RESEARCH REPORT

Percutaneous Transhepatic Removal of Bile Duct Stones

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The development of bile duct stones is a common biliary tract disorder in Taiwan. Surgery and choledochoscopy are the current methods of treatment. The purpose of this study was to describe percutaneous transhepatic intervention under fluoroscopy for the removal of biliary stones. Between July 1998 and June 1999, 46 patients with obstructive jaundice, biliary colic, and cholangitis secondary to the biliary stones underwent percutaneous biliary stone removal under fluoroscopy. Angiographic superselective catheterization technique was employed for superselective cholangiography to identify the location of stones and to deliver the basket and electrohydraulic lithotripsy (EHL) probe to the site of the stones. Most of the patients needed multiple sessions (four on average) to remove all the stones. Chills and fever were the procedure-related complications. Four patients (8.7%) had recurrent stone formation during 2 to 12 months of follow-up. Percutaneous biliary stone removal under fluoroscopy is of benefit for direct visualization of the location and number of stones and the architectural changes of the bile ducts.

Key words: **Bile ducts, calculi; Bile ducts, interventional procedure**

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Bile duct stones are common in Taiwan. Patients with this condition are prone to recurrent cholangitis which can easily induce life threatening sepsis. Despite advances in hepatobiliary surgery, the results of operative management have not been satisfactory because of high incidence (24 to 48%) of residual stones [1, 2] and a high rate of recurrence (83%)[2]. Retained stones present a difficult problem for the patient and the surgeon. Most patients with retained stones are either symptomatic or may be expected to become symptomatic, since spontaneous passage is rare.

In recent years, the use of fiberoptic choledochoscopy, either intra-operatively or percutaneously postoperatively, has significantly reduced the rate of residual stones in the bile duct. However, angulation and stricture of the intrahepatic duct have been major causes of failure. A safe, nonoperative approach would be desirable, thus avoiding the need for further surgery.

This study presents the results of 46 cases of percutaneous biliary stone removal under fluoroscopy.

MATERIALS AND METHODS

Forty-six patients underwent percutaneous biliary stone removal (PBSR) under fluoroscopy for common bile duct (CBD) and intrahepatic bile duct(IHD) stones between July 1998 and June 1999. There were 29 men and 17 women with an age range of 30 to 85 years (mean, 65 years); 19 other patients, treated with surgery, were identified during the same period. One patient had undergone biliary surgery one time, six patients had been managed with endoscopic sphincterotomy, two patients had been treated with PBSR, and 37 patients who refused surgical treatment had not undergone any biliary procedures. Thirteen patients had a single stone and 33 patients had multiple stones. Of the patients, 34 had stones located in the CBD, four in the CBD and right IHDs, seven in the CBD and left IHDs, and one in the CBD and bilateral IHDs (Table 1). The tracts for PBSR were a right percutaneous transhepatic cholangiographic drainage (PTCD) tract in 38 patients, a left PTCD tract in four, and bilateral PTCD tracts in four (Table 2).

All procedures were performed under fluoroscopic monitoring without choledochoscopic assistance. Selective cholangiographies were performed during the procedures, demonstrating the location and the number of stones and architectural changes of the biliary ducts (Fig. 1).

The PTCD tracts were set up first. The tracts for PBSR were 16 Fr in diameter. The PTCD tracts were dilated from 8 Fr to 18 Fr in two steps. Assisted with a safety guide wire, the PBSR could be started 3 days after the PTCD tract was dilated to the proper diameter.

An angiographic superselective catheterization technique with a cholangiographic catheter assisted with 0.035 guide wire was used.

Superselective catheterization of most of the biliary radicles was accomplished, then selective cholangiography and removal of the peripherally located stones could be performed.

We used Dormia 4-wire baskets (Boston, USA) to crush and remove the stones (Fig. 2). Electrohydraulic lithotripsy (EHL) through a guiding catheter was used to crush the stones which could not be trapped by the baskets.

A successful PBSR was defined as complete clearance of stones verified by both cholangiography (Fig. 2) and sonography. When symptoms recurred during the follow-up period, sonography and endoscopic retrograde cholangiography (ERCP) were used to verify the recurrence of stones.

RESULTS

The biliary stones ranged from 0.2 to 4 cm in diameter and were all removed from the biliary tract.

