Review of Simultaneous Double Stenting Using Endoscopic Ultrasound-Guided Biliary Drainage Techniques in Combined Gastric Outlet and Biliary Obstructions

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Concomitant malignant gastric outlet obstruction and biliary obstruction may occur in patients with advanced cancers affecting these anatomical regions. This scenario presents a unique challenge to the endoscopist in selecting an optimal management approach. We sought to determine the efficacy and safety of endoscopic techniques for treating simultaneous gastric outlet and biliary obstruction (GOBO) with endoscopic ultrasound (EUS) guidance for biliary drainage. An extensive literature search for peer-reviewed published cases yielded 6 unique case series that either focused on or included the use of EUS-guided biliary drainage (EUS-BD) with simultaneous gastroduodenal stenting. In our composite analysis, a total of 51 patients underwent simultaneous biliary drainage through EUS, with an overall reported technical success rate of 100% for both duodenal stenting and biliary drainage. EUS-guided choledochoduodenostomy or EUS-guided hepaticogastrostomy was employed as the initial technique. In 34 cases in which clinical success was ascribed, 100% derived clinical benefit. The common adverse effects of double stenting included cholangitis, stent migration, bleeding, food impaction, and pancreatitis. We conclude that simultaneous double stenting with EUS-BD and gastroduodenal stenting for GOBO is associated with high success rates. It is a feasible and practical alternative to percutaneous biliary drainage or surgery for palliation in patients with associated advanced malignancies. **Clin Endosc 2020;53:167-175**

Key Words: Biliary tract; Duodenal obstruction; Endoscopy, digestive system; Gastrointestinal neoplasms; Ultrasonography, interventional

INTRODUCTION

Individually, gastric outlet obstruction (GOO) and biliary obstruction are caused by a variety of disease processes, both benign and malignant. GOO is defined as a mechanical obstruction to gastric emptying, and normally presents with

decreased oral intake secondary to nausea and vomiting. Biliary obstruction, especially when long-standing, can result in cholangitis or liver dysfunction.[1] Therefore, these obstructions warrant time-sensitive treatment and often require procedural intervention.

It is not uncommon in patients with malignancies to present with simultaneous gastric outlet and biliary obstruction (GOBO).[2,3] It is estimated that 40%–92% of patients who have malignant GOO also have concurrent biliary obstruction.[2] GOBO is most commonly seen in pancreatic, periampullary, and gastric cancers, with differentiation by type depending on the location of the obstruction (Table 1). Dual obstructions were previously treated with complex gastric and biliary bypass surgeries such as hepaticojejunostomies and gastrojejunostomies. However, not all patients are amenable to surgery, especially those with advanced cancers involving vascular

invasion or distant metastasis. For this subset of patients, palliation with improvement in the quality of life is the ultimate goal, and minimally invasive procedures offering quicker recovery times have become the preferred modality.[4-6] Thus, endoscopy with transpapillary biliary stenting and duodenal stenting for drainage has become the standard palliative treatment for GOBO.[7,8] One composite review summarizes 17 publications that reported on double stenting,[1] in which the range of biliary drainage techniques included endoscopic retrograde cholangiopancreatography (ERCP), percutaneous transhepatic biliary drainage (PTBD), and EUS-guided biliary drainage (EUS-BD), with overall excellent technical success rates (94%–100% for duodenal stenting and 89%–100% for biliary stenting). Prior experience with double stenting for cases that did not require EUS-BD techniques suggests that it is safe and effective.[1,9]

Endoscopic approaches are favored over the percutaneous biliary drainage approach[10] or surgical approaches because of decreased costs, shorter hospitalizations, and less invasiveness. For duodenal obstructions, palliative stenting has been shown to be superior to surgery in enhancing the quality of life, as defined by earlier resumption of food intake and improvement in performance scores.[11] Adverse events may occur despite successful biliary stenting performed by a skilled endoscopist, including recurrent obstruction requiring reintervention. Although reinterventions also have high success rates, some patients require external drainage or advanced procedures, with a subsequent decline in the quality of life.[12]

Because direct transpapillary biliary stenting is not always possible in GOBO, EUS-assisted intervention may need to be considered. The use of EUS-BD as a feasible method in clinical practice has become more established.[13-19] Both EUS-guided choledochoduodenostomy (EUS-CDS) and EUS-guided hepaticogastrostomy (EUS-HGS) have been studied.[16,17,19,20] In the study by Ogura et al., GOBO was approached by first performing duodenal stent placement and waiting 1 week before attempting EUS-BD in a separate endoscopy session.[20] Fewer reports have been published with respect to the safety and efficacy of simultaneous double stenting with these techniques.

