Review Article

# Drainage of the right liver using EUS guidance

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## ABSTRACT

Hepaticogastrostomy (HGS) has been reported for the management of palliative malignant hilar stricture and involves draining the left liver as rescue therapy. For the management of this complex stenosis, another new option for draining the right liver under EUS guidance was introduced. Ten publications involving 38 patients have been reported in the literature, in which the following two main techniques have been described: direct puncture of the right liver from the bulbus and the bridge technique allowing the drainage of the right liver across the left liver through HGS. In this review, we describe the techniques used and the potential advantages and complications of these procedures. Although this kind of drainage is demanding and probably limited to specific patients, EUS-biliary drainage of the right liver seems feasible with acceptable complications.

**Key words:** EUS biliary drainage, liver, review, right liver endoscopic drainage

## INTRODUCTION

Since the first publication of EUS-biliary drainage (EUS-BD) of the left liver,[1,2] hepaticogastrostomy (HGS) has become a rescue treatment option for ERCP drainage failure.[3,4] A recent systemic review with meta-analysis compared EUS-BD and percutaneous transhepatic drainage (PCTD) in 483 patients with malignant biliary obstruction from nine studies and found that despite similar technical success rates, EUS-BD was associated with better clinical success, fewer adverse events, and lower reintervention rates, and overall, it was more cost-effective than PCTD.[5] Recently, HGS as first-line drainage option before ERCP has also been discussed.[6,7]

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Website: www.eusjournal.com

DOI: 10.4103/eus.eus_52_19

Similarly, HGS has been used in the palliative management of malignant hilar stricture. The first publication in 2007, with four patients, described drainage of the left liver under EUS guidance because of a previous stent in the right lobe. Thereafter, a few articles have described HGS as a rescue treatment for hilar stricture with the undrained left liver.[3,8] In managing complex stenoses, another new option for draining the right liver, which is considered as inaccessible under EUS guidance, was introduced. We herein describe the different liver drainage techniques and results of EUS-BD.

## LITERATURE SEARCH

All articles about the drainage of the right intrahepatic bile duct (IHBD) under EUS guidance found in



**How to cite this article:** Caillol F, Rouy M, Pesenti C, Ratone JP, Giovannini M. Drainage of the right liver using EUS guidance. Endosc Ultrasound 2019;8:S50-6.

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**Received:** 2019-06-30; **Accepted:** 2019-07-08; **Published online:** 2019-11-28

PubMed were included. We only excluded one article, because puncture of the IHBD was not a choice but was required because of altered anatomy due to Ivor-Lewis surgery.[9] Interestingly, these two case series showed the possibility of draining the right liver in the jejunum if the liver is accessible and if the left liver is not visible because of altered anatomy.

All studies had a retrospectives design with a small number of patients. The mean number of patients was 4.2, with a minimum of one patient. The most important series comprised 12 patients. Ten articles by seven different teams with 38 patients were found.

## TECHNIQUES OF RIGHT LIVER DRAINAGE UNDER EUS GUIDANCE

Two main techniques have been described in the literature. The first technique, described by Park *et al.*,[10] is EUS-BD, involving direct puncture of the right liver with transluminal stenting between the right hepatic duct and duodenal wall as anterograde bypass stenting. The second technique is the bridge technique, involving the placement of a stent between the right and left livers, which are both drained during HGS, as described by Ogura *et al.*[11,12]

## DIRECT PUNCTURE OF THE RIGHT LIVER AND HEPATICODUODENOSTOMY

The puncture is made through the bulbus with a therapeutic echoendoscope in a U-shaped, long endoscope position [Figures 1-3 and Tables 1 and 2]. The puncture must be made with a 19G needle if the goal is to insert a wire, or it has to be made with a 22G needle to insert a 0.021-inch wire before exchanging it with a 0.0025-inch wire, according to Mukai *et al.*[13]

In the case of transluminal stenting, the right anterior lobe was punctured in four (31%) patients[10,14,15] and the posterior lobe, in three (23%) patients.[15,16] There were no data for six (46%) patients.

