Korean Journal of Radiology

KJR

Fluoroscopy-Guided Percutaneous Gallstone Removal Using a 12-Fr Sheath in High-Risk Surgical Patients with Acute Cholecystitis

Young Hwan Kim, MD[1, 2], Yong Joo Kim, MD[3], Tae Beom Shin, MD[4]

[1]Department of Radiology, Keimyung University, College of Medicine, Daegu 700-712, Korea; [2]Institute for Medical Science, Keimyung University, Daegu 700-712, Korea; [3]Department of Radiology, Andong General Hospital, Gyeongsangbuk-do 760-410, Korea; [4]Department of Radiology, Gyeongsang National University, College of Medicine, Gyeongsangnam-do 660-702, Korea

Objective: To evaluate the technical feasibility and clinical efficacy of percutaneous transhepatic cholecystolithotomy under fluoroscopic guidance in high-risk surgical patients with acute cholecystitis.
Materials and Methods: Sixty-three consecutive patients of high surgical risk with acute calculous cholecystitis underwent percutaneous transhepatic gallstone removal under conscious sedation. The stones were extracted through the 12-Fr sheath using a Wittich nitinol stone basket under fluoroscopic guidance on three days after performing a percutaneous cholecystostomy. Large or hard stones were fragmented using either the snare guide wire technique or the metallic cannula technique.
Results: Gallstones were successfully removed from 59 of the 63 patients (94%). Reasons for stone removal failure included the inability to grasp a large stone in two patients, and the loss of tract during the procedure in two patients with a contracted gallbladder. The mean hospitalization duration was 7.3 days for acute cholecystitis patients and 9.4 days for gallbladder empyema patients. Bile peritonitis requiring percutaneous drainage developed in two patients. No symptomatic recurrence occurred during follow-up (mean, 608.3 days).
Conclusion: Fluoroscopy-guided percutaneous gallstone removal using a 12-Fr sheath is technically feasible and clinically effective in high-risk surgical patients with acute cholecystitis.
Index terms: *Gallbladder stone; Acute cholecystitis; Percutaneous cholecystolithotomy*

INTRODUCTION

Laparoscopic cholecystectomy (LC) has become the gold standard for treating symptomatic gallstones, and the

development of LC has reduced the appeal of percutaneous cholecystolithotomy (PCCL) as an alternative to open cholecystectomy. Nevertheless, PCCL is still performed under both fluoroscopic and endoscopic guidance, as an alternative treatment option in elderly debilitated patients with a high surgical risk due to underlying cardiopulmonary disease or a poor general condition (1–3). Most of the literature concerning PCCL involves the use of endoscopy to remove stones, and when used in this manner, does so at a high rate of success because the stones are more easily grasped or trapped under direct visualization, and even tiny stones easily missed by cholecystography can be completely removed. Furthermore, the application of intracorporeal electrohydraulic lithotripsy or laser lithotripsy may improve the clearance rate of large stones. However, PCCL with endoscopy has several limitations in patients

with acute calculous cholecystitis. In particular, it takes a relatively long time for a tract to mature enough for stone removal, and it is a painful procedure because introducing the endoscopic instrument requires substantial tract dilatation (2, 3). To resolve the limitations of endoscopic cholecystolithotomy, we attempted to extract stones using a Wittich nitinol stone basket through a 12-Fr sheath (Cook, Bloomington, IN) under fluoroscopic guidance, which was not yet reported. In this study, we describe our experiences of the fluoroscopy-guided PCCL technique using a 12-Fr sheath, as well as the results of our evaluation for the treatment of acute calculous cholecystitis in high-risk surgical patients.

