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Relationship Between the Intraperitoneal Stent Length in Endoscopic Ultrasound-Guided Hepaticogastrostomy and Surgically Altered Upper Gastrointestinal Anatomy in Patients With Malignant Biliary Obstruction

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Abstract

Background: Endoscopic ultrasound-guided hepaticogastrostomy (EUS-HGS) is associated with a relatively high proportion of adverse events, and this is attributable to the lack of standardized protocols and specialized equipment. Although the outcomes of EUS-HGS may differ between patients with and those without surgically altered upper gastrointestinal anatomy, there have been no reports on this topic. The present study aimed to evaluate the efficacy and safety of EUS-HGS using our standardized method and to compare the outcomes between patients with and those without surgically altered upper gastrointestinal anatomy.

Methods: In EUS-HGS, we used a long partially covered metal stent, and we kept the gastric wall pressed with the scope tip until the stent was deployed more than 1 cm inside the working channel of the scope to minimize free space between the liver and gastric wall (the intraperitoneal stent length). A total of 12 patients who underwent EUS-HGS using our method were retrospectively studied. Procedural success and adverse events were evaluated, and the outcomes of EUS-HGS were compared between six patients with and six without surgically altered upper gastrointestinal anatomy.

Results: The procedural success rate was 100%. Additionally, stent migration or dislocation was not noted in any of the patients. The intraperitoneal stent length was significantly greater in patients without surgically altered upper gastrointestinal anatomy than in those with surgically altered upper gastrointestinal anatomy (19.8 mm vs. 11.6 mm; 95% confidence interval, 2.185 - 14.147; P = 0.012).

Conclusions: EUS-HGS using our method was safe. Our findings suggested that special attention should be paid to stent migration or dislocation in patients without surgically altered upper gastrointestinal anatomy.

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Introduction

Studies have shown that endoscopic ultrasound-guided hepaticogastrostomy (EUS-HGS) was useful for the treatment of malignant biliary obstruction in patients with endoscopic retrograde cholangiopancreatography (ERCP) failure. However, a previous review article noted that despite the high success rate of EUS-HGS, it was associated with a relatively high rate of adverse events [1], which was attributable to the lack of standardized protocols and specialized equipment.

EUS-HGS is sometimes performed in patients who have undergone upper gastrointestinal surgery. These patients may have tissue adhesion around the stomach. Thus, the rates of success and adverse events with EUS-HGS and the intraperitoneal stent length may differ between patients with and those without surgically altered upper gastrointestinal anatomy. However, there have been no reports on this topic.

At our institution, since October 2014, we have been using a standardized procedure of EUS-HGS in patients with malignant biliary obstruction to prevent adverse events. The present study aimed to evaluate our procedure and compare the outcomes of EUS-HGS between patients with and those without surgically altered upper gastrointestinal anatomy.

Materials and Methods

Patients

Patients with biliary obstruction due to a malignant tumor, who underwent EUS-HGS between October 2014 and December 2017 at our institution, were identified from a database and were included in this study.

Table 1. Patient Characteristics

Mean age (SD), years	74.3 (14.7)
Male, n	8
Primary cancer, n	
Pancreatic cancer	6
Gastric cancer	3
Biliary tract cancer	2
Hepatocellular carcinoma	1
Reasons for EUS-HGS, n	
Failed ERCP	6
Failed passage of the endoscope due to a malignant duodenal stricture	4
Failed passage of the endoscope due to a malignant afferent loop stricture with recurrence of cancer	2

SD: standard deviation; EUS-HGS: endoscopic ultrasound-guided hepaticogastrostomy; ERCP: endoscopic retrograde cholangiopancreatography.

Endoscopic procedure

All procedures were performed using a convex-type echo endoscope (GF-UCT260; Olympus Medical Systems, Tokyo, Japan) and carbon dioxide insufflator. The left intrahepatic bile duct was punctured from the stomach using a 19-gauge needle (SonoTip; Medi-Globe, Rosenheim, Germany or EZShot-3plus; Olympus Medical Systems) under Doppler imaging guidance to avoid any intervening arteries or veins. After aspirating the bile juice, a small amount of contrast medium was injected to visualize the biliary tree. Next, a 0.025-inch guidewire (VisiGlide; Olympus Medical Systems) was inserted into the bile duct through a 19-gauge needle. This needle was subsequently exchanged for an ERCP catheter with a 3.5-Fr tip (PR-V110Q; Olympus Medical Systems) to avoid guidewire shearing. The guidewire was then advanced into the common or right intrahepatic bile duct, and the fistula was dilated using a 6-Fr cystotome (Cysto Gastro Set; Endo-flex, GmbH, Voerde, Germany). Subsequently, an electrosurgical high-frequency generator (ESG-100; Olympus Medical Systems) with the diathermy current set to the cut mode (90 W in pulse-cut slow mode) was used. Finally, we placed a long partially covered metal stent (LP-CMS) from the left intrahepatic bile duct to the stomach.