## BRIDGE TECHNIQUE

The liver segment II or III is punctured with a 19G access needle with a therapeutic echoendoscope [Figures 1 and 4, Tables 3 and 4]. After opacification, a guide wire is introduced into the left bile duct. Then, a fistula is created with a 6-French (Fr) cystotome or dilated with a 7-Fr catheter. By pushing the cystotome or catheter against the hilar stenosis, the guide wire can be inserted into the right liver, usually in the posterior portion. Hilar stenosis between the

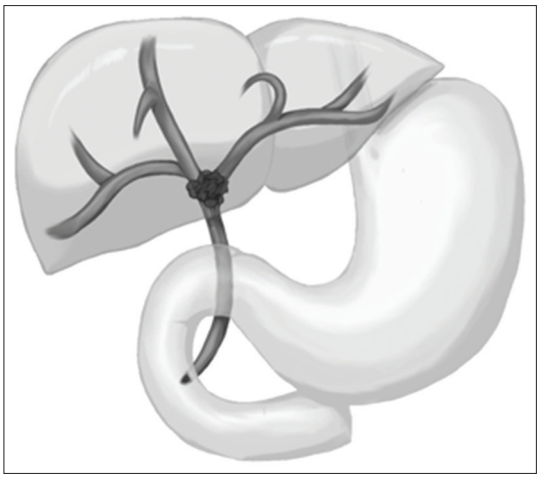

**Figure 1.** Hilar stenosis before drainage

**Figure 2.** U-shaped position before hepaticoduodenostomy

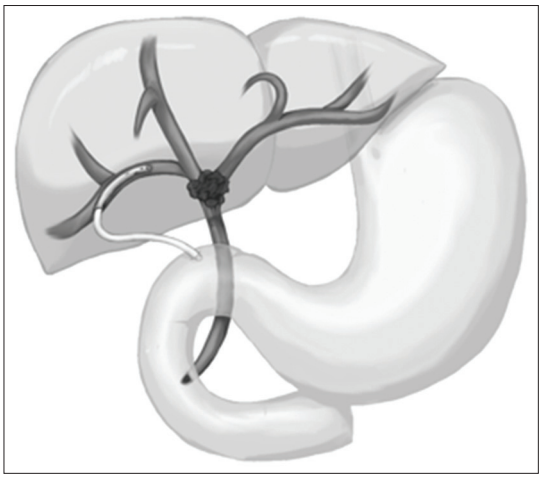

**Figure 3.** Plastic stent placed with hepaticoduodenostomy

**Table 1. Direct puncture of the right liver and transluminal drainage in 13 patients who underwent hepaticoduodenostomy**

| Author, year of publication | *n* | Access | Gauge of needle | Wire (inch) | Use of 6-Fr cystotome | Dilation of the fistula tract | Type of stent | Type of stenosis | Previous stent placement | Clinical success | Adverse event | Duration of survival |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ogura *et al.*, 2017[17] | 2 | Bulbus | 19 | 0.025 | No | 4-mm balloon dilation | Partially metal stent | Hilar | Yes | Unknown | No | Unknown |
| Minaga *et al.*, 2017[14] | 1 | Bulbus | 19 | 0.025 | No | 7-Fr bougie dilator | Metal, 100-mm × 10-mm stent | Right side branch (hilar) | No | Yes | No | 767 days |
| Minaga *et al.*, 2017[16] | 2 | Bulbus | 19 | | No | bougie dilator | 1 plastic stent and 1 covered metal stent | Right posterior intrahepatic duct (hilar) | Yes | Unknown | Unknown | <1 year |
| Mukai *et al.*, 2017[13] | 2 | Bulbus | 19 and 22 | 0.025 and 0.021 before exchange | | Bougie dilation or 6-Fr cystotome | Dedicated 7-Fr plastic stent | Hilar | Yes | Yes | No | Unknown |
| Park *et al.*, 2013[10] | 2 | Bulbes | 19 | 0.025 or 0.035 | NK in 1 case | 4-Fr cannula, 4-mm balloon dilation | Covered stents | Right anterior liver | Unknown | Yes | No | 57.5 days |
| Ogura *et al.*, 2015[13] | 4 | 3 stomach, 1 bulbus | 19 | 0.025 | No | 7-Fr tapered ERCP catheter, 4-mm balloon catheter | 1 covered stent, 1 uncovered stent (locking stent method) | 2 hilar, 2 right hepatic duct | No | Yes, 100% | No | 2 deaths at 88 days and 111 days, 2 alive at 189 days and 147 days |

