REVIEW ARTICLE

EUS-guided hepaticogastrostomy: practical tips and tricks

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Background and Aims: EUS-guided hepaticogastrostomy (EUS-HGS) has gained traction as a reliable and safe method for definitive biliary drainage in patients who cannot undergo traditional transampullary procedures. Many of the newly developed single-stage devices are not yet approved for clinical use in Western practice.

Methods: We highlight key clinical and technical aspects of EUS-HGS using devices that are currently available in Western countries. The article is a comprehensive step-by-step technical review of EUS-HGS, and the video demonstrates high-level tips to overcome commonly encountered procedural challenges.

Results: Patients with biliary obstruction underwent EUS-HGS at our center. The technical difficulties that were encountered are highlighted in the article and the accompanying video. The article and video provide a detailed review of (1) preprocedural considerations, (2) puncture site selection, (3) biliary puncture, (4) contrast injection, (5) guidewire manipulation, (6) tract dilation, and (7) stent placement.

Conclusion: An understanding and implementation of the technical nuances highlighted in this article should help Western endoscopists navigate the complexities of EUS-HGS and ensure optimal outcomes. (VideoGIE 2024;9:417-24.)

BACKGROUND AND AIMS

EUS-guided hepaticogastrostomy (EUS-HGS) has gained traction as a reliable and safe method for definitive biliary drainage in patients who cannot undergo traditional transampullary procedures. Since EUS-HGS was first described in 2003, there have been several developments in procedure techniques and devices.[1,2] Many of the newly developed single-stage devices are not yet approved for clinical use in the West.[3-5] Here, we highlight key clinical and technical aspects of EUS-HGS using devices that are currently available in Western countries.

Abbreviations: B2, segment 2 intrahepatic ducts; B3, segment 3 intrahepatic ducts; EUS-HGS, EUS-guided hepaticogastrostomy; HGS, hepaticogastrostomy; MRI, magnetic resonance imaging; SQJ, squamocolumnar junction.

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ENDOSCOPIC METHODS

Preprocedural considerations

a) Appropriate patient selection is essential to achieve good clinical outcomes. Cross-sectional imaging must be obtained before the procedure to screen for unfavorable factors that may increase the risk of adverse events (Table 1).[4,6]
b) It is helpful to have all necessary equipment available and ready at hand (Table 2). Minimizing delays between procedure steps will reduce the likelihood of intraprocedural biliary leakage and redundancy.
c) A prone position with neutral anteroposterior fluoroscopy is preferred by many, but supine position is acceptable as well. A slight downward inclination of the fluoroscopy table toward the patient's right will result in better filling of the right intrahepatic ducts without the need for overinjection (Fig. 1).

Step 1: Puncture site selection

a) Both intrahepatic bile ducts in segment 2 (B2) and segment 3 (B3) of the left lobe of the liver are suitable sites for puncture (Table 3). When technically feasible, accessing B3 close to and upstream from the B2-B3 junction is considered by many experts to be an optimal puncture site (Fig. 2).
b) Ideally, the targeted intrahepatic bile duct should have a diameter >5 mm. Operators with experience may find smaller diameters, such as >2 mm, acceptable. Distance

TABLE 1. Unfavorable factors and common pitfalls in EUS-HGS

Unfavorable for EUS-HGS	Notes
Large-volume ascites	Large distance between the stomach wall and liver results in increased risk of leakage, peritonitis, hemorrhagic adverse events, and stent migration
Portal hypertension or increased perigastric vascular collaterals	Risk of intraperitoneal hemorrhagic adverse events
Upstream liver parenchymal atrophy	Parenchymal atrophy in the targeted liver segment will result in minimal bilirubin improvement. In addition, a tract length of <2.5 cm is associated with an increased risk of stent migration and bile leak. Drainage may be considered in patients with refractory cholangitis.
Tumor close to the puncture site	Risk of bleeding increases when the tumor is located within the puncture tract; in addition, there is an increased risk of stent malfunction because of tumor ingrowth.
Segmental portal vein occlusion	Reduced vascular supply to the targeted liver segment will eventually result in liver atrophy regardless of biliary drainage. HGS should generally be avoided in such patients unless needed for cholangitis.

EUS-HGS, EUS-guided hepaticogastrostomy; *HGS*, hepaticogastrostomy.

