# How I do therapeutic EUS

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Therapeutic EUS encompasses different procedures. In this review, we will illustrate our technique of performing EUS-guided biliary drainage (EUS-BD) and EUS-guided gastroenterostomy (EUS-GE). Other therapeutic EUS procedures, such as drainage of pancreatic fluid collections, pancreatic duct drainage, and gallbladder drainage, will not be covered in this article.

## EUS-GUIDED BILIARY DRAINAGE

EUS-BD remains a technically challenging procedure. Although technical success in expert hands is high, serious adverse events may occur. Initial access into the biliary tree is achieved through either an intrahepatic or an extrahepatic approach. Subsequent drainage is either achieved upstream to the site of biliary obstruction (eg, hepatogastrostomy and choledochoduodenostomy) or downstream (eg, rendezvous and antegrade stent placement). In patients with benign biliary pathologic conditions in whom ERCP fails, we favor a rendezvous approach. In patients with distal malignant biliary obstruction without gastric outlet obstruction (GOO) in whom ERCP fails, we prefer choledochoduodenostomy over hepatogastrostomy. The bile duct is a large target that is close to the duodenum and is relatively fixed. The echoendoscope is positioned in the duodenal bulb in a stable long position. All these factors render this procedure relatively simple as compared with hepatogastrostomy. We, however, prefer the latter approach in patients with GOO because luminal compromise increases the incidence of enterobiliary reflux, cholangitis, and stent occlusion in patients who undergo a choledochoduodenostomy. Needless to say, hepatogastrostomy is the technique of choice in patients with more proximal biliary obstruction or altered anatomy.

When we perform EUS-BD, we follow these 5 principles with the goal of optimizing technical and therapeutic success and minimizing procedural risk:

1. Most therapeutic linear echoendoscopes used during EUS-BD offer oblique endoscopic luminal imaging. Thus, performance of the different steps of EUS-BD under the guidance of luminal endoscopic imaging can be misleading. After needle access of the biliary system under US guidance, the wire is advanced and a longitudinal view of the wire should be maintained under US view throughout the procedure. We perform most of the steps thereafter without luminal endoscopic guidance to avoid difficult tract dilation and loss of wire access. Deployment of the luminal end of the stent during hepatogastrostomy and choledochoduodenostomy is typically performed under endoscopic guidance. However, when we use a lumen-apposing metal stent, this last step can also be performed under US guidance with the luminal flange deployed within the endoscope channel, followed by pushing it out of the echoendoscope by advancing the stent sheath after deployment.
2. Fluoroscopy is essential for most cases of EUS-BD. The tip of the echoendoscope should be directed toward the hilum when both the choledochoduodenostomy and the hepatogastrostomy techniques are used. This allows appropriately advancing the wire toward the hilum. This is followed by cholangiography and careful interpretation of biliary anatomy, location of obstruction, and degree of biliary dilation.
3. Access of the biliary system is best performed with a 19-gauge FNA needle. This allows easy cholangiography and facilitates advancement of either a 0.025-inch or a 0.035-inch guidewire. Our preference is to use a 0.025-inch guidewire because this decreases the risk of wire shearing. Occasionally, we need to withdraw the wire into the needle; if resistance is felt while the wire is withdrawn into the needle, this signifies that the wire coating is jammed into the needle. To avoid wire shearing and retention of sheared wire

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within the biliary system, the needle is withdrawn out of the patient and a new wire should be used. Alternatively, an access needle (Cook Medical, Bloomington, Ind, USA) can be used. This needle has a sharp stylet and is relatively easy to insert into the bile duct. When the stylet is withdrawn, the needle left in place has a blunt end, which helps avoid shearing of the guidewire.