EUS-BD, owing to its limited availability and technical difficulty, is usually employed in cases in which ERCP is not a feasible option. Two retrospective studies have shown similar

efficacy between EUS-BD and ERCP with regard to technical and clinical success. Paik et al. suggested a non-inferiority between EUS-BD and ERCP for biliary drainage in a prospective study, arguing that EUS-BD could even be considered a first-line option associated with shorter hospitalization, lower reintervention rates, and less adverse events including acute pancreatitis.[21]

Our focus is to examine cases of GOBO that were treated with EUS-BD and in which ERCP was not possible, with concomitant duodenal stenting to show the feasibility, practicality, and safety of this technique.

METHODS

A systematic review of published literature was performed by searching PubMed for the most recent publications. The following search terms were used: "endoscopy of biliary and gastric outlet obstruction", "EUS-guided biliary drainage", "double stenting in biliary obstruction and duodenal obstruction", and "drainage of biliary and gastric outlet obstruction". A total of 461 publications were found using these keywords. Seven pertinent publications[2,12,22-25] were relevant to simultaneous interventions for biliary obstruction and GOO that included cases treated with EUS-BD. The indications, procedure details, success rates, clinical outcomes, adverse events, and limitations were reviewed. We excluded publications in which double stenting was performed in 2 separate endoscopy sessions.

RESULTS

Findings from Iwamuro et al. (2010)[22]

The study by Iwamuro et al., representing one of the early publications, described 2 patients with GOBO who underwent simultaneous double stenting in a series of 7 total patients reviewed.[22] Duodenal stent placement and transduodenal EUS-BD were successful in both cases (Table 2). Clinical success in this study was defined as improvement of oral intake, resolution of obstructive jaundice, or successful withdrawal of an external indwelling catheter, or a combination thereof. One

Table 1. Types of Stenosis in Gastric Outlet Obstruction

Type of stenosis	Definition (anatomy involvement)
Type 1	Proximal to and with no involvement ampulla of Vater
Type 2	Second part of the duodenum with involvement of ampulla of Vater
Type 3	Third part of the duodenum, not including ampulla of Vater

Table 2. Cases of Simultaneous Duodenal Stent and Endoscopic Ultrasound-Guided Biliary Drainage for Gastric Outlet and Biliary Obstruction

Study	No. of patients[a]	EUS-BD technique	Technical success, EUS-BD (No, %)	Technical success, DuS (No, %)	Clinical success (oral intake, No, %)	Non-mortality-related rate of post-endoscopy adverse events (early or late)	Biliary stent and/or DuS dysfunction (No., %)	Subsequent need for surgery after stent dysfunction	Biliary stent type	Duodenal stent type
Iwamuro et al. (2010)[22]	2	EUS-CDS	2/2 (100%)	2/2 (100%)	2/2 (100%)	Early: 1/2 (50%) Late: 0/2 (0%)	Biliary: 2/2 (100%)[b]	0%	PS (7 Fr 50 mm or 7 Fr 40 mm)	8 cm × 20 mm SEMS (Niti-S; TaeWoong Medical, Seoul, Korea)[c]
Kawakubo et al. (2012)[23]	2	EUS-CDS	2/2 (100%)	2/2 (100%)	2/2 (100%)	Early: 0/2 (0%) Late: 0/2 (0%)	Biliary: 0/2 (0%)	0%	7 Fr straight PS (Flexima; Boston Scientific, Marlborough, MA, USA)	Uncovered SEMS, WallFlex; covered SEMS (ComVi; TaeWoong Medical)
Rebello et al. (2012)[24] & Artifon et al. (2013)[25]	7	EUS-CDS	7/7 (100%)	7/7 (100%)	7/7 (100%)	Early: 0/7 (0%) Late: 1/7 (14.3%)	Biliary: 1/7 (14.3%)	0%	Partially covered self-expandable metal stents (WallFlex) (8×60 mm; 10×60 mm; 10×80 mm)	SEMS (18×90 mm; 18×110 mm; 22×60 mm; 22×90 mm)
Tonozuka et al. (2013)[26]	4	EUS-CDS; EUS-HGS	4/4 (100%)	4/4 (100%)	4/4 (100%)	Early: 0/4 (0%) Late: 2/4 (50%)	Biliary: 0/2 (0%)	0%	Not specified	10 cm × 20 mm Niti-S; 6–9 cm × 22 mm WallFlex[c]
Sato et al. (2016)[2]	17	EUS-CDS; EUS-HGS	17/17 (100%)[c]	17/17 (100%)[d]	N/A[e]	Early: 5/43 (12%)[f] Late: 3/43 (7%)[f]	N/A[c]	0%	EUS-CDS: Fully covered stent (WallFlex) (4 and 6 cm × 10 mm EUS-HGS: Fully covered stent (Niti-S)	Uncovered Niti-S and WallFlex stents (6, 8 10, 12 cm × 20 or 22 mm)
Matsumoto et al. (2017)[12]	19	EUS-CDS; EUS-HGS	19/19 (100%)	19/19 (100%)	19/19 (100%)	N/A[g]	DuS: 3/19 (15.8%); biliary stent by EUS-BD: 8/19 (42.1%)[h]	N/A	Covered 10 mm × 6 cm stents (WallFlex or Bonastent; Sewoon Medical, Seoul, Korea; PS (Flexima or Zimmon [Cook Medical, Winston-Salem, NC, USA])	20-mm covered SEMS (Niti-S); 20-mm and 22-mm uncovered SEMS (Niti-S or WallFlex)

DuS, duodenal stent; EUS-BD, endoscopic ultrasound-guided biliary drainage; EUS-CDS, endoscopic ultrasound-guided choledochoduodenostomy; EUS-HGS, endoscopic ultrasound-guided hepaticogastrostomy; N/A, not available; PS, plastic stent; SEMS, self-expanding metal stent.

