Percutaneous Transhepatic Cholecystoscopy and Biliary Endoscopic Lithotripsy

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Abstract
We have been developing procedures for percutaneous transhepatic cholecystoscopy (PTCCS) through the sinus tract of percutaneous transhepatic cholecystostomy since 1981, and have used this method on 67 patients with gall bladder diseases. We also performed biliary endoscopic lithotripsy with PTCCS and percutaneous transhepatic cholangioscopy (PTCS) using a Nd-YAG laser or electrohydraulic shock wave lithotripter to non-operatively treat 83 patients with cholangolithiasis, 11 with cholecystolithiasis, and four with choledocholithiasis. The present paper reports the PTCCS procedures and their usefulness for the precise diagnosis of early carcinoma of the gall bladder, and the usefulness and safety of biliary endoscopic lithotripsy techniques.

Key words: Percutaneous transhepatic cholecystoscopy, cholangioscopy, choledochoscopy, biliary endoscopic lithotripsy, laser lithotripsy, electrohydraulic shock wave, gall bladder carcinoma, diagnostic and therapeutic endoscopy.

Introduction
Endoscopic procedures in the gastrointestinal tract are well developed for diagnosis and treatment of several gastrointestinal disorders. However, the anatomy of the biliary system makes it difficult to perform endoscopy of the mucosa of the gall bladder or of the bile duct. Although there are several diagnostic imaging techniques available for biliary diseases, their precise diagnosis is very difficult in the absence of tissue diagnosis, especially in early carcinoma of the gall bladder and the bile duct. We have therefore been performing percutaneous transhepatic cholangioscopy (PTCS) since 1979 and percutaneous transhepatic cholecystoscopy (PTCCS) since 1981. These procedures are useful for precise preoperative diagnosis of carcinoma in the biliary system and for non-surgical treatment of high-risk patients with cholangitis. Our present paper reports the procedures for percutaneous transhepatic biliary endoscopy and its usefulness in the diagnosis and treatment of biliary diseases.

Materials and Methods
Between 1981 and 1987, PTCCS was performed in our hospital on 67 patients with gall bladder disease (carcinoma—19, adenoma—1, hyperplastic polyp—3, cholesterol polyp—13, and cholecystitis—31). From 1979 to 1987, PTCS was performed on 239 patients with biliary disease or obstructive jaundice (bile duct carcinoma—36, pancreas carcinoma—24, other malignant diseases—41, benign tumor of the bile duct—4, cholangitis—114, and other benign diseases—20). Of the cholangitis cases, we treated 83 patients with cholangolithiasis (intrahepatic stone—8 and extrahepatic stone—75) by PTCS, and 11 patients with cholecystolithiasis and four with choledocholithiasis with PTCCS.

Percutaneous Transhepatic Cholecystoscopy (PTCCS)
PTCCS was performed under irrigation by normal saline, through the sinus tract of percutaneous transhepatic cholecystostomy (PTCCD) (Fig. 1). Because a sinus tract about 5 mm in diameter is necessary for passing the biliary endoscope, the sinus tract of PTCCD needs to be dilated to 16 Fr (5.1 mm) diameter.
PTCCD was performed at the seventh or eighth intercostal space under ultrasonographic imaging using a real time scanner with a 3.5 or 5 MHz transducer. Dilatation of the sinus tract was usually performed immediately after the PTCCD procedure itself, with a polyurethane dilator set of 10, 14 and 16 Fr. PTCCS was performed starting a week after dilatation of the sinus tract. When PTCCS and pathological examinations of the biopsied specimens revealed carcinoma or adenoma, the patients were operated on, when benign tumours, such as cholesterol polyp, hyperplastic polyp or adenomyomatosis were revealed, the patients were discharged after removing the drainage catheter.

Percutaneous Transhepatic Cholangioscopy (PTCS)
The PTCS procedures were similar to the PTCCS ones. PTCS was performed under irrigation by normal saline, through the sinus tract of percutaneous transhepatic biliary drainage (PTCD) (Fig 2). PTCS was performed with puncture at the seventh or eighth intercostal space or right subcostally with ultrasonographic imaging, and dilatation of the sinus tract was performed immediately after PTCD itself. PTCS was performed starting a week after dilatation of the sinus tract. When PTCS revealed malignant lesion, the patient underwent operation, and when PTCS revealed benign lesion, the patient was discharged after removing the drainage catheter.

