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Clinical outcomes of endoscopic retrograde cholangiopancreatography after Billroth II anastomosis: a comparison of gastroscope and duodenoscope

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Abstract

Background Endoscopic retrograde cholangiopancreatography (ERCP) in patients with Billroth II anastomosis is challenging due to post-surgical anatomical alterations. This study aims to compare the clinical outcomes of using a duodenoscope and a cap-assisted gastroscope in these patients.

Methods Seventy-nine patients with Billroth II anastomosis and a naïve papilla were included in the study. ERCP was performed using either a cap-assisted gastroscope ($n=45$) or a duodenoscope ($n=34$). The primary outcome was the cannulation success rates, while secondary outcomes included clinical success rates, cannulation time, procedure duration, and complications.

Results Afferent limb intubation was successful in 67.1% of patients. Among these, selective biliary cannulation (SBC) was achieved in 73.6%, with no significant difference between the two groups. However, cannulation time was significantly longer in the cap-assisted gastroscope group (7.6 min vs. 5.8 min, $p=0.011$). Complications occurred only in the cap-assisted gastroscope group, including one perforation (2.2%) and two cases of pancreatitis (4.4%), though the overall complication rate was not significantly different. Among the 40 patients (50.7%) who failed ERCP, percutaneous transhepatic biliary drainage (PTBD) was the most common rescue intervention (55%), followed by other procedures, including percutaneous gallbladder drainage, repeated ERCP, surgery, and conservative treatment.

Conclusions Both cap-assisted gastroscopes and duodenoscopes are viable options for ERCP in patients with Billroth II anastomosis. However, cannulation time was significantly shorter in the duodenoscope group.

Keywords Endoscopic retrograde cholangiopancreatography, Gastroenterostomy, Gastrointestinal endoscopy, Bile duct disease, Complications

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Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) is a crucial procedure for diagnosing and treating biliary and pancreatic diseases [1]. However, in patients with a history of Billroth II gastrectomy, anatomical alterations can pose significant challenges, affecting both afferent limb intubation and selective biliary cannulation (SBC) [2].

A side-viewing duodenoscope is generally the preferred instrument for ERCP. However, in patients with Billroth II anastomosis, the sharp angulation of the anastomotic site and the rigidity of a duodenoscope pose significant challenges [2]. These factors make afferent limb intubation difficult and increase the risk of perforation [2, 3]. As an alternative, a forward-viewing gastroscope with a distal cap can facilitate afferent limb intubation and improve access to the papilla [4]. The transparent cap enhances visualization of the papilla and stabilizes the endoscope in a fixed position [2]. By trapping the papilla within the cap, the alignment between the common bile duct (CBD) and the catheter is improved, facilitating easier SBC [2].

Although several studies have evaluated ERCP in patients with Billroth II anastomosis using either a forward-viewing gastroscope or a side-viewing duodenoscope, direct comparisons between these two approaches remain limited [1–6].

Therefore, this study aimed to compare the clinical outcomes of ERCP in patients with Billroth II anastomosis using either a duodenoscope or a cap-assisted gastroscope.

Methods

Study design and population

This study was conducted as a retrospective, single-center analysis. The data were collected through a comprehensive review of medical records.

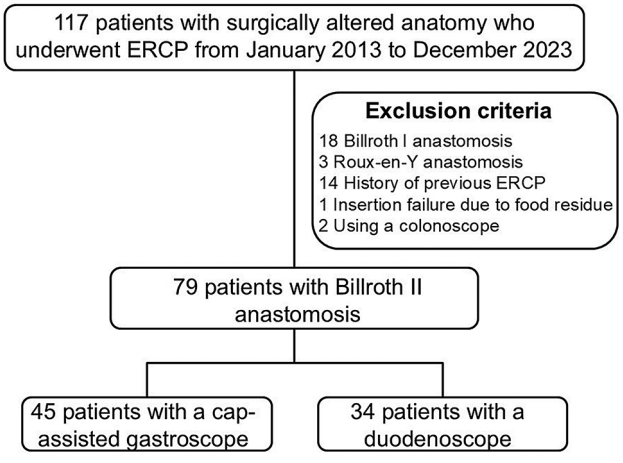

Fig. 1 Flowchart of patient selection and grouping according to endoscope type. ERCP, Endoscopic retrograde cholangiopancreatography

From January 2013 to December 2023, a total of 117 patients with surgically altered anatomy who underwent ERCP at Daegu Catholic University Medical Center were included in initial screening (Fig. 1). The exclusion criteria were as follows: patients with a history of Billroth I or Roux-en-Y reconstruction, patients with a prior history of ERCP, patients in whom endoscopic insertion failed due to excessive food residue in the stomach, and patients in whom a colonoscope was used for the procedure.