MATERIALS AND METHODS

Patients

Between November 2004 and March 2009, 63 consecutive patients of high surgical risk with acute calculous cholecystitis underwent percutaneous transhepatic gallstone removal under conscious sedation. Institutional Review Board approval was obtained for this study. The cohort was composed of 63 patients (33 men and 30 women) ranging in age between 55 and 91 years (mean age, 76 years). All patients were referred to our radiologic department for emergent percutaneous transhepatic cholecystostomy due to acute cholecystitis (n = 41) or to gallbladder empyema (n = 22) because of a high risk for surgery. The causes of high surgical risks included cardiac disease in 16 patients, cerebrovascular disease in seven, uncontrolled diabetes mellitus in seven, pulmonary disease in seven, poor general condition and old age in seven, liver cirrhosis in five, coexisting inoperable cancer in four, psychosis in four, recurrent cholecystitis due to a residual stone after cholecystectomy in three, and bleeding tendency in three. Diagnoses of acute calculous cholecystitis or empyema were confirmed by ultrasonography or CT scan in all patients. A total of 19 patients had single gallstones, as opposed to 44 with multiple gallstones. Stone sizes ranged from < 1 cm in 46 patients, to 1 to 3 cm in 14 patients, and > 3 cm in three patients. Twenty-six patients had at least one coexisting stone in the common bile duct.

Procedures

Emergent percutaneous transhepatic cholecystostomy was performed under combined sonographic and fluoroscopic guidance. The gallbladder was localized with ultrasound and

punctured with a 21 gauge Chiba needle (Solco Intermed, Seoul, Korea). An 8.5-Fr Dawson-Muller drainage catheter (Cook) was then placed in the gallbladder lumen with a transhepatic approach using the Seldinger technique. The drainage catheter was kept for gallbladder decompression and the drainage of infected bile. PCCL was performed under fluoroscopic guidance for two or three days after a percutaneous cholecystostomy. This duration was found to be adequate for controlling the symptoms of acute cholecystitis. PCLL was performed under local anesthesia using 2% lidocaine hydrochloride (Jeil, Daegu, Korea), midazolam (Bukwang, Seoul, Korea), and a pethidine hydrochloride (Jeil, Daegu, Korea) intravenous analgesic. Moreover, a 2-gram of intravenous cefotaxime sodium (Daewoong, Seoul, Korea) was administered on a daily basis as a prophylaxis to all patients for three days. In addition, a 12-Fr sheath in a Wittich nitinol stone basket set (Cook) was placed in the lumen of the gallbladder without dilating the tract after removal of the 8.5-Fr Dawson-Muller drainage catheter. Next, a 0.035-inch guide wire (Radifocus M, Terumo, Tokyo, Japan) was placed in the lumen of the gallbladder or common bile duct through the sheath for stone removal using the Wittich nitinol stone basket under fluoroscopic guidance with a safety guide wire positioned in the gallbladder or common bile duct for provision against inadvertent extraction of the 12-Fr sheath out of gallbladder during PCCL. The polyethylene portion in the shaft of the Wittich nitinol stone basket was peeled off using a blade to ease basket passage through the 12-Fr sheath with the safety guide wire in situ (Fig. 1). Stones were grasped and then extracted through the sheath using the Wittich nitinol stone basket. In nine patients, the stones were too large to grasp with the Wittich
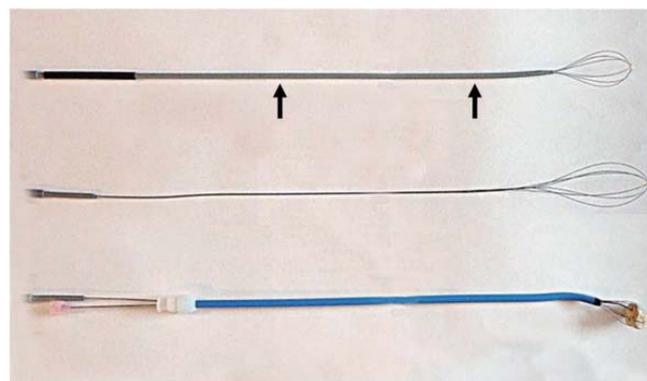

Fig. 1. Picture of Wittich nitinol basket. Polyethylene portion of shaft (upper, arrow) was peeled off with blade (middle) in order to ease passage of stone basket and guide wire or metallic cannula (lower).