[a] A total of 144 patients across 5 studies were analyzed; 44 patients were identified having underwent simultaneous EUS-BD and duodenal stenting for gastric outlet obstruction. Since our intent was to isolate only EUS-guided cases of double-stenting, data related to were interpreted and extracted from the associated articles.

[b] EUS-BD patency period was variable: 4.9 weeks and 46.4 weeks for each respective patient.

[c] The use of covered vs. uncovered stent was not explicitly specified.

[d] Because no immediate complications were explicitly attributed to double-stenting in these cases, this was regarded as technical success. However, seven patients later required re-intervention; in re-intervention group, 6 of 7 cases underwent EUS-BD, and 5 of 7 cases were technically successful (71.4%). Re-intervention was not counted against immediate technical success; re-intervention was considered "stent dysfunction". Because explicit correlation was not made for which of the re-interventions were attributed to the patients who underwent EUS-BD, a percentage could not be calculated.

[e] Clinical success was not explicitly reported for this group of patients.

[f] Due to inability to exactly ascribe each individual case with respective outcomes, this limitation affected interpretation of the proportions. For instance, in the reporting of post-endoscopy adverse events from Sato et al., the proportions could only be derived from a cohort of 43 patients instead of 17 patients.[2]

[g] Biliary sludge and stent migration were described; however, the incidence could not be not quantified based on presentation of data.

[h] Seven cases associated with biliary sludge development; one case associated with biliary stent migration.

of the 2 patients had complications of severe abdomen and fever, which resolved 1 week after antibiotic treatment. Both patients eventually died of their underlying diseases.

Findings from Kawakubo et al. (2012)[23]

In a case series of 2 patients (Table 2), both patients underwent EUS-BD with 100% technical success and clinical success.[23]

Findings from Rebello et al. (2012)[24] and Artifon et al. (2013)[25]

A series of 7 shared cases described by both Rebello et al. and Artifon et al. was presented in which patients with GOBO, with either type 1 or type 2 duodenal obstruction, underwent EUS-CDS, followed by duodenal self-expandable metallic stent (SEMS) placement in a single procedure session.[24,25] The technical success of EUS-CDS was reported to be 100%, without early complications. The technical success of duodenal SEMS placement was also 100%. A semisolid diet was possible in all 7 patients within the first week. Two patients died within the first 60 days, whereas 4 of the remaining 5 patients were still able to tolerate a semisolid diet by 90 days. One patient had stent ingrowth by 120 days after the procedure.

Findings from Tonozuka et al. (2013)[26]

In this case series, a total of 11 patients with pancreatic cancer who had undergone double stenting were studied.[26] Simultaneous double stenting involving EUS-BD was performed in 4 of the 11 patients (Table 2). The technical success was excellent (100% in duodenal stenting and EUS-BD). No patient developed early adverse events, and 2 developed cholangitis. The clinical success rate was 100% (based on the GOO scoring system [GOOSS] score).

Findings from Sato et al. (2016)[2]

Sato et al. described 43 patients, 38 (88.4%) of whom had pancreatic cancer and 18 (41.7%) had type 2 duodenal obstruction, who underwent double stenting exclusively with metallic stents.[2] A total of 17 of the 43 patients underwent EUS-BD (16 EUS-CDS and 1 EUS-HGS) (Table 2). Immediate technical success was implied in all cases, rationalized by the observation that 28 of the 43 patients did not develop biliary stent dysfunction, whereas the other 15 patients requiring reintervention for biliary stent dysfunction showed initial endoscopic success in stent placement. Biliary stent dysfunction eventually occurred in 15 of the 43 patients; 7 of those cases were associated with EUS-BD (6 EUS-CDS and 1 EUS-HGS), implying that 10 of the 17 EUS-BD cases retained biliary stent function. Reintervention with EUS-BD was successful in 5 of

7 cases (71.4% reintervention success rate). In the overall cohort of 43 patients, the early and late adverse events included jaundice, tumor bleeding, and stent dislocation, and the overall biliary stent adverse events included tumor growth, sludge formation, cholangitis, stent dislocation, and duodenal stent covering. However, the attributions of these adverse events to EUS-BD cases were not explicitly defined. The only clinical outcome was measured according to medial survival times and biliary dysfunction.