TABLE 2. Commonly used accessories in Western practice for EUS-HGS

Accessory	Company	Size	Notes
Biliary puncture			
Expect*	Boston Scientific Corp, Marlborough, Mass, USA	19-gauge	Stainless steel needle
EZ Shot 3 Plus	Olympus Medical Systems, Tokyo, Japan	19-gauge	Coiled sheath, nitinol needle
Guidewire selection			
VisiGlide 2*	Olympus Medical Systems, Tokyo, Japan	0.025 × 450 cm	Hydrophilic coating on the tip
Tract dilation			
Cotton graduated dilation catheter	Wilson-Cook Medical Inc, Winston-Salem, NC, USA	5F to 7F	Atraumatic graded dilators. Can be used for stents less than 7F.
Dilating balloon	Boston Scientific Corp, Marlborough, Mass, USA*	4 cm × 4 mm 4 cm × 6 mm	Single-size dilating balloons
Stent placement			
Gore Viabil (with drainage holes)*	WL Gore & Associates, Newark, Del, USA	10 mm × 100 mm 10 mm × 80 mm	FCSEMS with antimigratory fins on both sides. Version with side holes allows drainage of segmental ducts.
WallFlex biliary partially covered and fully covered stents	Boston Scientific Corp, Marlborough, Mass, USA	10 mm × 100 mm 10 mm × 80 mm	Partially covered stent allows drainage of segmental ducts and has antimigration properties.

HGS, Hepaticogastrostomy; *FCSEMS*, fully covered self-expandable metal stent.
*Accessories used in video demonstration.

between the liver capsule and targeted bile duct should ideally be 2.5 to 3 cm (Fig. 3).[2]

c) Transesophageal puncture should be avoided because of the risk of pneumothorax, mediastinitis, bile reflux esophagitis, or food occluding the stent. This can be avoided by accurately identifying the following landmarks:
   1. The squamocolumnar junction (SQJ): In the absence of a hiatal hernia, a puncture site that is 2 to 3 cm below the SQJ will ensure an intra-abdominal puncture and minimize the risk of transpleuritic access (Fig. 2A).
   2. In the presence of a hiatal hernia, the SQJ is frequently located above the diaphragm and does not accurately represent the location of the diaphragmatic crus (Fig. 2C). In such cases, EUS may be used to identify the right crus of the diaphragm.

d) The gastrohepatic ligament (GHL) can be identified as a homogenous hyperechoic structure, between the undersurface of the liver and the lesser curvature of the stomach (Fig. 4). Traversing the GHL during puncture should be avoided because this may result in angulation and kinking of the stent (Fig. 5).

e) The angle between FNA and the longitudinal axis of the targeted bile duct should ideally be >135°. This promotes unrestricted passage of the guidewire toward the hilum (Fig. 6).[7]

Step 2: Biliary puncture

a) Air bubbles within the biliary tree can significantly impair echo visualization. Withdrawing the stylet and priming the

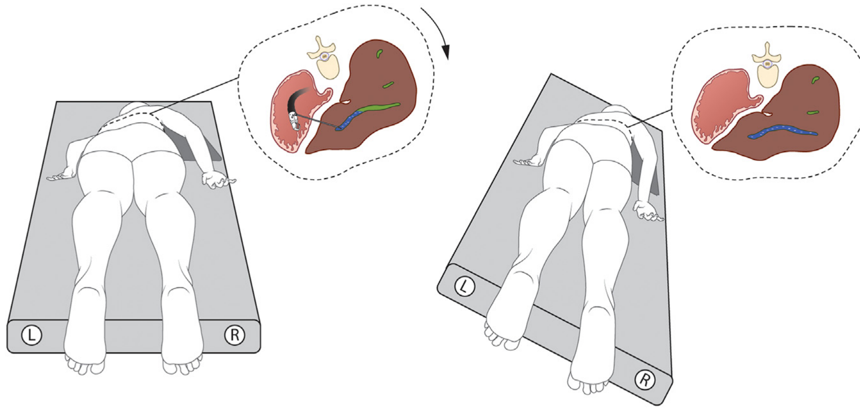

Figure 1. Modified prone position. Note that the right side of the patient is lowered by 10° to 20°. This lowers the antidependent (right-side) intrahepatic ducts. In this position, gravity-related pooling of contrast favors a more diffuse distribution within the biliary tree.