We used the following approach in all patients to avoid adverse events. First, we marked the gastroesophageal junction with clips before EUS. This allowed us to avoid mediastinitis due to transesophageal drainage, because we could recognize the gastroesophageal junction fluoroscopically. Second, we used a LP-CMS with a diameter of 8 mm, length of 12 cm, and uncovered portion of 1 cm at the distal, intrahepatic end (bare-end type, Niti-S biliary S-type; TaeWoong Medical, Seoul, Korea) to avoid bile leakage after stent placement and stent migration into the peritoneal cavity. Third, we kept the gastric wall pressed with the scope tip until deployment of the stent more than 1 cm inside the working channel conduit of the scope. This stent release method allowed us to avoid creating free space between the liver and gastric wall, enabling the intraperitoneal stent length to be minimized and the intragastric stent length to be extended.

Definitions and outcome measurement

The study was a retrospective, observational case series conducted in a single center. The primary outcome was the procedural success rate of EUS-HGS. The secondary outcomes were procedural time, adverse events, intragastric stent length, and intraperitoneal stent length. For comparison of the outcomes of EUS-HGS between patients with (Group A) and those without (Group B) surgically altered upper gastrointestinal anatomy, the following parameters were additionally evaluated: age, sex, primary diseases, and reasons for EUS-HGS.

We measured the stent lengths of the intragastric and intraperitoneal portions on computed tomography performed more than 48 h after EUS-HGS.

The study was reviewed and approved by the Institutional Review Board of Kyoto Second Red Cross Hospital. All study participants provided informed consent.

Statistical analysis

We used Fisher's exact test to compare the proportions of categorical variables, such as sex. After confirming homoscedasticity using the F test and normal distribution using the Kolmogorov-Smirnov test, we used Student's *t*-test to compare the means of continuous variables, such as age. All statistical analyses were performed using EZR (Saitama Medical Center, Jichi Medical University, Japan), which is a graphical user interface for R (The R Foundation for Statistical Computing, Vienna, Austria) [2]. A P-value < 0.05 was considered to indicate a statistically significant difference.

Results

Patient characteristics

Patient characteristics are presented in Table 1. A total of 12 patients (eight men) were analyzed in the present study. The

Table 2. Outcomes of EUS-HGS

Procedural success, n	12
Mean procedural time (SD), min	41.2 (12.6)
Adverse events	
Stent migration, n	0
Stent dislocation, n	0
Biliary peritonitis, n	0
Liver abscess, n	1
Mean intragastric stent length (SD), mm	57.4 (7.1)
Mean intraperitoneal stent length (SD), mm	15.7 (6.1)

EUS-HGS: endoscopic ultrasound-guided hepaticogastrostomy; SD: standard deviation.

mean patient age was 74.3 years (range, 42 - 93 years). The primary cancers were pancreatic cancer (n = 6), gastric cancer (n = 3), biliary cancer (n = 2), and hepatocellular carcinoma (n = 1). The reasons for EUS-HGS were failed ERCP (n = 6), failed passage of the endoscope due to a malignant duodenal stricture (n = 4), and failed passage of the endoscope due to a malignant afferent loop stricture with recurrence of cancer (n = 2).

EUS-HGS outcomes

The procedural success rate was 100%. Additionally, the mean procedural time was 41.2 min. No adverse events were noted in any of the patients during the procedure and within 30 days after the procedure. Although liver abscess around the stent occurred on postoperative day 32 in one patient, the patient recovered with antibiotic administration and percutaneous transhepatic aspiration. The mean intragastric stent length was 57.4 mm, and the mean intraperitoneal stent length was 15.7 mm (Table 2).

Comparison between patients with (Group A) and those without (Group B) surgically altered upper gastrointestinal anatomy

Six patients had surgically altered upper gastrointestinal anatomy, including two who underwent distal gastrectomy with Roux-en-Y reconstruction, two who underwent choledochojejunostomy with Roux-en-Y reconstruction, and two who underwent gastrojejunostomy. There was no stent migration or dislocation, or biliary peritonitis in both groups. Fisher's exact test showed no significant difference in procedural time between the groups. The intraperitoneal stent length was significantly greater in Group B than in Group A (19.8 mm vs. 11.6 mm; 95% confidence interval, 2.185 - 14.147; P = 0.012) (Table 3).

