Efficacy of Endoscopically Created Bypass Anastomosis in Treatment of Afferent Limb Syndrome: A Single-Center Study

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Afferent limb syndrome is a postoperative complication of gastrointestinal surgery, resulting from obstruction of a biliary-enteric limb. Surgery has been the cornerstone of treatment for this condition, but advances in endoscopic and percutaneous techniques could offer less-invasive options. Creation of an internal endoscopic anastomosis between the obstructed afferent limb and an adjacent gastrointestinal lumen can relieve symptoms and might provide a long-term solution. We report the efficacy of endoscopic treatment of afferent limb syndrome using lumen-apposing self-expandable metal stents to create 3 types of enteric anastomoses: a jejunojejunostomy, 2 gastrojejunostomies, and a duodenuojejunostomy in patients who developed afferent limb obstruction following a resection for pancreaticobiliary cancer.

Keywords: Endoscopic Ultrasound; Intestinal Obstruction; Stents.

Methods

This single center report comprises 4 cases of EUS-guided bypass of an afferent limb obstruction, by creation of 1 jejunojejunostomy, 2 gastrojejunostomies, and 1 duodenuojejunostomy, respectively (Table 1), with the use of LAMS (AXIOS, Boston Scientific, Marlborough, MA). All procedures were performed under general endotracheal anesthesia.

Enteroenterostomies were created with a forward-viewing linear echoendoscope (TGF-UC180J, Olympus, Center Valley, PA). In the first 2 cases, endosonographically visualized, fluid-filled, dilated afferent limbs were punctured using a 19-gauge needle (Expect, Boston Scientific), followed by bile aspiration and instillation of contrast under fluoroscopic guidance. Guidewires (Hydra Jagwire, Boston Scientific) were then advanced through the needle into the afferent limbs and the tracts were dilated with 4-mm balloons (Hurricane, Boston Scientific) to allow passage of the stent delivery system. LAMS (10-mm diameter) were then deployed over guidewires using EUS and fluoroscopic guidance. In the third case, a 10-mm LAMS with electrocautery-enhanced delivery system (AXIOS EC, Boston Scientific) was advanced through the duodenum and deployed into the afferent limb under EUS and fluoroscopic guidance. In the fourth case, we punctured and placed a guidewire into the dilated afferent limb as described in the first 2 cases, followed by 15-mm LAMS electrocautery and delivery. In all patients, double pigtail stents (7F or 10F catheter) were subsequently placed within the LAMS.

Results

Case 1

A 61-year-old woman presented 3 years after pancreaticoduodenectomy for T3N1 pancreatic adenocarcinoma. Two years thereafter, she developed partial

Abbreviations used in this paper: EUS, endoscopic ultrasound; LAMS, lumen-apposing self-expandable metal stents.
obstruction of the afferent loop, requiring conversion to a Roux-en-Y anastomosis. She subsequently presented with afferent limb syndrome and cholangitis, treated with percutaneous transhepatic biliary drainage. She was later found to have a stricture of the afferent limb. Attempts to reach the obstructed limb with deep enteroscopy were unsuccessful because of adhesions. Therefore, we elected to create a diverting jejunojunostomy using a LAMS. The patient did well following the procedure, without adverse events or recurrence of cholangitis. Her percutaneous drain was removed and the endoscopically placed stents were removed 4 months later. At the time of stent removal, a widely patent endoscopic anastomosis was seen (Figure 1A). However, 3 months later the afferent limb syndrome recurred because of closure of the anastomosis. The LAMS was replaced as before, and the patient remains well.

Case 2

A 56-year-old man presented 1 year after pancreaticoduodenectomy for T3N1 pancreatic adenocarcinoma with afferent limb syndrome and acute cholangitis. Computed tomography revealed regional lymph node enlargement, omental nodularity, and new-onset ascites. At endosonography, a fluid-filled, dilated afferent limb measuring 2.5 cm in diameter was visualized and a diverting gastrojejunostomy was created using a LAMS. The patient did well without adverse events or recurrent cholangitis. He remains without jaundice 3 months later. Follow-up computed tomography scan showed decreased dilation of the afferent loop and excellent positioning of the stent (Figure 1B).