Findings from Matsumoto et al. (2017)[12]

In this retrospective study, 81 patients were reviewed, in which type 2 duodenal stenosis occurred in 40% of the patients.[12] The initial interventions included ERCP-BD (in 75 patients), EUS-CDS (in 1 patient), and EUS-HGS (in 5 patients). Because 13 patients failed the initial ERCP-BD, they were converted to EUS-CDS (12 patients) or EUS-HGS (1 patient). Because the case converted to EUS-HGS failed, it was subsequently converted to EUS-CDS. Therefore, a total of 19 patients were considered to have undergone EUS-BD intervention for our analysis. EUS-HGS was successful in 4 of 6 cases (including the failed conversion attempt). As EUS-CDS was pursued after one of the failed EUS-HGS, a total of 14 cases of EUS-CDS were performed. The paper did not explicitly define the technical success of each of the 14 cases, and it was implied that they were successful with an explicit statement of successful duodenal stent placement in all 19 patients. Of 21 patients (from the overall cohort of 72 patients requiring reintervention), 8 were intervened with EUS-CDS with a 100% (8 of 8) technical success rate and 87.5% (7 of 8) clinical success rate (Table 2). However, the paper does not specify which of the respective patients who initially underwent EUS-BD eventually developed stent dysfunction.

Double stenting

For the endoscopic management of GOBO, all 6 patient series used similar techniques with slight differences in the approach (Table 2). The type of stenosis and whether duodenal obstruction occurred before biliary obstruction determined the approach. EUS was employed in cases in which ERCP was not feasible. Most of the studies combined the different techniques used; however, we focused on EUS-guided procedures. The general principle of EUS is to puncture the bile duct with a needle, dilate the tract, and then place a stent, which allows for drainage.

SUMMARY OF RESULTS FROM STUDIES

A total of 151 patients from 7 publications (6 unique stud-

ies) were analyzed, and 51 patients were found to have undergone simultaneous endoscopic drainage of biliary obstruction (with EUS-BD) and GOO (with duodenal stenting) (Table 2). Our goal was to isolate only biliary drainage cases managed with EUS, as those cases represent the most challenging scenarios in which ERCP was not feasible.

In our analysis, 51 patients underwent EUS-BD with a reported 100% technical success of both duodenal stenting and biliary drainage on the initial intervention. Either EUS-CDS or EUS-HGS was employed as the initial technique in these patients. Of 34 cases for which clinical success was examined (as ascertained by the ability for oral intake), 100% of those patients derived benefit. The rates of adverse events were variable. With mortality specifically excluded in the analysis, the correlated cases in 4 of the 6 unique studies showed only 15 cases that could be reliably tracked; early adverse events occurred in 1 of 15 cases (6.7%), and late adverse events occurred in 3 of 15 cases (20%).[22-26] The exact correlation of adverse events in the studies by Sato et al. and Matsumoto et al. could not be easily calculated for distinct EUS-BD cases.[2,12] Common adverse events associated with double stenting include cholangitis, stent migration, bleeding, food impaction, and pancreatitis.

CASE IN POINT

An 80-year-old woman was evaluated for new-onset abdominal pain, nausea, emesis, involuntary weight loss, generalized fatigue, and a left-sided neck mass. Two months prior, laboratory testing showed new-onset abnormal liver biochemical tests of undetermined etiology. The serum alanine aminotransferase (ALT) was as high as 343 U/L, aspartate aminotransferase (AST) 171 U/L, alkaline phosphatase (ALP) 595 U/L, total bilirubin (TB) 1.6 mg/dL, and direct bilirubin 1.0 mg/dL. A subsequent computed tomography of the abdomen revealed intrahepatic and extrahepatic biliary ductal dilatation, with a normal liver size without hepatic masses; the gallbladder had features of wall thickening at the neck. Repeat computed tomography imaging after 2 weeks, during this presentation, demonstrated similar findings with enlarged gallbladder impressing upon the anterior abdominal wall, causing distortion; the stomach was distended with significant retained gastric contents with type 2 GOO. Magnetic resonance cholangiopancreatography identified a 1.8-cm segment of severe narrowing of the common bile duct (CBD) at the level of the pancreas head, with no apparent focal mass or filling defect; there were also several small pancreatic cysts. Repeat laboratory testing showed ALT 74 U/L, AST 33 U/L, ALP 697 U/L, TB 1.3 mg/dL, and direct bilirubin 0.6 mg/dL. Ultrasound-guided percutaneous biopsies were performed to evaluate the left neck mass, which was determined to be carcinoma. The sample was positive for CK7 and CK20, suggesting a pancreaticobiliary origin, and positive for p40 and p63, suggesting squamous differentiation. The primary malignancy was still undetermined. Four days after presentation, the ALT level increased to 321 U/L, AST to 336 U/L, ALP to 938 U/L, and TB to 2.3 mg/dL. At 9 days from presentation, it was determined that the patient may benefit from potential biliary stenting as well as duodenal stenting.

