RESULTS OF BILIARY DILATION AND STONE REMOVAL VIA FLEXIBLE CHOLANGIOSCOPY FOR THE TREATMENT OF PRIMARY BILIARY STRICTURES AND STONES AT MILITARY HOSPITAL 103

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Abstract

Objectives: To evaluate the results of biliary dilation and stone removal via flexible cholangioscopy for the treatment of primary biliary strictures (BS) and stones. ***Methods:*** A prospective, descriptive, uncontrolled study was conducted on 62 patients with primary BS and stones treated by biliary dilation and stone removal via flexible cholangioscopy at Abdominal Surgery Centre, Military Hospital 103, from July 2021 to July 2024. ***Results:*** The mean age was 60.1 ± 14.1; the female/male ratio was 1.69/1. 75.8% of patients had a history of biliary stones. Most patients had multiple stones (79%), including choledocholithiasis and hepatolithiasis. BS were mostly in one location (90.3%), intrahepatic strictures (88.7%), and were all benign. The mean length and diameter of the strictures were 3.96 ± 2.9mm and 3.6 ± 0.7mm, respectively. Surgical methods were choledochotomy with intraoperative cholangioscopy (90.3%) and percutaneous cholangioscopy (9.7%). Stone removal was performed using baskets, electrohydraulic, and/or laser lithotripsy. BS was performed using balloon dilation; then, biliary-cutaneous stents were placed in 64.5% of cases at risk of recoil. Intraoperative complications accounted for 16.1%; postoperative complications accounted for 12.9%. The rate of stone clearance and successful stricture dilation after surgery was 83.9% and 87.1%. Rechecked at 1 month, 3 months, and 6 months after operation, the ratio of recurrent stones and BS was 0%, 0%, 5.8% and 1.9%, 7.4%, 11.1%, respectively. ***Conclusion:*** Stone removal and stricture dilation by flexible cholangioscopy is a safe and effective method for treating primary BS and stones.

Keywords: Flexible cholangioscopy; Biliary stricture; Primary bile duct stone; Biliary balloon dilator; Laser lithotripsy; Electrohydraulic lithotripsy.

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INTRODUCTION

Biliary stricture is a common disease in East Asia, Southeast Asia, and Vietnam. According to statistics, the rate of BS in patients with primary bile duct stones can reach 45.6 - 70% [1]. This disease greatly affects the treatment results of biliary stones and is the main cause of stone recurrence, requiring patients to undergo multiple surgeries.

In 2022, IHPBA (International Hepatobiliary-Pancreatic Association) defined: "BS is a localized reduction in the diameter of the bile duct compared to the adjacent biliary ducts, accompanied by the dilation above the stricture" [2]. In patients with both BS and stones, whether BS is the cause or consequence of stones has not been proven. They combine each other to create a pathological spiral. Although BS has always been considered a challenging problem, the diagnosis and treatment of BS were rarely mentioned in the past due to difficulties in directly investigated imaging. Until Shore first performed intraoperative flexible cholangioscopy in 1970, BS had gradually been mentioned. Since then, flexible cholangioscopy has become an effective method for diagnosing and treating BS by its ability to show clear images. Based on the cholangioscope, Lee SK proposed a classification of BS that has been widely applied nowadays [3]. In 2023, the ACG (American College of Gastroenterology) issued recommendations on the technique of cholangioscopy, BS dilation, and biliary stenting [4].

Up to now, very few Vietnamese authors have published researches that deeply evaluate the treatment results of BS. At Military Hospital 103, cholangioscopy has been performed since 2008 to treat stones. In recent years, we have developed a technique for dilating the BS with balloon dilation. The research problem was posed with the question: What is the effectiveness of the technique of stone removal combined with biliary dilation in the treatment of primary BS and stones? Because of that, we conducted this research with the aim to: *Evaluate the results of biliary dilation and stone removal via flexible cholangioscopy for the treatment of primary BS and stones.*

MATERIALS AND METHODS

1. Subjects

Including 62 patients with primary BS and stones treated by biliary dilation and stone removal via flexible

cholangioscopy at Abdominal Surgery Centre, Military Hospital 103 from July 2021 to July 2024.

