Percutaneous Trans-Papillary Elimination of Common Bile Duct Stones Using an Existing Gallbladder Drain for Access

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ABSTRACT: **Background:** The presence of stones in the common bile duct (CBD) may cause complications such as obstructing jaundice or ascending cholangitis, and the stones should be removed.
Objectives: To assess the efficacy of percutaneous elimination of CBD stones from the gallbladder through the papilla.
Methods: During a 4 year period, six patients (five men and one woman, mean age 71.5 years) who had CBD stones and an existing gallbladder drain underwent percutaneous stone push into the duodenum after balloon dilatation of the papilla, with a diameter equal to that of the largest stone. Access into the CBD was from the gallbladder, using an already existing percutaneous gallbladder drain (cholecystostomy tube).
Results: Each patient had one to three CBD stones measuring 7–14 mm. Successful CBD stone elimination into the duodenum was achieved in five of the six patients. The single failure occurred in a patient with choledochal diverticulum, who was operated successfully. There were no major or minor complications during or after the procedures.
Conclusions: Trans-cholecystic CBD stone elimination is a safe and feasible percutaneous technique that utilizes existing tracts, thus obviating the need to create new percutaneous access. This procedure can replace endoscopic or surgical CBD exploration.

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KEY WORDS: common bile duct (CBD), bile stones, cholecystostomy, balloon, trans-papillary expulsion

Bile stones may be located along the entire biliary tree, mostly in the gallbladder [1]. In the common bile duct, bile stones may be asymptomatic or they may cause a spectrum of symptoms that include biliary colic, obstructing jaundice, ascending cholangitis, biliary sepsis, pancreatitis, and even death [1]. Most of the stones can be eliminated successfully by surgical exploration of the CBD (open or laparoscopic) or by endoscopic means [3-6]. In patients at high surgical risk with contraindications to endoscopic intervention or in whom endoscopy failed, various percutaneous interventions to eliminate CBD stones are feasible. With all these treatments the bile stones are expulsed into the duodenum after balloon dilatation of the papilla using occlusion balloon, or the stones are crushed using a stone basket. Access is through existing intrabiliary tubes such as an indwelling T-tube drain or percutaneous trans-hepatic biliary drain, or through a new percutaneous trans-hepatic cholangiography access into the bile ducts [7-11].

Today, patients with acute cholecystitis are treated conservatively in the acute phase [12,13]. In elderly patients, especially in those with severe comorbidities, there is an increasing tendency to insert a cholecystostomy drain more liberally and earlier in the disease course [14,15]. Patients who fail to improve are usually treated surgically. Not infrequently, in addition to the gallbladder, stones may also coexist in the CBD. It is believed that about 80% of stones migrate from the gallbladder (secondary calculi) and the rest are formed in the CBD due to bile stasis (primary calculi) [16]. CBD stones are more difficult to eliminate surgically since the CBD must be opened and explored in order to remove the stones. In this report we present our experience using an existing drain in the gallbladder as a port to eliminate CBD stones into the duodenum.

CBD = common bile duct

PATIENTS AND METHODS

This was a retrospective study to evaluate the efficacy and safety of trans-papillary expulsion of CBD stones into the duodenum, utilizing existing gallbladder drains. Institutional Review Board approval was not required at our institution for a retrospective study such as this. However, in keeping with the ethical conduct of studies, the principles of the Declaration of Helsinki were followed.

PATIENTS

Between January 2006 and May 2009, six patients (five males and one female, age 44–88 years, mean age 71.5) with existing

Table 1. Summary of patient data and results of the CBD stone expulsion procedures

	Age/ Gender	No. of stones	Size of the largest stone (mm)	Balloon size used for dilatation and expulsion (mm)	No of interventions	Success/failure
1	76 / F	1	14	14 x 40	1	S
2	73 / M	1	8	8 x 40	1	S
3	44 / M	1	8	8 x 40	2	S
4	77 / M	3	7	8 x 40	1	S
5	71 / M	2	10	10 x 40	1	S
6	88 / M	1	14	14 x 40	1	F, due to choledochal cyst; patient was successfully operated

percutaneous cholecystostomy tube that had been inserted earlier in our unit for acute cholecystisis, and known to also have CBD stones, were referred to our interventional radiology unit for stone expulsion to the duodenum [Table 1]. The first two patients had a cholecystostomy drain, and since endoscopic retrograde cholangiopancreatography was contraindicated due to a history of small bowel and gastric bypass surgery they were considered at high surgical risk. We decided to try to eliminate the CBD stones percutaneously, based on our experience of expelling CBD stones into the duodenum from the PTC or trans-cystic access according to the method described by Garcia-Villa et al. [8] and Gil et al. [9] – but from the gallbladder. We wanted to utilize the existing gallbladder access as a route to the CBD before creating a new PTC access. Based on the knowledge that the cystic duct has a muscular layer that enables its dilatation, we assumed that it may enable passage of the vascular sheath into the CBD. After succeeding in the first two patients and based on the collaboration with surgeons in the percutaneous treatment for CBD stones either by balloon push into the duodenum through PTC drain or laser stone maceration through the PTC tract in the operating room, an additional four patients with an existing cholecystostomy tube were referred for treatment via the gallbladder. There were one to three stones measuring 7 to 14 mm in the CBD; there were no stones in the intrahepatic ducts. Each patient had between one and three stones.

