

## Feasibility of Cap-Assisted Endoscopic Retrograde Cholangiopancreatography in Patients with Altered Gastrointestinal Anatomy

Ho-Seok Ki, Chang-Hwan Park, Chung-Hwan Jun, Seon-Young Park, Hyun-Soo Kim, Sung-Kyu Choi, and Jong-Sun Rew

*Division of Gastroenterology, Department of Internal Medicine, Chonnam National University Medical School, Gwangju, Korea*

**Background/Aims:** Endoscopic retrograde cholangiopancreatography (ERCP) is technically challenging in patients with altered gastrointestinal (GI) anatomy. We evaluated the feasibility of cap-assisted ERCP in patients with altered GI anatomy. **Methods:** The outcome of ERCP procedures (n=136) was analyzed in 78 patients with Billroth II (B-II) gastrectomy (n=72), Roux-en-Y total gastrectomy (n=4), and hepaticoduodenostomy (n=2). The intubation rate for reaching the papilla of Vater (POV), deep biliary cannulation rate, therapeutic interventions and procedure-related complications were analyzed. All of the procedures were conducted using a cap-fitted forward-viewing endoscope. **Results:** The rate of access to the POV was 97.1% (132/136). In cases with successful access, selective biliary cannulation was achieved in 98.5% (130/132) of the patients. The successful biliary cannulation rates were 100% (125/125) for B-II gastrectomy, 50% (2/4) for Roux-en-Y gastrectomy and 100% (3/3) for hepaticoduodenostomy. After selective biliary cannulation, therapeutic interventions, including stone extraction (n=57), sphincterotomy (n=54), stent placement (n=37), nasobiliary drainage (n=20), endoscopic papillary balloon dilatation (n=7) and mechanical lithotripsy (n=15), were performed successfully. The procedure-related complication rate was 8.8% (12/136), including immediate bleeding (5.9%, 8/136), pancreatitis (2.2%, 3/136), and perforation (0.7%, 1/136). There were no procedure-related deaths. **Conclusions:** Cap-assisted ERCP is efficient and safe in patients with altered GI anatomy. (*Gut Liver* 2015;9:109-112)

**Key Words:** Cholangiopancreatography, endoscopic retrograde; Cap; Billroth II gastrectomy

### INTRODUCTION

Endoscopic retrograde cholangiopancreatography (ERCP) is used for the diagnosis and treatment of pancreatobiliary disease.<sup>1</sup> Experienced endoscopists have high cannulation rates in an intact stomach, equal to or above 95%.<sup>2</sup> However, patients with altered gastrointestinal (GI) anatomy present a challenge to the therapeutic endoscopist. The success rate of ERCP in patients with a prior Billroth II (B-II) gastrectomy vary from 52% to 92%.<sup>3-7</sup>

The degree of difficulty of ERCP has been suggested as an objective way of assessing outcomes on the basis of procedural difficulty. The B-II diagnostic ERCP has been suggested as difficulty grade 2, and B-II therapeutic as difficulty grade 3.<sup>8</sup> Two problems are inherent in B-II ERCP. First, the afferent loop intubation can be difficult because of the sharp angulations of the anastomosis or a long afferent loop, especially in a Braun anastomosis, or sometimes because of loop formation at the Treitz ligament. The second problem is that the cannulation has to be done in an opposite direction.<sup>9</sup> To overcome the problems, various techniques have been introduced for the successful ERCP in patients with a B-II gastrectomy, including using a cap-fitted forward-viewing endoscope, a single-balloon or a double-balloon enteroscope, an anterior oblique-viewing endoscope, and a multibending endoscope.<sup>10-16</sup>

However, experience with these techniques has not been evaluated so in a large case series. The primary aim of this study was to analyze the feasibility of cap-assisted ERCP in altered gastrointestinal anatomy.