TABLE 3. Important clinical considerations when choosing between B2 and B3 for EUS access

B2	B3
More cephalad	More caudal
Higher risk of transesophageal puncture and mediastinitis	Low risk of transesophageal puncture and mediastinitis
Generally easier to access; endoscope is in a neutral position	More difficult to access; endoscope is in an angled position
More favorable because the needle and guidewire are in the same direction (obtuse angle) toward the hilum	Less favorable because the needle and guidewire are in different directions (acute angle), ie, the trajectory of the guidewire may not be toward the hilum

B2, segment 2 intrahepatic ducts; *B3*, segment 3 intrahepatic ducts.

needle with contrast will minimize the likelihood of pneumobilia.

b) Excluding arterial or venous blood vessels on EUS before puncture is essential. This is ideally done without the application of excess pressure on the transducer because this may collapse veins and mask Doppler flow.
c) As the needle is advanced from the liver capsule to the target intrahepatic bile duct, care should be taken to avoid puncturing any intervening biliary radicles or blood vessels. This may result in bleeding, bile leak, or potentially a portobiliary fistula.
d) Puncture of the target bile duct can be particularly challenging in patients with fibrosis or biliopathy. In such situations, a rapid forward thrust of the needle may be required to gain access. It is not uncommon to puncture beyond the posterior wall of the bile duct. If this does occur, apply gentle suction while slowly withdrawing the needle. A bilious aspirate confirms an intraductal location of the needle tip.
e) Consider using the "curved-needle technique" when a suitable needle trajectory cannot be obtained. The technique involves unsheathing the needle ex vivo and bending it gently by hand to create a smooth arc. The bent needle tip allows it to follow an elliptical path after entering the liver parenchyma, hence avoiding intervening structures.[8]

Step 3: Contrast injection

a) Decompressing the biliary tree before injecting the contrast will reduce the risk of bacterial dissemination in patients with cholangitis.[8] Aspirated bile may be sent for microbiologic studies.
b) Using a water-soluble radiocontrast that is diluted to 50% with sterile saline solution or water will result in better visualization of the guidewire and a more uniform distribution of contrast within the biliary tree.
c) Very quick contrast dissipation indicates an intravascular injection. This should be recognized and the needle repositioned.
d) Inject only enough contrast to plan the procedure and direct the guidewire. Overinjection of contrast will increase intraductal pressure and may increase the risk of a bile leak.

Step 4: Guidewire insertion and manipulation

a) An ideal guidewire for EUS-HGS should have a hydrophilic soft tip and adequate rigidity to support instrument advancement and stent placement. An angled tip allows access and maneuverability within the biliary tree and helps with traversing tight strictures if needed.
b) A 19-gauge needle can support both 0.035-inch and 0.025-inch guidewires. A 0.025-inch guidewire with a

