Review Article

Outcomes and limitations: EUS-guided hepaticogastrostomy

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ABSTRACT

One of the major roles of interventional EUS is biliary decompression as an alternative to ERCP or percutaneous transhepatic biliary drainage. Among EUS-guided biliary drainage, EUS-guided hepaticogastrostomy with transmural stenting (EUS-HGS) may be the most promising procedure since this procedure can overcome the limitation of ERCP. However, EUS-HGS has disadvantages, and the safety issue is still not resolved. In this review, the clinical outcomes and limitations of EUS-HGS will be discussed.

Key words: Adverse event, EUS, hepaticogastrostomy

INTRODUCTION

EUS-guided hepaticogastrostomy with transmural stenting EUS-HGS has the following advantages over endoscopic retrograde biliary drainage (ERBD) and percutaneous transhepatic biliary drainage (PTBD).[1,2] ERBD is not available when the papilla is not accessible endoscopically. However, EUS-HGS is possible even in surgically altered anatomy or inaccessible papilla. One of the major concerns of ERBD is procedure-related acute pancreatitis. In EUS-HGS, traumatic papillary irritation which can develop acute pancreatitis may be avoided. The stent patency might be longer in EUS-HGS than in ERBD since the stents are not needed to be placed across the stricture site. EUS-HGS shows similar efficacy compared to PTBD when performed by expertise, and may be more comfortable and physiologic to the patients than PTBD because of internal drainage. The overall number of reinterventions seems to be lower after EUS-HGS than after PTBD.[1,3] However, EUS-HGS is still limited because of the complexity of this procedure and the lack of dedicated device for EUS-HGS. Because of the anatomical proximity to the mediastinum, very serious adverse events can occur in EUS-HGS.

EFFICACY OF EUS-GUIDED HEPATICOGASTROSTOMY

Based on 27 clinical studies, the technical and clinical success rates of EUS-HGS were reported to be 96% (range, 65%–100%) and 90% (range, 66%–100%), respectively [Table 1]. The success rate of EUS-HGS was comparable to ERBD and PTBD procedures.[1,2]

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The technical and clinical success rates of EUS-guided choledochoduodenostomy (EUS-CDS) were similar to EUS-HGS; however, EUS-CDS has been more widely used because the extrahepatic biliary access through EUS is closer and easier. Nevertheless, EUS-HGS may be preferred over EUS-CDS as an alternative to ERBD, given the clinical situation where ERBD is not feasible. In cases of surgically altered anatomy or duodenal obstruction, EUS-HGS will be the primary choice.

Theoretically, because EUS-HGS stents are placed away from the malignant stricture, the stent patency seems to be longer in EUS-HGS than in ERBD. However, stent patency of EUS-HGS was reported variously, ranging from 62 days to 402 days [Table 1]. Although EUS-HGS may have fewer chance of tumor ingrowth or overgrowth, it can have more cases of stent migration and clogging by food material, and these reasons may shorten the stent patency of EUS-HGS. The location and degree of biliary stricture, presence of gastric or duodenal obstruction, ileus, type and length of the placed stent, and the presence of liver metastasis may affect the stent patency of EUS-HGS. There has been only one prospective study comparing the stent patency between EUS-guided biliary drainage (EUS-HGS and EUS-CDS) and ERBD,[2] and the stent patency was significantly longer in EUS-guided biliary drainage than in ERBD (6-month stent patency 85% *vs.* 49%, $P = 0.001$). Ogura *et al.* reported that EUS-HGS had significantly longer stent patency than EUS-CDS in patients with duodenal obstruction (median 133 *vs.* 37 days; hazard ratio 0.391, 95% confidence interval 0.156–0.981, $P = 0.045$), and duodenobiliary reflux caused by duodenal obstruction may contribute shorter stent patency of EUS-CDS.[21] However, in the recent study of our group, there was no significant difference in stent patency between EUS-HGS and EUS-CDS in subgroup analysis of patients with duodenal invasion.[2] EUS-CDS can be performed in patients with type II or III duodenal obstruction (intact duodenal bulb). Further prospective studies comparing EUS-HGS and EUS-CDS among patients with type II or III duodenal obstruction would be warranted.

