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【 ORIGINAL ARTICLE 】

Large Balloon Anchor Technique for Endoscopic Retrograde Cholangiopancreatography Required for Esophagogastroduodenal Deformities

Shinya Kawaguchi, Takuya Ohtsu, Ryosuke Itai, Shuzo Terada, Shinya Endo and Naofumi Shirane

Abstract:

Objective It is difficult to insert a side-viewing duodenoscope during endoscopic retrograde cholangiopancreatography in patients with esophagogastroduodenal deformities. To evaluate the efficacy and safety of using a large balloon anchor technique for cases in which inserting side-viewing duodenoscopes is difficult.

Methods We retrospectively examined patients with endoscopic retrograde cholangiopancreatography who required the large balloon anchor technique between April 2016 and October 2020. Patients with deformed superior duodenal angles, esophagogastric junctions and pyloric rings and those having a shortened lesser curve were included.

Results The balloon as an anchor was safely used to insert the duodenoscopes in 17 patients, and this procedure was performed 21 times. The procedure was successful 20 out of 21 times (95.2%), including 12 cases with duodenal deformities, 5 with shortening of the lesser curve, 2 after duodenal stent placement and 1 with a deformity of the esophagogastric junction. In the remaining patient, the first ERCP was successful, but the second was unsuccessful with duodenal deformities. There were no complications throughout the course of the study.

Conclusion The large balloon anchor technique is a safe and useful technique for patients when inserting side-viewing duodenoscopes is difficult for various reasons.

Key words: large balloon anchor technique, endoscopic retrograde cholangiopancreatography, side-viewing duodenoscopy

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Introduction

The standard endoscopic retrograde cholangiopancreatography (ERCP) procedure involves inserting a duodenoscope, which is a specialized endoscope used for side-viewing (as opposed to forward-viewing), through the mouth to the second portion of the duodenum. However, it is difficult to use and advance this scope into the correct gastrointestinal lumen in patients in whom the superior duodenal angle, esophagogastric junction or pyloric ring is deformed due to peritoneal dissemination or direct tumor invasion or in whom the lesser curve is shortened and deformed (1).

When the scope is unable to reach the papilla, alternative methods include percutaneous transhepatic biliary drainage (PTBD) or hepaticojejunostomy. However, these procedures are highly invasive, carry risks of complications and affect the quality of life of the patient. Thus, endoscopic ultrasound-guided biliary drainage (EUS-BD) was developed as an alternative drainage modality. It is necessary to use PTBD or EUS-BD appropriately, depending on the site of bile duct stricture. Furthermore, if the bile duct dilation is slight, the treatment itself is difficult. The development of EUS-BD is ongoing, and it is performed largely at high-

Department of Gastroenterology, Shizuoka General Hospital, Japan
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Correspondence to Dr. Shinya Kawaguchi, shinya-kawaguchi@i.shizuoka-pho.jp

volume tertiary-care centers, being difficult to perform in general hospitals (2).

The large balloon anchor technique was first reported in 2009. Kikuyama et al., in their four-case series, reported the utility of the technique for one-step endoscopic biliary stenting in patients with a major papilla that was inaccessible due to difficult duodenal stricture. After duodenal dilation, the slightly deflated balloon was pushed with the endoscope into the major papilla through the duodenal stricture (pushing method). In the cases in which the major papilla was not accessible by the pushing method, the large dilation balloon was deflated completely after dilation, advanced beyond the stricture into the third portion of the duodenum, and reinflated to the maximum size. Pulling the dilation balloon catheter into the working channel while hooking the inflated balloon as the anchor at the anal side of the duodenal stricture, the endoscope was straightened to allow advancement to the major papilla (1).

We considered it necessary to examine the safety and usefulness of the ERCP procedure using the large balloon anchor technique in many cases, as there is no evidence concerning these aspects in the literature aside from one reported case series.

Materials and Methods

Study design

Patients who underwent ERCP using a large balloon as an anchor between April 2016 and October 2020 at a single center, Shizuoka General Hospital were retrospectively examined.