Fr: French, NK: Needle knife

**Table 2. Materials used for hepaticoduodenostomy**

| | NK | Cannula | Needle | Wire | Dilation | Stent |
|---|---|---|---|---|---|---|
| Park *et al.*, 2013[10] | Triple lumen NK with a 7-Fr shaft diameter (Microtome; Boston Scientific, Natick, MA) | 4-Fr cannula, Glo-tip (Cook Medical, Winston Salem, NC) | | | Hurricane balloon dilator (Boston Scientific) | Fully covered stent, 8-mm diameter, 6-cm long with anchoring flaps (nitinol stent MI-Tech, Seoul, South Korea) |
| Ogura *et al.*, 2015[15] | | | Medi-Globe GmbH (Roseinheim, Germany) | MTW (Endoscopy, Dusseldorf, Germany) | Balloon dilation, ExPander Biliary (Medi-Globe GmbH or Medico's Hirata, Inc., Osaka, Japan) | Bile Rush (Piolax Medical Device, Inc., Kanagawa, Japan) |
| Ogura *et al.*, 2017[17] | | | 19G Sono Tip Pro Control (Medi-Globe GmbH or Medico's Hirata Inc.) | VisiGlide (Olympus Medical Systems, Tokyo, Japan) | Hurricane balloon dilator (Boston Scientific) or REN biliary dilation catheter (Kaneka Corporation, Osaka, Japan) | Unknown |
| Minaga *et al.*, 2017[14] | | | 19G Sono Tip ProControl (Medi-Globe GmbH) | VisiGlide 2 (Olympus Medical System) | Bougie dilator, Sohendra Biliary dilation catheter (Cook Medical) | Niti-S biliary covered stent (Taewong Medical, Seoul, South Korea) |

Fr: French, G: Gauge, NK: Needle knife

left and right livers is seen in most cases enlarged with a 4-mm dilation balloon. Next, an uncovered 6 cm long stent is inserted between the right and left livers, creating a bridge between the two organs. Another stent (covered or partially covered) is finally placed between the liver and stomach or jejunum for HGS or hepaticojejunostomy.

## ANTEROGRADE TECHNIQUE WITHOUT HEPATICODUODENOSTOMY

The rendezvous technique has also been described in one patient.[12] In the study by Park *et al.*, a stent was placed using the anterograde technique across the area of stenosis in one case, only an anterograde balloon

**Table 3. Bridge technique in 25 patients**

| Author, year of publication | *n* | Access | Gauge of the needle | Wire (inch) | Use of a 6-Fr cystotome | Dilation | Type of stent | Type of stenosis | Previous stent placement | Clinical success | Adverse events | Survival/ follow-up |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ogura *et al.*, 2015[15] | 7 | Stomach | 19 | 0.025 | No | Yes, 7-Fr tapered ERCP catheter, 4-mm balloon catheter (2 patients) | 6 cm uncovered metal stent, fully covered stent | Obstructed right IHBD | No | 100% | No | 116 days |
| Moryoussef *et al.*, 2017[18] | 3 (6 attempts) | Stomach | 19 | 0.035 | Yes for HGS, no for bridge technique | Yes, hilar stenosis with a balloon No, hepatic fistula | 8 cm metal covered, uncovered metal stent | Bismuth, 2 | Unknown | 50% | No | Unknown |
| Caillol *et al.*, 2019[19] | 12 | Stomach | 19 | 0.035 | Yes | Yes, hilar stenosis with a 4-mm balloon | 6 cm or 8 cm metal uncovered, partially metal covered stent | Type II, 9 Type IIIB, 2 Type IV, 1 | No | 83% (10/12) | Yes, morbidity rate: 33% (4 patients) with 1 patient needing re-endoscopy; mortality rate: 8% (1 patient) | 6 months |