Discussion

We found that our EUS-HGS approach was safe and that the intraperitoneal stent length was significantly greater in patients without surgically altered upper gastrointestinal anatomy than in those with surgically altered upper gastrointestinal anatomy.

According to the literature, the complication of stent migration to the peritoneal cavity may occur in both the early and late post-EUS-HGS phases and might lead to a very poor prognosis. Reports have presented a case in which a 6-cm covered metallic stent migrated with a fatal outcome and a case in which an 8-cm covered metallic stent migrated, necessitating surgical treatment [3, 4]. Moreover, a recent report described a significantly shorter median stent patency duration in patients who underwent EUS-HGS with an intragastric stent < 3 cm in length than in those who underwent EUS-HGS with an intragastric stent ≥ 3 cm in length [5]; therefore, we believe that stents measuring 10 cm or longer should be used [6].

A recent report showed the efficacy and safety of EUS-HGS using a LP-CMS, but the stent release method was not described in that study [7]. Another recent report showed the efficacy and safety of EUS-HGS with the intra-channel release method, but the stents used in that study were not standardized [8]. In the present study, we evaluated the outcomes of EUS-HGS with the intra-channel release method using the same LP-CMS in all patients.

No studies have compared the outcomes of EUS-HGS between patients with and those without surgically altered upper gastrointestinal anatomy. In the present study, although we used the same stents and released them with the same method, the intraperitoneal stent length was significantly greater in patients without surgically altered upper gastrointestinal anatomy. This may be clinically plausible because we thought that those patients did not have tissue adhesion around the stomach and the stomach wall could be easily moved away from the liver during the procedure. Thus, we should be more careful with regard to stent migration or dislocation when EUS-HGS is performed in patients who have never undergone upper gastrointestinal surgery. This may be important clinical information for EUS-HGS.

The present study has several limitations. This was a single-arm, retrospective study in a single center, and the number of patients was too small to draw solid conclusions. However, this is the first study to compare the outcomes of EUS-HGS between patients with and those without surgically altered upper gastrointestinal anatomy. We were able to compare the intraperitoneal stent length between those patients, because we used the same stents and a standardized release method.

In conclusion, EUS-HGS with the intra-channel release method using a LP-CMS was safe. Our findings suggested that special attention should be paid to stent migration or dislocation in patients without surgically altered upper gastrointestinal anatomy, as the intraperitoneal stent length tended to be long.

Conflict of Interest

All the authors declare no conflict of interest associated with

Table 3. Comparison of Outcomes Between Patients With (Group A) and Those Without (Group B) Surgically Altered Upper Gastrointestinal Anatomy

	Group A (N = 6)	Group B (N = 6)	Two-tailed P-value	Odds ratio	95% CI
Mean age (SD), years	66.6 (14.3)	82.0 (11.5)	0.068[a]	-	-1.376 - 32.043
Male, n	6	2	0.060[b]	-	0.968 - 9.302
Primary cancer, n			0.545[b]	0.23	0.25 - 1.442
Pancreato-biliary	3 (pancreas 2, biliary tract 1)	5 (pancreas 4, biliary tract 1)			
Others	3 (gastric cancer)	1 (HCC)			
Reasons for EUS-HGS, n			1.000[b]	1	0.323 - 3.101
Failed ERCP	3	3			
Failed passage of the endoscope	3 (malignant duodenal stricture 1, malignant afferent loop stricture 2)	3 (malignant duodenal stricture)			
Procedural success, n	6	6	-	-	-
Mean procedural time (SD), min	35.0 (9.4)	47.5 (13.0)	0.085[a]	-	-2.108 - 27.108
Stent migration, n	0	0	-	-	-
Stent dislocation, n	0	0	-		
Biliary peritonitis, n	0	0	-	-	-
Liver abscess, n	1	0	1.000[b]	-	-
Mean intraperitoneal stent length (SD), mm	11.6 (4.4)	19.8 (4.8)	0.012[a]	-	2.185 - 14.147
Mean intragastric stent length (SD), mm	57.8 (7.6)	57.0 (7.2)	0.850[a]	-	-10.432 - 8.766

HCC: hepatocellular carcinoma; EUS-HGS: endoscopic ultrasound-guided hepaticogastrostomy; ERCP: endoscopic retrograde cholangiopancreatography; SD: standard deviation; CI: confidence interval. [a]Student's *t*-test, [b]Fisher's exact test.

this study.

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