The inclusion criteria were patients with (i) no symptoms, such as vomiting, caused by esophagogastroduodenal (EGD) stricture; (ii) findings from a pre-examination, such as computed tomography, performed before ERCP showing no gastric outlet obstructions; (iii) side-viewing duodenoscope insertion; (iv) a severe EGD deformity with the direction of insertion unable to be confirmed; and (v) ERCP unable to be safely performed by conventional techniques as judged by experienced therapeutic pancreatobiliary endoscopists who had performed ERCP more than 400 times annually. For the patients with (iii) and (iv), we determined the possibility of passing the duodenoscope under fluoroscopy with gastrografin using an endoscope or by switching to a forward-viewing endoscope. Shortening of the lesser curve referred to cases in which the lesser curvature side of the stomach had been shortened, and the cardia and pylorus ring resembled a drawstring bag on gastroscopy. In the present study, cases with recurrence of gastric cancer after gastrectomy and cases associated with gastric ulcer scar were included.

The exclusion criteria were patients with (i) a surgically altered upper gastrointestinal anatomy in whom a side-viewing duodenoscope was not used and (ii) difficulty passing a forward-viewing endoscope through the stricture as well as deformities, as there is a risk of gastrointestinal perforation during the procedure due to the temporary expansion of a severe stricture with a large balloon. For such patients, endoscopic self-expandable duodenal stent placement or surgical bypass (i.e., gastrojejunostomy) was indicated.

If it is possible to pass through with a forward-viewing endoscope, or if it is deemed that a diameter of approximately 10 mm can be secured by fluoroscopy, placing an EGD stent increases the risk of migration because the stenosis is not severe. Especially in these cases, it was necessary to fix the insertion of the side-viewing duodenoscope to the duodenum of patients with EGD deformities, which seemd to be a good indication.

The institutional review board approved this retrospective study, which was conducted in accordance with the principles of the Declaration of Helsinki (current revision, October 2013), and the need for informed consent was waived.

ERCP devices and procedures

The objective of using a large balloon was not to expand the severe EGD stricture but to use the balloon as an anchor to safely insert the duodenoscope into the second portion of the duodenum and perform ERCP treatment. ERCP was performed using a side-viewing duodenoscope (JF-260V; Olympus Medical Systems, Tokyo, Japan). When a duodenoscope could not be passed through the EGD deformities, first, an ERCP catheter and a guidewire were passed through the EGD deformity under direct endoscopic vision cautiously. It was then confirmed that the guidewire has been inserted into the correct duodenal lumen by injecting contrast medium and air via the catheter. Subsequently, the catheter was replaced with a large balloon catheter (Giga balloon, maximum diameter 18 mm, length 4 cm; Century Medical, Tokyo, Japan). The balloon was then inflated (2-4 atm in pressure, 16-17 mm in diameter) and pulled back to the deformity side. With this procedure, it was necessary to focus on fluoroscopic imaging. The duodenoscope and balloon were integrated and linearized, and a pushing force was then applied to the tip of the balloon, taking care not to bend the scope due to the rightward twist of the duodenum. Simultaneously, the duodenoscope was pushed into the distal position of the deformity. Fluoroscopy was used to monitor the axis of the balloon and the duodenoscope, thereby minimizing the risk of perforation.

Results

Outcomes of large balloon anchor techniques

During the study period, 2,570 ERCPs were performed at our hospital. Excluding 175 patients with surgically altered upper gastrointestinal anatomy in whom a side-viewing duodenoscope was not used, the number of patients in whom the side-viewing duodenoscope was inserted and the direction of insertion could not be confirmed, resulting in ERCP not being able to be safely performed by conventional tech-