SAFETY OF EUS-GUIDED HEPATICOGASTROSTOMY

As many clinical data related to EUS-HGS have been reported, this procedure seems to be a safe procedure, and produces fewer procedure-related adverse events than PTBD.[1,32] The overall rate of adverse events was 18% [range, 0%–50%, Table 1]. Common adverse events of EUS-HGS include abdominal pain, self-limiting pneumoperitoneum, bile leak, cholangitis, and bleeding. In rare cases, serious adverse events such as perforation, intraperitoneal migration of the stent, and mediastinitis may happen. Even there have been six deaths associated with EUS-HGS, three of which were associated with bile leak, and the remaining three associated with sepsis.[3,18] EUS-HGS has more types of adverse events than EUS-CDS, and some of them are life-threatening.[15,33] For beginners, more adverse events occur in EUS-HGS than in EUS-CDS.[12] Therefore, EUS-HGS should be tried after sufficient experience of EUS-guided tissue acquisition, pseudocyst drainage, and EUS-CDS. The learning curve of EUS-HGS is still unclear; however, a recent study revealed that over 33 cases might be required to reach the plateau phase for successful EUS-HGS [Figure 1].[28]

In order to prevent procedure-related adverse events in EUS-HGS, it is important to reduce the number of accessory changes and shorten the procedure time. For this purpose, a dedicated device for one-step EUS-BD without additional fistula dilation has been introduced, which may result in shortened procedural time with less procedure-related adverse events.[19]

LIMITATIONS OF EUS-GUIDED HEPATICOGASTROSTOMY

Because EUS-HGS is still technically challenging, it is available only in a small number of hospitals so far. There remains a risk of losing access since only a short length of the guide wire left coiled inside the intrahepatic during the exchange of accessories.[34] For a beginner of EUS-HGS, conversion of PTBD to EUS-HGS would provide an additional advantage to achieve the plateau of learning curve for EUS-HGS.[23] By opacification of the intrahepatic through a PTBD catheter, the practitioner more easily finds the optimal puncture site of the intrahepatic. Even if EUS-HGS fails, the risk of adverse events such as cholangitis or bile leak may decrease because of the indwelling catheter.

In advanced hilar stricture or isolated right intrahepatic bile duct obstruction, EUS-HGS has some technical limitations draining the right intrahepatic. However, several techniques of EUS-HGS have been introduced to drain right lobe as follows: (1) Bridging method that inserts uncovered