After applying these exclusion criteria, a total of 79 patients with Billroth II anastomosis and a naïve papilla were included in the final analysis. These patients were classified into two groups: 45 patients who underwent ERCP using a cap-assisted gastroscope and 34 patients who underwent ERCP using a duodenoscope.

The primary outcome was the cannulation success rate, compared between the duodenoscope and cap-assisted gastroscope groups. Secondary outcomes included clinical success rates, cannulation time, procedure duration, and complication rates.

Procedure

All endoscopic procedures were performed by three experienced endoscopists at a high-volume center where more than 800 ERCP cases were conducted annually. Two of the endoscopists had more than 10 years of experience performing ERCP, while the third had more than 5 years of experience. For each procedure, two of the three endoscopists were involved, one serving as the primary operator and the other as the assistant. In technically challenging cases, the primary and assistant endoscopists occasionally exchanged roles during the procedure to improve the likelihood of success. Trainees did not participate in any of the procedures. ERCP was performed using either a forward-viewing gastroscope (GIF-260 or GIF-290; Olympus, Tokyo, Japan) with a cap attached to the distal end or a side-viewing duodenoscope (JF-260 V or TJF-260 V; Olympus, Tokyo, Japan). The choice of scope was made at the endoscopist's discretion based on anatomical considerations and procedural feasibility.

ERCP was conducted under conscious sedation using midazolam and pethidine. For SBC, a standard ERCP catheter (Tandem™ XL, Boston Scientific, Natick, MA, USA) preloaded with a straight 0.035-inch hydrophilic-tipped guidewire (Jagwire™, Boston Scientific, Natick, MA, USA) was used in both the gastroscope and duodenoscope groups. If necessary, the guidewire was switched to a 0.025-inch guidewire (Visiglide™, Olympus, Tokyo, Japan) based on procedural requirements. All modifications, including guidewire selection changes or decisions to discontinue the procedure, were made at the discretion of the endoscopist.

When using a cap-assisted gastroscope, the endoscope was carefully maneuvered into the afferent limb with

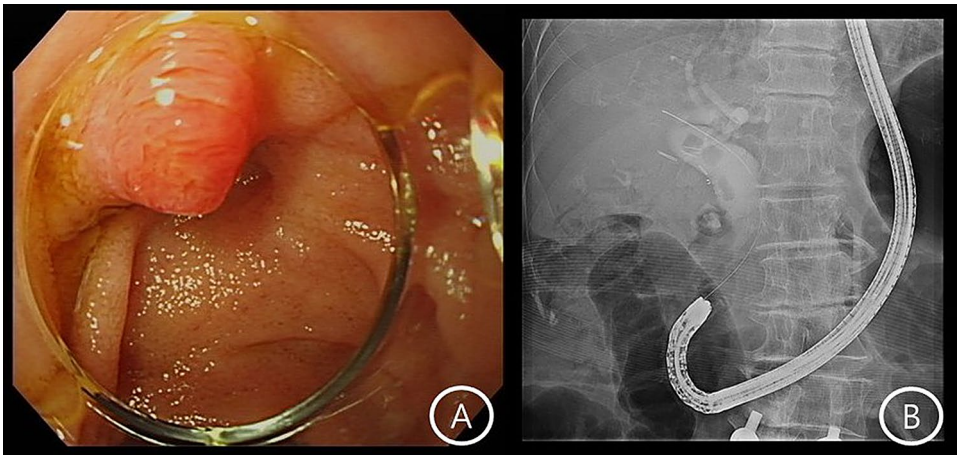

Fig. 2 Endoscopic and fluoroscopic images of ERCP using a cap-assisted gastroscope in a patient with Billroth II anastomosis. (**A**) Endoscopic view showing the papilla at the 11 to 12 o'clock position using a forward-viewing gastroscope with a cap. (**B**) Fluoroscopic image confirming successful selective biliary cannulation. ERCP, Endoscopic retrograde cholangiopancreatography