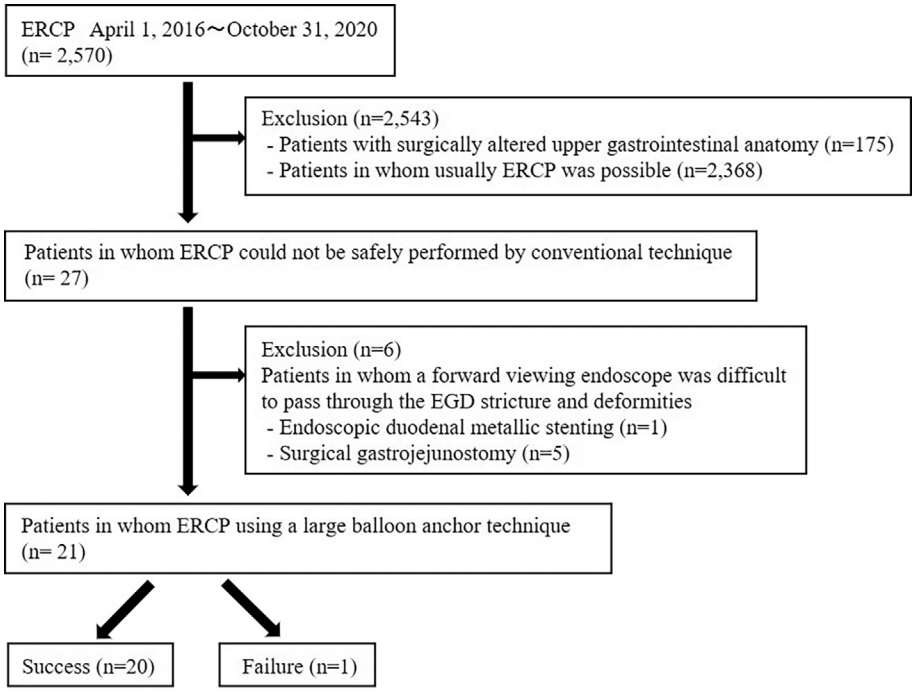

Figure 1. Flowchart of the entire study on endoscopic retrograde cholangiopancreatography (ERCP) using the large balloon anchor technique. ERCP was performed with the large balloon anchor technique in 0.88% of the study population (21 of 2,395 cases). EGD: esophagogastroduodenum

niques, was 27. It was difficult to pass a forward-viewing endoscope through the stricture and deformities in six patients. One patient underwent endoscopic duodenal metallic stenting, and five underwent gastrojejunostomy. This technique was used in 0.88% of the study population (i.e., 21 out of 2,395 cases; Fig. 1).

Of the 17 patients who underwent ERCP (procedure performed 21 times) in the study, 13 were men, and 4 were women, with ages ranging from 38 to 85 years old (median, 73 years old) (Table). The procedure was repeated two and three times for two and one patient, respectively. The primary diseases included gastric cancer with disseminated recurrence in six patients, pancreatic cancer in five patients, hilar carcinoma in two patients and gallbladder carcinoma, hepatocellular carcinoma, colon cancer with dissemination and benign biliary stricture in one patient each. Duodenal deformities were observed in 10 patients, shortening of the lesser curve in 4 patients, a duodenal metallic stent placement in 2 patients and a deformity of the esophagogastric junction in 1 patient.

Using the balloon as an anchor to safely insert the duodenoscope into the second portion of the duodenum was successful in 17 patients (procedure performed 21 times), including 9, 7, 3 and 1 patient who required self-expandable metallic stenting (SEMS), plastic stenting, nasobiliary drainage and a cholangiogram, respectively. In one patient (case 12), the first ERCP procedure was successful using this technique, but the second was unsuccessful because of severe duodenal deformity due to advancement of groove pancreatic carcinoma. She was scheduled to receive a pancreatic duct stent for obstructive pancreatitis but subsequently received conservative treatment.

The median ERCP total treatment time was 43 minutes (range 14-88). The median procedure time from inserting the guidewire past the EGD deformities to inserting the duodenoscope into the second portion of the duodenum using a large balloon was 5 minutes (range 2-28). There were no complications throughout the course of the study.