### MATERIALS AND METHODS

#### 1. Patients

From March 2006 to March 2011, the results of 81 consecu-

Correspondence to: Chang-Hwan Park

Department of Internal Medicine, Chonnam National University Medical School, 160 Baekseo-ro, Dong-gu, Gwangju 501-746, Korea

Tel: +82-62-220-6296, Fax: +82-62-228-1330, E-mail: p1052ccy@hanmail.net

Received on December 11, 2013. Revised on January 12, 2014. Accepted on February 4, 2014. Published online on June 18, 2014

pISSN 1976-2283 eISSN 2005-1212 <http://dx.doi.org/10.5009/gnl13447>

© This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

tive patients with a B-II gastrectomy (n=72), Roux-en-Y total gastrectomy (n=4), and hepaticoduodenostomy (n=2) were analyzed for their outcome of ERCP. The patients' demographic characteristic and clinical data, including age, sex, indications for ERCP, and a history of failed ERCP were reviewed. Patients were excluded from the analysis if they had a history of a previous endoscopic sphincterotomy (EST), endoscopic papillary balloon dilatation (EPBD), biliary or pancreatic stent, and when there was known gastric or afferent loop obstruction. This retrospective study was performed in accordance with the guidelines of our Institutional Review Board. All patients gave written informed consent to undergo the procedure.

## 2. Endoscopic procedures

Before ERCP, patients who didn't have an examination of esophagogastroduodenoscopy (EGD) within 1 year underwent EGD to define the nature of surgically altered gastrointestinal anatomy and to locate the papilla of Vater (POV). All ERCP procedures were carried out with a cap-fitted forward-viewing endoscope (Olympus GIF 230 and Q260; Olympus Optical Co., Ltd., Tokyo, Japan). A transparent cap (distal attachment; Olympus, Tokyo, Japan) was attached to the tip of the endoscope. Patients were sedated with midazolam (2.5 to 10 mg) or diazepam (5 to 10 mg), supplemented with pethidine (12.5 to 25 mg) if necessary. All patients received oxygen administered by nasal prong and were monitored by pulse oximetry and electrocardiography. Antibiotics were not routinely given as a prophylaxis. Cap-assisted ERCP using a cap-fitted forward-viewing endoscope has already been described.<sup>10</sup> Selective biliary cannulation was achieved with a straight catheter (PR-10Q; Olympus) through the cap. After selective biliary cannulation, therapeutic procedures, such as EST, EPBD, stone extraction, and biliary drainage, were performed. EST was performed with a Soehendra Billroth II sphincterotome. EPBD was performed in cases with large stones and inadequate EST. The papilla was dilated up to 12 to 20 mm.

## 3. Definitions and complications

The results were evaluated as follows: intubation rate for reaching POV, deep biliary cannulation rate, number of biliary cannulation attempts, success rate for therapeutic ERCP, intubation time for reaching the papilla, total procedure time at the first session, number of sessions, and the procedure-related complication rate. The intubation time for reaching the papilla was defined as the time (in minutes) from initial intubation into the oral cavity until the endoscope reached POV. Number of biliary cannulation attempts was defined as the number of attempts for biliary cannulation until optimal visualization of the common bile duct (CBD) was achieved. The total procedure time was defined as the time, in minutes, from initial intubation into the oral cavity to extubation out of the oral cavity. Procedure-related pancreatitis was defined as abdominal pain, with at least a 3-fold elevation of the serum amylase for more than 24 hours

after the procedure. Post-ERCP bleeding was defined as clinical evidence of bleeding, with a decrease in hemoglobin of more than 2 g/dL.<sup>17</sup>

All statistical analyses were performed using the IBM SPSS Statistics software version 19.0 (IBM Corp., Armonk, NY, USA). Continuous data were summarized as mean±standard deviation. Student t-test and analysis of variance were used to compare the mean values of the continuous variables. The chi-square test, with or without linear-by-linear association, was used for the comparison of categorical variables. Null hypotheses of no difference were rejected if p-values were less than 0.05.