nitinol stone basket, and hence were fragmented using a polytetrafluoroethylene coated curved Amplatz Extrastiff wire (Cook) using the snare wire technique (Fig. 2). After folding the wire, we inserted the folded wire through the 12-Fr sheath, and then made a loop snare to grasp the large stone and fragmented it by pulling the wire. To describe this method, we used the term snare wire technique. In eight patients, stones were crushed using the metallic cannula in the 8.5-Fr Dawson-Muller drainage catheter set, because they were too hard to fragment using the stone basket. We introduced coaxially the metallic cannula through the 12-Fr sheath with the peeled stone basket in situ, and then fragmented hard stone by repeating the stick while the stone basket grasped the stone (Fig. 3). If the stones were not cleared in one session, the procedure was repeated at two or three day intervals. The end point of the procedure was complete clearance of the gallbladder stones and a patent cystic duct by cholecystography and ultrasonography. The gallbladder drainage catheter was removed when the patient's clinical status remained stable for three days with the external drainage tube clamped. Coexistent stones in the common bile duct were removed using a trans-cystic duct approach in six patients, and by an additional percutaneous transhepatic biliary drainage route in 20 patients.
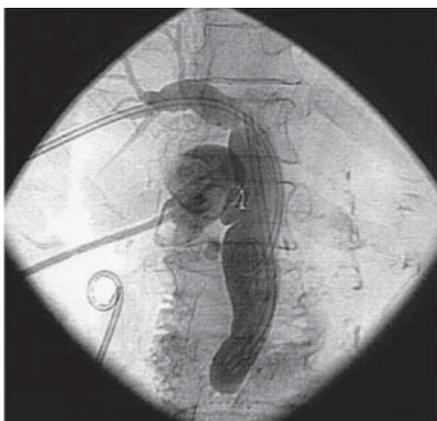
RESULTS