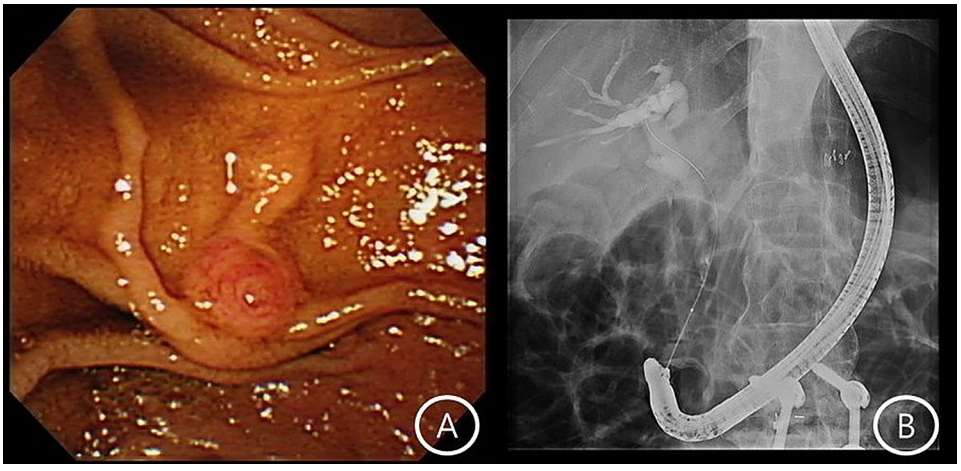

Fig. 3 Endoscopic and fluoroscopic images of ERCP using a side-viewing duodenoscope in a patient with Billroth II anastomosis. (**A**) En face endoscopic view of the papilla using a duodenoscope. (**B**) Fluoroscopic image confirming successful selective biliary cannulation. ERCP, Endoscopic retrograde cholangiopancreatography

controlled insufflation to prevent excessive distension. Once the papilla was identified at the 11 to 12 o'clock position on the endoscopic view, the endoscope was adjusted to align the axis of the ERCP catheter with the CBD. After achieving proper alignment, cannulation was attempted in the 5 o'clock direction of the papilla (Fig. 2).

When using a duodenoscope, the papilla was visualized en face. The distance between the duodenoscope and the papilla was carefully adjusted, and the elevator was used to achieve proper alignment of the catheter with the CBD. After achieving optimal positioning, cannulation was attempted in the 5 o'clock direction of the papilla (Fig. 3). Fluoroscopy was used for real-time guidance to confirm proper guidewire placement, and fluoroscopic images were obtained at each procedural step. Image acquisition was performed by the endoscopist using a foot pedal-controlled system. There were no differences in the use or method of fluoroscopy between the two groups.

Definitions

Cannulation success was defined as the achievement of SBC, confirmed by the visualization of contrast within the CBD under fluoroscopy. Clinical success was defined as the completion of the intended procedure, such as stone removal or stent placement, without major complications.

Procedure duration was measured from the administration of the sedative agent to the final withdrawal of the endoscope, as recorded in the endoscopic report. Cannulation time was defined as the interval between the fluoroscopic image obtained after achieving an en face view of the ampulla and the image confirming successful SBC.

Complications assessed in this study included cholangitis, bleeding, perforation, and post-ERCP pancreatitis (PEP). Bleeding was classified as either immediate or delayed [7]. Immediate bleeding was defined as intraprocedural bleeding that necessitated procedural modification or premature termination. Delayed bleeding was characterized by the presence of hematemesis, melena, and/or hematochezia, along with a hemoglobin drop of ≥ 2 g/dL. Perforation was identified by the presence of free air, detected either fluoroscopically during the procedure or through post-procedural imaging studies.

PEP was defined according to international consensus criteria, which require an amylase level at least three times the upper normal limit more than 24 h after the procedure, accompanied by hospitalization or an extended planned admission of 2–3 days [8]. ERCP-related cholangitis was defined based on the Tokyo Guidelines 2018 criteria for acute cholangitis, characterized by a newly developed fever of ≥ 38 °C and worsening cholestasis within 48 h after the procedure [9].

Statistical analysis

Statistical analysis was conducted using IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA). Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate. Continuous variables were expressed as medians with interquartile ranges (IQRs) and compared using the Mann-Whitney U test. A two-tailed p-value of < 0.05 was considered statistically significant for all analyses.

Results

Patient characteristics and ERCP outcomes

A total of 79 patients with Billroth II anastomosis underwent ERCP, with a cap-assisted gastroscope used in 45 patients (57%) and a duodenoscope used in 34 patients (43%) (Table 1). The median age was 76 years, and 61 patients (77.2%) were male.

When stratified by sex, the median age was 75 years among males and 81 years among females. No significant differences were observed in age distribution between the cap-assisted gastroscope and duodenoscope groups for either sex ($p = 0.523$ for males; $p = 0.791$ for females). Body mass index (BMI) did not significantly differ between the groups ($p = 0.158$).