Fr: French, HGS: Hepaticogastrostomy, IHBD: Intrahepatic bile duct

**Table 4. Materials used for the bridge technique**

| | Needle | Wire | Dilation | Stent | Cystotome |
|---|---|---|---|---|---|
| Ogura *et al.*, 2015[13] | 19G Sono Tip, Pro Control (Medi-Globe GmbH, Rosenheim, Germany) | VisiGlide (Olympus Medical Systems, Tokyo, Japan) | MTW (Endoscopy, Dusseldorf, Germany; ExPander Biliary; Medi-Globe GmbH; or Medico's Hirata, Inc., Osaka, Japan) | Zilver 635 biliary self-expanding stent; end-bare type stent; or Niti-S biliary covered stent (Taewong Medical, Seoul, South Korea) | |
| Moryoussef *et al.*, 2017[18] | 19G (Cook Medical, Winston Salem, NC) | Jagwire (Boston Scientific, Natick, MA) | | Zylver (Cook Medical) | Endoflex (Boucart Medical, Brussels, Belgium) |
| Caillol *et al.*, 2019[19] | Access or echo tip (Cook Medical) | Jagwire (Boston Scientific) and Acrobat 2 (Cook Medical) | | Zylver stent, Boston stent, or covered stent (Wallflex, Boston Scientific; or Hanarostent, MI-Tech, Life Partners Europe, Bagnolet, France) | Endoflex (Boucart Medical) |

dilation was placed for benign stricture in 1 case, and the roadmap technique was used in one case.[10] In the absence of transluminal stenting, the anterior lobe was punctured in two cases and posterior lobe, in two cases (including a case of EUS-BD failure); data were lacking in one case.

## ROADMAP TECHNIQUE

Only one case in which the roadmap technique was used has been described. The puncture must be made with a 22G needle to perform the roadmap technique in the right posterior lobe,[10] and the cholangiogram obtained by EUS-guided transduodenal puncture of the right hepatic duct is used as a roadmap. ERCP is performed after opacification of the targeted segment for drainage.

## RENDEZVOUS TECHNIQUE

There was only one case in which the rendezvous technique has been described. The puncture in the right IHBD was made with a 19G needle (Sono Tip ProControl; Medi-Globe, Rosenheim, Germany) near the hepatic hilum. A guide wire was inserted into the common bile duct across the stricture (0.025-inch,

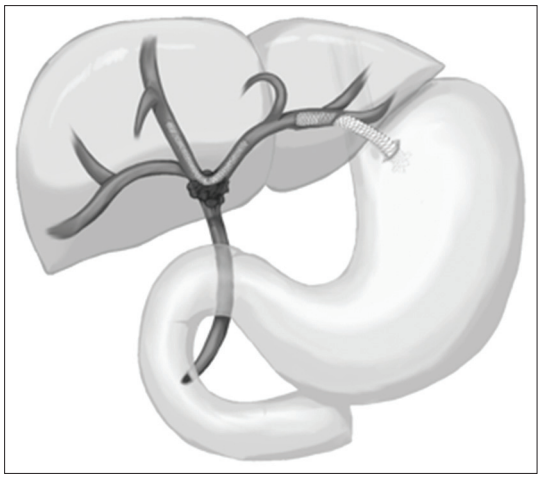

**Figure 4.** Metallic stent between the right liver and left liver: Bridge technique associated with hepaticogastrostomy

angle-type, VisiGlide; Olympus Medical Systems, Tokyo, Japan). Then, dilation with an 8-mm balloon catheter was performed (Hurricane balloon catheter; Boston Scientific Japan, Tokyo, Japan). Subsequently, the catheter for ERCP was exchanged, and the guide wire was used as a landmark.[12]

## BALLOON DILATION AND PLACEMENT OF A STENT

Two cases of EUS-guided anterograde transanastomotic balloon dilation with or without stenting have been described:[10] one case of balloon dilation alone for benign stricture in altered anatomy and one case of placement of a stent in an anterograde path. In the first case, balloon dilation was performed with a 4-mm dilation balloon, and in the second case, an uncovered metal stent was placed through the echoendoscope across the stricture after dilation.

Given the small number of cases, cases in which the anterograde, roadmap, and rendezvous techniques were used could be considered as clinical cases; thus, we excluded them from the results [Table 1].

