Prior minimal endoscopic sphincterotomy to prevent pancreatitis related to endoscopic balloon sphincteroplasty

Ryo Kanazawa, Jin Kan Sai, Tomoyasu Ito, Hiroko Miura, Shigeto Ishii, Hiroaki Saito, Ko Tomishima, Ryo Shimizu, Koki Sato, Manabu Hayashi, Sumio Watanabe, Shuichiro Shiina

Ryo Kanazawa, Jin Kan Sai, Tomoyasu Ito, Hiroko Miura, Shigeto Ishii, Hiroaki Saito, Ko Tomishima, Ryo Shimizu, Koki Sato, Manabu Hayashi, Sumio Watanabe, Shuichiro Shiina, Department of Gastroenterology, Juntendo University School of Medicine, Tokyo 113-8421, Japan

Author contributions: Kanazawa R and Sai JK contributed equally to this work; Kanazawa R collected and analyzed the data, and drafted the manuscript; Sai JK provided analytical oversight and designed and supervised the study; Watanabe S and Shiina S revised the manuscript for the important intellectual content; Ito T, Miura H, Ishii S, Saito H, Tomishima K, Shimizu R, Sato K and Hayashi M supported collecting the data; all authors have read and approved the final version to be published.

Institutional review board statement: This study was approved by the Institutional Review Board of Juntendo University.

Clinical trial registration statement: In the study period (October 2010 - March 2014), clinical trial registration was not required for our prospective study.

Informed consent statement: Written informed consent for the procedures and treatment was obtained from patients or their next of kin in accordance with normal clinical practice.

Conflict-of-interest statement: No conflict of interests.

Data sharing statement: Technical appendix, statistical code, and dataset available from the corresponding author at jinkans@juntendo.ac.jp. Participants gave informed consent was not obtained but the presented data are anonymized and risk of identification is low.

Open-Access: This article is an open-access article which was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/4.0/

Manuscript source: Invited manuscript

Correspondence to: Jin Kan Sai, MD, Department of Gastroenterology, Juntendo University School of Medicine, 2-1-1 Hongo, Bunkyo-ku, Tokyo 113-8421, Japan. jinkans@juntendo.ac.jp

Received: February 2, 2016
Peer-review started: February 9, 2016
First decision: March 23, 2016
Revised: July 18, 2016
Accepted: August 6, 2016
Article in press: August 8, 2016
Published online: October 16, 2016

Abstract

AIM
To investigate the efficacy of prior minimal endoscopic sphincterotomy (EST) to prevent pancreatitis related to endoscopic balloon sphincteroplasty (EBS).

METHODS
After bile duct access was gained and cholangiogram confirmed the presence of stones < 8 mm in the common bile duct at endoscopic retrograde cholangiography, patients were subjected to minimal EST (up to one-third of the size the papilla) plus 8 mm EBS (EST-EBS group). The incidence of pancreatitis and the difference in serum amylase level after the procedure were examined and compared with those associated with 8-mm EBS alone in 32 patients of historical control (control group).
We evaluated the efficacy of prior minimal endoscopic sphincterotomy (EST) to prevent pancreatitis related to endoscopic balloon sphincteroplasty (EBS). One hundred and five patients with bile duct stones < 8 mm were subjected to minimal EST (up to one-third of the size the papilla) plus 8 mm EBS (EST-EBS group). The incidence of pancreatitis and the difference in serum amylase level after the procedure were examined and compared with those associated with 8-mm EBS alone in 32 patients of historical control (control group). The difference in serum amylase level after the procedure was -25.0 (217.9) IU/L in the EST-EBS group and 15.6% (5/32) in the control group (P < 0.001).

CONCLUSION
Prior minimal EST might be useful to prevent the elevation of serum amylase level and the occurrence of pancreatitis related to EBS.

Key words: Cholelithiasis; Adverse event; Pancreatitis; Endoscopic sphincterotomy; Endoscopic balloon sphincteroplasty

© The Author(s) 2016. Published by Baishideng Publishing Group Inc. All rights reserved.