Nd-YAG laser was used. Laser irradiation on cholesterol stone was performed at a power of 50 watt for one second, and on pigment stone at 30 to 50 watts for 0.5 second. Recently we have used an electrohydraulic shock wave lithotriptor (EHL). EHL was performed at a power of 70 watts for 0.5 seconds. After repeating irradiation several times, the stone was perforated with a lot of holes and became fragile. It was then easily crushed by a grasping forceps. After destruction, the small pieces were removed by a basket catheter through the sinus tract. When no residual stones could be recognized either endoscopically or radiologically, the patients were discharged 2 or 3 days after removing the drainage catheter.

Results

PTCCS

PTCCD and PTCCS were successfully accomplished in all 67 patients. Endoscopic diagnosis was confirmed by histopathological examination of the surgical specimens in all patients who underwent subsequent surgery. We experienced no severe complications at the time of PTCCD and dilatation of the sinus tract of the PTCCD; however, in 3 of 67 cases, the liver and abdominal wall were ruptured at the time of PTCCS.

PTCCS revealed that the normal mucosa of the gall bladder had a fine reticular pattern (FRP). In gall bladder carcinoma, PTCCS revealed the protruded type as papillary, nodular, or sessile tumors (Fig 3), the superficial elevated type as slight-elevated, nodular or granular, or sessile tumor, and the superficial flat type as irregular or granular mucosa without FRP. The mucosa of the carcinoma bled easily on touching with the endoscope. Adenoma was revealed as a papillary, velvety, and sessile tumor. Cholesterol polyp was a slightly yellowish, pedunculated, and multifibulated tumor. Hyperplastic tumor was slightly reddish, smooth, and sessile.

![Fig 2: Cholangiography during PTCS on patient with choledocholithiasis reveals several stones in the dilated common bile duct.](image)

Biliary Endoscopic Lithotomy

Biliary endoscopic lithotomy was performed with PTCS and/or PTCCS using laser irradiation or electrohydraulic shock wave lithotriptor (EHL). When endoscopic lithotomy was performed, the biliary endoscope had to be removed from the sinus tract without a guidewire. Since a strong sinus tract is necessary, biliary endoscopic lithotomy was not performed until two weeks after dilatation of the PTCD or PTCCD sinus tract.

![Fig 3: Endoscopic findings by PTCCS. A papillary tumor is observed on the fundus of the gallbladder. The surrounding normal mucosa shows a fine reticular pattern.](image)
Biliary Endoscopic Lithotomy

PTCS lithotomy was successful in 87 of 88 patients with cholecolithiasis (with intrahepatic stones—8, with extrahepatic stones—75 and with cholecysto-choledocholithiasis—4; these last four patients were also treated by PTCCS). The complication rate with PTCS lithotomy was 9.2% (8 of 87 patients).

Laser lithotomy was performed on 38 patients; other methods, we basket catheter, biopsy forceps, battery-operated drill, were employed in 41 patients; and EHL on eight patients. PTCCS lithotomy was successful in all 11 patients with cholecystolithiasis. Laser lithotomy was performed on five patients with stones larger than 1 cm in diameter.

Discussion

Cholecystoscopy was first described in 1937 by Hol- lenberg and Eihnm, who used a urinary bladder cystoscope through a cholecystotomy stoma. The purpose of their procedure was to find and remove stones left in the gall bladder or in the first part of the cystic duct. Siegel and Mayer reported that cholecystoscopy and cholecdochoscopy had assumed essential roles in the management of biliary tract diseases, providing a new approach to extracting retained stones, obtaining biopsies, providing antegrade manometric determinations, and assisting sphincterotomy. They performed cholecystoscopy after operation, but we developed it for detailed preparative diagnosis of gall bladder polypoid lesions. Early diagnosis of gall bladder carcinoma is essential, because the prognosis for advanced carcinoma of the gall bladder is very poor.

Carcinoma of the gall bladder is difficult to diagnose preoperatively, and Fehler and Crehorski, based on a review of the literature, estimated that the mean correct preoperative rate of diagnosis was only 8.6%. Because of the development of diagnostic imaging, like ultrasonography, computed tomography, endoscopic retrograde cholangiopancreatography and percutaneous transhepatic cholangiography, the rate of correct preoperative diagnosis has increased to 70% to 82% in patients with advanced carcinomas of the gall bladder. Since the development of ultrasonography, several patients have been found with small lesions of the gall bladder without symptoms. However, because of the anatomical situation of the gall bladder, there were no reliable methods for precise diagnosis in the biliary system which were comparable to endoscopy in the gastrointestinal tract.