* *Inclusion criteria:* Patients were diagnosed with primary BS and stones, treated by stone removal and stricture dilation via flexible cholangioscopy.

* *Exclusion criteria:* Patients had tumors or cancers in the bile duct, liver, pancreas's head or Vater's ampulla; patients had ASA score > 3 (classification of patient's health status before surgery according to the American Society of Anesthesiologists).

2. Methods

* *Study design:* A prospective, descriptive, uncontrolled study.

* *Research process:*

Patients were clinically examined and had para-clinical tests for preoperative diagnosis. If patients had primary BS and stones, met the selection criteria, and did not fall under the exclusion criteria, surgery was performed.

Surgical methods:

- If the patient had not previously undergone surgery, choledochotomy with intraoperative flexible cholangioscopy was performed to remove stones and dilate the stricture.

- If the patient had undergone percutaneous biliary drainage, percutaneous flexible cholangioscopy via the tunnel was performed to remove stones and dilate the stricture.

* *Stone removal and biliary dilation via flexible cholangioscopy technique:*

We used a cholangioscopic system with a Japanese Olympus CHF-V2 5mm diameter flexible cholangioscope, 2mm diameter instrument channel combined with irrigation way, 2-directions adjustable controller (up 160° - down 130°).

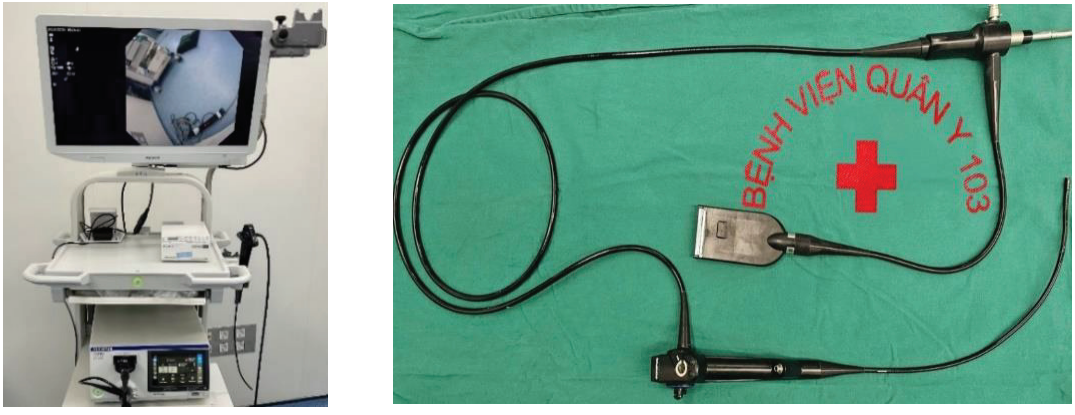

Figure 1. Cholangioscopic system and Olympus CHF-V2 flexible cholangioscope.

The surgeon took the cholangioscope with the right hand and held the controller with the left hand. Then, the cholangioscope was inserted into the bile duct. A continuously irrigated stream of NaCl 0.9% was used to dilate the bile duct and create a clean environment during cholangioscopy. The common bile duct was investigated first, then stones were removed to check the sphincter of Oddi and enterohepatic circulation. After that, the cholangioscope was controlled up to the common hepatic duct and the intrahepatic bile ducts sequentially. Within intrahepatic bile ducts, cholangioscopy was performed in order from the right hepatic duct, right anterior section, segments 5, 8, right posterior section, segments 6, 7, to the left hepatic duct, segments 2, 3, 4, and 1.

In this research, we performed stone removal using baskets, laser, and electrohydraulic lithotripsy and pumped small fragments outside or into the duodenum through the Oddi's sphincter. Stone removal was performed from near to far, to make a good enterohepatic circulation.