Most of the stones were crushed and removed with the 4-wire basket, but 10 patients (21.7%) needed EHL to crush the stones through a guiding catheter. The patients received one to eight sessions (mean, foursessions) to remove the stones completely.

The average time from initial catheterization until the percutaneous catheter was removed was 10 days (range, 3 to 29 days). All patients were discharged at the end of catheterization.

Forty-four of the 46 patients were afforded complete removal. Two of the 46 had intrahepatic duct stones which could not be completely removed. These stones were trapped in angulated short peripheral hepatic ducts, making catheterization or opening of the basket impossible. Overall, the successful clearance rate was 95.7%.

Fever and chills were the procedure-related complications which developed in six patients (13%). There were no deaths from the procedure.

Four patients (8.7%) had recurrent stone formation during 2 to 12 months of follow-up.

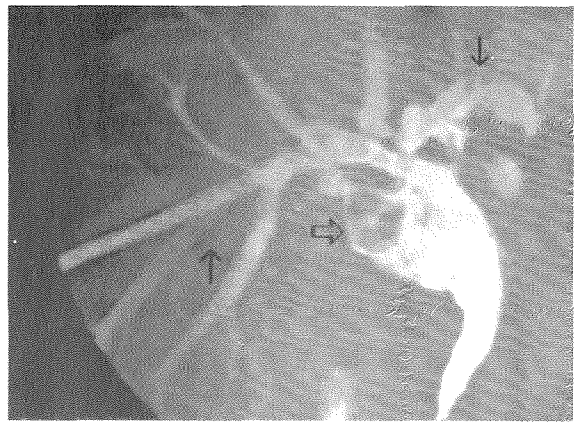


Figure 1. Cholangiogram demonstrating multiple stones in the bilateral intrahepatic ducts and common bile duct.

DISCUSSION

Biliary duct stones have a high complication rate (over 50%) and thus must be removed. Operative extraction is a major surgical procedure. However, operative management has not been satisfactory, with a high incidence (24 to 48%) of residual stones [1, 2] and a high rate of recurrence (83%)[2].

Chen et al [2] reported a 57.1% success rate for residual intrahepatic stone removal through a T-tube by choledochoscopy. Chen et al [3] also achieved an 80% success rate with percutaneous transhepatic removal of common bile duct and intrahepatic duct stones using choledochoscopy.

The advantages of choledochoscopy are the direct visual control of the instruments for stone removal, permitting accurate recognition of air bubbles and blood clots which had been mistaken as stones radiographically, and no absence of radiation exposure for both patients and physicians. However, a duct which is tortuous or has strictures and stones located in the peripheral radicals are major causes of failure by means of choledochoscopy [2, 4].

Percutaneous transhepatic removal of common bile duct stones and intrahepatic duct stones in our patients was performed because of residual stones post surgery, unsuccessful stone removal after endoscopic sphincterotomy or because the patients preferred the transhepatic approach.

All procedures, namely, stone crushing and removal, were performed under fluoroscopic monitoring. After instillation of contrast medium into the bile duct, the location and number of stones and the architecture of the bile duct are well demonstrated. Using an angiographic catheterization technique, a guiding catheter could be placed into most of the peripheral radicles of intrahepatic ducts through the PTCD tract, so that we could achieve a high successful clearance rate. However, the increased radiation dose to both patients and physicians still the major disadvantage of this procedure under fluoroscopy.

Because of the nature of the disease, most of the patients had multiple stones and architectural changes of the bile ducts. These factors increase the difficulty of stone removal. One patient underwent eight sessions to remove bilateral intrahepatic stones and CBD stones completely. An average of four sessions was needed for each patient to clear the stones in our series. Needing longer fluoroscopic time to

Table 1. Locations of bile duct stones

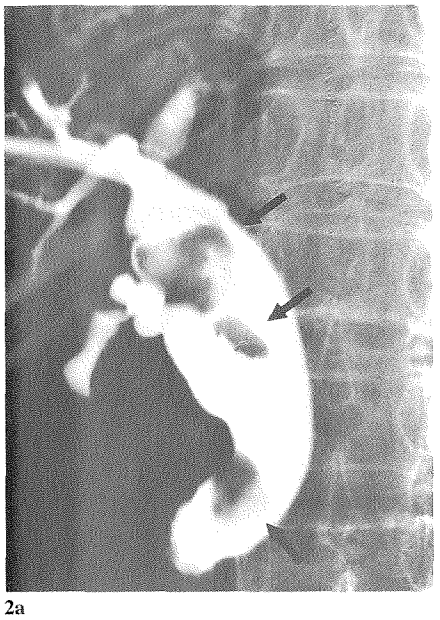
CBD	34
CBD + Rt. IHD	4
CBD + Lt. IHD	7
CBD + Bil IHDs	1
Total	46

CBD: common bile duct; Rt. IHD: right intrahepatic duct;
Lt. IHD: left intrahepatic duct; Bil IHDs: bilateral intrahepatic ducts.

