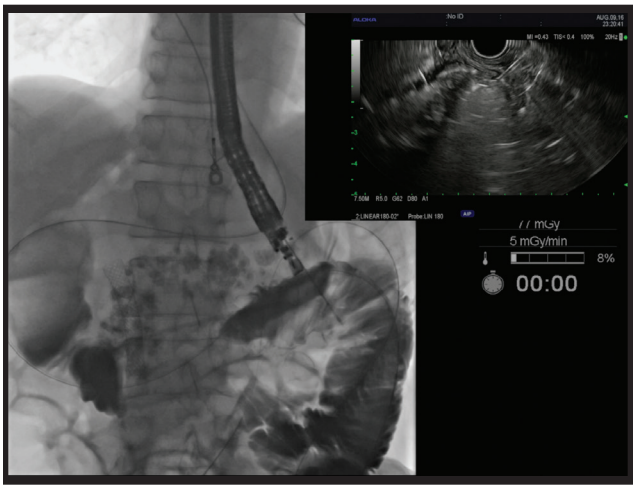

Figure 4.

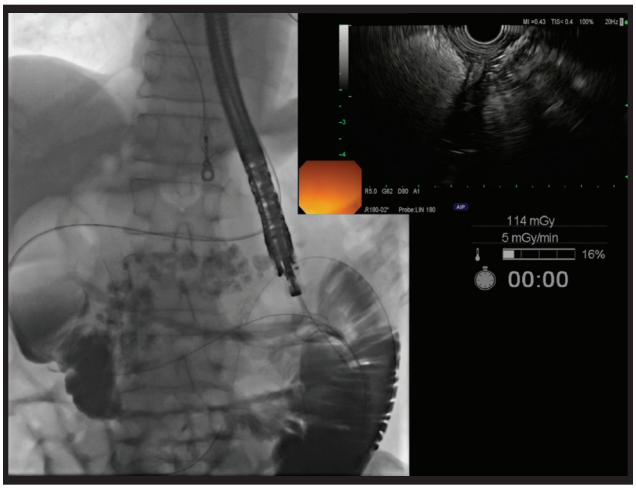

Figure 5.

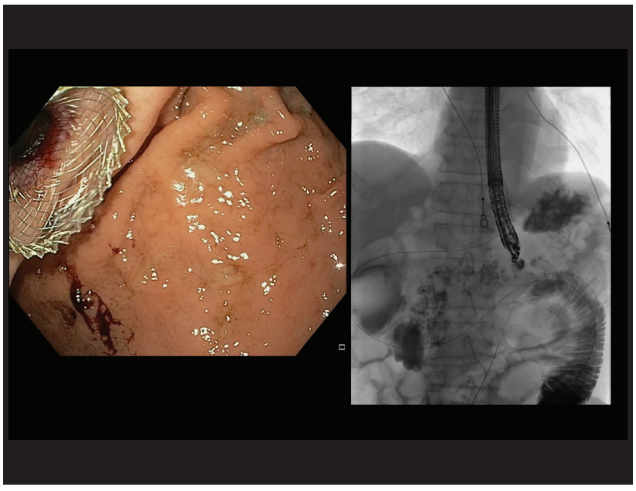

Figure 6.

bowel was performed using biliary or luminal dilation balloons advanced over a guidewire under fluoroscopic guidance.[7,8] In this approach, the balloon in the small bowel can serve as target for the 19-gauge needle to puncture. Our preference when using the balloon-assisted technique is the longer length dilation balloons since they provide a larger target for needle puncture.