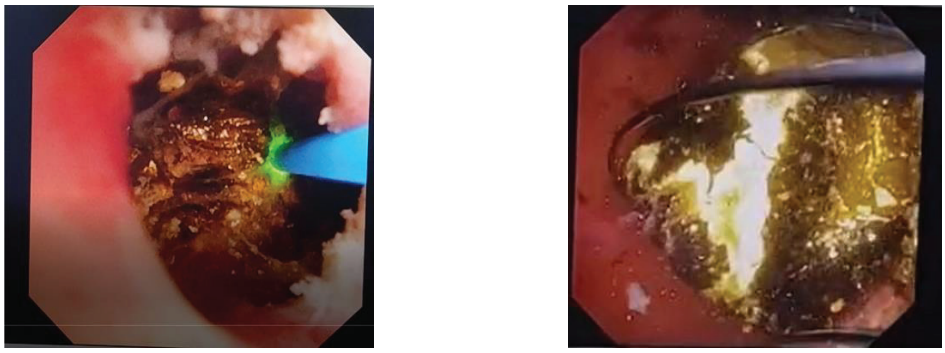

Figure 2. Stone removal with laser lithotripsy and basket.

After removing as many stones as possible, the bile ducts were examined for BS. When BS was found, its characteristics were evaluated, and the stricture was immediately biopsied with biopsy forceps. If the biopsy result was benign, the biliary dilation would be performed. In this research, we applied the balloon dilation method.

- Balloon dilation technique: Using a specialized 3-stage Biliary Balloon Dilation, 0.2 x 290cm, Model BD-410X Olympus, Japan. The dilation technique was applied according to the recommendations of Nunes T (2021) [5]. Based on the diameter of the BS, the appropriate type of dilation balloon was chosen, with a diameter 0.5 - 1mm

larger than the BS. The uninflated dilation balloon was inserted via the cholangioscope's instrument channel through the stricture position. Then, the balloon was slowly inflated with increasing pressure from 1 - 20atm, depending on the desired dilation size, and was held for about 2 minutes. This process was performed under the observation of the flexible cholangioscope to directly assess the result. The biliary dilation would be performed many times until the cholangioscope could go through the stricture. If the dilation was successful, we would continue to remove stones behind the stricture. After that, the indication for placing a biliary stent was considered. If the dilation was unsuccessful, consider other methods such as liver resection, biliary-enteric anastomosis, or conservative procedure.

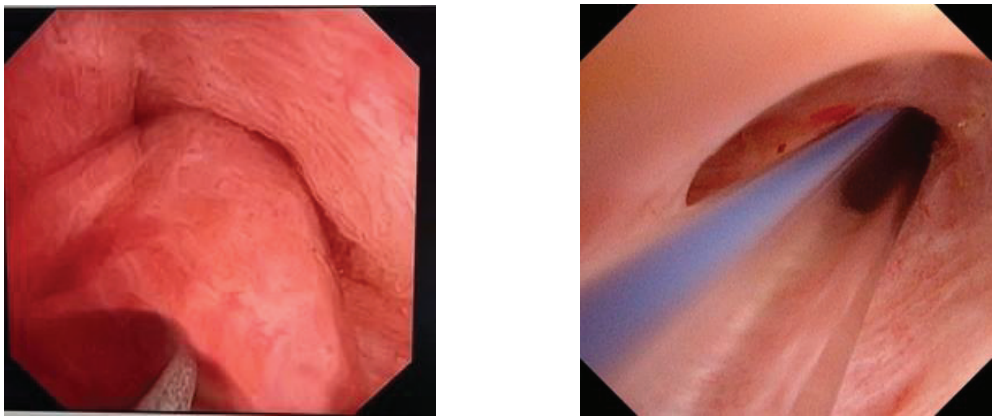

Figure 3. BS's balloon dilation and stent placement.

- Biliary stent placement: ACG clinical guideline 2023 recommended that if the BS was membranous, biliary stent placement would not be needed because it usually did not recoil after dilation. In other cases, the biliary stent should be placed [4]. In this study, we used a 16Fr biliary-cutaneous stent made of latex (T-tube drainage) or silicon.

- Patients who had completed stone clearance and BS dilation would be re-examined after 1, 3, and 6 months for re-evaluation. They would be clinically and para-clinically examined with ultrasound and magnetic resonance cholangio-pancreatography to check and compare with their surgery's results.

* *Data analysis:* The information was recorded and arranged in detail according to the research medical record form. The research data was processed using SPSS 20.0 software.