Core tip: We evaluated the efficacy of prior minimal endoscopic sphincterotomy (EST) to prevent pancreatitis related to endoscopic balloon sphincteroplasty (EBS). One hundred and five patients with bile duct stones < 8 mm were subjected to minimal EST (up to one-third of the size the papilla) plus 8 mm EBS (EST-EBS group). The incidence of pancreatitis and the difference in serum amylase level after the procedure were examined and compared with those associated with 8-mm EBS alone in 32 patients of historical control (control group). The difference in serum amylase level after the procedure in the EST-EBS group was significantly lower than that observed in the control group (P < 0.001). The incidence of post-procedure pancreatitis was 0% (0/105) in the EST-EBS group and 15.6% (5/32) in the control group (P < 0.001).

INTRODUCTION
Preventing major adverse events related to endoscopic interventions to remove bile duct stones is a matter of great concern to endoscopists and patients. Endoscopic balloon sphincteroplasty (EBS) using a 6–8 mm balloon is associated with a lower frequency of hemorrhage and perforation compared with endoscopic sphincterectomy (EST) [1–4]. However, EBS alone is rarely performed these days because of the high risk of acute pancreatitis and concern for fatal pancreatitis [5,6]. Several studies have recently shown that EST plus large balloon sphincteroplasty (LBS) carries a low risk of post-procedure pancreatitis (0%–3%) [7,8], although there have been no comparative studies between LBS alone and EST followed by LBS.

In the present study, we investigated the efficacy of prior minimal EST (up to one third of the papilla) to prevent pancreatitis related to EBS by comparing a group subjected to EBS alone with another subjected to minimal EST followed by EBS.

MATERIALS AND METHODS

Patients
Between October 2010 and March 2014, patients aged 18 years or older were prospectively included in the current study after bile duct access was gained and cholangiogram confirmed the presence of bile duct stones (EST-EBS group). Patients were excluded if they had a history of EST or EBS, a choledochoduodenal fistula, concurrent hepatolithiasis, Billroth II or Roux-en-Y anatomy, or a concomitant pancreatobiliary malignancy. Patients with conditions suggesting difficult bile duct cannulation, such as requirement of pancreatic guide-wire, pancreatic stent, precut sphincterotomy, pancreatic sphincterectomy or the Rendezvous technique for difficult bile duct access, were also excluded. Patients under anticoagulant therapy or with a coagulopathy (international normalized ratio > 1.3, partial thromboplastin time greater than twice that of control) and a platelet count of < 50 000 × 10^3/µL were excluded and subjected to EBS only. Patients with stones ≥ 8 mm were subjected to limited EST (up to half of the papilla) plus LBS and excluded from the current study. The size of bile duct stones was measured on endoscopic retrograde cholangiopancreatography (ERCP) images corrected for magnification using the diameter of the endoscope as a reference.

As the historical control, 32 consecutive patients, who fulfilled the same inclusion criteria as the EST-EBS group and had undergone 8 mm EBS alone between November 2009 and December 2011, served as the control group.

Informed consent was obtained from all patients. The study was approved by the ethics committee of our institution.

Endoscopic procedure
ERCP was performed using a side-viewing duodenoscope (JF-240, JF-260V, TJF-260; Olympus, Tokyo, Japan). Electrocautery was carried out using a 120-watt endocut current (ERBE International, Erlangen, Germany) [9,10]. One of four trainees (> 100 ERCPs) accompanied by one specialist (> 10000 ERCPs) performed the procedures. Following preparation with pharyngeal anesthesia and intravenous injection of midazolam (0.06 mg/kg), ERCP was performed. After bile duct access
was gained and cholangiogram confirmed the presence of bile duct stones ≤ 8 mm, minimal EST followed by 8-mm EBS was performed. Minimal EST up to one third of the papilla was performed with a 30-mm-pull-type sphincterotome (Clever Cut 3; KD-V41M, Olympus) under the guidewire. EBS was performed with wire-guided hydrostatic balloon catheters (Eliminator, ConMed, NY; balloon length 3 cm, maximum inflated outer diameter 8 mm) placed across the papilla. The balloon was centered at the sphincter, and was dilated to the size of the lower bile duct or 8 mm, whichever was smaller. Inflation time was 30 s.