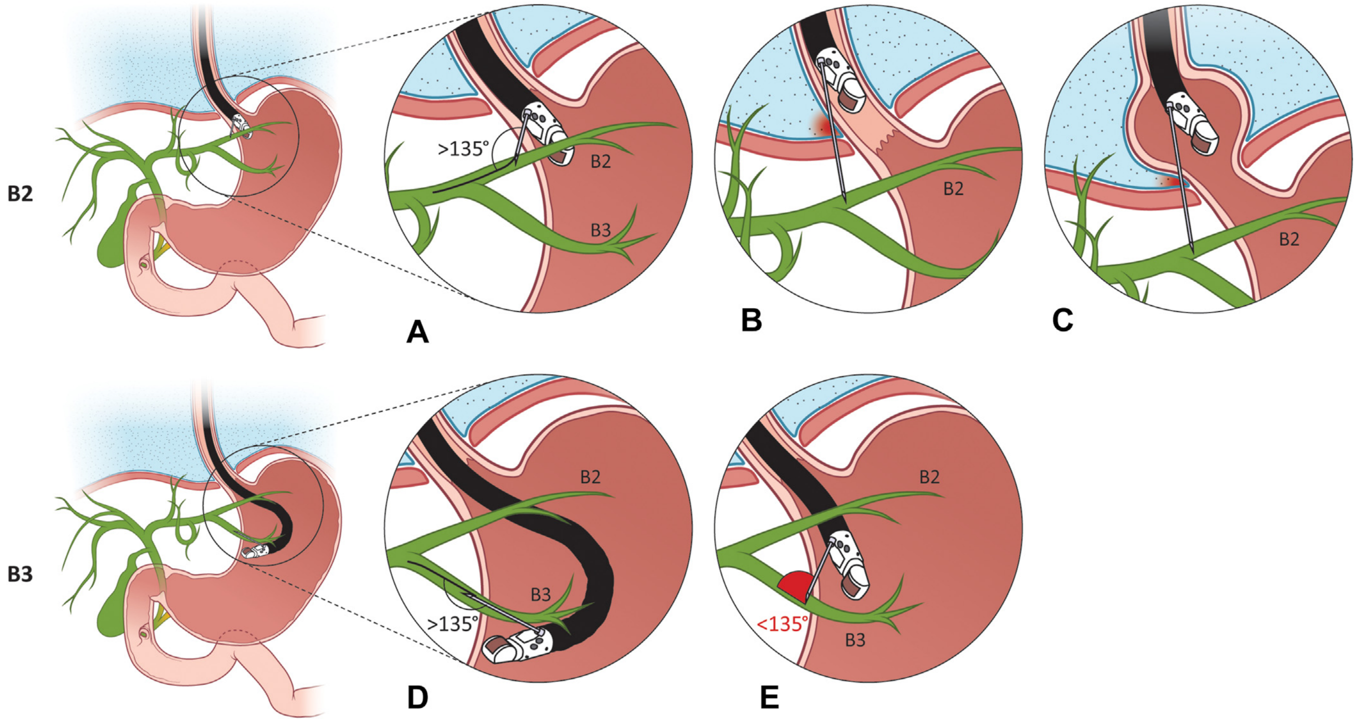

Figure 2. Key differences between EUS-guided access when using segment 2 (B2) and segment 3 (B3) intrahepatic ducts. (**A**) Ideal puncture site for B2 ducts located 2 to 3 cm below the squamocolumnar junction (SQJ). (**B**) Risk of transpleuritic access if the puncture site is above the SQJ. (**C**) Patient with a hiatal hernia. Note that the SQJ is located within the chest cavity, and despite puncturing 2 to 3 cm below the SQJ, the pleura is breached. (**D**) Optimal endoscope position and puncture site to access B3. The endoscope is in a deep (caudal) and flexed position. Note the favorable (>135°) angle of approach. (**E**) Suboptimal endoscope position and puncture site for B3 access. The endoscope is in a shallow (cranial) and straight position. Note the unfavorable (<135°) angle of approach.

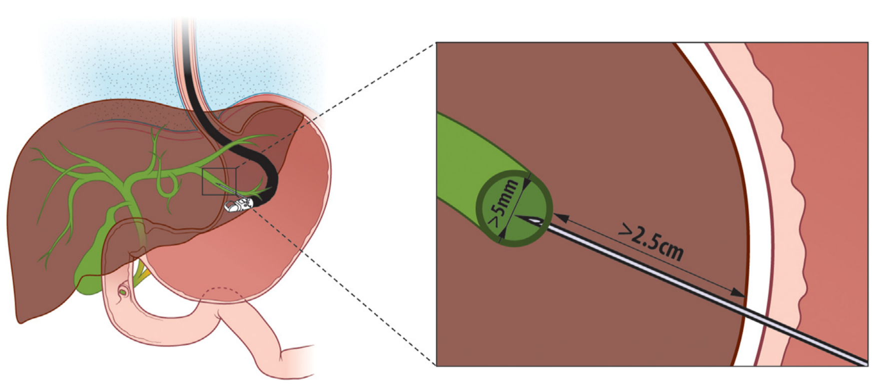

Figure 3. Optimal parameter when choosing an intrahepatic duct for puncture.

sturdy core is generally preferred because they are easier to manipulate within the needle and have a lower risk of shearing. They also support a wide array of instruments that are needed for the procedure.

c) If the guidewire is unintentionally advanced to the peripheral side of the liver, consider the following maneuvers: (1) looping the guidewire, (2) adjusting the echoendoscope, (3) impacting the needle, and (4) using a rotatable catheter. If all of the above-mentioned measures fail, withdraw the needle and wire and repeat puncture of the bile duct using a more favorable angle toward the hilum using fluoroscopy (Video 1, available online at www.videogie.org).