The most common indication was choledocholithiasis (87.3%), followed by malignant obstruction (8.9%) and cholangitis (3.8%), with no significant differences between the groups ($p = 0.700$). Baseline laboratory values, including white blood cell (WBC) count, aspartate aminotransferase, alanine aminotransferase, total bilirubin, alkaline phosphatase (ALP), gamma-glutamyl transferase, amylase, and lipase were comparable between the two groups.

Clinical outcomes are summarized in Table 2. The median procedure duration was 10.9 min for the cap-assisted gastroscope group and 9.8 min for the

Table 1 Baseline characteristics of the patients who underwent ERCP after Billroth II surgery

Variables	Total (*N* = 79)	Cap-assisted gastroscope (*N* = 45, 57%)	Duodenoscope (*N* = 34, 43%)	*P* value
Age, yrs	76 (68–83)	76 (69–84)	76 (68-81.5)	0.696
Male, yrs	75 (66–82)	75 (66–84)	74 (67–80)	0.523
Female, yrs	81 (74–85)	81 (74–84)	78 (76–86)	0.791
Sex				0.686
Male	61 (77.2)	34 (75.5)	27 (79.4)	
Female	18 (22.8)	11 (25.5)	7 (21.6)	
BMI, kg/m2	21.4 (19.1–22.9)	21.1 (18.6–22.9)	21.5 (20.7–22.9)	0.158
Indications for ERCP				0.700
Choledocholithiasis	69 (87.3)	40 (88.9)	29 (85.3)	
Malignant obstruction	7 (8.9)	3 (6.7)	4 (11.8)	
Clinical cholangitis	3 (3.8)	2 (4.4)	1 (2.9)	
Laboratory tests before ERCP				
WBC, /μL	9700 (7050–13100)	9200 (6600–11500)	11,500 (7750–14725)	0.055
AST, U/L	159 (66.25-288.75)	145 (51–322)	163 (72–240)	0.784
ALT, U/L	133 (67.5–221)	133 (74–221)	130 (65–221)	0.768
Total bilirubin, mg/dL	2.7 (1.35–4.74)	2.5 (0.81–4.6)	3.23 (1.8–5.17)	0.087
ALP, U/L	267 (173–407)	266 (165-386.75)	267 (181–426)	0.257
GGT, U/L	291 (179–457)	273 (168.75–429.5)	317 (182–426)	0.973
Amylase, U/L	50.5 (36-78.75)	57 (36-102.5)	47 (36.5–67)	0.148
Lipase, U/L	33 (19–72)	38 (21.5-105.5)	24 (17–44)	0.106

Data are presented as number (%) or median (interquartile range)

ERCP, endoscopic retrograde cholangiopancreatography; BMI, body mass index; WBC, white blood cell; AST, aspartate aminotransferase; ALT, alanine aminotransferase; ALP, alkaline phosphatase; GGT, gamma-glutamyl transferase

Table 2 Clinical outcomes of the patients who underwent ERCP after Billroth II surgery

Variables	Total (*N* = 79)	Cap-assisted Gastroscope (*N* = 45, 57%)	Duodenoscope (*N* = 34, 43%)	*P* value
Afferent limb intubation success	53 (67.1)	30 (66.7)	23 (67.6)	0.927
Cannulation success	39 (49.3)	21 (46.7)	18 (52.9)	0.581
Clinical success	38 (48.1)	21 (46.7)	17 (50.0)	0.769
Procedure duration, min	10.7 (7.0-17.9)	10.9 (8.1–16.2)	9.8 (5.5–18.0)	0.635
Cannulation success	14.5 (9.8–19.7)	14.5 (9.8–18.5)	16.3 (10.4–20.8)	0.686
Cannulation failure	7.3 (3.3–12.0)	8.8 (3.8–13.5)	5.1 (3.1–8.3)	0.134
Complication				
Bleeding	0 (0.0)	0 (0.0)	0 (0.0)	N/A
Perforation	1 (1.2)	1 (2.2)	0 (0.0)	1.000
Pancreatitis	2 (2.5)	2 (4.4)	0 (0.0)	0.503
Cholangitis	0 (0.0)	0 (0.0)	0 (0.0)	N/A

Data are presented as number (%) or median (interquartile range)

ERCP, endoscopic retrograde cholangiopancreatography; N/A, not available

Table 3 Clinical outcomes according to the type of endoscope in patients with successful afferent limb intubation