Table 1. Studies about EUS-HGS

References, years	Study design	Total number	Technical success, *n* (%)	Clinical success, *n* (%)	Early adverse events, *n* (%)	Profiles of early adverse events (*n*)	Mean stent patency (d)
Burmester *et al.*, 2003[4]	Retrospective	1	1 (100)	1 (100)	0	Nil	N/A
Kahaleh *et al.*, 2006[5]	Retrospective	2	2 (100)	2 (100)	0	Nil	N/A
Will *et al.*, 2007[6]	Prospective	4	4 (100)	3 (75)	1 (25)	Cholangitis (1)	N/A
Bories *et al.*, 2007[7]	Retrospective	11	10 (91)	10 (100)	4 (36)	Ileus (1) Biloma (1) Stent migration (1) Cholangitis (1)	388 (95% CI: 203-574)
Artifon *et al.*, 2007[8]	Retrospective	1	1 (100)	1 (100)	0	Nil	N/A
Ramírez-Luna *et al.*, 2011[9]	Prospective	2	2 (100)	2 (100)	1 (50)	Stent migration (1)	N/A (range 4-240)
Park *et al.*, 2011[10]	Prospective	31	31 (100)	27 (87)	6 (19)	Pneumoperitoneum (4) Bleeding (2)	132
Kim *et al.*, 2012[11]	Retrospective	4	3 (75)	2 (66)	1 (25)	Peritonitis (1)	N/A
Vila *et al.*, 2012[12]	Retrospective	34	22 (65)	N/A	11 (29)	Biloma (3) Bleeding (3) Perforation (2) Liver hematoma (2) Abscess (1)	N/A
Park *et al.*, 2013[13]	Prospective	15	14 (93)	14 (100)	2 (13)	Biloma (1) Intraperitoneal stent migration (1)	N/A
Kawakubo *et al.*, 2014[14]	Retrospective	20	19 (95)	N/A	7 (35)	Bile leak (2) Stent misplacement (2) Bleeding (1) Cholangitis (1) Biloma (1)	62
Paik *et al.*, 2014[15]	Prospective	28	27 (96)	24 (89)	0	Nil	150[a] (95% CI: 5-295)
Artifon *et al.*, 2015[16]	RCT	25	24 (96)	22 (92)	5 (20)	Bacteremia (1) Biloma (2) Bleeding (3)	N/A
Umeda *et al.*, 2015[17]	Prospective	23	23 (100)	23 (100)	4 (17)	Abdominal pain (3) Bleeding (1)	120[a] (range 15-270)
Poincloux *et al.*, 2015[18]	Retrospective	66	65 (98)	61 (94)	10 (15)	Bile leak (5)[b] Pneumoperitoneum (2) Liver hematoma (1) Severe sepsis and death (2)	N/A
Park *et al.*, 2015[19]	RCT	20	20 (100)	18 (90)	5 (25)	Mild (2) Moderate (3)	121
Khashab *et al.*, 2016[20]	Retrospective	61	56 (92)	50 (89)	12 (20)	Peritonitis (3) Bile leak (2) Cholangitis (2) Intraperitoneal stent migration (2) Bleeding (1) Hepatic collection (1) Shared wire (1)	N/A
Ogura *et al.*, 2016[21]	Retrospective	26	26 (100)	24 (92)	0	Nil	133[a]
Guo *et al.*, 2016	Retrospective	7	7 (100)	7 (100)	1	Sepsis (1)	N/A
Nakai *et al.*, 2016[22]	Retrospective	33	33 (100)	33 (100)	3 (9)	Bleeding (1) Abscess (1) Cholangitis (1)	255[a]
Paik *et al.*, 2017[23]	Retrospective	16	16 (100)	13 (81)	2 (13)	Intraperitoneal stent migration (1) Cholecystitis (1)	402 (95% CI: 97-707)

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Table 1. Contd...

References, years	Study design	Total number	Technical success, *n* (%)	Clinical success, *n* (%)	Early adverse events, *n* (%)	Profiles of early adverse events (*n*)	Mean stent patency (d)
Minaga *et al.*, 2017[24]	Retrospective	30	29 (97)	22 (76)	3 (10)	Bile peritonitis (3)	63[a] (range 31-201)
Cho *et al.*, 2017[25]	Prospective	21	21 (100)	18 (86)	4 (19)	Pneumoperitoneum (2) Bleeding (1) Abdominal pain (1)	166 (95% CI: 95-238)
Amano *et al.*, 2017[26]	Prospective	9	9 (100)	9 (100)	1 (11)	Abdominal pain (1)	N/A
Sportes *et al.*, 2017[3]	Retrospective	31	31 (100)	25 (81)	5 (16)	Severe sepsis (2)[c] Bile leak (2) Bleeding and death (1)	N/A
Moryoussef *et al.*, 2017[27]	Prospective	18	17 (94)	13 (76)	1 (6)	Bleeding and death (1)	N/A
Oh *et al.*, 2017[28]	Retrospective	129	120 (93)	105 (88)	32 (25)	Bacteremia (16) Bleeding (5) Bile peritonitis (4) Pneumoperitoneum (4) Intraperitoneal stent migration (3)	137
Honjo *et al.*, 2018[29]	Retrospective	49	49 (100)	N/A	11 (22)	Abdominal pain (6) Bleeding (5)	N/A
Okuno *et al.*, 2018[30]	Prospective	20	20 (100)	19 (95)	3 (15)	Cholangitis (3)	87[a]
Miyano *et al.*, 2018[31]	Retrospective	41	41 (100)	41 (100)	6 (15)	Bile peritonitis (4) Cholangitis (1) Stent migration (1)	112
Paik *et al.*, 2018[2]	RCT	32	31 (97)	26 (84)	2 (6)	Pneumoperitoneum (1) Cholangitis (1)	220
Total		810	774 (96)	510 (90)	143 (18)		