One major pitfall in this technique is the difficulty in obtaining reliable apposition of the small bowel wall to the gastric wall to prevent misdeployment of the stent into the peritoneum. Currently available LAMS have a 1cm length and therefore the walls must be in close proximity for proper deployment. Some endoscopists theorize that once the small bowel is punctured with the 19-gauge needle and guidewire is passed, it may push the small bowel away from the stomach. Therefore, they advocate for the direct puncture technique using CE-LAMS. Meanwhile, puncture using a 19-gauge needle and passage of a guidewire over which CE-LAMS can be passed allows maintenance of access and potential for "rescue" placement of a longer fully covered biliary stent to serve as a bridge in cases of LAMS misdeployment.[8]

Careful stent deployment is critical. In our experience, applying gentle traction is useful to ensure appropriate deployment of the proximal phalange, but care must be taken not to apply too much traction that can cause migration of the distal flange out of the small bowel and into the peritoneum. Once the LAMS has been deployed, careful balloon dilation of the stent lumen can be performed. We suggest dilating to just below the diameter of the stent (i.e. 12mm if 15mm LAMS used). The anastomosis created by the stent can be seen endoscopically and by fluoroscopy. Contrast can also be seen passing through the LAMS from the small bowel and into the stomach under fluoroscopy when placement is correct.

To help illustrate this technique we have added a series of figures on an EUS-GE performed at our institution in a patient with severe gastroduodenal outlet obstruction due to chronic calcific pancreatitis. (Figures 1-6.) The patient has previously had a metal biliary stent placed at an outside hospital for a benign biliary stricture and jaundice. In our case, we used the dilation balloon over a guidewire technique. First, we injected copious amounts of dilute contrast into the small bowel and advanced an 0.035mm guidewire under fluoroscopic and endoscopic guidance (Figure 2). After removing the endoscope, a 20-mm through the scope dilation balloon was passed over the guidewire under fluoroscopic guidance and inflated with contrast. Next, the EUS linear scope was passed down and the dilation balloon was visualized in the small bowel with the scope tip in the stomach (Figure 3). We then used a 19-gauge needle to puncture the balloon in the small bowel and advanced a second 0.035 guidewire deeper into the small bowel. The needle was then exchanged for a 15mm CE-LAMS that was deployed successfully. (Figures 4-6). Finally, the LAMS was dilated using a 12mm balloon allowing contrast from the small bowel to enter the stomach.

Our patient was started on a full liquid diet the next day and then advanced to a low residue diet. He was discharged 48 hours after the procedure, gained 40lbs in 8 weeks and continues to do well 6 months after the procedure. Currently, there are no data to suggest optimal time for stent removal but there are anecdotal reports of gastroenterostomy tract closure after LAMS removal.

Safety and Efficacy of EUS-GE

Since this is a new technique, the data evaluating its efficacy and safety is limited to a few small studies. The data includes patients with benign and malignant gastric outlet obstruction and reported the results of ten patients,[7] twenty patients[6] and twenty-six patients,[8] describing 90% technical success rates, and clinical success rates of 90%[6,7] and 85%.[8]

By analyzing these studies, even though the number of patients is limited, the rate of adverse events was low (less than 5%). Nonetheless, it is important to note that when complications happen these are not trivial. Khashab et al.[7] reported one case of stent misdeployment that ultimately resulted in conversion to a surgical gastrojejunostomy. The case series by Itoi et al.[6] reported two stent misdeployements and the multicenter study published by Tyberg et al.[8] reported one case of bleeding, one case of post procedural pain and one patient who developed peritonitis and died the following day after the procedure. Therefore, close collaboration with surgery and review of the technique is key to ensure success during this intervention.

CONCLUSION

EUS-guided gastroenterostomy (EUS-GE) is a novel, minimally invasive technique that can be used to palliate the symptoms of gastroduodenal outlet obstruction due to benign or malignant conditions. Due to the risk for serious adverse events, no current standardized technique and limited published data, this endoscopic technique should only be undertaken by experienced endosonographers. Furthermore, use of CE-LAMS for EUS-GE is not currently an FDA approved indication. Multidisciplinary care is strongly encouraged, incorporating surgeons, radiologists and gastroenterologists to ensure proper patient selection. EUS-GE remains to be prospectively evaluated, but early results show promise in the treatment of gastric outlet obstruction. This technique may be of particular interest for benign indications where long-term stent patency is desired but more study is warranted. ■

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