Variables	Total (*N* = 53)	Cap-assisted gastroscope (*N* = 30, 57%)	Duodenoscope (*N* = 23, 43%)	*P* value
Cannulation success	39 (73.6)	21 (70.0)	18 (78.3)	0.499
Clinical success	38 (71.7)	21 (70.0)	17 (73.9)	0.754
Procedure duration, min	13.6 (9.5–19.3)	12.5 (9.5–18.5)	14.4 (9.2–20.5)	0.693
SBC time, min*	6.3 (2.6–8.8)	7.6 (5.4–9.8)	5.8 (1.7–6.3)	0.011
Unintended PD cannulation	14 (26.4)	7 (23.3)	7 (30.4)	0.561
Complication				
Bleeding	0 (0.0)	0 (0.0)	0 (0.0)	N/A
Perforation	1 (1.9)	1 (3.3)	0 (0.0)	1.000
Pancreatitis	2 (3.8)	2 (6.7)	0 (0.0)	0.499
Cholangitis	0 (0.0)	0 (0.0)	0 (0.0)	N/A

Data are presented as number (%) or median (interquartile range)

SBC, selective biliary cannulation; PD, pancreatic duct; N/A, not available

*Selective biliary cannulation time was calculated only in cases with successful biliary cannulation

duodenoscope group ($p = 0.635$). Afferent limb intubation was successful in 53 patients (67.1%), and there was no significant difference between the groups. SBC was achieved in 39 patients (49.3%), while clinical success was achieved in 38 patients (48.1%), with no significant difference between the two groups. In the duodenoscope group, one patient failed to achieve complete stone removal.

Complications included one perforation (2.2%) and two cases of pancreatitis (4.4%) in the cap-assisted gastroscope group. No complications were reported in the duodenoscope group; however, the difference was not statistically significant.

Clinical outcomes in patients with successful afferent loop intubation

Table 3 presents the clinical outcomes of 53 patients in whom afferent limb intubation was successfully achieved using either a cap-assisted gastroscope ($n = 30$, 57%) or a duodenoscope ($n = 23$, 43%). Cannulation success was achieved in 39 cases (73.6%), with no significant difference between the cap-assisted gastroscope and duodenoscope groups (70.0% vs. 78.3%, $p = 0.499$). Similarly, clinical success rates were comparable between the two groups (70.0% vs. 73.9%, $p = 0.754$). The median procedure duration did not differ significantly between the groups (12.5 min vs. 14.4 min, $p = 0.693$), but cannulation time was significantly longer in the cap-assisted gastroscope group (7.6 min vs. 5.8 min, $p = 0.011$).

Unintended pancreatic duct (PD) cannulation occurred in 14 cases (26.4%), with no significant difference between the groups ($p = 0.561$). Post-procedural complications included one case of perforation (3.3%) and two cases of pancreatitis (6.7%) in the cap-assisted gastroscope group, while no complications were observed in the duodenoscope group. However, the overall complication rate was not significantly different between the two groups.

Comparison of success and failure of selective biliary cannulation

Table 4 compares the clinical characteristics and outcomes between patients with successful SBC ($n = 39$, 73.6%) and those in whom SBC failed ($n = 14$, 26.4%) after successful afferent limb intubation. There were no significant differences between the success and failure groups in age (77 vs. 74 years, $p = 0.480$), sex (74.4% vs. 85.7% male, $p = 0.480$), BMI, or indication for ERCP ($p = 0.599$). The type of endoscope used was not significantly associated with SBC success ($p = 0.499$).

When stratified by sex, the median age of males was 75 years in the success group and 69 years in the failure group ($p = 0.287$), whereas for females, it was 81 and 86 years, respectively ($p = 0.182$). However, these differences were not statistically significant.

Among laboratory parameters, ALP level was significantly higher in the failure group (323 vs. 206 U/L, $p = 0.033$), whereas other values, including WBC count, liver enzymes, and pancreatic enzymes, were comparable between the two groups.

Complication rates did not differ significantly between the groups. However, perforation (7.1%) and pancreatitis

Table 4 Comparison of successful and failed selective biliary cannulation after successful afferent limb intubation