After the procedure, the stones were retrieved with an extraction balloon under the guidewire. When necessary, a mechanical lithotripter (Lithocrush, Olympus) was used to crush stones. An occlusion cholangiogram was obtained at the end of the procedure. Biliary stents or nasobiliary drains were placed when the stones were not completely removed. None of the patients had prophylactic pancreatic stents placed before or after the procedure.

Each patient was kept under fasting conditions after the procedure and was carefully monitored for the development of any adverse events. Physical examination and laboratory tests were performed daily after the procedure. Serum amylase was checked in all patients before and 24 h after the procedure. If the acute condition had settled and the serum concentration of amylase was below 375 IU/L (normal range: < 125 IU/L), the patient was allowed to take a meal.

Definitions of individual adverse events were similar to those given by Cotton et al.\cite{11,12}. The severity of adverse events was graded according to the length of hospitalization. Mild adverse events required 2 to 3 d of hospitalization; moderate adverse events required 4 to 10 d; and severe adverse events requiring more than 10 d of hospitalization\cite{11,12}. Procedure-induced pancreatitis was defined as new or worsened abdominal pain associated with a serum concentration of amylase three or more times the upper limit of normal at 24 h after the procedure, requiring hospitalization or prolongation of planned admission\cite{11,12}. Hemorrhage was considered clinically significant only if there was clinical evidence of bleeding, such as melena or hematemesis, with an associated decrease of at least 2 g per deciliter in hemoglobin concentration, or the need for a blood transfusion\cite{11,12}. Cholangitis was diagnosed when there was right upper quadrant abdominal tenderness, body temperature of > 38 °C, and elevated serum concentrations of liver enzymes. Acute cholecystitis was diagnosed based on suggestive clinical and radiographic signs. Perforation referred to retroperitoneal or bowel-wall perforation documented by any radiographic technique\cite{11,12}.

### Outcome measurements

The incidences of procedure-related pancreatitis and the differences in serum amylase levels from baseline at 24 h after the procedure were examined in both groups of patients. Secondary outcome measures included the stone clearance rate, and the number of ERCPs required for complete stone clearance. Complete stone clearance was defined as the absence of filling defects on the occlusion cholangiogram as noted by the endoscopists.

### Statistical analysis

Statistical analyses were performed using statistical software (SPSS version 17.0 for Windows). Data were presented as the mean ± SD and were compared using paired t test. Mann-Whitney U test was used for comparing continuous data with skewed distribution in the two groups. A $\chi^2$ test with Yate's correction was used to analyze gender. The difference in serum amylase level after the procedure and the incidence of post-procedure pancreatitis were compared using Wilcoxon signed-rank test. Statistical significance was defined as a $P$ value $< 0.05$ (two tailed).

### RESULTS

Among the 171 consecutive patients with choledocholithiasis who were enrolled in the current study, 8 patients were excluded for a history of EST and/or EBS, 1 was excluded for a choledochoduodenal fistula, 2 for concurrent hepatolithiasis, 6 for Billroth II or Roux-en-Y anatomy, 2 for concomitant biliary malignancies, 13 were excluded for difficult bile duct cannulation; besides, 8 patients who were under anticoagulant therapy or had a coagulopathy and 3 with a platelet count of $< 50000 \times 10^3/\mu L$ were also excluded. Twenty-three patients with stones larger than 8 mm were subjected to limited EST plus LBS (Figure 1).

Consequently, there were 105 patients in the EST-EBS group. The clinical characteristics of the patients in each group are shown in Table 1. The two groups were similar with respect to demographic features. Minimal EST plus 8 mm EBS was successfully performed in all patients. The waist of the balloon at the papilla was observed under fluoroscopic examination in both groups of patients during inflation of the balloon, and, after inflation, the waist remained in 9 (8.6%) patients of the EST-EBS group and 3 (8.7%) of the control group because of the stenosis or small diameter of the distal bile duct.

