Observational Study

Medicine®

OPEN

Endoscopic retrograde cholangiopancreatography with balloon-assisted enteroscopy in patients with Roux-en-Y anastomosis and Whipple operation

Jiheng Wang, MD[a], Yuqi He, MD[a], Dongliang Yu, BS[a], Ge Gao, BS[a], Lei Li, MD[b,*]

Abstract

In patients with Roux-en-Y (R-Y) anastomosis (including hepaticojejunostomy and R-Y gastric bypass) and Whipple operation, endoscopic retrograde cholangiopancreatography (ERCP) can be challenging. We retrospective analyses our experience with ERCP using balloon-assisted enteroscopy (BAE) (BAE-ERCP) in patients with R-Y anastomosis and Whipple operation.

ERCP was performed in 15 patients (4 pancreaticoduodenectomy and 10cholangiojejunostomy and 1 Subtotal gastrectomy with R-Y reconstruction; age ranging from 4 to 63 years) with BAE. Double- and single-balloon enteroscopy was applied in 5 and 10 patients, respectively.

Bile duct cannulation was successful in 13 of 15 cases (86.7%), including simple stenosis of the anastomotic stoma (n = 2), intrahepatic bile duct stones (n = 10), and pancreatic cancer (n = 1). Cannulation failed because the guidewire could not pass through the anastomotic stenosis in 1 patient and because the endoscope could not enter the acute angle of the anastomosis of the afferent limb in the other patient. Adverse events included jaundice (n = 1) and perforation (n = 1), which were successfully treated by conservative therapy.

ERCP with BAE in patients with R-Y anastomosis and Whipple operation is safe and useful but has unique complications. The success rate is lower than that of conventional ERCP.

Abbreviations: BAE = balloon-assisted enteroscopy, ERCP = endoscopic retrograde cholangiopancreatography, R-Y = Roux-en-Y.

Keywords: balloon-assisted enteroscopy, biliary obstruction, complications., endoscopic retrograde cholangiopancreatography, Roux-en-Y anastomosis, Whipple operation

1. Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) in patients with a surgically altered gastrointestinal anatomy involves challenging procedures, especially in patients who have undergone cholangiojejunostomy. In such cases, conventional ERCP is almost impossible; however, with balloon-assisted enteroscopy (BAE), it becomes possible. These procedures include identifying and accessing the afferent limb, reaching the papilla or anastomotic site of the pancreatico-biliary-enteric anastomosis, and cannulating the bile and pancreatic ducts through the native papilla or anastomotic site without using an elevator function. In particular, the endoscope must be inserted beyond the long afferent limb in patients who have undergone Roux-en-Y (R-Y) reconstruction or hepaticojejunostomy. Moreover, in patients with pancreatic or biliary anastomosis, the anastomotic site occasionally has stenosis due to biliary-enteric anastomosis. Compared with conventional ERCP, BAE + ERCP combine 2 digestive endoscopic technologies. Although BAE technology has been popularized in tertiary hospitals, ERCP is still rarely associated with BAE. A retrospective analysis of this technology is now available.

2. Materials and methods

This study was approved by the ethic committee of Chinese PLA General Hospital. Written informed consent was obtained from all individual participants included in the study.

2.1. Study subjects

A total of 15 patients who underwent BAE + ERCP in the Department of Gastroenterology of the Seventh Medical Center

Editor: Wen-Jun Tu.

This study was supported by the Digestive Medical Coordinated Development Center of Beijing Municipal Administration of Hospitals (No.XXZ0303), Beijing High-level Health Technicians (No.2013-03-073) and the State Key Projects Specialized on Infectious Diseases (No.2017ZX10203202003008).

The authors have no conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

[a] Department of Gastroenterology, the Seventh Medical Center, Chinese PLA General Hospital, [b] Liver Disease Digestion Center, Beijing You'an Hospital, Capital Medical University, Beijing, China.

[*] Correspondence: Lei Li, Liver Disease Digestion Center, Beijing You'an Hospital, Capital Medical University, Beijing 100069, China (e-mail: lileiyouan@ccmu.edu.cn).