Variables	Total (*N* = 53)	Success (*N* = 39, 73.6%)	Fail (*N* = 14, 26.4%)	*P* value
Age, yrs	77 (68–84)	77 (70–83)	74 (62–86)	0.480
Male, yrs	75 (66–82)	75 (68–82)	69 (61–80)	0.287
Female, yrs	82 (78–86)	81 (77–84)	86 (85–87)	0.182
Sex				0.480
Male	41 (77.4)	29 (74.4)	12 (85.7)	
Female	12 (22.6)	10 (25.6)	2 (14.3)	
BMI, kg/m2	21.3 (19.2–22.9)	21.5 (19.2–22.9)	21.2 (20.2–22.1)	
Indication for ERCP				0.599
Choledocholithiasis	48 (90.6)	36 (92.3)	12 (85.7)	
Malignant obstruction	5 (9.4)	3 (7.7)	2 (14.3)	
Type of endoscope				0.499
Cap-assisted gastroscope	30 (56.6)	21 (53.8)	9 (64.3)	
Duodenoscope	23 (43.4)	18 (46.2)	5 (35.7)	
Laboratory tests before ERCP				
WBC, /μL	8800 (6400–12300)	8500 (6350–12450)	9000 (7175–10550)	0.880
AST, U/L	162 (66–274)	155 (67–288)	189 (65–264)	0.910
ALT, U/L	139 (72–238)	136 (60–243)	158 (102–229)	0.577
Total bilirubin, mg/dL	2.6 (1.7–5.1)	2.6 (1.8-5.0)	2.6 (1.6–5.9)	0.701
ALP, U/L	256 (149–397)	206 (124–357)	323 (261–467)	0.033
GGT, U/L	291 (176–482)	291 (156–434)	291 (197–667)	0.364
Amylase, U/L	58 (36–79)	59 (33–77)	53 (44–147)	0.538
Lipase, U/L	36 (20–79)	28 (20–51)	50 (25–128)	0.184
Complications				
Bleeding	0	0	0	N/A
Perforation	1 (1.9)	0	1 (7.1)	0.264
Pancreatitis	2 (3.8)	1 (2.6)	1 (7.1)	0.462
Cholangitis	0	0	0	N/A

Data are presented as number (%) or median (interquartile range)

ERCP, endoscopic retrograde cholangiopancreatography; BMI, body mass index; WBC, white blood cell; AST, aspartate aminotransferase; ALT, alanine aminotransferase; ALP, alkaline phosphatase; GGT, gamma-glutamyl transferase; N/A, not available

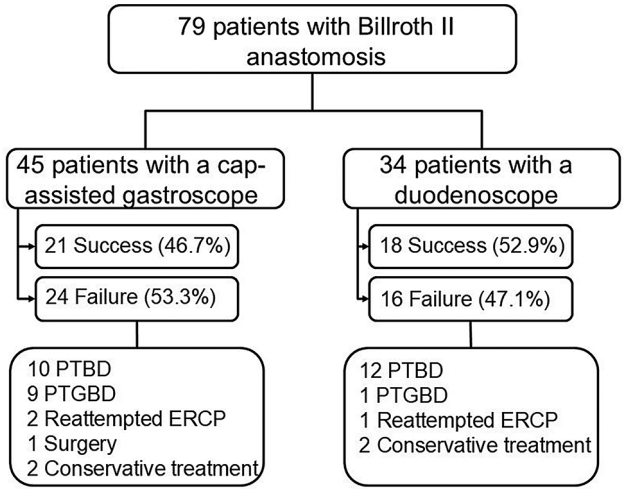

Fig. 4 Clinical outcomes following ERCP in patients with Billroth II anastomosis, categorized by endoscope type. This flowchart illustrates the secondary interventions performed in 40 patients who experienced ERCP failure, categorized by the type of endoscope used. PTBD, percutaneous transhepatic biliary drainage; PTGBD, percutaneous transhepatic gallbladder drainage; ERCP, endoscopic retrograde cholangiopancreatography

(7.1%) occurred in the SBC failure group, whereas only one case of pancreatitis (2.6%) was observed in the success group.

Management of patients with failed ERCP

Figure 4 illustrates the secondary procedures performed in 40 patients who experienced ERCP failure. Among these, 24 were in the cap-assisted gastroscope group, and 16 in the duodenoscope group. In the cap-assisted gastroscope group, the most common procedure was percutaneous drainage, including percutaneous transhepatic biliary drainage (PTBD) (41.7%) and percutaneous transhepatic gallbladder drainage (PTGBD) (37.5%), followed by reattempted ERCP (8.3%), surgery (4.2%), and conservative management (8.3%). Similarly, in the duodenoscope group, percutaneous drainage was the most common rescue procedure, including PTBD (75.0%) and PTGBD (6.3%), followed by reattempted ERCP (6.3%) and conservative management (12.5%).

Discussion

SBC is the most critical initial step in ERCP, with a recommended cannulation rate exceeding 90% and a target standard of 95% at expert centers [10]. However, in patients with surgically altered anatomy, particularly those with Billroth II anastomosis, achieving SBC can be challenging due to two major obstacles: afferent limb intubation and the reversed ampulla position [2, 11].