Complete duct clearance was accomplished in both groups of patients. The stones were completely removed in the first session in all patients of the EST-EBS group and in 27 (84.3%) of the control group ($P < 0.001$). The other 5 (15.7%) patients of the control group required 2 sessions. Mechanical lithotripsy was required in 2 (1.9%) patients of the EST-EBS group, and in one (4.3%) of the control group due to stenosis or small diameter of the distal bile duct (Table 2).

The mean (SD) serum amylase levels before and after the procedure were 148.2 (301.6) IU/L and 123.3 (138.7) IU/L in the EST-EBS group, and 164.5 (136.3)
associated with a high risk of acute pancreatitis.

In the study by Disario et al. [6], pancreatitis occurred in 17.9% of patients subjected to EBS and in 3.3% of those subjected to EST; besides, 2 (1.7%) patients in the EBS group died because of severe pancreatitis. In addition, in five prospective randomized controlled trials of EBS vs EST [5,6,13-15], the incidence of pancreatitis after EBS varied between 4.9% and 20%. Furthermore, EBS was identified as an independent risk factor of post-ERCP pancreatitis in a large prospective multicenter study, including one death related to pancreatitis after EBS [16]. Therefore, it is necessary to modify the EBS technique to reduce the risk of pancreatitis.

EST plus LBS for the extraction of large bile duct stones has shown a low incidence of pancreatitis (0%-4.0%) in large-scale studies [8,9,17], although pancreatitis was thought to be closely related to balloon sphincteroplasty. Attasaranya et al. [8] suggested that

**DISCUSSION**

EBS using a 6- to 8-mm balloon is associated with a lower frequency of hemorrhage and perforation compared with EST [1,2], and allows preservation of sphincter of Oddi function [3,4]. However, EBS alone has been associated with a high risk of acute pancreatitis [2,5,6].

In the study by Disario et al. [6], pancreatitis occurred in 17.9% of patients subjected to EBS and in 3.3% of those subjected to EST; besides, 2 (1.7%) patients in the EBS group died because of severe pancreatitis. In addition, in five prospective randomized controlled trials of EBS vs EST [5,6,13-15], the incidence of pancreatitis after EBS varied between 4.9% and 20%. Furthermore, EBS was identified as an independent risk factor of post-ERCP pancreatitis in a large prospective multicenter study, including one death related to pancreatitis after EBS [16]. Therefore, it is necessary to modify the EBS technique to reduce the risk of pancreatitis.

EST plus LBS for the extraction of large bile duct stones has shown a low incidence of pancreatitis (0%-4.0%) in large-scale studies [8,9,17], although pancreatitis was thought to be closely related to balloon sphincteroplasty. Attasaranya et al. [8] suggested that
EST performed before LBS may result in a separation between the pancreatic and biliary orifices, and balloon dilation forces that are exerted away from the pancreatic duct might lead to a lower risk of postprocedure pancreatitis compared with EBS alone.

In the current study, we performed minimal EST before 8-mm EBS in 105 patients with bile duct stones ≤ 8 mm in diameter. We successfully extracted the stones in all the patients with none of them experiencing post-procedure pancreatitis. Furthermore, in this group the difference in serum amylase level between the baseline value and that after the procedure was significantly lower and the incidence of post-procedure pancreatitis was significantly lower compared with the control group subjected to EBS alone. The objective of minimal EST was to separate the pancreatic orifice from the biliary orifice to prevent pancreatitis related to EBS, and to avoid bleeding and perforation related to standard EST. The objective of EBS after EST was to maximize the biliary sphincterotomy orifice and thereby enable free access of a retrieval balloon catheter or basket to the common channel. Actually, all patients in the current study showed a waist at the papilla during balloon dilation after minimal EST, and if the sphincter is not dilated by a balloon, resistance may occur at the biliary outlet during retrieval of the stone using a basket or retrieval balloon catheter; besides papillary edema or spasm may obstruct the flow of pancreatic juice and the pancreas would be injured as a result of these manipulations[28].