How to cite this article: Wang J, He Y, Yu D, Gao G, Li L. Endoscopic retrograde cholangiopancreatography with balloon-assisted enteroscopy in patients with Roux-en-Y anastomosis and Whipple operation. Medicine 2020;99:42(e22653).

Received: 8 April 2020 / Received in final form: 17 August 2020 / Accepted: 9 September 2020

http://dx.doi.org/10.1097/MD.0000000000022653

Table 1

Basic patient data.

Patient	Age (yr)	Sex	Previous surgical procedures	Reason for ERCP
Case 1	51	Male	Pancreatoduodenectomy for pancreatic head cancer	Cholangiojejunostomy stenosis (ERCP failure)
Case 2	54	Male	Pancreatoduodenectomy for pancreatic head cancer	Cholangioenteric anastomotic stenosis with intrahepatic bile duct stones
Case 3	53	Male	Pancreatoduodenectomy for bile duct cancer	Biliary-jejunal anastomotic stoma stenosis
Case 4	47	Male	Extra- and intrahepatic cholangiolithiasis; R-Y cholangiojejunostomy	Cholangioenteric anastomotic stenosis with intrahepatic bile duct stones
Case 5	36	Male	Congenital choledochocyst; R-Y cholangiojejunostomy	Cholangioenteric anastomotic stenosis with intrahepatic bile duct stones
Case 6	28	Male	Congenital choledochocyst; R-Y cholangiojejunostomy	Cholangioenteric anastomotic stenosis with intrahepatic bile duct stones
Case 7	54	Male	R-Y cholangiojejunostomy for hilar cholangiocarcinoma	Cholangiojejunostomy stenosis (ERCP failure)
Case 8	52	Male	R-Y cholangiojejunostomy for hilar cholangiocarcinoma	Cholangioenteric anastomotic stenosis with intrahepatic bile duct stones
Case 9	52	Female	Pancreatoduodenectomy for lower bile duct cancer	Biliary-jejunal anastomotic stoma stenosis
Case 10	4	Female	Congenital choledochocyst; R-Y cholangiojejunostomy	Cholangioenteric anastomotic stenosis with intrahepatic bile duct stones
Case 11	30	Female	Congenital choledochocyst; R-Y cholangiojejunostomy	Cholangioenteric anastomotic stenosis with intrahepatic bile duct stones
Case 12	48	Female	Extra- and intrahepatic cholangiolithiasis; R-Y cholangiojejunostomy	Cholangioenteric anastomotic stenosis with intrahepatic bile duct stones
Case 13	50	Male	Extra- and intrahepatic cholangiolithiasis; R-Y cholangiojejunostomy	Cholangioenteric anastomotic stenosis with intrahepatic bile duct stones
Case 14	52	Male	R-Y cholangiojejunostomy for hilar cholangiocarcinoma	Cholangioenteric anastomotic stenosis with intrahepatic bile duct stones
Case 15	63	Famale	Subtotal gastrectomy with Roux-en-Y reconstruction for gastric cancer	Obstructive jaundice

ERCP = endoscopic retrograde cholangiopancreatography.

of the PLA General Hospital from April 2016 to March 2019 were enrolled, including 10 males and 5 females aged 4 to 63 years. In all, 10 patients had undergone R-Y cholangiojejunostomy, and 4 had undergone pancreaticoduodenectomy, and 1 had undergone subtotal gastrectomy with R-Y reconstruction. Four patients had been treated for congenital choledochocysts, 3 had been treated for intrahepatic and extrahepatic choledocholithiasis, 1 had been treated for gastric cancer, and the remaining 7 had been treated for pancreatic and biliary malignancies. The patient details are shown in Table 1.

2.2. Methods

A Fujinon double-balloon enteroscope and an Olympus single-balloon enteroscope were used. The model EN-450T5 Fujinon (Fuji Photo Film Co., Ltd, Tokyo, Japan) enteroscope had a working length of 200 cm and a working channel diameter of 2.8 mm. The model SIF-Q260 Olympus (OLYMPUS CORPORATION, Tokyo, Japan) enteroscope had a working length of 200 cm and a working channel diameter of 2.8 mm. All patients underwent ERCP under endotracheal intubation with general anaesthesia.CO_2 insufflation was used in all cases. Routine ECG monitoring, oxygen intake, balloon dilatation, basket or balloon lithotomy, and nasal bile duct drainage were performed according to the different patient conditions. Double-balloon enteroscopy was used in 4 patients, and single-balloon enteroscopy was used in 11 patients. Routine postoperative treatment was performed, including the inhibition of gastric acid, the administration of anti-inflammatory drugs, and monitoring for various complications, as well as targeted treatments.