Previous studies have reported afferent limb intubation success rates ranging from 76.7 to 91.5% [1, 2, 4, 12, 13]. Additionally, successful SBC rates in patients with successful afferent limb intubation have been reported to range from 81.3 to 96.7% [1, 2, 4, 12, 13]. In our study, afferent limb intubation was achieved in 67.1% and the cannulation success rate was 73.6%, both of which were relatively low. This finding can be attributed to two factors. First, the most common cause of intubation failure is long and angulated afferent loop [1, 2, 4], which varies depending on the surgeon's technique. Second, at our center, interventional radiology support is typically prearranged and is readily available in most cases when performing ERCP in patients with Billroth II anastomosis. This allows for a timely transition to percutaneous intervention in cases where SBC is unsuccessful or technically difficult. As a result, endoscopists may have had a lower threshold for discontinuing the procedure in technically challenging cases. This practice is indirectly reflected in the relatively short overall median procedure time of 10.7 min compared to 37.7 min in a previous study [14]. Notably, the procedure duration in the ERCP failure group was even shorter, with a median of 7.3 min, further supporting the likelihood of earlier termination in more complex situations.

A meta-analysis showed that duodenoscopes may facilitate SBC more effectively but are associated with a higher risk of perforation, whereas gastroscopes allow easier intubation but have lower SBC success rates [3]. However, few studies have directly compared cap-assisted gastroscopes and duodenoscopes within a single study. Coskun O et al. reported that the overall success rate of reaching the papilla was 80%, with intubation success rates being higher in the gastroscope group (91.2%) than in the duodenoscope group (70.7%), although this difference was not statistically significant [4]. SBC was achieved in 100% of cases using the duodenoscope and 90.3% using the gastroscope. Wang F et al. reported an intubation success rate of 62.5% for duodenoscopes and 84.6% for gastroscopes [14]. The cannulation success rate was 81.8% for gastroscopes and 100% for duodenoscopes. Additionally, the mean cannulation time was 18.3 min for gastroscopes and 20.5 min for duodenoscopes. Similarly, our study found no significant differences in procedural outcomes between the cap-assisted gastroscope and duodenoscope groups. However, cannulation time was significantly longer in the cap-assisted gastroscope group (7.6 min vs. 5.8 min, $p = 0.011$). The shorter cannulation time in the duodenoscope group may be attributed to its structural advantages, including its side-viewing capability, which provides a direct en face view of the ampulla, and the presence of an elevator, which facilitates precise guidewire and catheter manipulation. Because longer cannulation time is associated with a higher risk of complications [15], our findings suggest that the duodenoscope may be the preferred instrument for ERCP in patients with Billroth II anastomosis.

According to the ESGE guidelines, the incidence of ERCP-related adverse events has been reported as 3.5–9.7% for pancreatitis, 0.5–3.0% for cholangitis, 0.3–9.6% for bleeding, and 0.08–0.6% for perforation [16]. A meta-analysis of ERCP in patients with Billroth II anastomosis showed similar adverse event rates, except for perforation, which was reported at 3.6% for duodenoscopes and 3.0% for gastroscopes [3]. In our study, one case (1.9%) of perforation occurred, which was detected during the procedure by the presence of free air on fluoroscopic imaging. The procedure was immediately terminated, and the patient subsequently underwent percutaneous transhepatic biliary drainage (PTBD) followed by conservative management, leading to full recovery.

Although the difference was not statistically significant, all adverse events in our study occurred in the gastroscope group, including two cases of PEP (4.4%) and one case of perforation (2.2%). A previous study suggested that the relatively higher risk of bowel perforation associated with side-viewing duodenoscopes may result from their limited direct visual field and reduced flexibility [3]. However, in our study, no perforations occurred in the duodenoscope group. As discussed earlier, this may be attributed to our institutional tendency to avoid prolonged or forceful cannulation attempts, facilitated by the availability of immediate interventional radiology backup. Regarding PEP, our study found that cannulation time was significantly shorter in the duodenoscope group, which may partly explain the absence of pancreatitis in that cohort. Given that prolonged cannulation time is a known risk factor for PEP [17], this finding may indicate a relative advantage of the duodenoscope in terms of procedural safety.