Case 3

A 76-year-old woman presented 3 months after common bile duct resection and Roux-en-Y hepaticojejunostomy for pT3N1 hilar cholangiocarcinoma. Her postoperative course was complicated by persistent anastomotic leakage, biloma formation, and continued biliary leakage, despite percutaneous catheter drainage of the biloma. The percutaneous drains became dislodged leaving a 5-mm biliary fistula, which we accessed using a pediatric videotranshepatic biliary drainage system with electrocautery-enhanced delivery system (GLIDEWIRE, Terumo Medical Corporation, Somerset, NJ) was passed through the endoscope and navigated to the hepaticojunostomy, and then into the obstructed afferent limb under fluoroscopic guidance. A 20-mm biliary stone extraction balloon (Multi-3V Plus, Olympus) was advanced over the guidewire for fluid instillation, to define the afferent limb by EUS (Figure 1C). Swirling of the injected fluid was seen with a forward-viewing linear echoendoscope positioned in the

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Table 1. Summary of Patients with Afferent Limb Syndrome Who Underwent Endoscopic Ultrasound-Guided Therapy Using Lumen-Apposing Metal Stents

<table>
<thead>
<tr>
<th>Age/gender</th>
<th>Previous surgery</th>
<th>Previous treatments for ALS</th>
<th>Anastomosis created</th>
<th>Tract creation</th>
<th>LAMS diameter, mm</th>
<th>Technical success</th>
<th>Clinical success</th>
<th>LAMS removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>61/F</td>
<td>Pancreaticoduodenectomy</td>
<td>Roux-en-Y hepaticojejunostomy and percutaneous transhepatic biliary drainage</td>
<td>Jejunojunostomy</td>
<td>19-gauge needle/guidewire followed by balloon dilation</td>
<td>10</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>56/M</td>
<td>Pancreaticoduodenectomy</td>
<td>None</td>
<td>Gastrojejunostomy</td>
<td>19-gauge needle/guidewire followed by balloon dilation</td>
<td>10</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>63/M</td>
<td>Roux-en-Y hepaticojejunostomy</td>
<td>Percutaneous transhepatic biliary drainage</td>
<td>Duodenoojunojunostomy</td>
<td>LAMS with electrocautery-enhanced delivery system</td>
<td>10</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>55/M</td>
<td>Pancreaticoduodenectomy</td>
<td>ERCP</td>
<td>Gastrojejunostomy</td>
<td>19-gauge needle/guidewire followed by LAMS with electrocautery-enhanced delivery system</td>
<td>15</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

ALS, afferent limb syndrome; ERCP, endoscopic retrograde cholangiopancreatography.

ALS recurrence after LAMS removal because of loss of patency of the anastomosis.
duodenal bulb. A diverting duodenuojejunostomy using a LAMS was created (Figure 1D and E). The patient did well without adverse procedural events and was discharged home 2 days later. She remains well 1 month later, with resolution of the right upper quadrant collection and closure of the biliary fistula.

Case 4

A 66-year-old woman developed obstructive jaundice 14 months after a classic pancreaticoduodenectomy for pancreatic adenocarcinoma. Attempts to reach the biliary-enteric anastomosis endoscopically were unsuccessful because of malignant stenosis of the afferent limb. A forward-viewing linear echoendoscope was then advanced into the stomach, where the dilated afferent limb was visualized by ultrasound. A diverting gastrojejunostomy using a LAMS was created. The LAMS was then dilated with a 15-mm balloon (CRE Wireguided, Boston Scientific) and a forward-viewing upper endoscope was advanced through the LAMS into the afferent limb to perform endoscopic retrograde cholangiopancreatography, with placement of a 10 × 40 mm covered metal stent (Viabil, Gore, Flagstaff, AZ) across a malignant distal bile duct stricture. The jaundice resolved and the patient did well without adverse events.

Discussion

Interventional EUS provides a convenient means to take advantage of the compactness of the gastrointestinal tract; obstructed small bowel segments can often be readily imaged from adjacent portions of the foregut, providing a potential window for enteroenteric anastomosis creation. Recent advances in stent design and deployment have simplified nonsurgical treatment of the afferent limb syndrome.