3. Results

3.1. Treatment results

ERCP was completed in 13 patients: 2 patients were treated for simple anastomotic stenosis by biliary anastomotic stenosis expansion (Fig. 1), 1 patient was treated for obstructive jaundice because of pancreatic cancer, and 10 patients were treated for anastomotic stenosis combined with intrahepatic bile duct stones by basket stone removal (Fig. 2). Some patients underwent nasobiliary drainage after stone extraction (Fig. 3). In 1 of the 2 cases of incomplete ERCP, the guidewire reached the end of the bilioenteric anastomosis but failed to enter the bile duct due to the extreme stenosis of the anastomotic stoma; in the other case of incomplete ERCP, the acute angle of anastomosis of the afferent limb prevented the lens body from entering the afferent limb. The overall success rate was 86.7%, and in the unsuccessful cases, the patients were treated with single-balloon enteroscopy.

Figure 1. Bilioenteric anastomosis with balloon dilatation.

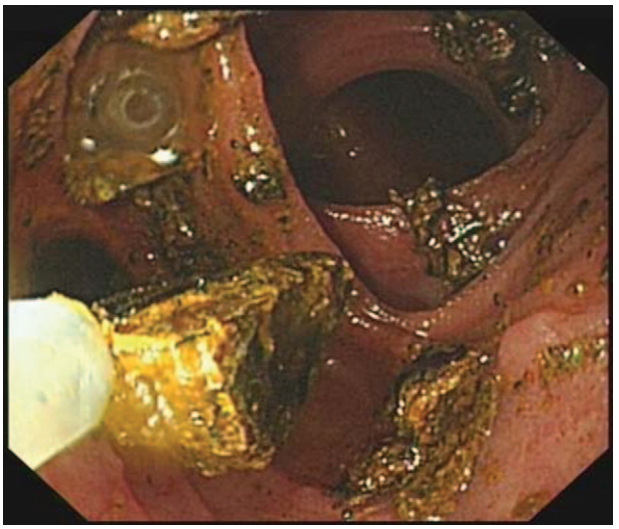

Figure 2. Intrahepatic bile duct stone extraction by basket.

3.2. Complications and postoperative outcomes

One case of jaundice and 1 case of gastrointestinal perforation occurred after the procedure, yielding a complication rate of 13.3%, and these complications were resolved after medical treatment. The remaining patients recovered well after the procedures, and no complications related to ERCP occurred. Surgical treatment was performed in the case of unsuccessful ERCP due to anastomotic stenosis; local tissue contracture was found to result in complete atresia of the anastomosis. In the case of unsuccessful ERCP due to failure to enter the afferent limb, percutaneous transhepatic cholangiodrainage was performed as a palliative treatment.

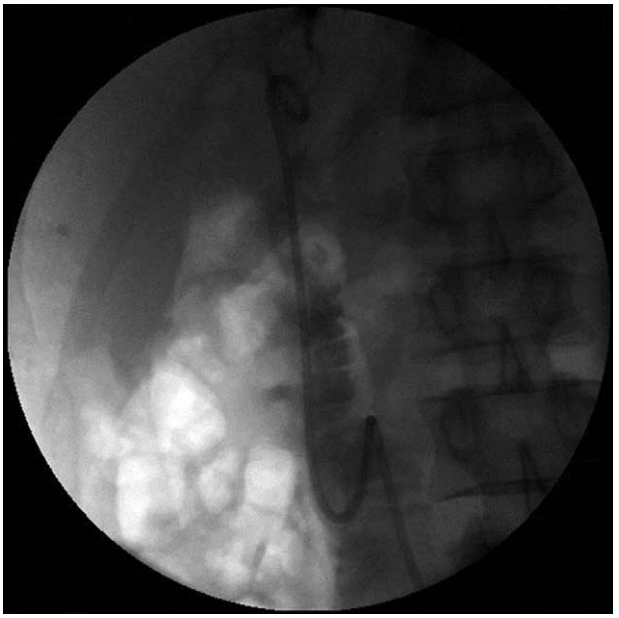

Figure 3. Nasobiliary drainage through bilioenteric anastomosis.