Complete stone clearance was achieved in 59 patients (94%). For the other four patients, stone removal failed because a large stone could not be grasped in two patients, and because the tract was lost during the procedure in two patients due to a collapsed gallbladder. In the two with a large gallstone, the cholecystostomy catheter was removed two weeks after initial placement, and the gallstone was left in the gallbladder. In the remaining two patients with a collapsed gallbladder, the percutaneous tract was lost due to dislodgement of the sheath during the first stone removal session. No further attempts including, cholecystectomy or laparoscopic cholecystectomy were planned because the two patients were elderly and had cardiopulmonary disease. Three of these four patients remained asymptomatic after catheter removal during follow-up (range, 8–21 months).
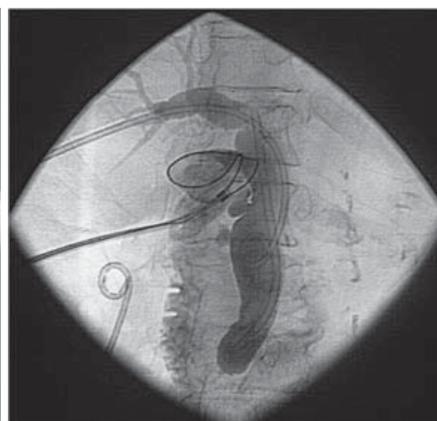
Fig. 2. 83-year-old female with ruptured gallbladder empyema. A. Photograph of snare guide wire technique. **B, C.** Large stones were fragmented using snare guide wire technique. **D.** Cholecystogram obtained after stone extraction using Wittich nitinol stone basket showing complete stone clearance.
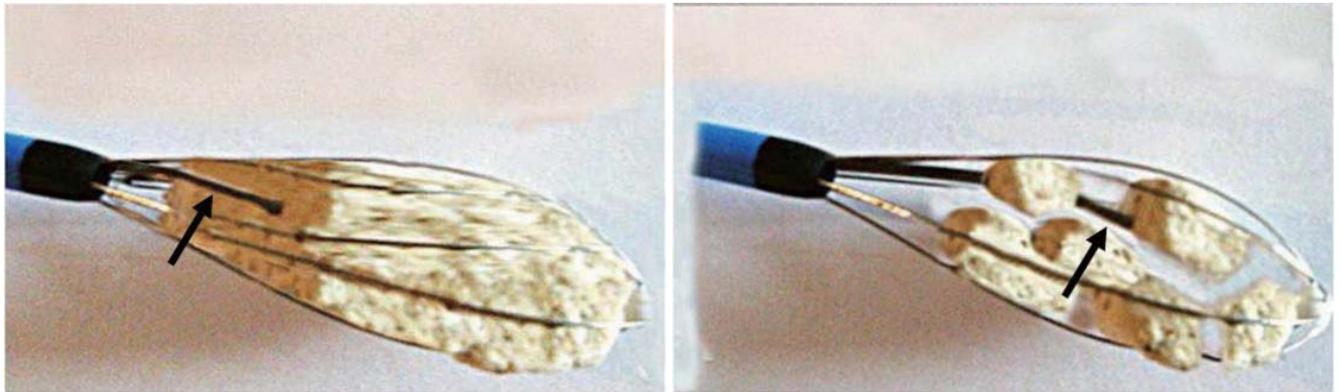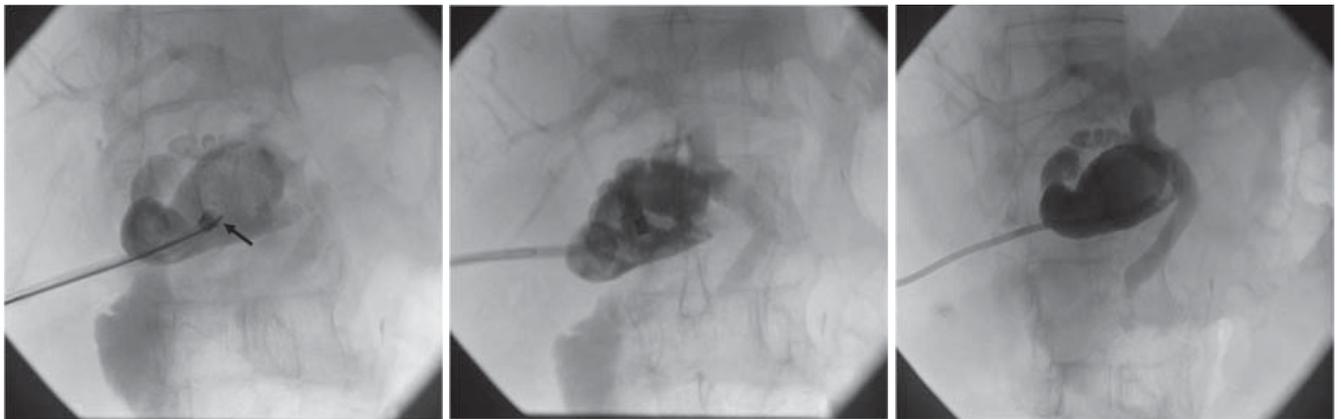
The other patient suffered from abdominal pain due to bile peritonitis after tract loss during the first stone removal session. As a result, a drainage catheter was placed in the abdominal cavity to drain bile leakage over five days, and then the drainage catheter was successfully removed. Complete stone removal was obtained in one session in 46 patients, and in multiple sessions in 13 patients. All coexistent common bile duct stones were successfully
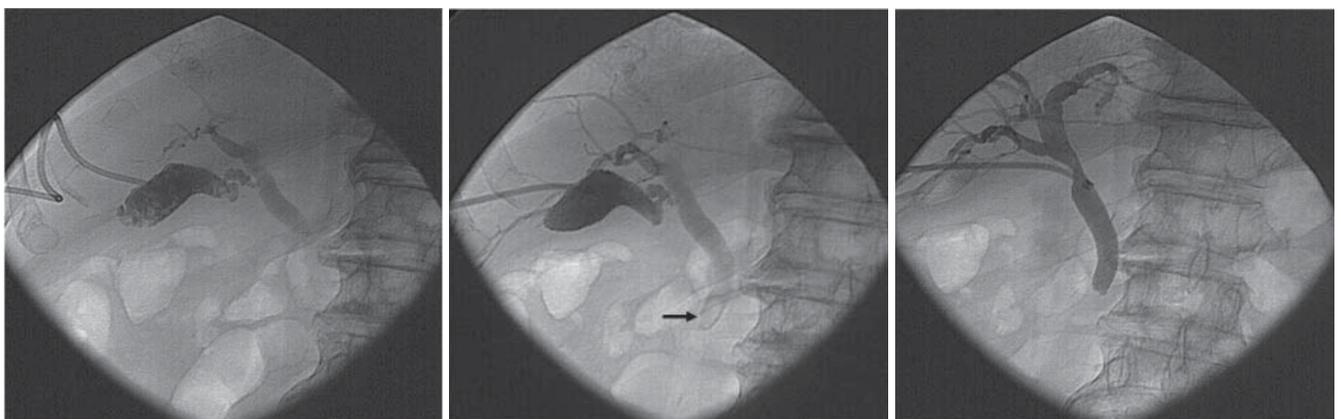