Step 5: Biliary tract dilation

a) The tract from the stomach to the intrahepatic bile duct is composed of (1) gastric wall, (2) 2 layers of visceral peritoneum, (3) liver capsule, (4) liver parenchyma, and (5) bile duct wall (Fig. 7). Pathologic thickening of any of the layers could lead to difficulty in advancing instruments.

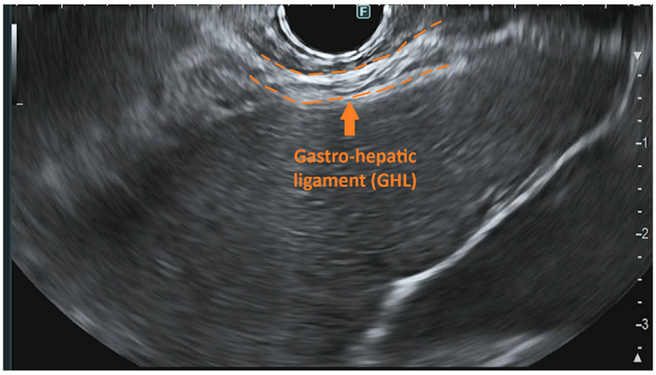

Figure 4. EUS image of the gastrohepatic ligament.

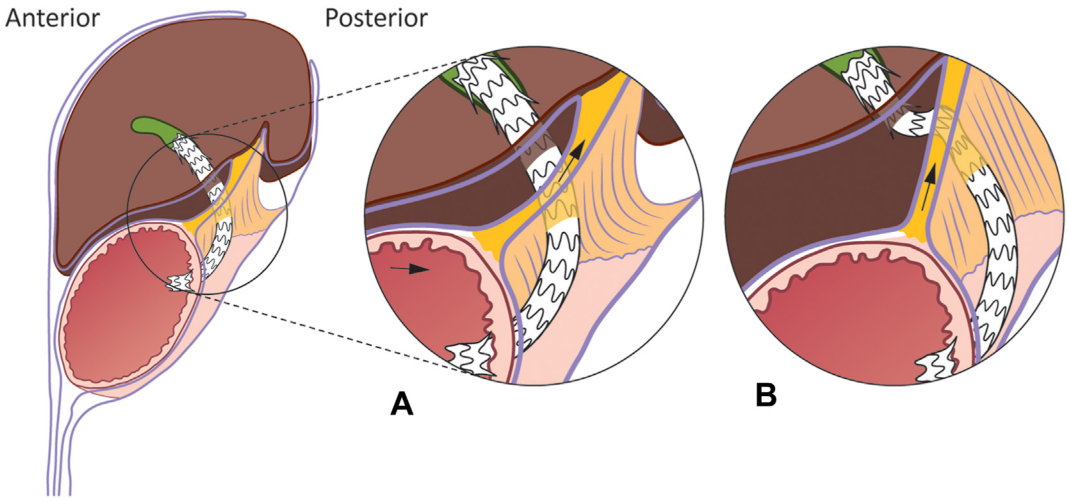

Figure 5. (**A**) Stent placement across the gastrohepatic ligament. (**B**) Position-dependent kinking of the stent that may occur as the stomach is pulled away from the undersurface of the liver.

b) The tract may be dilated using the following devices:
1. Graded dilation catheters. This is generally considered to be the safest method for tract dilation because it does not result in mechanical shearing or thermal injury within the tract. Graded catheters are an appropriate choice during B2 puncture, when the anticipated stent size is smaller than 7F.
2. Balloon dilators. These are relatively easy to push through the track and very effective at dilating; however, considering the dilation size (4 mm preferably or 6 mm), they may be associated with a higher risk of bile leak. Larger instruments such as fully covered self-expandable metal stents are generally easier to introduce after balloon dilation.
3. Diathermic dilators. These are highly efficient and reliable when creating a tract. Thermal tissue injury within the tract results in a higher incidence of bile leaks and bleeding and may be associated with the development of hepatic artery pseudoaneurysms.[6,9]
4. Most experts recommend using a graded dilation catheter for smaller stents (7F or less), a dilating balloon for larger stents (8F or larger), and a diathermy-assisted dilator as a rescue in patients with ductal or parenchymal fibrosis that could fail dilation with a balloon or graded catheter.