The percentages were calculated and presented in table form.

3. Ethics

This research has been approved by the Ethics Committee of Military Hospital 103 according to Decision No. 69/CNChT-HĐĐ, dated October 17th, 2022. The patients were clearly explained about the benefits and risks of the surgery, and agreed to participate in the study. Military Hospital 103 granted permission for the use and publication of the research data. The authors declare to have no conflicts of interest in this research.

RESULTS

From July 2021 to July 2024, we studied 62 patients.

* *Age and gender:* Patients' ages ranged from 20 - 86. The mean age was 60.1 ± 14.1. The female/male ratio was 1.69/1 (39/23). 75.8% of patients had a history of biliary stones, of which 54.8% had undergone biliary surgery.

* *Location of stones and BS:* Most patients had multiple stones (79%), including choledocholithiasis and hepatolithiasis. Stones were often located around the BS. The BS were mostly intrahepatic strictures. Left hepatic duct stricture accounted for the highest rate (30.6%). There were 69 BS among 62 patients.

Table 1. Characteristics of BS (n = 69).

Characteristics	Percentage (%)
Number of BS positions	
1	90.3
2	8.1
3	1.6
Classification of BS	
Mild	85.5
Moderate	8.7
Severe	5.8

All strictures were benign. The average length of BS was 3.96 ± 2.9mm. The average BS's diameter was 3.6 ± 0.7mm.

Table 2. Results of stone removal and BS dilation (n = 62).

Characteristics	Percentage (%)
Surgical methods	
Choledochotomy with intraoperative cholangioscopy	90.3
Percutaneous cholangioscopy	9.7
Stone removal methods	
Using basket only	11.3
Using baskets and electrohydraulic lithotripsy	21.0
Using basket and laser lithotripsy	37.1
Using basket, electrohydraulic, and laser lithotripsy	30.6
Balloon dilation of BS	
Success	87.1
Failure	12.9
Biliary-cutaneous stent placement	
T-tube 16Fr	30.6
Silicon tube 16Fr	33.9
No stent	35.5
Intraoperative complications	16.1
Bleed	14.5
Duodenal perforation	1.6
Postoperative complications	12.9
Bleed	3.2
Bile leakage	1.6
Surgical site infection	4.9
Acute pancreatitis	3.2
General results after surgery	
Completed stone clearance	83.9
Completed BS dilation	87.1

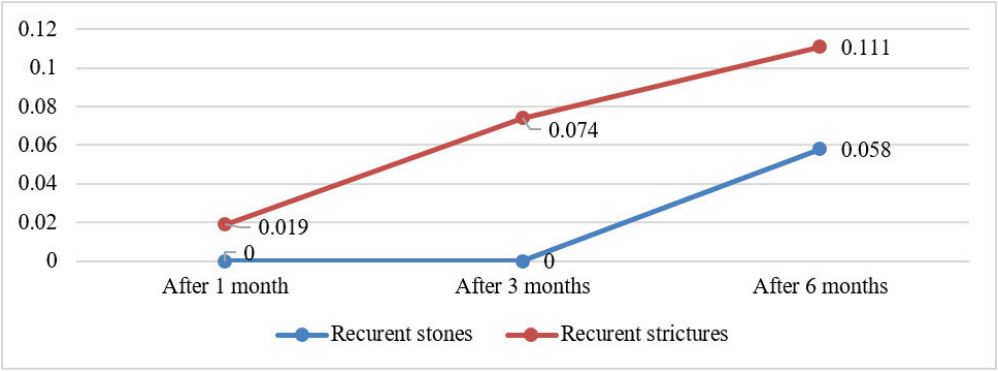

Chart 1. Recurrent biliary stones and strictures.

At 1, 3, and 6 months postoperative periodically, we scheduled follow-up examinations for 52 patients who had completed stone clearance and 54 patients who had completed BS dilation. The recurrence rates of stones and strictures were 0%, 0%, 5.8%, and 1.9%, 7.4%, 11.1%, respectively.

DISCUSSION

In this research, 75.8% of patients had a history of biliary stones, of which 54.8% had undergone biliary surgery. This showed that the prominent characteristic of BS patients was the high rate of residual and recurrence stones postoperative.