4. Discussion

The advent of double-balloon enteroscopy in 2001 opened up new opportunities for the diagnosis and treatment of small bowel diseases and currently serves as a new method for treating patients with ERCP after gastrointestinal bowel surgery. In 2005, the first instance of ERCP with double-balloon enteroscopy was reported.[1] In 2006, the single-balloon enteroscope system was established; the basic principle of the structure of the single-balloon enteroscope was similar to that of the double-balloon enteroscope. The balloon at the front end of the lens body was removed, leaving only the balloon of the outer casing. The single-balloon endoscope has increased flexibility and a wider range of viewing angles for easier operation. Subsequently, doctors applied it in ERCP in patients with a surgically altered anatomy.[2–4] The use of either a double- or single-balloon enteroscope is now collectively referred to as BAE.

Both BAE and ERCP are difficult techniques in digestive endoscopy, and combining the 2 techniques for endoscopic treatment increases the difficulty even further. For successful BAE + ERCP, the following conditions must be met:

(1) the endoscopist must be proficient in operative techniques involved in using the 2 endoscopes;
(2) the endoscopist must be familiar with the anatomical features of surgically altered gastrointestinal tracts;
(3) the anaesthesia and endoscopy teams must be experienced;
(4) the operative team must be able to anticipate and correctly treat complications;
(5) all other members of the endoscopic team must fully cooperate with the surgeon.

Due to these many restrictions, during the 17 years since BAE's advent, there have been few reported cases of its application in ERCP in the world; there are fewer than 150 related articles in the literature, most of which are case reports. A retrospective literature study performed in 2014[5] reported that there were only 945 cases of BAE + ERCP worldwide. According to literature in mainland China since 2012,[6] only a few centres continue to apply this technology.[7,8] The success rate of ERCP reported in most studies is approximately 75% to 90%, and no significant difference between single- and double-balloon enteroscopy has been found. The main reasons for failure are anastomotic stenosis leading to failed exploration and inability of the endoscope to pass through the R-Y intestinal anastomosis. Postoperative complications are mainly perforation and bleeding, pancreatitis, and cholangitis, which are relatively rare, and barotrauma, which is a specific complication of BAE.[9,10] This specific adverse event probably results from the combination of a "closed loop" phenomenon and deep introduction of the guidewire into the intrahepatic biliary tree, which may occur when using balloon-assisted enteroscope overtubes when sealing the distal end of the blind afferent limb. When air is insufflated continuously during the procedure without the capability of decompression via the mouth or anus, intraluminal pressure increases in the closed afferent limb, resulting in air leakage through a weak wall area (sphincterotomy, mucosal tear in afferent limb, biliary tract after sphincterotomy/sphincteroplasty). Continuous air insufflation into the closed biliary tract may cause rupture of the gallbladder or dehiscence of the hepatic capsule. Air leakage may result in peritoneal or gas retroperitoneal accumulation and may even cause aerodermectasia. In addition, the endoscope directly enters the intrahepatic bile duct to remove stones, which can also cause damage to the bile duct, aggravating