c) Technical tips and tricks:
1. In patients with extremely fibrotic parenchyma or bile duct walls, predilation of the tract with a hard-tip cannula such as the Olympus StarTip (Olympus Medical Systems, Tokyo, Japan) cannula or angioplasty balloon is helpful.
2. All downstream acute biliary angles and narrowings should be dilated before withdrawing the dilating device. This will ensure smooth passage of a stent.
3. Patients with medical conditions that compromise liver tissue compliance, such as infiltrative liver disease (eg, sarcoidosis or amyloidosis), and patients with parenchymal atrophy are more prone to developing bile leaks. Diathermy should be avoided in such patients.
4. Soon after dilation, once the dilating instrument is withdrawn from the tract, it is common for bile to leak out of the ducts. In addition to aspirating bile

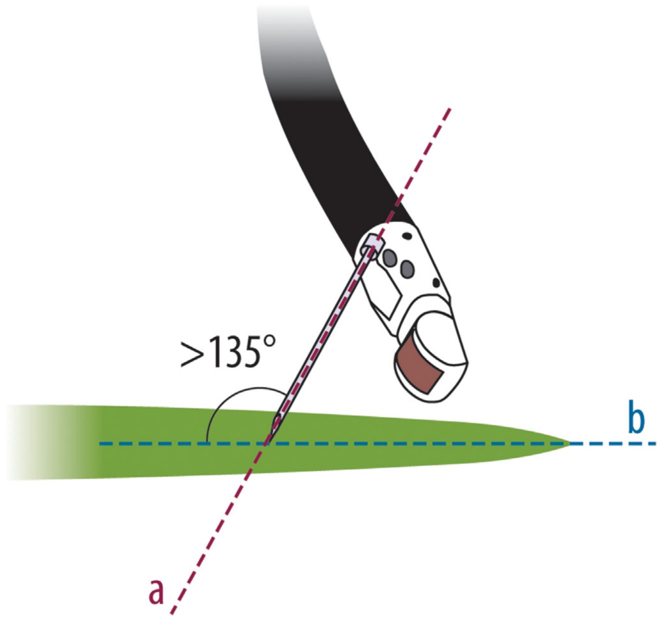

Figure 6. Optimal angle of approach between the needle and targeted bile duct. (*a*) Longitudinal axis of needle and guidewire. (*b*) Longitudinal axis of bile duct.

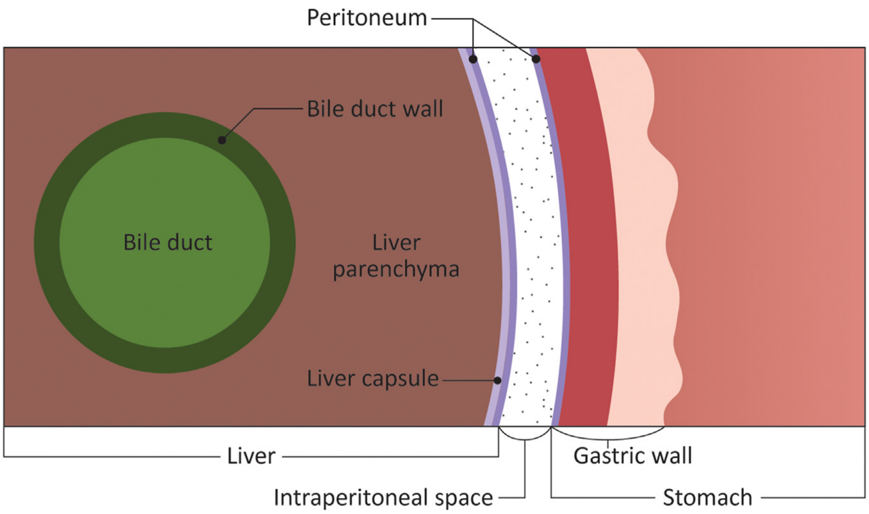

Figure 7. Different layers that comprise the hepaticogastrostomy tract.