Fig. 3. 81-year-old male with gallbladder empyema.
A. Photograph of metallic cannula (arrow) technique. **B.** Hard stone being fragmented using metallic cannula (arrow) technique. **C.** Fragmented stones were extracted through 12-Fr sheath. **D.** Cholecystogram showing complete stone clearance and patent cystic duct.

Fig. 4. 90-year-old male with acute cholecystitis.
A. Cholecystogram showing multiple GB stones. **B.** Stones were successfully removed, but small stone remained in common bile duct (arrow). **C.** 12-Fr sheath was placed in common bile duct through cystic duct, and small common bile duct stone was extracted using Wittich stone basket.

removed through a cystic duct approach or an additional percutaneous biliary drainage route (Fig. 4). Fifty-six patients had pigmented stones, and three patients had cholesterol stones. The mean hospitalization duration was 7.3 days (range, 5–30 days) in acute cholecystitis patients, and 9.4 days (range, 6–80 days) in gallbladder empyema patients. A long hospitalization period of more than 30 days was needed in four patients because of ruptured empyema, septic shock, or multiple remnant cystic duct stones. Bile peritonitis requiring percutaneous drainage developed in two patients including a case with tract loss during the first stone removal session. No symptomatic recurrence occurred during follow-up (mean, 608.3 days). Eleven patients died over the course of the follow-up period. The causes of death included underlying cancer in three, pulmonary disease in three, diabetes mellitus in two, congestive heart failure in one, chronic renal failure in one, and cerebrovascular disease in one.

DISCUSSION

Acute calculous cholecystitis is an emergent disease because it can rapidly progress to a serious infection if not treated. Although laparoscopic cholecystectomy is the mainstay therapy for acute calculous cholecystitis, percutaneous cholecystostomy is an alternative treatment for emergent decompression of the gallbladder in acute cholecystitis, especially when managing critically ill patients considered high risk for surgery (4, 5). After gallbladder decompression and symptom improvement in acute cholecystitis treated by percutaneous cholecystostomy, subsequent management for gallstones is needed in high-risk patients. However, although laparoscopic cholecystectomy is a minimally invasive form of surgery, it requires general anesthesia, which is a major risk factor in patients with severe cardiac or pulmonary disease. The nonsurgical options that can be performed under local anesthesia in high-risk surgical patients include extracorporeal shock wave lithotripsy (ESWL), percutaneous gallbladder stone dissolution with methyl-tert-butyl ether (MTBE), and PCCL. However, only 10–25% of patients are suitable candidates for ESWL, and 20% for contact dissolution with MTBE (6). Of these three options, PCCL has the major advantage that it can be attempted in most patients. Furthermore, many authors have reported on the effectiveness of PCCL in patients with a high surgical risk, with success rates ranging from 85 to 100% (3, 7–11). In