There are some limitations in comparing the current data with previous data from the viewpoint of efficacy and safety. First, the procedure for endotherapy of bile duct stones may depend on the endoscopist, although a trainee attempted the procedure and was supported by an expert on each occasion in our study. Second, our series included patients with a mean age of 70 years, whereas the median age was 49 years in the prospective multicenter trial done in the United States that showed a higher rate of pancreatitis after EBS[6]. Therefore the risk associated with minimal EST plus EBS in younger patients was not fully estimated in the current study. Third, the true advantage of one technique over the other can only be assessed in a randomized controlled trial, while the current study was conducted prospectively and the results were compared with a historical control. Fourth, although minimal EST plus 8-mm EBS resulted in a high cost due to the use of a balloon catheter and a sphincterotome knife, preventing post-procedure pancreatitis was undoubtedly worth the higher cost. Fifth, long-term adverse events including cholangitis, recurrence of bile duct stones, and cholecystitis are an important problem and should be assessed in future studies.

In conclusion, prior minimal EST is expected to significantly reduce the risk of pancreatitis related to EBS for the treatment of patients with bile duct stones. Further studies involving a larger series of patients are required to confirm the reliability of the present results.

### COMMENTS

**Background**

Endoscopic balloon sphincteroplasty (EBS) is associated with lower frequency of bleeding and perforation compared with endoscopic sphincterotomy (EST), as well as preservation of sphincter of Oddi function. But, EBS has a higher risk of acute pancreatitis and concern for fatal pancreatitis. It is necessary to modify the EBS technique to reduce the risk of pancreatitis.

**Innovations and breakthroughs**

Prior minimal EST is expected to significantly reduce the risk of pancreatitis related to EBS for the treatment of patients with bile duct stones.

**Applications**

The paper may interest readers because prior minimal EST might be useful to prevent the elevation of serum amylase level and the occurrence of pancreatitis related to EBS.

**Terminology**

The objective of minimal EST was to separate the pancreatic orifice from the biliary orifice to prevent pancreatitis related to EBS, and to avoid bleeding and perforation related to standard EST. The objective of EBS after EST was to maximize the biliary sphincterotomy orifice and thereby enable free access of a retrieval balloon catheter or basket to the common channel.

**Peer-review**

In this article, the authors found that prior minimal EST might be useful to prevent the elevation of serum amylase level and the occurrence of pancreatitis.

---

**Table 1** Baseline characteristics of the patients

|                    | EST-EB (n = 105) | EBS alone (n = 32) | P value |
|--------------------|------------------|-------------------|---------|
| Sex (female/male)  | 61/44            | 17/15             | NS      |
| Age (yr)           | 70.2 (29-83)     | 71.4 (28-88)      | NS      |
| Maximum CBD diameter (mm) | 8.1 ± 4.5 | 7.7 ± 3.9 | NS      |
| Maximum stone diameter (mm) | 6.6 ± 1.1 | 4.9 ± 1.8 | NS      |
| Stone number       | 2.1 ± 1.4        | 2.3 ± 1.7         | NS      |
| Serum amylase (IU/L) | 148.2 ± 301.6  | 164.5 ± 136.3     | NS      |
| Periampullary diverticulum, n (%) | 41 (35.5) | 10 (31.2) | NS      |
| Acute cholangitis before ERCP, n (%) | 44 (16.6) | 6 (21.8) | NS      |
| Acute cholecystitis before ERCP, n (%) | 3 (2.8) | 1 (3.1) | NS      |

**Table 2** Results of stone retrieval

|                    | EST-EB (n = 105) | EBS alone (n = 32) | P value |
|--------------------|------------------|-------------------|---------|
| n (%) sessions required |                 |                   |         |
| 1                  | 105 (100)        | 27 (84.3)         | < 0.001 |
| 2                  |                  | 5 (15.7)          |         |
| Complete removal, n (%) | 105 (100)      | 32 (100)          | NS      |
| Mechanical lithotripsy, n (%) | 2 (1.9)    | 3 (4.3)           | NS      |
| Pancreatogram, n (%) | 34 (32.7)        | 10 (31.2)         | NS      |
| Serum amylase (IU/L) | -25.0 ± 217.9    | 365.5 ± 576.3     | < 0.001 |
| Post procedure pancreatitis | 0 (0)        | 5 (15.6)          | < 0.001 |