before contrast injection as mentioned above, the following tips are helpful to limit bike leakage:

i. Having instruments ready and at hand will increase efficiency and minimize delay during this step.
ii. Segmental dilation method: The tract length that is primarily composed of liver parenchyma is not dilated separately at the gastric side and bile duct side, leaving 2 to 3 cm of undilated liver parenchyma in between. This undilated liver parenchyma does not resist the passage of instruments and closely encases the wire and stent, thereby preventing leakage from the tract (Fig. 8).[4,10]

5. When possible, the use of a wire-guided needle-knife should be avoided because this increases the risk of adverse events such as perforations and leaks.[11]

Step 6: Stent placement

a) An ideal stent for EUS-HGS should (1) serve as an anchor between the liver and gastric wall, that is, have antimigratory properties such as flaps, flares, exposed mesh at the ends, and pigtails and (2) prevent the leakage of bile into the peritoneal space, that is, the part that is located between the liver capsule and gastric wall should be fully covered (Table 2).[12]

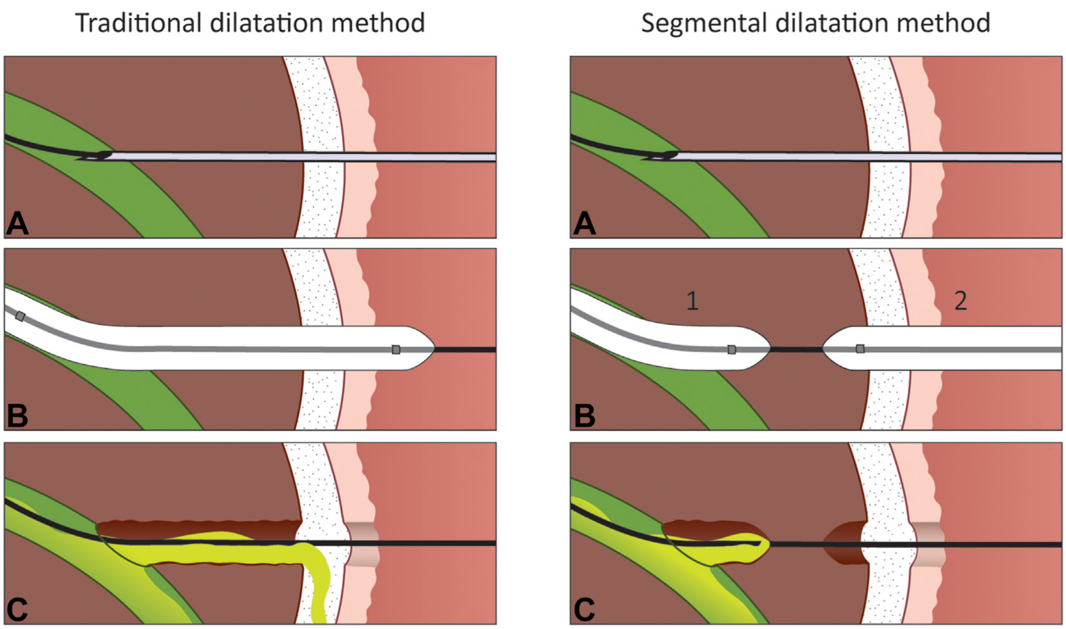

Figure 8. Traditional (**left**) and segmental (**right**) tract dilation method. (**A**) Biliary puncture and guidewire insertion. (**B**) Balloon dilation. Note the separate dilation of the bile duct side (*1*) and gastric side (*2*) when using the segmental dilation method. (**C**) Post-dilation bile leak (**left**). Note the absence of bile leak (**right**) due to the non-dilated segment of liver parenchyma.