Case report

A 70-year-old man (case 8) underwent Billroth I reconstruction following distal gastrectomy for gastric cancer 5 years prior and was undergoing chemotherapy for stage IV gallbladder carcinoma. He developed obstructive jaundice. Contrast-enhanced computed tomography revealed hilar invasion of gallbladder carcinoma, but no gastric obstruction was observed. Prior to the third ERCP procedure, two ERCP procedures were performed using a large balloon anchor technique: the first with an SEMS at the hilar part and the other with nasobiliary drainage in the right hepatic duct. At this time, standard ERCP was performed, but it was difficult to insert the duodenoscope into the duodenum due to gastroduodenal anastomotic deformity and shortening of the lesser curve, as with the previous ERCP procedure (Fig. 2). At the time of the previous ERCP procedure, it was confirmed that the gastroduodenal deformity could be passed by switching to a forward-viewing endoscope. Therefore, under fluoroscopy with contrast medium, a large balloon was inserted through the working channel of a side-viewing duodenoscope and inserted through the deformity using guidewire assistance. The balloon was inflated (4 atm in pressure, 17 mm in diameter) and pulled back to the de-

Table. **Patients Using Large Balloon Anchor Technique.**

No. of patients	Age	Gender	Primary disease	Obstructive jaundice	ERCP procedure	Success or failure	Reasons for choosing this technique
1	73	M	hilar carcinoma, post duodenal MS	(+)	PS in SEMS	success	deformity due to duodenal MS
2	69	F	pancreatic carcinoma, duodenal invasion	(+)	SEMS	success	duodenal deformity
3	73	M	gastric cancer, post DG, peritoneal disseminated recurrence	(+)	SEMS	success	duodenal deformity
4	77	F	hilar carcinoma, peritonitis carcinomatosa	(+)	PS	success	esophagogastric deformity
5	80	M	gastric cancer, post duodenal MS	(+)	SEMS	success	deformity due to duodenal MS
6	73	M	hepaticolithiasis, benign biliary stricture	(-)	NBD	success	shortening of lesser curve
	73	M	hepaticolithiasis, benign biliary stricture	(-)	NBD	success	shortening of lesser curve
7	38	M	gastric cancer, peritonitis carcinomatosa	(+)	PS	success	duodenal deformity
8	70	M	gallbladder carcinoma, post DG	(+)	cholangiogram	success	duodenal deformity
	70	M	gallbladder carcinoma, post DG	(+)	SEMS	success	duodenal deformity
	70	M	gallbladder carcinoma, post DG	(+)	SEMS	success	duodenal deformity
9	85	M	gastric cancer, duodenal invasion	(+)	SEMS	success	duodenal deformity
10	71	M	recurrence of HCC, post left hepatectomy	(+)	PS	success	shortening of lesser curve
11	83	M	gastric cancer, post DG, peritoneal disseminated recurrence	(+)	PS	success	shortening of lesser curve
12	76	F	groove pancreatic carcinoma, duodenal invasion	(+)	SEMS	success	duodenal deformity
	76	F	groove pancreatic carcinoma, duodenal invasion, obstructive pancreatitis	(-)	Pancreatic stent placement was scheduled	failure	duodenal deformity
13	66	M	colon cancer, peritonitis carcinomatosa	(+)	PS	success	deformity of the pylorus
14	51	M	gastric cancer, post DG, peritoneal disseminated recurrence	(+)	SEMS	success	shortening of lesser curve
15	64	F	pancreatic carcinoma, duodenal invasion	(+)	PS+NBD	success	duodenal deformity
16	79	M	pancreatic carcinoma	(+)	SEMS in SEMS	success	duodenal deformity
17	83	M	pancreatic carcinoma	(+)	NBD in SEMS	success	duodenal deformity

M: male, F: female, ERCP: endoscopic retrograde cholangiopancreatography, MS: metallic stent, PS: biliary plastic stent placement, SEMS: self-expandable metallic stent placement, DG: distal gastrectomy, NBD: nasobiliary drainage, HCC: hepatocelluer carcinoma