## RESULTS

### 1. Intubation rate for reaching POV and deep biliary cannulation rate

Clinical characteristics of the patients were summarized in Table 1. Seventy-eight patients underwent a total of 136 ERCP procedures with a mean of 1.74 sessions per patient. Among 136 sessions in patients with anatomical variations, POV was successfully reached in 132 sessions (97.1%) with the cap-assisted forwarding endoscope. The successful intubation rates were 99.2% (125/126) in the B-II gastrectomy, 57.1% (4/7) in Roux-en-Y gastrectomy, and 100% (3/3) in hepaticoduodenostomy. Among the 132 sessions in which access to the papilla was achieved, selective biliary cannulation was successful in 130 sessions (98.5%). The successful biliary cannulation rates were 100% (125/125) in the B-II gastrectomy, 50% (2/4) in Roux-en-Y gastrectomy, and 100% (3/3) in hepaticoduodenostomy (Table 2).

After selective biliary cannulation, therapeutic interventions

**Table 1.** Clinical Characteristics of the Patients

Characteristic	Value
Age, yr	70.1 (40–90)
Sex, male/female	54/24
Anatomical variation	
Billroth-II gastrectomy	72 (88.9)
Roux-en-Y total gastrectomy	4 (4.9)
Hepaticoduodenostomy	2 (2.5)
Indication of ERCP	
CBD stone	55 (70.5)
CBD stricture	7 (8.9)
Cholangitis	11 (14.1)
CBD malignancy	2 (2.6)
Pancreatic malignancy	1 (1.3)
Intrahepatic bile duct stone	2 (2.6)

Data are presented as mean (range) or number (%). ERCP, endoscopic retrograde cholangiopancreatography; CBD, common bile duct.

**Table 2.** Success Rates of Intubation and Selective Biliary Cannulation

	Intubation	Cannulation
Overall	132/136 (97.1)	130/132 (98.5)
Billroth-II gastrectomy	125/126 (99.2)	125/125 (100.0)
Roux-en-Y total gastrectomy	4/7 (57.1)	2/4 (50)
Hepaticoduodenostomy	3/3 (100.0)	3/3 (100.0)

Data are presented as number/total number (%).

including stone extraction (n=57), sphincterotomy (n=54), stent placement (n=37), nasobiliary drainage (n=20), endoscopic papillary balloon dilatation (n=7), and mechanical lithotripsy (n=15) were performed successfully.

## 2. Performance of the ERCP procedures with cap-fitted forward-viewing endoscope in B-II patients

Among 72 B-II patients, 33 patients underwent EGD with a forward-viewing endoscope to locate POV before ERCP. We failed to find POV in 10 of 33 patients (30.3%) with forward-viewing endoscope only. After using a cap-fitted forward-viewing endoscope, we found POV in all of the 10 patients. In eight patients who failed ERCP with a side-viewing endoscope, ERCP was successfully performed with a cap-fitted forward-viewing endoscope.

The overall mean intubation time±standard deviation for reaching POV was 4.1±4.4 minutes in B-II patients. The overall mean number of biliary cannulation attempts was 3.8±4.1. Number of biliary cannulation attempts significantly decreased from 5.0±4.9 for the first half (from 1st to 36th patients) to 2.4±2.6 for the second half (from 37th to 72nd patients, p<0.01).

## 3. Procedure related complications

The procedure related complication rate was 8.8% (12/136). Immediate bleeding developed in 5.9% (8/136) of cases during the procedure. Bleeding was controlled only by a local injection of epinephrine in all cases. Procedure-related pancreatitis developed in 2.2% (3/136) of cases. One patient had a perforation at the EST site. She recovered uneventfully but underwent open cholecystectomy for acute calculous cholecystitis. There was no procedure-related death (Table 3).

## DISCUSSION

Diagnostic and therapeutic ERCP in patients after gastric resection with reconstruction poses a challenge to the biliary endoscopists because of the altered anatomy. The present study had a high success rate with the cap-assisted ERCP technique in patients with altered GI anatomy in a relatively large case series. The cap-assisted ERCP technique has certain benefits in approaching POV in the patients with the altered GI anatomy. First, the cap is useful for overcoming the sharp angulations

**Table 3.** Endoscopic Retrograde Cholangiopancreatography-Related Complications

Complication	Case (%) (n=136)
Overall	12 (8.8)
Immediate bleeding	8 (5.9)
Delayed bleeding	0
Post-ERCP pancreatitis	3 (2.2)
Perforation	1 (0.7)