NS: Not significant; ERCP: Endoscopic retrograde cholangiopancreatography; EST: Endoscopic sphincterotomy; EBS: Endoscopic balloon sphincteroplasty; CBD: Common bile duct.
This new method would maybe reduce the risk of post ERCP pancreatitis. This is a well-written paper containing interesting results which merit publication.

REFERENCES
1. Staritz M, Ewe K, Meyer zum Büschenfelde KH. Endoscopic papillary dilation (EPD) for the treatment of common bile duct stones and papillary stenosis. *Endoscopy* 1983; 15 Suppl 1: 197-198 [PMID: 6872989 DOI: 10.1055/s-2007-1021507]
2. Baron TH, Harewood GC. Endoscopic balloon dilation of the biliary sphincter compared to endoscopic sphincterotomy for removal of common bile duct stones during ERCP: a metaanalysis of randomized, controlled trials. *Am J Gastroenterol* 2004; 99: 1455-1460 [PMID: 15307859 DOI: 10.1111/j.1572-0241.2004.30151.x]
3. Yasuda I, Tomita E, Enya M, Kato T, Moriwaki H. Can endoscopic papillary balloon dilation really preserve sphincter of Oddi function? *Gut* 2001; 49: 686-691 [PMID: 11600473 DOI: 10.1136/gut.49.5.686]
4. Sato H, Kodama T, Takaaki J, Tatsunami Y, Maeda T, Fujita S, Fukui Y, Ogasawara H, Mitsufuji S. Endoscopic papillary balloon dilatation may preserve sphincter of Oddi function after common bile duct stone management: evaluation from the viewpoint of endoscopic manometry. *Gut* 1997; 41: 541-544 [PMID: 9391256 DOI: 10.1136/gut.41.4.541]
5. Fujita N, Maguchi H, Komatsu Y, Yasuda I, Hasebe O, Igarashi Y, Murakami A, Makai H, Fujii T, Yamao K, Maeshiro K. Endoscopic sphincterotomy and endoscopic papillary balloon dilation for bile duct stones: A prospective randomized controlled multicenter trial. *Gastrointest Endosc* 2003; 57: 151-155 [PMID: 12556774 DOI: 10.1067/mge.2003.56]
6. Disario JA, Freeman ML, Bjorkman DJ, Macmathuna P, Petersen BT, Jaffe PE, Morales TG, Hixson LJ, Sherman S, Lehman GA, Jannal MM, Al-Kawas FH, Khandelwal M, Moore JP, Derflas GA, Jamidar PA, Ramirez FC, Ryan ME, Woods KL, Carr-Locke DL, Alder SC. Endoscopic balloon dilation compared with sphincterotomy for extraction of bile duct stones. *Gastroenterology* 2004; 127: 1291-1299 [PMID: 15520997 DOI: 10.1053/j.gastro.2004.07.017]
7. Ersoz G, Tekesin O, Ozutemiz AO, Gunser F. Biliary sphincterotomy plus dilation with a large balloon for bile duct stones that are difficult to extract. *Gastrointest Endosc* 2003; 57: 156-159 [PMID: 12556775 DOI: 10.1067/mge.2003.52]
8. Attasaranya S, Cheon YK, Vittal H, Howell DA, Wakelin DE, Cunningham JT, Ajmone N, Ste Marie RW, Bhattacharya K, Gupta K, Freeman ML, Sherman S, McHenry L, Watkins JL, Fogel EL, Schmidt S, Lehman GA. Large-diameter biliary orifice balloon dilation to aid in endoscopic bile duct stone removal: a multicenter series. *Gastrointest Endosc* 2008; 67: 1046-1052 [PMID: 18178208 DOI: 10.1016/j.gie.2007.08.047]