Stones were both choledocholithiasis and hepatolithiasis. Stones were often located around the BS, which were mostly intrahepatic strictures. Left hepatic duct stricture was the highest rate (30.6%). Nguyen Quang Nam also found that the rate of intrahepatic stones and strictures was also higher than that of extrahepatic ones. The author assumed that left hepatic stones were more common than right hepatic stones (20.8% compared to 11.1%) [6].

In this study, when the majority of patients had multiple stones (79%), most of the cases were one-location BS (90.3%). We found that the average length and diameter of BS were 3.96 ± 2.9mm and 3.6 ± 0.7mm, respectively, and all BS were benign. Jeng KS published that the diameter of BS was the indication for choosing treatment methods, and the length of BS was the indication for biliary stent placement to prevent recoil [7]. We classify BS according to Lee SK [3]: 81.2% of BS were mild, and only 5.8% were severe.

Our most used surgical method was choledochotomy with intraoperative flexible cholangioscopy (90.3%). For patients who already had the percutaneous tunnel from previous interventions (8.7%), we performed flexible cholangioscopy via the existing channel without the

need for reoperation. Zhu J believed that the key to achieving a high stone clearance rate was using a variety of methods to remove the stones [8]. In this study, we used 3 methods to remove biliary stones via cholangioscopy such as baskets, electrohydraulic, and laser lithotripsy. The baskets were used alone only in 7 cases with few stones. The remaining cases used baskets combined with lithotripsy. Especially, we used both electrohydraulic and laser lithotripsy in 19 cases (30.6%) to take advantage of diverse stones (*Table 3*).

We used balloon dilation for BS. The results after dilation were evaluated using direct cholangioscopy. We successfully dilated 87.1% of cases and were able to continue removing stones in the bile duct behind the stricture. Only 8 cases (12.9%) failed to dilate because of severe (2 cases) and moderate (6 cases) strictures.

40/62 patients had biliary stents placed to prevent strictures recoiling. In patients with 2 or 3 BS, only 1 stent was placed through all strictures. We did not place stents on other cases with a low possibility of recoiling according to the ACG guideline [4] or BS dilation failure. We used 2 types of stents: T-tube 16Fr and Silicon tube 16Fr. In fact, we used the T-tube in cases of extrahepatic or right, left hepatic BS (33.9%). In cases of section or segment BS, we use a silicone tube (35.5%).

Intraoperative complications were 16.1%, with 9 cases of biliary bleeding after dilation and lithotripsy, all of which were treated with hemostatic drugs. The remaining case was duodenal perforation during dissection to find the choledoc on the patient who had previous surgeries. We performed a 2-layer suture duodenal repair. Then, the patient was in stable condition. The postoperative complication rate was 12.9%, with biliary bleeding (2 cases), bile leak (1 case), surgical site infection (3 cases), and acute pancreatitis (2 cases). These patients were all treated with medicine and were stable without the need for reoperation. According to Nunes T, in general, complications of cholangioscopy were rare because it was a minimal intervention [5].

Our completed stone clearance and BS dilation rates were 83.9% and 87.1%, respectively. 8 patients who failed dilation still had biliary strictures. Among the 10 patients with residual stones, 8 had remained strictures, and 2 had inaccessible angled bile ducts. Zhang W found that when the bile duct was highly angled, the cholangioscope could neither properly investigate nor remove stones [9].

At 1, 3, and 6 months postoperative periodically, we scheduled follow-up examinations for 52 patients who had completed stone clearance and 54 patients who had completed BS dilation. After

1 and 3 months, no cases of stone recurrence were found; however, there were 1 (1.9%) and 4 cases (7.4%) of BS recurrence, respectively. After 6 months, the rate of stones and BS recurrence increased, at 5.8% and 11.1%, respectively. Le Quan Anh Tuan also concluded that the longer the postoperative period, the higher the risk of stones and BS recurrence [10].

CONCLUSION

Biliary dilation and stone removal via flexible cholangioscopy were initially safe and effective methods for treating primary BS and stones. These methods had a high rate of completed stone clearance and stricture dilation and a low rate of complications and recurrence.

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