Upper endoscopy identified extrinsic compression causing obstruction at the second portion of the duodenum, which
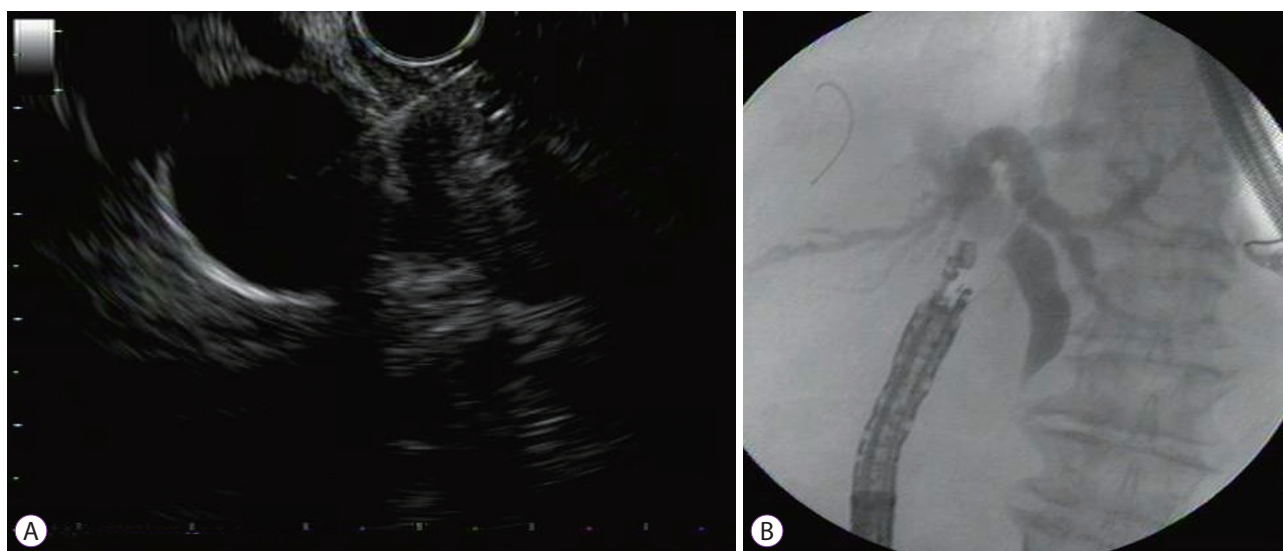

Fig. 1. (A) Endoscopic ultrasound image showing a dilated common bile duct (CBD). (B) Cholangiogram demonstrating dilation of the CBD with tapering to the point of obstruction at the distal CBD.

was not traversable with an endoscope. Consequently, ERCP with direct papillary access was not possible. EUS was then performed, identifying a 5.4-cm pancreatic head mass and CBD dilatation of 1.1 cm (Fig. 1). By using a 19-gauge needle, biliary access was initially achieved from the duodenal bulb into the CBD with advancement of a 0.035-inch guidewire into the CBD through the papilla; however, the wire could not be retrieved. Next, the guidewire was advanced instead into a branch of the right hepatic duct, and the transduodenal tract was dilated with a 4 cm × 4 mm Hurricane balloon (Boston Scientific, Marlborough, MA, USA). A fully covered 60 × 10 mm metal biliary stent (WallFlex; Boston Scientific) was placed with the proximal end in the right hepatic duct and the distal end at the duodenal lumen. Fluoroscopy confirmed adequate drainage of contrast. Satisfactory positioning of this biliary stent was also confirmed endoscopically (Fig. 2).

Subsequently, duodenal stenting was attempted. With an 0.035-inch guidewire and balloon catheter assistance, a 60 × 22 mm uncovered metal duodenal stent (WallFlex; Boston Scientific) was placed across the stenotic region, with the distal portion of the stent residing in the third part of the duodenum. Positioning was confirmed with fluoroscopy (Fig. 3).

After the procedure, the patient's abdominal pain resolved. She was able to tolerate a full liquid diet without nausea or emesis after successful clear liquid diet challenge the day after the procedure. The patient's presentation appeared to be most consistent with a pancreatic primary malignancy with metastasis that involved the left neck mass. She was diagnosed with a rare malignancy: primary squamous cell carcinoma of the pancreas. About 2 weeks after endoscopy, her serum ALT level improved to 28 U/L, AST to 26 U/L, ALP to 247 U/L, and TB to 0.9 mg/dL. However, in light of the poor performance status, the patient was not a candidate for chemotherapy. Owing to poor prognosis, the patient elected for hospice care.