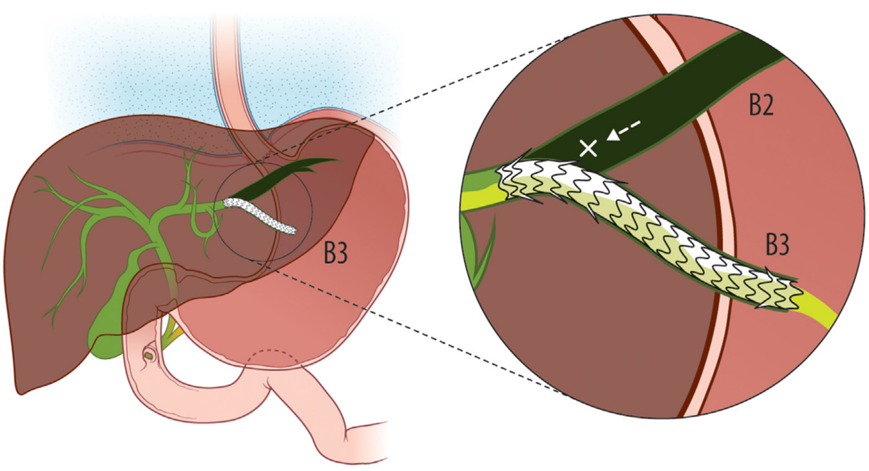

Figure 9. A fully covered stent that is placed deep within the intrahepatic ducts, resulting in complete blockage of segment 2 bile ducts. *B2*, segment 2 intrahepatic ducts; *B3*, segment 3 intrahepatic ducts.

b) Stents with delivery systems that are larger than 6F typically require predilation of the tract, whereas stents with smaller delivery systems may be introduced without tract dilation.
c) When placing the stent, it is recommended to have at least 2 cm, preferably 3 cm, located within the intrahepatic ducts and similarly within the gastric lumen. This reduces the risk of both early and late stent migration and bile leaks.[13,14]
d) A fully covered stent, when placed across the liver hilum or deep within the intrahepatic ducts, may result in segmental biliary blockage and focal obstructive cholangitis. Partially and fully covered stents with side holes should be considered in such patients, especially for malignant indications (Fig. 9).
e) Technical tips and tricks for successful stent deployment:
   1. It is essential to maintain constant transducer contact and apply continuous appositional force between the gastric wall and liver during all steps of the procedure. Moving the transducer away from the gastric wall enlarges this space and may result in inadvertent looping of the guidewire, accessories, or stents.
   2. Maintain echocoupling and visualize the instrument tract at all times. This allows one to keep the wire straight and better direct the forward vector forces during stent insertion.

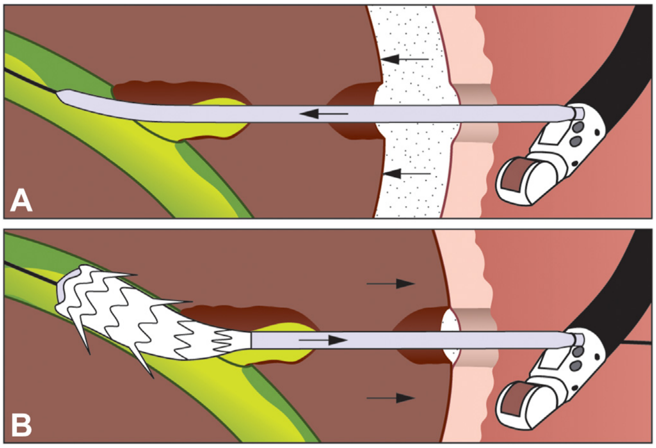

Figure 10. Increase in "dead space" when instruments are introduced into the liver (**A**). After the proximal flange of the stent is deployed, pulling the stent sheath slightly backward during the deployment process will reduce the "dead space" (**B**).

3. As the stent is introduced across the gastric wall, the liver is typically pushed away, and the intraperitoneal space between the gastric wall and liver is increased. Before deploying the stent, it is important to reduce this gap by advancing the stent deep into the hepatic ducts and then withdrawing it back toward the endoscope (Fig. 10).
4. The unsheathing process should be started only after obtaining an optimal stent position, that is, the distal tip of the stent is located 2 to 3 cm within the selected intrahepatic duct.
5. When deploying under endosonographic and fluoroscopic guidance, the endoscope should not be moved back or uncoupled from the gastric wall during stent deployment until stent expansion has clearly crossed the gastric wall. Once the expandable stent and gastric wall are clearly apposed, the stent sheath may be pushed forward into the channel of the endoscope. This pushes the gastric wall away from the endoscope lens, and the remaining stent may be deployed under direct vision.

CONCLUSION

EUS-HGS is a viable option for biliary drainage in select patients by using devices that are available in Western practice. An understanding and implementation of the technical nuances highlighted in this article should help Western endoscopists navigate the complexities of EUS-HGS and ensure optimal outcomes (Video 1, available online at www.videogie.org).

DISCLOSURE

Dr Irani is a consultant for Boston Scientific, WL Gore & Associates. The other author disclosed no financial relationships relevant to this publication.

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