The placement of a biflanged lumen apposition stent between a dilated afferent limb and an adjacent portion of the upper digestive tract (stomach, duodenum, or proximal jejunum) allows drainage of the obstructed afferent limb, without need for external drains or complex repeat surgeries, which may reduce hospital stay and improve quality of life. EUS-guided bypass anastomosis can be performed at a variety of sites in the upper digestive tract, as long as the afferent limb can be

Figure 1. (A) Endoscopic image. Endoscopic anastomosis was widely patent after stent removal. (B) Transverse computed tomography scan image. Biflanged anastomotic stent between the stomach and the jejunum afferent loop. (C) Fluoroscopic image. Biliary tree and hepaticojejunostomy filled with contrast after instillation of contrast through the percutaneous fistula to dilate and define the afferent limb under EUS guidance. (D) Fluoroscopic image. LAMS and plastic stents in place between the stomach and the jejunum afferent loop. (E) Endoscopic image. Jejunum afferent loop visualized through the LAMS.
visualized by EUS from a location not more than 1 cm from the EUS transducer. The existence of an external biliary fistula allows instillation of contrast and water into the obstructed afferent loop, which facilitates endosonographic confirmation of the target for needle puncture. A 10-mm LAMS is probably adequate for long-term decompression of biliary and pancreatic secretions. A larger diameter LAMS could result in reflux of food contents into the afferent limb. If an endoscope needs to be advanced into the afferent limb, a 15-mm diameter stent is preferred.

Careful review of radiological images is important for preprocedural planning, but the best site for anastomosis creation is usually determined intraprocedurally, using fluoroscopic and endosonographic guidance, often both simultaneously. Although this is nominally an “endoscopic” procedure, we mainly use fluoroscopic and endosonographic imaging during anastomosis creation. Forward-viewing echoendoscopes seem to simplify these procedures, because greater axial forces can be generated with this scope than with oblique-viewing echoendoscopes.

One needs to be particularly cognizant of proper device deployment, particularly the final, crucial step involving proximal flange release. According to the manufacturer’s instructions, the endoscope should be pulled back slightly to directly visualize 2–3 mm of the black catheter shaft marker in the gastrointestinal tract before deploying the proximal flange. An alternative option that does not sacrifice a stable scope position or risk placing excessive traction on the self-expandable metal stent involves releasing the proximal flange while it is still inside the endoscope, and the endoscope tip remains close to the puncture site. At that point, advancing the delivery system while gently withdrawing the endoscope allows the proximal flare to spring open as the stent exits the endoscope.

Fully covered biflagged anastomotic stents seem to effectively prevent migration and leakage. However, they are currently only manufactured in a single length, limiting selection of an anastomotic site. Longer stents would likely allow creation of endoscopic anastomoses across a wider range of clinical circumstances. These stents are not currently approved by the Food and Drug Administration for creation of internal anastomoses. The recently released electrocautery-tipped self-expandable metal stent delivery system enables single-step puncture and stent deployment, decreasing the risk of losing access to the target organ during device exchanges, inadvertent creation of a noncovered fistula, and intraperitoneal leakage of luminal contents. This modified LAMS system also likely shortens procedural times. Placement of plastic stents at the end of procedure is intended to prevent LAMS occlusion by food, although it is unclear whether this step is necessary.

The duration of stent placement needed to establish a permanent and patent enteroenteric fistula following stent removal remains unknown. It is also unknown if the LAMS needs to be removed, especially in patients with recurrent cancer, although the devices are not intended for long-term use. Although a long-lasting enteroenteric fistula might be expected following self-expandable metal stent removal, the only patient of ours (Case 1) in whom the LAMS was removed experienced recurrent afferent limb syndrome because of loss of patency of the anastomosis.

Endoscopically created enteroenteric anastomoses for relief of afferent limb syndrome, although seemingly very effective in this small case series, are in their infancy; no long-term results have been reported. The endoscopic approaches described herein are technically demanding and should only be performed by operators having the requisite experience.

References


Reprint requests
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Conflicts of interest
These authors disclose the following: Ian Grimm is a consultant for Boston Scientific. Todd Baron is a consultant for Boston Scientific and Olympus Medical Systems. The remaining author discloses no conflicts.