most reports, PCCL was performed under both fluoroscopic and endoscopic guidance. Whereas, PCCL performed under fluoroscopic guidance alone with a small sheath has not been previously reported. Many reports have stated that the two main drawbacks of PCCL with a sheath large enough for endoscopy (2, 3, 7–9, 12) are that the procedure is time consuming and because it requires tract maturation, which is required to prevent intraperitoneal bile leaks or bleeding, necessitates a considerable waiting time. According to the literature, the tract should be dilated by more than 18-Fr to allow endoscopy, and PCCL should be performed 10–14 days after tract dilatation or initial tube drainage when the patient is clinically stable and the sinus tract has matured (2, 9). The duration of the entire procedure from initial tube placement to final tube removal ranged from 17–126 days (2, 8). To reduce waiting times and intraperitoneal bile leak rates, many authors have recommended the transhepatic approach, which provides a more secure route for tract dilatation because the gallbladder is relatively fixed by the hepatic attachment (3, 8, 9). Nevertheless, intraperitoneal bile leaks can occur and the requirement of an adequate waiting period is inevitable. Some authors have opted for the direct transperitoneal approach to ease stone removal and to avoid injuring the intrahepatic arterial branch despite the substantial time required for tract maturation (7). In the present study, the mean duration of the procedure was 7.3 days in acute cholecystitis patients and 9.4 days in gallbladder empyema patients, which are substantially shorter than previously reported. We used the transhepatic approach in all patients to insert the small sheath without waiting for tract maturation in order to reduce the hospitalization period (13). We did not experience any bleeding complication due to damage caused by the intrahepatic arterial branch because we used a small sheath. In addition, large diameter tract dilatation causes considerable pain despite medication, and in the present study, all patients reported tolerable pain, which was well controlled by midazolam and pethidine. We attribute this lower level of pain to the smaller sheath used and a treatment using a transhepatic approach. The major limitation of PCCL without endoscopy was the difficulty of fragmenting a large or hard stone using the stone basket alone. We were unable to use lithotripsy devices under endoscopic guidance because of the small sheath. To overcome this limitation of PCCL under fluoroscopic guidance alone with a small sheath, we used the snare guide wire technique or the metallic cannula technique and

successfully removed the largest or hardest stones. Another disadvantage of PCCL under fluoroscopic guidance alone is the possibility that a tiny stone left in situ acts as a nidus for stone growth, because small stones can be missed by cholecystography (9). PCCL under fluoroscopy or endoscopy is known to preserve gallbladder function, but gallstones may recur even when complete stone clearance is confirmed by endoscopic examination. Reported rates of gallstone recurrence following cholecystolithotomy vary from 14–44% (9, 14–16). Zou et al. (15) reported that gallstone recurrence is most likely during the 5th to 6th postoperative years. Nevertheless, although the frequency of gallstone recurrence is high, PCCL is still useful in elderly patients who may not be able to tolerate cholecystectomy, because most patients with recurrent stones were asymptomatic (14). The other concern regarding the preservation of the gallbladder in PCCL is of subsequent gallbladder cancer development in patients with acute calculous cholecystitis (17). However, the short life expectancy in debilitated high surgical risk elderly patients reduces concerns of recurrent stones or cancer development.

Our study has several limitations. First, gallstone recurrence was not evaluated by follow-up ultrasonography or CT; although, no symptomatic recurrence was encountered. Second, although we emphasize that the described procedure is less painful than PCCL under endoscopy, we did not establish pain scores or statistically compare pain findings with those of endoscopic guidance. Third, we believe that no waiting time is required for tract maturation by the transhepatic approach when a small sheath is used, because we experienced only two cases of bile peritonitis requiring further interventional treatment. However, we did not explore this idea because we were unable to document clinically silent bile leakage or its cause in the two cases with bile leakage.