DISCUSSION

Endoscopic drainage to palliate simultaneous GOBO is becoming more recognized as a reasonable and effective alternative for patients who are poor candidates for surgery or if PTBD is not preferred. These patients typically have late-stage malignancies or diminished life expectancy, and palliation with preservation of the quality of life is desired. Poor survival may be expected after the onset of GOBO because of the already advanced nature of the malignant diseases; thus, enhancing the quality of life through rapid reinitiation of feeding, minimizing the recovery time, minimizing the duration of hospitalization, and reducing adverse events are the goals of therapy. EUS-BD would be able to offer these advantages. Owing to the anatomical challenges in GOBO, particularly in type 2 duodenal obstructions, the ability to offer both biliary drainage and duodenal patency is paramount. Traditionally, gastroduodenal stent placement may have been considered secondary to PTBD. The endoscopic practices we described encourages a shift in the paradigm in the considerations of interventions offered to patients.

EUS-BD has been more widely accepted following subsequent studies after its introduction by Giovannini et al.[27,28] One of the first published and reported cases involved a pa-
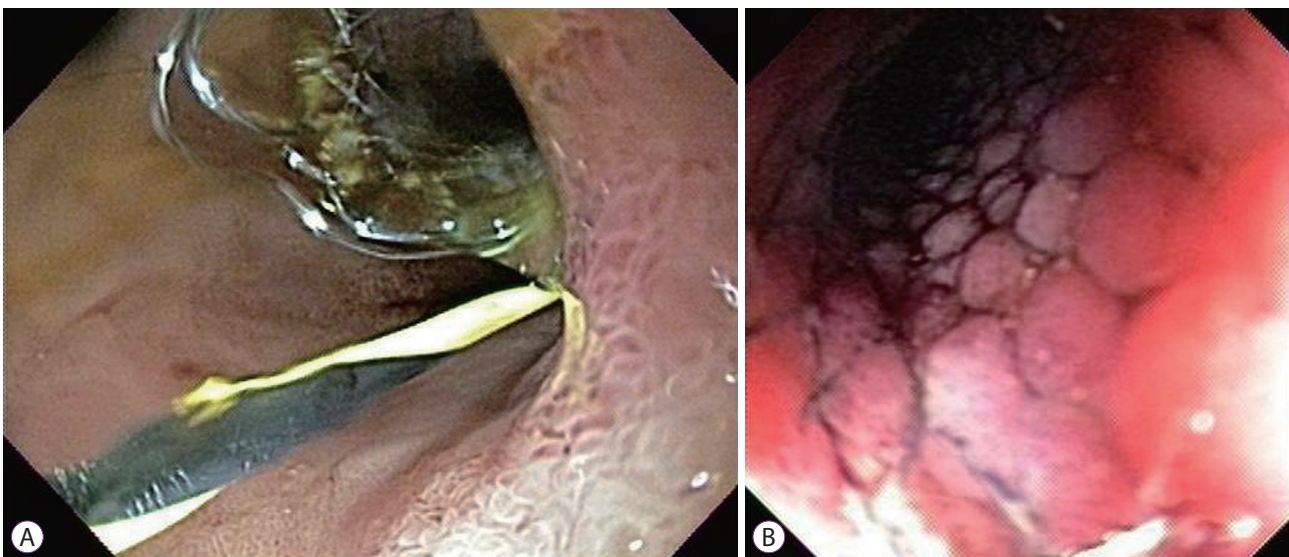

Fig. 2. Endoscopic images of the biliary stent. (A) Successful deployment of a biliary stent through endoscopic ultrasound-guided choledochoduodenostomy, with guidewire assistance. (B) Endoscopic view from the new lumen created by the biliary stent.

tient with pancreatic cancer who underwent successful biliary drainage with EUS guidance by stenting of the CBD through the wall of the duodenum.[27] In a scenario in which a duodenal stent is already in place and biliary drainage is necessary, EUS-BD can even be performed in such a way to intersect into the lumen of the duodenal stent.[29] A recent prospective study suggested the non-inferiority of EUS-BD, with the additional advantage of potentially less adverse effects, compared with ERCP.[21] Long-term studies describing the outcomes of EUS-BD alone are rarely published or conducted, at least in part as a result of poor survival secondary to advanced malignancies. With respect to long-term durability before stent occlusion or migration, 1 small case series of 5 patients had an average time to stent exchange of 211.8 days.[30] In a recent randomized study by Paik et al., the technical and clinical success rates between EUS-BD and ERCP were comparable, in which EUS-BD was associated with more preserved quality of life and arguably lower rates of reintervention.[21] Results from a single-center randomized trial by Bang et al. suggested similar rates of adverse outcomes between EUS-BD and ERCP.[31] Such studies highlight the feasibility and value of EUS-BD.