TECHNIQUE

The interventions were performed using intravenous sedation (midazolam) in the angiography suite after obtaining informed consent. We used the technique described by Garcia-Villa et al. [8] and Gil et al. [9] with a few minor modifications. Cholangiography was performed through the existing drain, demonstrating the patent cystic duct and verifying the existence, size and number of the CBD stones. Prophylactic IV broad-spectrum antibiotics (ceforal) were administered prior to the intervention. The drain was exchanged over a guide-wire (Bentson, Cook, Bloomington, IN, USA) and a 4 Fr 65 cm angled-tip catheter was inserted into the gallbladder (Berenstein, Angiodynamics, NY, USA). The Bentson wire was exchanged for hydrophilic 0.035" angled guide (Glidewire, Terumo, Tokyo, Japan) and, by manipulating the wire and the catheter, they were advanced into the CBD via the cystic duct and through the papilla into the duodenum. The glide-wire was inserted through the existing drain exchanged with a 180 or 260 cm stiff guide-wire (Amplatz super-stiff, Boston Scientific, Natic, MA, USA) and a 9 Fr 23 cm sheath (Cook, Bloomington) was introduced into the CBD. A non-compliant balloon (Powerflex, Cordis, Warren NJ, USA), equal to the diameter of the largest balloon (ranging from 8 x 40 to 14 x 40 mm was then advanced to the region of the papilla of Vater. Quick manual dilatation of the papilla was performed with the balloon, and after balloon deflation and its advancement into the duodenum, a cholangiogram was obtained through the sheath to locate the stones [Figures 1 and 2]. The balloon was retracted proximally to the stones in the CBD, and after inflation the balloon was firmly pushed over the wire into the duodenum and a repeat cholangiogram was performed. If the stones moved proximally into the liver hilum, diluted contrast was injected into the CBD and the bed was tilted for gravitational stone movement. This maneuver was then repeated until no stone was evident in the CBD; this usually took up to five times. After completion cholangiography, a 10 Fr internal biliary drain (Cook, Bloomington) was left closed for internal drainage for 1 to 2 weeks to allow bile secretion. A repeat cholangiograph was obtained through the sheath, while leaving safety wire in the duodenum to verify that all the CBD stones had been expelled. If stones were still evident (as in one of our patients) the procedure was repeated. If the CBD was stone-free and good passage of contrast into the duodenum was evident, the safety guide-wire and sheath were extracted, leaving the patient without drainage. Elective laparoscopic cholecystectomy was to follow if gallbladder stones were evident. Our modifications of the technique described by Gil and Garcia-Villa and teams

PTC = percutaneous trans-hepatic cholangiography

Figure 1. CBD stone elimination in a 76 year old woman. **[A]** Routine cholangiography through gallbladder drain inserted during acute cholecystitis demonstrates a solitary 12 mm CBD stone (arrow). **[B]** A12 x 40 mm balloon inserted through a 9 Fr sheath over a guide-wire is inflated at the papilla. **[C]** Cholangiogram via the sheath demonstrates elimination of the stone and good passage into the duodenum. **[D]** Control cholangiography performed one week later, prior to drain removal, verifies that the stone is no longer present in the CBD