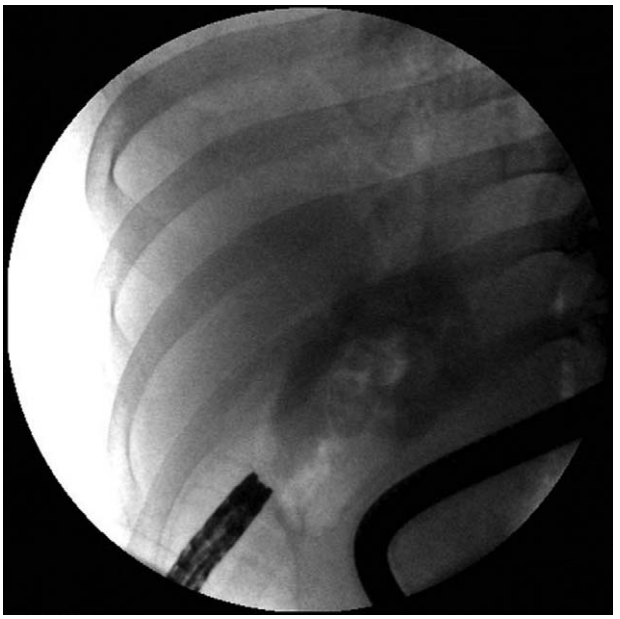

Figure 4. Intrahepatic bile duct gas collection after intrahepatic bile duct stone removal.

the barotrauma. These types of barotrauma should be avoided by insufflating with CO_2, which is absorbed much faster by the intestinal mucosa than air, and intermittent desufflation of the over tube's balloon to allow decompression of the afferent limb. However, this balloon desufflation manoeuvre may lead to the position of the enteroscope being lost and the need to re-introduce the enteroscope. There have been no statistical analyses of the incidence of barotrauma because of the small number of BAE-assisted ERCP cases and the lack of clinical data for large samples. The success in this study is similar to those reported in previous studies but the complication rates are higher than the previous studies. Although the cases of failure occurred with single-balloon enteroscopy, few cases of double-balloon enteroscopy were included in this study; thus, this difference could not be explained. One patient with postoperative jaundice showed an increase in the total bilirubin of more than 100 μmol/L and a direct bilirubin ratio of 80%, but no significant expansion of the intrahepatic bile duct or subcutaneous emphysema were found in the chest or abdomen; obvious gas collection in the intrahepatic bile duct was clearly observed on an X-ray film (Fig. 4). In the procedure, the balloon was used to expand the anastomotic stenosis of the bilioenteric anastomosis, and the basket was repeatedly used to enter the intrahepatic bile duct. We considered barotrauma to have occurred because the gas entered the bile duct system, and the subcutaneous emphysema appeared to be poorly excreted through the cholangioles. After 2 months of oral treatment with choleretic drugs, the patient returned to normal.

Another reason why BAE cannot be widely adopted in clinical practice is related to the endoscopic length (200 cm) and the working channel diameter (2.8 mm); the available standard ERCP accessories rarely meet the treatment requirements and often need to be customized by relevant companies. The long waiting time for custom-made instruments is not tolerated by many patients in the clinic, leading to only a small number of patients undergoing BAE + ERCP. In Japan, a short type of enteroscope system is used (working length 152 cm, working channel 3.2 mm), which is compatible with most ERCP accessories.[11] However, this system has not been widely used and is unavailable in mainland China. Currently, only standard BAE can be performed in mainland China, and only imaging tubes and expanded balloons are available as long accessories; other accessories need to be customized. We often use a snare to replace the basket for stone removal, which is inconvenient. In recent years, Chinese ERCP accessory manufacturers have rapidly improved their technical level, and the quality of related products rivals that of imported products. Moreover, they can produce customized accessories with various specifications according to the requirements of doctors, which is conducive to BAE + ERCP.

Patient factors also restrict the development of this technology. Currently, patients can be divided into 3 main categories, one of which is patients previously operated on for congenital choledochocysts. Most of these patients are very young at the time of surgery and can even be in early childhood. After these patients have grown up, the anatomical features of the R-Y anastomosis are often inconsistent with the operation records, which increase the difficulty of subsequent procedures. The second category is patients undergoing cholangiojejunostomy because of cholangiolithiasis. Due to the multiple surgeries, adhesion in the abdominal cavity can be serious, making it extremely difficult to find the efferent and afferent limbs and increasing the likelihood of perforation. The third category of patients consists of those who had previously been operated on for pancreatic or biliary malignancy, often combined with obstructive jaundice. These patients have a poor physical condition and a poor tolerance for endoscopy; thus, this procedure is more likely to fail in these patients.