One of the first cases of simultaneous duodenal and (non-EUS-guided) biliary stenting was published by Maetani et al.[32] in 1994, which employed the use of metal stents. Several studies have described the role of and reported the efficacy of double stenting in this scenario.[1,9] Because direct biliary stenting is not always possible in GOBO, EUS-assisted intervention is often necessary. In particular, type 1 and type 2 outlet obstructions generally preclude the ability to perform ERCP; thus, alternative 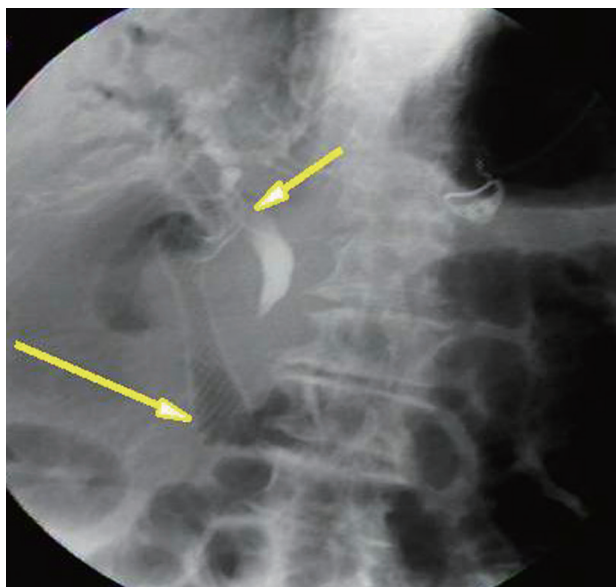techniques are pursued. EUS-BD has been used in practice for many years and itself is a technique with good technical and clinical success rates.[13-18,33] Specifically, in EUS-CDS, the technical success rate may range from 50% to 100% with a clinical success rate of 92%–100%.[16] In EUS-HGS, the literature suggests an overall technical success rate of 82% with a clinical success rate of 97%; however, the adverse event rate is about 23%.[17,33] A literature review of the safety of EUS-BD documented common adverse effects, which included bleeding, bile leakage, pneumoperitoneum, stent migration, cholangitis, abdominal pain, and peritonitis.[33] Each of these adverse events occurred individually in <5% across a composite of 278 patients.[33] In the literature, fewer reports have been published with respect to the safety and efficacy of simultaneous double stenting. However, similar adverse event rates should be expected in simultaneous double stenting. The development of biliary and duodenal stent dysfunction should be anticipated.

Our aim was to identify some of the most challenging scenarios in which ERCP or direct transpapillary biliary stenting is precluded by the nature of the duodenal obstruction, prompting the gastroenterologist to resort to EUS-assisted techniques. The 7 publications identified included cases that employed EUS-BD, either EUS-CDS or EUS-HGS, with simultaneous duodenal stent placement in a total of 51 patients. Both technical success and immediate clinical success (ability to advance oral intake) were excellent. In a report by Belletrutti et al., 1 patient in a case series of 7 patients was described as having had duodenal stent placement in the same session as EUS-CDS with technical success and improvement in bilirubin and without stent dysfunction on follow-up by 26 weeks.[19] As the scope of that case series was focused on EUS-BD, additional details about this case as it relates to the duodenal stent or to clinical improvement were not sufficient to be included in our patient selection.

In the study by Sato et al., it was implied that all patients had successful double stenting with EUS-BD, as it was not stated otherwise until reintervention, which had a 71.4% technical success rate.[2] This was not considered in the initial analysis, as patients who require reintervention are believed to have lower rates of success related to the anatomy and potential progression of disease. It reveals from this small sample that a repeat EUS-BD may still be an appropriate option and technique, if necessary, given a >70% technical success rate. Sato et al. also described the principles of double stenting.[2] "Separate-type" and "crossed-type" forms of double stenting were defined. Separate-type stenting involves placement of the biliary stent proximal to the gastroduodenal stent, whereas crossed-type stenting involves the 2 stents physically crossing or in direct physical apposition with each other. The authors suggested that a type 2 duodenal obstruction, for instance,

Fig. 3. Fluoroscopic image demonstrating successful placement of both biliary and duodenal stents (arrows).

may benefit from gastroduodenal stenting first before performing either EUS-CDS or EUS-HGS,[2] and this approach was similarly reflected in the case series by Ogura et al.[20]

The limitations of our review include the variable definition of clinical success, which limits the ability to adequately attribute some cases of EUS to technical and clinical success, as biliary drainage techniques were described without necessarily ascribing some immediate outcomes to EUS-BD cases. Few studies employed the use of GOOSS.[2,12,26] The duration of follow-up after endoscopy was also variable. Long-term clinical outcomes may be challenging to measure owing to the advanced status of malignancy, which itself affects prognosis or mortality, as these endoscopic procedures are generally performed for palliation. Specifically, we excluded an analysis on associated mortality after the procedure in these patients with advanced cancer, to avoid suggesting that the endoscopic intervention was a proximate cause of death. Technologies such as the 1-step stent introducer used in EUS-BD in a recent study,[21] with the experience of trained endoscopists at high-volume centers, may be conducive to better EUS-BD success rates.[28] More recently, the use of lumen-apposing metal stents for EUS-CDS has been successfully demonstrated, expanding the toolbox of modalities.[34] Additional experience will streamline and potentially standardize the management of GOBO scenarios.