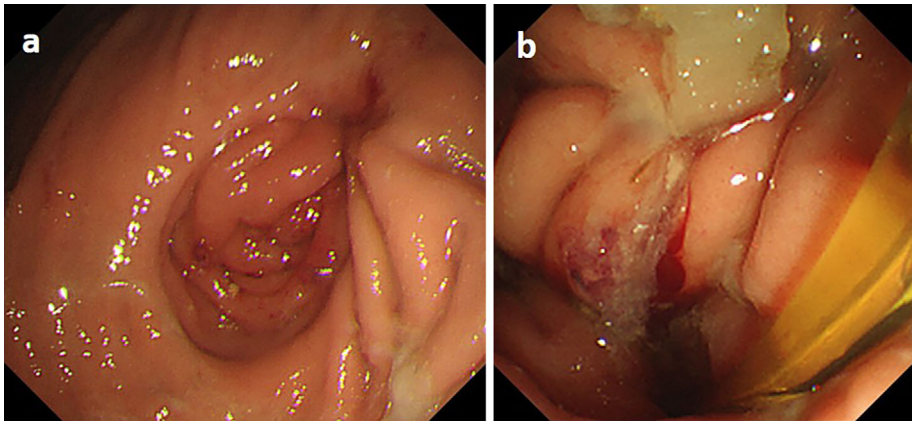

Figure 2. **Endoscopic imaging of gastroduodenal anastomotic deformity (a: forward-viewing scope, b: side-viewing duodenoscope).**

formity side. The large balloon was able to be inserted beyond the deformity by aligning it with the axis of the lumen and applying pushing force to the tip of the scope, all while avoiding bending the scope due to the rightward twist of the duodenum. To reach the second portion of the duodenum, the large balloon was deflated, and ERCP was successfully completed by inserting an SEMS at the hilar part without any complications (Fig. 3).

Discussion

Since the duodenoscope is a side-viewing scope used for ERCP, the insertion direction cannot always be determined. In addition, blindly inserting the scope will cause bleeding and perforation, especially when there is EGD stricture and/or a deformity. One of the complications seen during ERCP