ERCP, endoscopic retrograde cholangiopancreatography.

that can be encountered when entering the afferent loop. Second, the cap is also useful for traversing the afferent loop because it can facilitate reducing the loops created during the procedure. The risk of perforation can be reduced by avoiding excessive looping and not attempting any blind rotational maneuvers. Also, the boundary of transparent cap can provide a careful excision during EST.<sup>10</sup>

The forward-viewing endoscope is preferred for ERCP in patients with a B-II gastrectomy, for easy and safe procedures; nevertheless, selective biliary cannulation can be problematic in some cases.<sup>18</sup> The cap-assisted ERCP can improve the success rate of selective biliary cannulation. Successful deep biliary cannulation can be facilitated by either push or suction technique using a straight catheter (PR-10Q; Olympus) through the transparent cap. Because of the reversed papilla in the patients with a B-II and Roux-en-Y gastrectomy, the most important step in biliary cannulation is keeping the tip of the straight catheter in a position that will allow access to the CBD at the 5 o'clock position. The transparent cap can enable to maintain that position.<sup>10</sup> After proper position of the straight catheter, push of the catheter permits the selective biliary cannulation. When the push technique failed, the tip of the catheter was passively advanced into the CBD while the papilla was being sucked through the cap. After deep CBD cannulation and EST, further therapeutic procedures, including EPBD, stone removal with Dormia baskets, and mechanical lithotripsy, can be performed without difficulty.

In the present study, the success rate for reaching POV and selective cannulation of the bile duct in patients with a Roux-en-Y gastrectomy were relatively low compared to those with a B-II gastrectomy. Patients with a Roux-en-Y gastrectomy had several obstacles to the success of the ERCP. First, they had longer afferent loops than patients with B-II reconstruction. Another obstacle was the presence of severe postoperative adhesions, which restricted manipulation of the endoscope, hindered the introduction of the endoscope to POV. Once POV was reached, cannulation into the papilla was not substantially different from the method used in patients with a B-II gastrectomy. Several another recent studies showed that the ERCP with a short double-balloon enteroscope or single-balloon enteroscope might be promising for diagnostic and therapeutic ERCP in patients with

a Roux-en-Y gastrectomy.

The present results also showed that the cap-assisted forward-viewing endoscope was a safe, time-saving, and cost-effective modality. First, the overall clinically important procedure-related complication rate was 8.8% comparable to the previously reported complication rates of 4% to 11.2% with the conventional ERCP.<sup>19-21</sup> Second, it as an experience is a time-saving procedure in the patients with a B-II gastrectomy. The mean time required for reaching papilla with this technique was only 4.1±4.4 minutes. Deep biliary cannulation could be performed efficiently with a cap-fitted forward-viewing endoscope in the patients with a B-II gastrectomy after the experience of some cases. Finally, the cap-assisted ERCP technique does not require a special endoscope. According to subgroup analysis, the cap-assisted ERCP technique was successful to find POV in 10/33 (30.3%) of B-II patients who were failed to find POV with a forward-viewing endoscope only. After reaching POV, all of the 10 patients underwent successful therapeutic ERCP with the cap-assisted ERCP technique. In addition, ERCP was successfully performed with the cap-assisted ERCP technique in eight patients who failed ERCP with a side-viewing endoscope. Therefore, the cap-assisted ERCP technique was a salvage treatment in the 18 patients.

In conclusion, ERCP with the cap-fitted forward-viewing endoscope was safe and effective in patients with the altered GI anatomy. The cap-assisted ERCP method can be considered one of the primary approaches in patients with the altered GI anatomy.

## CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

## REFERENCES

- Cotton PB. ERCP. *Gut* 1977;18:316-341.
- Baron TH, Petersen BT, Mergener K, et al. Quality indicators for endoscopic retrograde cholangiopancreatography. *Gastrointest Endosc* 2006;63:S29-S34.
- Forbes A, Cotton PB. ERCP and sphincterotomy after Billroth II gastrectomy. *Gut* 1984;25:971-974.
- Osnes M, Rosseland AR, Aabakken L. Endoscopic retrograde cholangiography and endoscopic papillotomy in patients with a previous Billroth-II resection. *Gut* 1986;27:1193-1198.
- Faylona JM, Qadir A, Chan AC, Lau JY, Chung SC. Small-bowel perforations related to endoscopic retrograde cholangiopancreatography (ERCP) in patients with Billroth II gastrectomy. *Endoscopy* 1999;31:546-549.
- Swarnkar K, Stamatakis JD, Young WT. Diagnostic and therapeutic endoscopic retrograde cholangiopancreaticography after Billroth II gastrectomy: safe provision in a district general hospital. *Ann R Coll Surg Engl* 2005;87:274-276.
- Bagci S, Tuzun A, Ates Y, et al. Efficacy and safety of endoscopic retrograde cholangiopancreatography in patients with Billroth II anastomosis. *Hepatogastroenterology* 2005;52:356-359.
- Cotton PB. Income and outcome metrics for the objective evaluation of ERCP and alternative methods. *Gastrointest Endosc* 2002;56:S283-S290.
- Lin LF, Siau CP, Ho KS, Tung JC. ERCP in post-Billroth II gastrectomy patients: emphasis on technique. *Am J Gastroenterol* 1999;94:144-148.
- Park CH, Lee WS, Joo YE, Kim HS, Choi SK, Rew JS. Cap-assisted ERCP in patients with a Billroth II gastrectomy. *Gastrointest Endosc* 2007;66:612-615.
- Wang AY, Sauer BG, Behm BW, et al. Single-balloon enteroscopy effectively enables diagnostic and therapeutic retrograde cholangiography in patients with surgically altered anatomy. *Gastrointest Endosc* 2010;71:641-649.
- Itoi T, Ishii K, Sofuni A, et al. Single-balloon enteroscopy-assisted ERCP in patients with Billroth II gastrectomy or Roux-en-Y anastomosis (with video). *Am J Gastroenterol* 2010;105:93-99.
- Chu YC, Yang CC, Yeh YH, Chen CH, Yueh SK. Double-balloon enteroscopy application in biliary tract disease-its therapeutic and diagnostic functions. *Gastrointest Endosc* 2008;68:585-591.
- Nakahara K, Horaguchi J, Fujita N, et al. Therapeutic endoscopic retrograde cholangiopancreatography using an anterior oblique-viewing endoscope for bile duct stones in patients with prior Billroth II gastrectomy. *J Gastroenterol* 2009;44:212-217.
- Koo HC, Moon JH, Choi HJ, et al. The utility of a multibending endoscope for selective cannulation during ERCP in patients with a Billroth II gastrectomy (with video). *Gastrointest Endosc* 2009;69:931-934.
- Kaffes AJ, Sriram PV, Rao GV, Santosh D, Reddy DN. Early institution of pre-cutting for difficult biliary cannulation: a prospective study comparing conventional vs. a modified technique. *Gastrointest Endosc* 2005;62:669-674.
- Cotton PB, Lehman G, Vennes J, et al. Endoscopic sphincterotomy complications and their management: an attempt at consensus. *Gastrointest Endosc* 1991;37:383-393.
- Kim MH, Lee SK, Lee MH, et al. Endoscopic retrograde cholangiopancreatography and needle-knife sphincterotomy in patients with Billroth II gastrectomy: a comparative study of the forward-viewing endoscope and the side-viewing duodenoscope. *Endoscopy* 1997;29:82-85.
- Vandervoort J, Soetikno RM, Tham TC, et al. Risk factors for complications after performance of ERCP. *Gastrointest Endosc* 2002;56:652-656.
- Cotton PB, Garrow DA, Gallagher J, Romagnuolo J. Risk factors for complications after ERCP: a multivariate analysis of 11,497 procedures over 12 years. *Gastrointest Endosc* 2009;70:80-88.
- Christensen M, Matzen P, Schulze S, Rosenberg J. Complications of ERCP: a prospective study. *Gastrointest Endosc* 2004;60:721-731.