CONCLUSIONS

In conclusion, simultaneous double stenting employing EUS-BD methods is reasonably effective and safe with high technical and immediate clinical success for patients with GOBO. Our review of the literature suggested that this is a viable option for palliation in patients with advanced malignancies who may not be optimal surgical candidates or as a potentially PTBD-sparing option. Our example case also describes successful simultaneous double stenting through a separate-type stenting method employing EUS-CDS followed by duodenal stenting. The notion that endoscopic intervention for malignant GOBO with simultaneous duodenal stenting and EUS-BD (whether by EUS-CDS or by EUS-HGS) is supported by the review of these examined literature cases. Even if reintervention is necessary, repeat EUS-BD can still be pursued. An algorithmic approach (Fig. 4) should be employed to aid in the identification of the suitable candidates, especially if the goals are palliative.
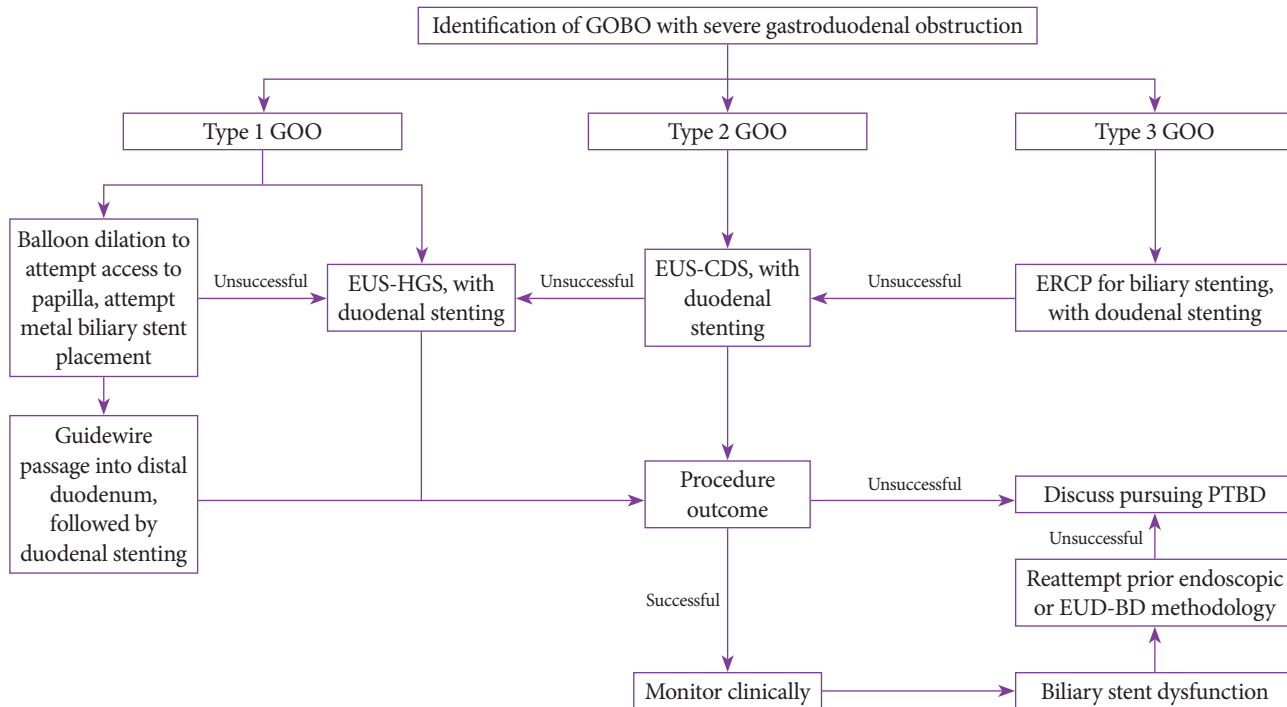

Fig. 4. Proposed algorithm to determine the decision to pursue endoscopic ultrasound-guided biliary drainage (EUS-BD) and simultaneous duodenal stenting and management for initial biliary stent dysfunction. Accessibility to the papilla dictates the endoscopic methodology. After a successful endoscopy, patients should be monitored clinically, including for signs suggesting stent dysfunction. ERCP, endoscopic retrograde cholangiopancreatography; EUS-CDS, endoscopic ultrasound-guided choledochoduodenostomy; EUS-HGS, endoscopic ultrasound-guided hepaticogastrostomy; GOBO, gastric outlet and biliary obstruction; GOO, gastric outlet obstruction; PTBD, percutaneous transhepatic biliary drainage.

Conflicts of Interest

The authors have no financial conflicts of interest.

Author Contributions

Conceptualization: Shashideep Singhal
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Investigation: HCZ, MT, KK, SS
Methodology: HCZ, SS
Supervision: SS
Visualization: HCZ, MT, KK
Writing-original draft: HCZ, MT, KK
Writing-review&editing: HCZ, MT, KK, SS

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