9. Maydeo A, Bhandari S. Balloon sphincteroplasty for removing difficult bile duct stones. *Endoscopy* 2007; 39: 958-961 [PMID: 17701853 DOI: 10.1055/s-2007-966784]
10. Mariani A, Di Leo M, Giardulli N, Giussani A, Marini M, Buffoli F, Cipolletta L, Radaelli F, Raveli P, Lombardi G, D’Onofrio V, Macchiarelli R, Iuriano E, Le Grazie M, Panteleo G, Testoni PA. Early precut sphincterotomy for difficult biliary access to reduce post-ERCP pancreatitis: a randomized trial. *Endoscopy* 2016; 48: 530-535 [PMID: 26990509 DOI: 10.1055/s-0042-102250]
11. Cotton PB, Lehman G, Veness J, Geenen JE, Russell RC, Meyers WC, Liguori C, Nick N. Endoscopic sphincterotomy complications and their management: an attempt at consensus. *Gastrointest Endosc* 1991; 37: 383-393 [PMID: 2070995 DOI: 10.1016/S0001-5707(91)70740-2]
12. Freeman ML, Nelson DB, Sherman S, Haber GB, Herman ME, Dorsher PJ, Moore JP, Fennerty MB, Ryan ME, Shaw MJ, Lande JD, Pheley AM. Complications of endoscopic biliary sphincterotomy. *N Engl J Med* 1996; 335: 909-918 [PMID: 8782497 DOI: 10.1056/NEJM199609263351301]
13. Bergman JJ, Rauws EA, Fockens P, van Berkel AM, Bossuyt PM, Tijssen JG, Tytgat GN, Huibregtse K. Randomised trial of endoscopic balloon dilation versus endoscopic sphincterotomy for removal of bile duct stones. *Lancet* 1997; 349: 1124-1129 [PMID: 9113010 DOI: 10.1016/S0140-6736(96)11026-6]
14. Villananos P, Chopra K, Mandalia S, Anderson M, Thompson J, Westaby D. Endoscopic balloon dilation versus endoscopic sphincterotomy for the removal of bile duct stones: a prospective randomised trial. *Gut* 2003; 52: 1165-1169 [PMID: 12865276 DOI: 10.1136/gut.52.8.1165]
15. Arnold JC, Benz C, Martin WR, Adamek HE, Riemann JF. Endoscopic papillary balloon dilation vs. sphincterotomy for removal of common bile duct stones: a prospective randomized pilot study. *Endoscopy* 2001; 33: 563-567 [PMID: 11473325 DOI: 10.1055/s-2001-15307]
16. Freeman ML, DiSario JA, Nelson DB, Fennerty MB, Lee JG, Bjorkman DJ, Overby CS, Aas J, Ryan ME, Bochans GA, Shaw MJ, Snady HW, Erickson RV, Moore JP, Roel JP. Risk factors for post-ERCP pancreatitis: a prospective, multicenter study. *Gastrointest Endosc* 2001; 54: 425-434 [PMID: 11577302 DOI: 10.1067/mge.2001.117550]
17. Heo JH, Kang DH, Jung HJ, Kwon DS, An JK, Kim BS, Suh KD, Lee SY, Lee JH, Kim GH, Kim TO, Jeo J, Song GA, Cho M. Endoscopic sphincterotomy plus large-balloon dilation versus endoscopic sphincterotomy for removal of bile-duct stones. *Gastrointest Endosc* 2007; 66: 720-726; quiz 768, 771 [PMID: 17905013 DOI: 10.1016/j.gie.2007.02.033]
18. Jeong S, Ki SH, Lee DH, Lee JI, Lee JW, Kwon KS, Kim HG, Shin YW, Kim YS. Endoscopic large-balloon sphincteroplasty without preceding sphincterotomy for the removal of large bile duct stones: a preliminary study. *Gastrointest Endosc* 2009; 70: 915-922 [PMID: 19647241 DOI: 10.1016/j.gie.2009.04.042]