Peroral cholangio-pancreatoscopy was developed in 1974 by Takagi in Japan, and was reported in 1978 by Nakajima et al, but this manoeuvre does not enable insertion of an endoscope into the gall bladder. Meanwhile, percutaneous transhepatic cholangioscopy (PTCS), for inserting endoscopes into the bile duct and observing the mucosa of the bile duct directly, has become a useful and safe method for the diagnosis of biliary tumours and treatment of cholecystitis. The first PTCS was reported in 1972 by Takada and established as a diagnostic and therapeutic technique in 1976 by Nimura in Japan. We developed percutaneous transhepatic cholecystoscopy (PTCCS) from procedures similar to PTCS. PTCCS is more useful than peroral cholangioscopy for the diagnosis of gall bladder carcinoma, because one can perform biopsy under endoscopic observation in PTCCS.

Although a rigid scope is reported to be convenient in cholecystoscopy, inexpensive to maintain and easy to use, a flexible endoscope is also available. The use of flexible cholangioscope was first reported by Shore and Lippman in 1962. Yamakawa et al reported an improved cholecystoendoscopy with non-surgical removal of retained calculi after operation, and it is further improving year by year. We used the flexible endoscope because we wanted to observe the whole mucosa of the gall bladder, and this can be done by a flexible endoscope more easily than a rigid one. We now consider the flexible endoscope to be useful and necessary for early detection and pathological diagnosis of carcinoma of the gall bladder.

Mortality in early surgical intervention for acute cholecystitis or cholangitis in patients older than 65 years of age is still high (4-4.2% to 6-7%). On the other hand, as many as 15% of patients with acute cholecystitis do not respond to conservative treatment. So the treatment of such patients must be selected carefully. Percutaneous transhepatic cholecystostomy and percutaneous transhepatic biliary drainage have become safe methods for the treatment of elderly, high-risk patients with acute cholecystitis and cholangitis. Because we can perform biliary endoscopy consecutively with biliary drainage, biliary endoscopic lithotomy is useful and safe for the treatment of high-risk patients with cholecystitis, especially with acute cholecystitis or acute cholangitis, when the patients cannot be operated on because of the risk of complications such as renal failure, congestive heart failure, etc. Earlier literature has reported a few complications at the time of percutaneous transhepatic cholecystostomy (PTCCS): biliary peritonitis after catheter dislodgement, valgus reaction, and intrahepatic bleeding. Dunik emphasized that the puncture was not performed on the anterior abdominal wall, but near the right axillary line through the liver to avoid entry into the fundus. Using our technique we found PTCCS and PTCS to be safe when performed by those skilled in intrahepatic manoeuvres.

The treatment of first choice for patients with cholelithiasis is undoubtedly surgery. In cholecdocholithiasis, endoscopic sphincterotomy is a useful and safe method, but it cannot be performed in patients after Billroth II gastrostomy, and is contra-indicated in patients with stenosis of the intrahepatic bile duct or with intrahepatic stones. When bigger than 2 cm in diameter, cholesterol stones are too hard to crush by the basket catheter usually used in endoscopic sphincterotomy. In such cases, PTCS lithotomy becomes useful as the main procedure. While post-operative cholecystoscopy through the sinus tract of cholecdocholithiasis has been reported to be a useful complementary procedure for bile duct stone, PTCS lithotomy is more useful for patients with previous multiple operations or patients with severe complications. Operation is difficult in patients with bilateral intrahepatic stone, and another major problem is recurrence of intrahepatic stone. In these situations the
treatment of first choice. In cholecystolithiasis, surgery is the first option. However, operation is dangerous for elderly, high-risk patients with acute cholecystolithiasis, mentioned before. Since percutaneous transhepatic cholecystostomy can be performed safely, and dilatation of the sinus tract is also easy and safe, PTCCS is useful for such patients. Patients with cholecystolithiasis can now be treated non-operatively with PTCCS.25

The lithotripter is another recent development. Laser lithotripsy of intrahepatic stones was reported in 1981,26,27 and its usefulness for biliary stone has been reported by others.28 However, laser itself is very expensive and, because quartz fiber is hard, when inserting it into the biopsy channel the endoscope cannot be bent to its normal limit. The electrolydraulic shock wave lithotripter is cheap—one tenth the cost of the laser instrument—and its probe is softer than quartz fiber. EHL was reported in 1975 by Burhenne29 through the sinus tract of cholecystostomy under fluoroscopic observation, and in 1980 by Koch30 through the papilla of Vater with duodenoscopic manoeuvre under fluoroscopic observation. However, irrigation without direct observation entails the danger of injury to the bile duct, so we consider biliary endoscopic lithotripsy to be a better procedure. Biliary endoscopic lithotripsy with an electrolydraulic lithotripter, like urinay endoscopic lithotripsy, was reported in 1985 in Japan.

Although biliary endoscopic lithotripsy is both useful and safe, one disadvantage is the long period of admission. Hopefully, this problem will be solved in the near future with development of better techniques for crushing stones.

References