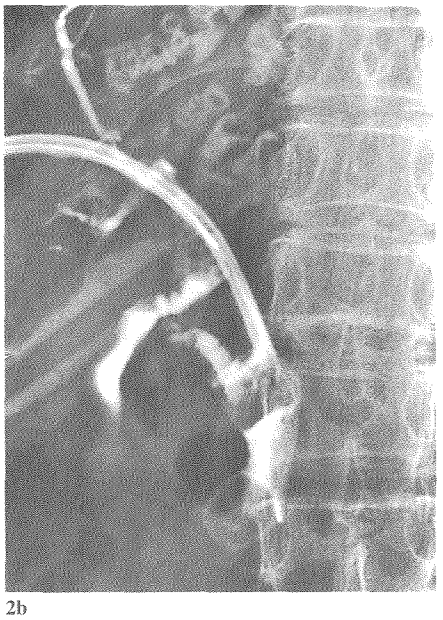
Table 2. Tracts for percutaneous biliary stone removal

Rt. PTCD	38
Lt. PTCD	4
Bil PTCD	4

Rt. PTCD: right percutaneous cholangial drainage tract;
Lt. PTCD: left percutaneous cholangial drainage tract;
Bil PTCD: bilateral percutaneous cholangial drainage tracts.



2a



2b

Figure 2. a. The view through a right percutaneous drainage catheter shows a large common bile duct stone which could not be removed with ERCP. **b.** The stone has been trapped in the basket; **c.** After fragmentation; **d.** The final cholangiogram shows clearance of fragments from the CBD.

2c

2d

do the procedures implied more irradiation to both the patients and the radiologists. For removal of multiple bilateral intrahepatic duct stones, bilateral PTCD tracts must be set up.

Chills and fever after the procedure were the major complications in our series, occurring in six cases which involved multiple stones. This illustrated that pre-existing biliary infection can result in septicemia during the procedure. Adequate biliary drainage and antibiotic administration were necessary to prevent septicemia. Intrahepatic arterial injury is related to PTCD for tract establishment. Immediate transcatheter arterial embolization can be performed to stop arterial bleeding and a new PTCD tract for stone removal can be established. Jeng et al [5] reported bleeding in 24% of their cases. In our series, no intrahepatic arterial injury was found. Other reported complications [6, 7] of pancreatitis and common bile duct perforation also did not occur in our study.

Recurrent biliary stone formation is the nature of the disease. Recurrent stone formation was found in 8.7% of the patients in 2 to 12 months of follow-up. Choi et al [8] cited that unrelieved biliary stricture also contributed to a high rate of recurrence. Opening the strictures with a balloon dilator is expected to prevent biliary stasis and stone formation.

In summary, we think that percutaneous transhepatic removal of biliary duct stones is the treatment of choice for retained or recurrent biliary stones. The morbidity and mortality rates compare favorably with those of surgery. ◆

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X-光透視下經皮穿肝膽道取石術

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本研究計劃中有46位患者接受X-光透視下經皮穿肝膽道取石之手術。這些患者常合併有阻塞性黃膽，膽絞痛及膽管炎。血管攝影的超選擇性導管操作技術可應用來作超選擇性膽道攝影，也可利用於將取石套籃或電擊碎石的探頭送到膽石的位置。

為了取出所有的膽道結石，大部分的病患需要施行多次的取石術(平均4次)。發燒，畏寒，胰臟炎，肝動脈損傷及膽管穿孔是施行此手術時可能引發的併發症。

X-光透視下經皮穿肝膽道取石術的優點在於可以直接清楚的觀察到結石的數目及位置，同時也可以明瞭膽道結構的變化。

關鍵詞：膽道，結石；膽道，介入性步驟