4. Tract dilation is the most challenging step during EUS-BD. We do not attempt to dilate the tract until adequate wire positioning is established. Failed subsequent stent placement after tract dilation risks massive biliary leakage. When we use cautery-assisted dilation, we use coaxial instruments (eg, 6F cystotome) and avoid noncoaxial ones (eg, needle-knife) because the latter have been associated with an increased risk of adverse events. In addition, we avoid aggressive tract dilation because it also increases the risk of bile leak. For example, tract dilation to 8-9F is adequate for placement of a biliary metallic stent across choledochoduodenostomy or hepatogastrostomy tracts. Last, as mentioned above, tract dilation should be done under radiologic and US guidance.
5. Several EUS-BD–related deaths have been reported in the literature, most commonly resulting from intraperitoneal stent migration after hepatogastrostomy. We follow several steps to avoid this serious but largely preventable adverse event: (A) we leave 3 to 4 cm of the self-expandable metallic stent in the stomach to account for postdeployment shortening of the stent and movement of the stomach away from the liver during respiration; (B) we place a partially covered metallic stent, which decreases the risk of migration, and at the same time avoid blockage of primary intrahepatic biliary radicals, eg, Wallflex (Boston Scientific, Marlborough, Mass, USA); GIOBOR metallic stent (Taewoong Medical Co, Seoul, South Korea); and Hanaro stent (M.I.Tech Medical Co, Seoul, South Korea); other options that we use if the intragastric length of the stent is relatively short are (C) clipping of the stent to the gastric wall or (D) placement of a plastic double-pigtail stent through the metallic stent for anchorage.

## EUS-GUIDED GASTROENTEROSTOMY

EUS-GE is the endoscopic equivalent of surgical gastrojejunostomy and is an alternative endoscopic technique to duodenal stent placement in the treatment of patients with malignant GOO. EUS-GE is a promising technique because it eliminates the risk of recurrent stent obstruction resulting from tumor ingrowth. EUS-GE is currently the preferred approach in these patients at The Johns Hopkins Hospital. However, EUS-GE is a challenging procedure, and we suggest the following 4 technical tips:

1. EUS-GE can be performed by either the balloon-assisted technique or the direct or "freehand" technique. The former entails advancing a wire and then a balloon catheter across the obstruction into the jejunum. The inflated balloon serves as a US target for transgastric puncture with an FNA needle, followed by wire and stent placement. The mere purpose of the balloon is to ensure appropriate targeting of the intended organ (ie, small-bowel loop distal to the obstruction). We have found that this technique is tedious because placement of instruments across the obstruction is frequently challenging and often requires placement of an overtube. We favor the direct EUS-GE approach, whereby the small bowel is filled with fluid and then directly targeted by use of a lumen-apposing metallic stent with an electrocautery-enhanced delivery system. In our experience, we have also found that wire advancement across the GE fistula before stent placement may push the jejunum away from the stomach. This may result in technical failure and misplacement of the stent. Therefore, the direct GE technique does not necessitate any wire placement throughout the procedure.
2. One essential step of EUS-GE is filling the small bowel with fluid. We insert a diagnostic gastroscope, which is advanced until it is just proximal to the site of the small-bowel stenosis. A solution made of contrast material and blue dye (eg, methylene blue) is then injected through the working channel, and the small bowel is seen filling with contrast material under fluoroscopy. It is essential to administer an agent that inhibits intestinal motility before injection of contrast material (eg, glucagon). Once the proximal small bowel is filled with dye, the gastroscope is quickly exchanged to a therapeutic linear echoendoscope. This is advanced under endoscopic and fluoroscopic guidance to the stomach in such a manner that the tip of the echoendoscope is close to a dilated and fluid-filled small-bowel loop adjacent to the gastric wall. This loop is targeted with an FNA needle (finder needle), and blue dye is aspirated. This confirms correct targeting of the jejunum and avoids an inadvertent gastrocolostomy. The needle is then removed, and direct GE is performed.
3. Although EUS-GE is appropriate in most patients with malignant GOO, in some circumstances this technique should be avoided. We do not perform EUS-GE in patients with perigastric varices. Therefore, examination of abdominal imaging before attempting EUS-GE is warranted. These varices can be found in patients with pancreaticobiliary tumors and thrombosis of the portal vasculature. Similarly, EUS-GE is best avoided in patients with large volume ascites because of the risk of secondary peritonitis, leakage, and dehiscence. Last, we prefer duodenal stent placement over EUS-GE in patients with suspected or known

extensive peritoneal adhesions. Pulling the jejunum toward the stomach and maintaining it in that position by use of the lumen-apposing forces of the stent may not be possible and risks delayed stent migration and leakage.

4. EUS-GE is also effective for the treatment of patients with afferent loop syndrome. A review of abdominal imaging is essential to ensure procedural feasibility where the afferent loop is adjacent to the stomach and without any intervening structures. Although the afferent loop is typically distended, further injection of fluid is occasionally needed. However, aggressive fluid injection should be avoided because it can result in dehiscence of the bilioenteric anastomosis.

Therapeutic EUS has come long way in recent years with enhancement of techniques and availability of tailored devices. Attention to procedural details and further refinement of techniques and development of devices are essential to render these technically challenging procedures mainstream.