In conclusion, we found that fluoroscopy-guided PCCL using a 12-Fr sheath to be an effective alternative therapy to surgical cholecystectomy for acute calculous cholecystitis in patients at high surgical risk. In particular, this procedure was found to preserve gallbladder function without symptomatic recurrence, and it is likely to be much less painful and have a substantially shorter procedure time than PCCL under fluoroscopic or endoscopic guidance.

REFERENCES

1. McDermott VG, Arger P, Cope C. Gallstone recurrence and gallbladder function following percutaneous cholecystolithotomy. *J Vasc Interv Radiol* 1994;5:473-478

2. Wong SK, Yu SC, Lam YH, Chung SS. Percutaneous cholecystostomy and endoscopic cholecystolithotripsy in the management of acute cholecystitis. *Surg Endosc* 1999;13:48-52

3. Picus D, Hicks ME, Darcy MD, Vesely TM, Kleinhoffer MA, Aliperti G, et al. Percutaneous cholecystolithotomy: analysis of results and complications in 58 consecutive patients. *Radiology* 1992;183:779-784

4. Lammert F, Miquel JF. Gallstone disease: from genes to evidence-based therapy. *J Hepatol* 2008;48:S124-S135

5. Melin MM, Sarr MG, Bender CE, van Heerden JA. Percutaneous cholecystostomy: a valuable technique in high-risk patients with presumed acute cholecystitis. *Br J Surg* 1995;82:1274-1277

6. Cheslyn-Curtis S, Russell RC. New trends in gallstone management. *Br J Surg* 1991;78:143-149

7. Cope C, Burke DR, Meranze SG. Percutaneous extraction of gallstones in 20 patients. *Radiology* 1990;176:19-24

8. Picus D, Marx MV, Hicks ME, Lang EV, Edmundowicz SA. Percutaneous cholecystolithotomy: preliminary experience and technical considerations. *Radiology* 1989;173:487-491

9. Kim HJ, Lee SK, Kim MH, Yoo KS, Lim BC, Seo DW, et al. Safety and usefulness of percutaneous transhepatic cholecystoscopy examination in high-risk surgical patients with acute cholecystitis. *Gastrointest Endosc* 2000;52:645-649

10. Gillams A, Curtis SC, Donald J, Russell C, Lees W. Technical considerations in 113 percutaneous cholecystolithotomies. *Radiology* 1992;183:163-166

11. Ohashi S. Percutaneous transhepatic cholecystoscopic lithotomy in the management of acute cholecystitis caused by gallbladder stones. *Diagn Ther Endosc* 1998;5:19-29

12. Bonnel DH, Liguory CE, Cornud FE, Lefebvre JF. Common bile duct and intrahepatic stones: results of transhepatic electrohydraulic lithotripsy in 50 patients. *Radiology* 1991;180:345-348

13. Park YS, Kim JH, Choi YW, Lee TH, Hwang CM, Cho YJ, et al. Percutaneous treatment of extrahepatic bile duct stones assisted by balloon sphincteroplasty and occlusion balloon. *Korean J Radiol* 2005;6:235-240

14. Gibney RG, Chow K, So CB, Rowley VA, Cooperberg PL, Burhenne HJ. Gallstone recurrence after cholecystolithotomy. *AJR Am J Roentgenol* 1989;153:287-289

15. Zou YP, Du JD, Li WM, Xiao YQ, Xu HB, Zheng F, et al. Gallstone recurrence after successful percutaneous cholecystolithotomy: a 10-year follow-up of 439 cases. *Hepatobiliary Pancreat Dis Int* 2007;6:199-203

16. Donald JJ, Cheslyn-Curtis S, Gillams AR, Russell RC, Lees WR. Percutaneous cholecystolithotomy: is gall stone recurrence inevitable? *Gut* 1994;35:692-695

17. So CB, Gibney RG, Scudamore CH. Carcinoma of the gallbladder: a risk associated with gallbladder-preserving treatments for cholelithiasis. *Radiology* 1990;174:127-130