## INDICATIONS

In the case of hepaticoduodenostomy (HDS) (13 patients), the indication of EUS-BD was ERCP failure in 11 (85%) patients, duodenal obstruction in one (8%) patient, and altered anatomy in one (8%) patient. In the case of the bridge technique (25 patients), the indication of EUS-BD was duodenal obstruction in 11 (44%), altered anatomy in eight (32%), and unknown in six (24%) patients. In the study by Poincloux *et al.*, direct puncture of the right IHBD was performed in the case of left hepatectomy and altered anatomy in two cases.[4] Stenosis was benign in three cases (strictures at the site of anastomosis).[10]

## ADVANTAGES AND COMPLICATIONS

### *Feasibility*

Thirteen patients have undergone HDS [Tables 1 and 3]. The bridge technique was used in 25 patients, and drainage of the right liver under EUS guidance was performed in 46 patients, with four drainage failures. Only one case of failure of HDS drainage was reported by Park *et al.*[10] Moryoussef *et al.* reported a success rate of 50% (3 successes from 6 attempts) for the bridge technique.[18] The size of the IHBD in HDS has been reported in only one study[10] with consequent dilation of the IHBD at approximately 7.8 mm (range, 7.7–11 mm).

### *Complications*

A few complications have been reported. Four minor complications (pain managed conservatively)[19] and one case of clinical failure with mortality due to a Bismuth IV tumor were reported[19] with the bridge technique. Thus, the global morbidity rates are 16% for the bridging technique and 9% for all cases of drainage of the right liver under EUS guidance. Survival has been reported for seven patients with HDS (mean 227 days; range, 88–767 days).

### *Advantages*

The advantage of this kind of procedure must be evaluated in comparison to that of percutaneous drainage. It is important to perform drainage in these patients to improve survival regardless of the technique used. However, external drainage may not improve patient survival.[20] In complex drainage cases, the risk associated with an external drain increases in cases of percutaneous drainage. As a result, HDS can be advantageous in that a previous stent is placed. In the case of altered anatomy or duodenal obstruction, the bridge technique could avoid temporary external drainage.

## DISCUSSION

The bridge technique has the following potential complications: Bile leak, stent migration, and cholangitis. Stent dysfunction related to the bridge stent is

particularly concerning because of the sharp angle encountered during stent delivery. Therefore, with this stent, it could be challenging to insert the wire into the right IHBD and to place the stent. Ogura *et al.*[15] recommended the use of a controllable ERCP catheter, fine stent G, and effective delivery system, if necessary. They also strongly advised placing an uncovered stent in the bridge technique to avoid occluding the side branch duct.

In HDS, visualization of the right IHBD can be difficult. It can also be difficult to puncture the right IHBD because it may not be immediately adjacent to the duodenal wall, and the portal vein could be close to the route of the approach. Moreover, the puncture can be difficult because of the position of the endoscope, as sufficient dilation of the right bile duct is needed. Park *et al.*[10] suggested sufficient IHBD dilation (7.8 mm [range, 7.7–11 mm] in their study) and being as close as possible to the IHBD to facilitate this type of drainage. The authors placed the echoendoscope in a U-shaped position and perform gentle rotation under radiography for better and closer visualization of the right IHBD.

These demanding BD methods are preformed instead of percutaneous transhepatic BD, a drainage technique described before EUS-BD and considered as salvage therapy in the case of ERCP failure according to some publications. However, PCTD is also associated with the following complications: Cholangitis, bile leak, and pneumothorax. The frequency of major complications, such as prolonged hospital stay and permanent adverse sequelae, ranges from 4.6% to 25%.[21,22] Although this review cannot conclude the superiority of EUS-BD of the right liver over PCTD, it highlights the feasibility of this technique.

This review has a couple of limitations. First, complications and clinical success are not always reported, and all studies had noncomparative retrospective designs; thus, it is difficult to get a precise idea of the complications. Second, EUS-BD for right IHBD can be challenging because the usual puncture site under EUS is the left IHBD or common bile duct. The feasibility of puncturing the posterior or anterior lobe should be discussed.

## CONCLUSIONS

In the case of HDS or the bridge technique, it may be very challenging to choose the anterior or posterior part of the right liver. These procedures should be selected under strict criteria, such as in patients with a limited prognosis who may not be suitable because they have benign disease.[14]

### *Financial support and sponsorship*
Nil.

### *Conflicts of interest*
There are no conflicts of interest.

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