We also compared the SBC success and failure groups. No significant differences were observed between the groups, except for higher ALP levels in the failure group ($p = 0.033$). However, this finding should be interpreted with caution. Although not statistically significant ($p = 0.599$), malignant obstruction was more frequent in the SBC failure group (14.3% vs. 7.7%) and may have contributed to ALP elevation. Several studies have reported that malignant strictures often cause more prolonged and complete biliary obstruction than benign conditions,

potentially leading to higher ALP levels [18]. Given the small sample size and the retrospective nature of our study, it would be premature to conclude that elevated ALP is a reliable predictor of cannulation failure. Nevertheless, this finding raises the possibility that elevated ALP may reflect a more complex or advanced biliary obstruction. It could also potentially serve as a predictive marker for SBC failure. Further prospective studies with larger sample sizes are needed to validate the predictive value of ALP as a biomarker in this setting. Additionally, we found no significant differences in age or sex distribution between the SBC success and failure groups. These findings suggest that demographic factors such as age and sex were unlikely to have influenced the cannulation outcomes.

Various device-assisted enteroscopy techniques, such as single-balloon enteroscopy (SBE), double-balloon enteroscopy, and rotational overtube-assisted endoscopy, have been utilized to improve ERCP success in patients with surgically altered anatomy [19, 20]. Short-type SBE has demonstrated high procedural success rates in patients with Billroth II anastomosis. A retrospective study by Tanisaka et al. reported a procedural success rate of 100% and a median procedure time of 40 min in Billroth II patients undergoing short SBE-assisted ERCP [21]. Despite these promising results, the use of balloon-assisted techniques is often limited by factors such as device availability, cost, and operator expertise. Additionally, in patients with Billroth II anastomosis where the afferent loop is relatively short, such advanced techniques may not be necessary. Therefore, SBE may be considered in cases where conventional endoscopes fail.

This study has several limitations. First, it was a single-center retrospective analysis, which limits the generalizability of the findings to other institutions or broader patient populations. Additionally, the relatively small sample size may have reduced the statistical power of the study and increased the risk of type II errors. Second, selection bias was unavoidable, as the choice of endoscope was not randomized but left to the endoscopist's judgment, possibly influenced by anatomical difficulty or preference. Third, although procedures were performed by three experienced endoscopists at a high-volume center, differences in their individual skill levels or familiarity with each endoscope type may have affected the outcomes. Fourth, potential confounding factors including patient comorbidities, prior abdominal surgeries, and anatomical variations such as loop length or anastomotic angulation were not systematically evaluated and could have influenced procedural difficulty and success. Fifth, although most patients visited outpatient clinics within 1–2 weeks of discharge without reporting complications, long-term follow-up beyond this period was not evaluated. Therefore, delayed adverse events might have been underreported. Finally, procedural strategies, including cannulation techniques and procedure cessation, were made at the endoscopist's discretion. Given the availability of immediate interventional radiology support at our institution, endoscopists may have tended to avoid prolonged ERCP attempts. This may have contributed to the relatively low cannulation success rate and shorter procedure time compared to previous studies.

Conclusion

In summary, both cap-assisted gastroscopes and duodenoscopes are viable options for ERCP in patients with Billroth II anastomosis, showing comparable rates of success and complications. However, the significantly shorter cannulation time observed in the duodenoscope group suggests that it may be the preferred choice in cases where minimizing procedure duration or reducing the risk of PEP is a concern. To further validate these findings, future prospective or multicenter studies with larger patient populations are warranted.

Abbreviations

ERCP	Endoscopic retrograde cholangiopancreatography
SBC	Selective biliary cannulaion
CBD	Common bile duct
PTBD	Percutaneous transhepatic biliary drainage
PTGBD	Percutaneous transhepatic gallbladder drainage
PEP	Post-ERCP pancreatitis
ALP	Alkaline phosphatase
WBC	White blood cell
PD	Pancreatic duct
IQR	Interquartile range
ESGE	European Society of Gastrointestinal Endoscopy
SBE	Single-balloon enteroscopy

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Author contributions

Conceptualization: HTJ; Data curation: KHL, GHY; Formal analysis: KHL, JMH; Investigation: KHL, GHY, JMH, HTJ; Methodology: JMH; Supervision: JMH, HTJ; Writing-original draft: KHL; Writing-review & editing: GHY, HTJ, JMH.

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Data availability

The datasets used in this study are available from the corresponding author upon reasonable request, subject to approval by the Institutional Review Board.

Declarations

Ethics approval and consent to participate

This study was performed in compliance with the ethical guidelines of the revised Helsinki Declaration of 2013, and the study protocol was reviewed and approved by the Institutional Review Board of Daegu Catholic University Medical Center (DCUMC 2025-01-018). As this study was a retrospective analysis, the need for informed consent was waived.

Consent for publication

Not applicable.

Competing interests
The authors declare no competing interests.

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