[a]Median stent patency, [b]There were three procedure-related deaths, [c]There was one procedure-related death at day 1. RCT: Randomized controlled trial, CI: Confidence interval, N/A: Not applicable

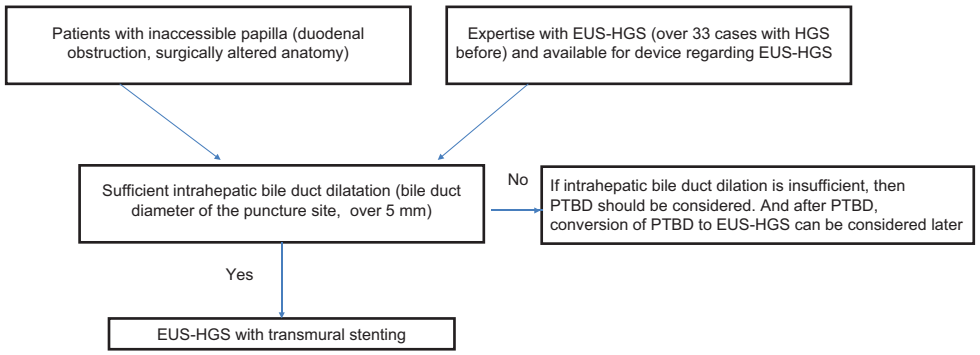

Figure 1. Proposed algorithm for EUS-HGS. *When patient have insufficient intrahepatic ductal dilatation and indwelling percutaneous transhepatic biliary drainage catheter, the conversion of percutaneous transhepatic biliary drainage to EUS-guided hepaticogastrostomy may be considered after failed internalization of percutaneous transhepatic biliary drainage

metal stent between right and left intrahepatic first, then inserts the covered metal stent between left intrahepatic and stomach[35] and (2) hepaticoduodenostomy that access right intrahepatic in the duodenum.[36] However, right-sided biliary access may be difficult because of the acute angulation of the access route.

The long distance of the track through the liver parenchyma between the puncture site in the gastric wall and the intrahepatic contributes procedure-related adverse events.[37] The fistula dilation is also a difficult step, and the use of noncoaxial electrocautery during fistula dilation is a risk factor for procedure-related adverse events.[10,20] Another big problem is that the stent could migrate into the peritoneal cavity since there is a free space between the liver and the stomach. The movement of the liver during respiration may also lead to stent migration.[20] To prevent stent migration,

the distance between the liver and stomach should be as close as possible, and intrachannel stent release technique should be applied while the HGS stent is deployed.[15,38] Moreover, to prevent stent migration by shortening of the stent, a long stent of 10 cm or more and over 3 cm gastric end of the stent are recommended.[22] In order for EUS-HGS to become more popular, the development of dedicated accessories and devices, and standardization of EUS-HGS technique is mandatory.

CONCLUSIONS

EUS-HGS is a very attractive procedure because it can be performed by the same practitioners of ERCP, and it is possible for endoscopically inaccessible papilla. The clinical studies about EUS-HGS after failed ERCP have shown comparative efficacy with fewer adverse events compared to PTBD. However, since most of the procedures in these studies have been done by experts, EUS-HGS should be performed after sufficient practice and experiences of EUS and ERCP, and surgeons and interventional radiologist should also be available to help with the procedure-related adverse events.

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Conflicts of interest
There are no conflicts of interest.

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