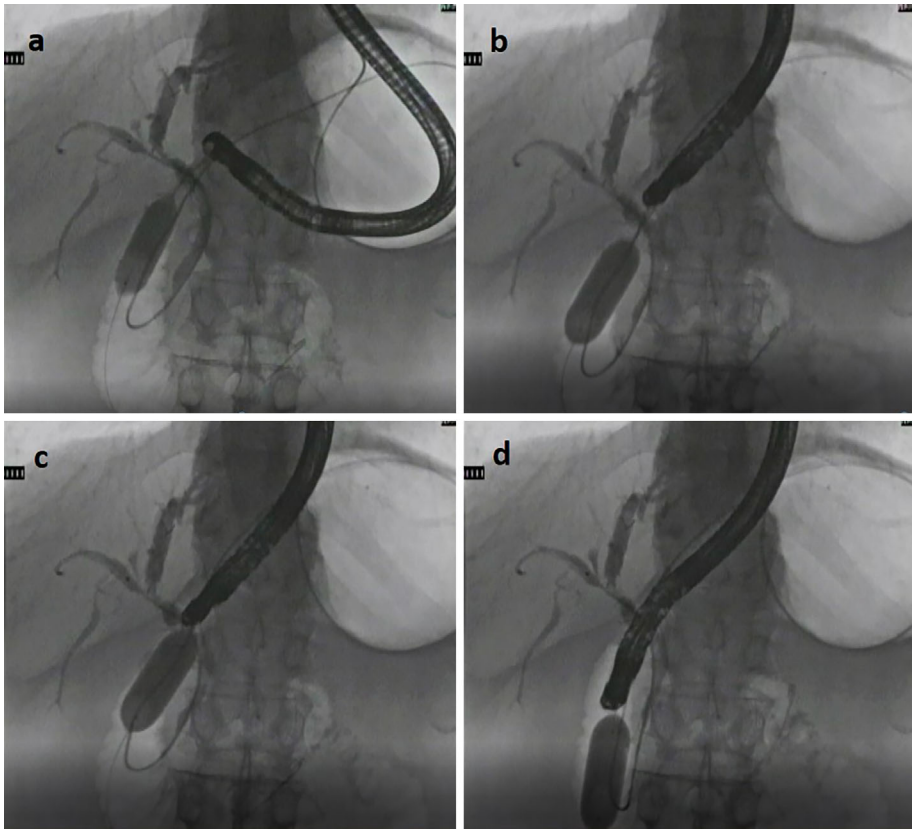

Figure 3. **Fluoroscopy images. The large balloon was inflated and hooked at the distal position of the deformity (a), remaining in the second portion of the duodenum. At the same time, the balloon catheter was forcefully pulled into the working channel to allow the endoscope (b) and balloon catheter to be straightened (c). The duodenoscope was simultaneously pushed into the deformity (d).**

is luminal perforation by the endoscope, typically resulting in intraperitoneal perforation. The incidence of duodenal perforation during ERCP is approximately 0.08% to 0.6% (3-5). Perforations must be promptly diagnosed and treated, as delayed therapy may result in sepsis and multiple organ failure, which are associated with a mortality rate of 8% to 23% (6). In addition, perforations of the esophagus, stomach, and afferent limb have been reported during ERCP (4, 7).

The large balloon anchor technique was first reported by Kikuyama et al. in 2009 in patients with inaccessible major papilla due to difficult duodenal stricture (1). They reported two methods: the pushing method and hooking method. The pushing method involves pushing the endoscope through the stricture with a slightly deflated balloon after balloon dilatation of the duodenal stricture. The hooking method involves the advancement of a completely deflated balloon beyond the stricture into the third portion of the duodenum and then reinflating and hooking the balloon at the distal edge of the stricture, with the balloon remaining in the second or third portion of the duodenum. The endoscope is then straightened, and the balloon catheter is simultaneously forcefully retracted into the working channel to allow the endoscope to advance.

The aim of using a large balloon in this study was not to expand the severe EGD stricture but rather to use the balloon as an anchor to safely insert the duodenoscope into the second portion of the duodenum to perform ERCP treatment. Thus, if a patient required an EGD stent or surgical bypass as the first choice of therapy due to an obvious obstruction, that patient was excluded from the indication. The large balloon anchor technique is considered safe and useful for cases without severe EGD strictures where it is difficult to insert side-viewing duodenoscopes for various reasons. In particular, the insertion direction of the scope can be difficult to determine due to EGD deformities caused by direct cancer invasion or dissemination and shortening of the lesser curve due to gastrectomy or stomach deformities.

Although our technique is not yet widely established and was not always successful, a noteworthy advantage is that this procedure can be performed using conventional duodenoscopes and standard equipment. The conventional technique used for passing the endoscope through a deformity is performed by inserting the balloon through the working channel of a side-viewing duodenoscope and inflating it at the distal position of the EGD deformity. In this study, we advanced the endoscope while pushing the inflated balloon toward the distal part of the deformity to reach the major papilla in patients with EGD deformities. With this technique, the dilation balloon guided the side-viewing endoscope to the distal part of the deformity.

Of note, duodenal perforation is a possible complication

associated with large balloon dilatation or insertion of a duodenoscope and must be considered during the procedures. Furthermore, duodenal perforation at the deformity site and throughout the duodenal wall may occur, as the dilatation balloon becomes rigid and straight. However, by matching the axis of the balloon and duodenoscope under fluoroscopy and avoiding unexpected perforation, we were able to avoid complications in this study.

The present study's limitations include its small sample size and retrospective, single-center design. Therefore, due to these limitations, multicenter studies with larger sample sizes will be required to fully assess the efficacy and safety of this procedure.

Conclusion

Our study shows that the use of a large balloon as a guide for a duodenoscope is a promising technique that may contribute to successful ERCP in patients with EGD deformities. However, multicenter studies with larger sample sizes will be required to fully assess the efficacy and safety of this procedure.

The authors state that they have no Conflict of Interest (COI).

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