With the popularization and development of BAE technology, ERCP in patients with a surgically altered anatomy is gradually increasing.[12,13] However, the use of these new endoscopes may lead to new difficulties and complications, such as previously unseen types of barotrauma in closed afferent intestinal limbs. There are currently no gold standard approaches for addressing biliopancreatic disorders in patients with a surgically altered anatomy. In addition, there are no standardized technical guidelines for ERCP with BAE. It is necessary not only to improve BAE technology and develop special accessories but also to conduct multi-centre studies to evaluate the success and complication rates and the treatment procedures, as well as to determine the indications and contraindications, so more patients can benefit from the technology.

Author contributions

Conceptualization: Jiheng Wang, Lei Li.
Data curation: Jiheng Wang, Yuqi He, Dongliang Yu, Ge Gao.
Formal analysis: Jiheng Wang, Yuqi He, Dongliang Yu, Ge Gao, Lei Li.
Funding acquisition: Lei Li.
Project administration: Lei Li.
Writing – original draft: Jiheng Wang.
Writing – review & editing: Yuqi He, Dongliang Yu, Ge Gao, Lei Li.

References

[1] Haruta H, Yamamoto H, Mizuta K, et al. A case of successful enteroscopic balloon dilation for late anastomotic stricture of choledochojejunostomy after living donor liver transplantation. Liver Transpl 2005;11:1608–10.

[2] Neumann H, Fry LC, Meyer F, et al. Endoscopic retrograde cholangiopancreatography using the single balloon enteroscope technique in patients with Roux-en-Y anastomosis. Digestion 2009;80:52–7.
[3] Inamdar S, Slattery E, Sejpal DV, et al. Systematic review and meta-analysis of single-balloon enteroscopy-assisted ERCP in patients with surgically altered GI anatomy. Gastrointest Endosc 2015;82:9–19.
[4] Kawamura T, Mandai K, Uno K, et al. Does single-balloon enteroscopy contribute to successful endoscopic retrograde cholangiopancreatography in patients with surgically altered gastrointestinal anatomy? ISRN Gastroenterol 2013 May 15;2013:214958.
[5] Skinner M, Popa D, Neumann H, et al. ERCP with the overtube-assisted enteroscopy technique: a systematic review. Endoscopy 2014;46:560–72.
[6] Li K, Huang Y, Yao W, et al. Balloon-assisted enteroscopy for biliary and pancreatic diseases after complex gastrointestinal surgery. Chin J Dig Endosc 2012;29:393–6.
[7] Mei J, Zhang Y, Zhang W, et al. Diagnostic and therapeutic endoscopy for biliary stones following bilioenterostomy: a report of 17 patients. Chin J Pract Surg 2014;34:953–6.
[8] Jin H, Zhang X, Li S, et al. Single-balloon enteroscopy assisted ERCP for diagnosis and treatment of patients with biliary obstruction after gastrointestinal reconstruction. Chin J Dig Endosc 2013;30:499–502.
[9] De Koning M, Moreels TG. Comparison of double-balloon and single-balloon enteroscope for therapeutic endoscopic retrograde cholangiography after Roux-en-Y small bowel surgery. BMC Gastroenterol 2016;16:98. Published 2016 Aug 22.
[10] Moreels TG. Endoscopic retrograde cholangiopancreatography in patients with altered anatomy: how to deal with the challenges? World J Gastrointest Endosc 2014;6:345–51.
[11] Yamauchi H, Kida M, Okuwaki K, et al. Short-type single balloon enteroscope for endoscopic retrograde cholangiopancreatography with altered gastrointestinal anatomy. World J Gastroenterol 2013;19: 1728–35.
[12] Sano I, Katanuma A, Kuwatani M, et al. Long-term outcomes after therapeutic endoscopic retrograde cholangiopancreatography using balloon-assisted enteroscopy for anastomotic stenosis of choledochojejunostomy/pancreaticojejunostomy. J Gastroenterol Hepatol 2019; 34:612–9.
[13] Sawas T, Storm AC, Bazerbachi F, et al. An innovative technique using a percutaneously placed guidewire allows for higher success rate for ERCP compared to balloon enteroscopy assistance in Roux-en-Y gastric bypass anatomy. Surg Endosc 2020;34:806–13.