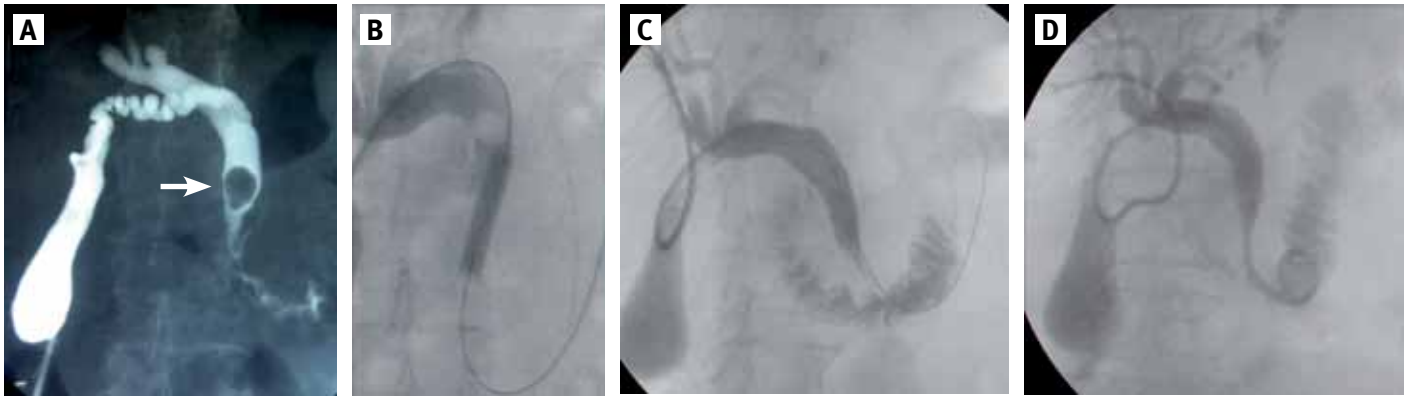
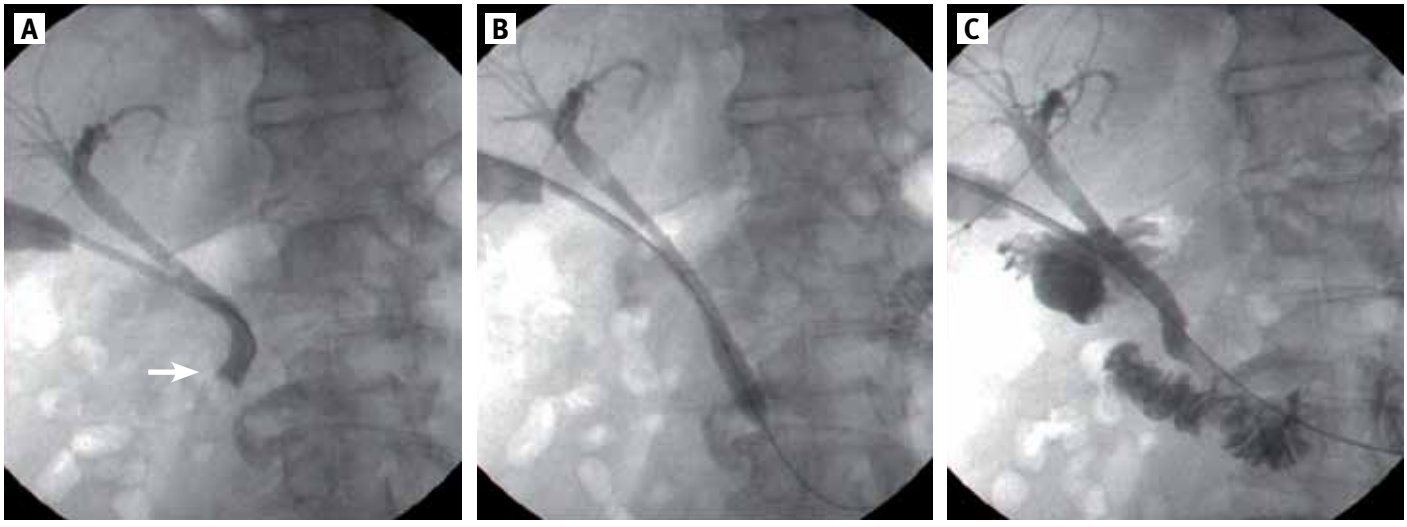


Figure 2. Solitary CBD stone detected during cholangiography in a 77 year old man. **[A]** Contrast media injection through a catheter inserted from the gallbladder replacing the gallbladder drain. An 8 mm single stone in the distal CBD, demonstrated as a filling defect (arrow). **[B]** An 8 x 40 mm balloon is inflated at the papilla. **[C]** Colangiography after stone push verifies its passage



were not injecting glucagon or nitrites to relax the sphincter, reducing the papillary inflation time (up to 10 seconds), and using only one balloon for both papillary dilatation and stone elimination.

RESULTS

Complete CBD stone expulsion was successful in five patients. The one failure occurred in a patient with choledochal cyst that was unknown prior to the intervention. The cannulation from the gallbladder into the duodenum went well, but the balloon push failed because the stone persistently entered the cyst rather than the duodenum. The patient received an internal biliary 10 Fr drain (Cook, Bloomington) that was kept in place until the operation was successful, verifying the existence of the choledochal diverticulum.

In four of the five successful procedures the stones were eliminated in one session, and in one patient in two sessions. There were no symptoms or signs of acute pancreatitis. In one patient because of right-sided upper quadrant abdominal pain and mild fever the drain was kept open for external drainage and the pain subsided. On follow-up cholangiographies, if there was no obstruction and no bile stones were evident the drain was removed. All five patients remained asymptomatic until elective cholecystectomy was performed.

DISCUSSION

Common bile duct stones are a relatively frequent finding, occurring in 7%–20% of patients with cholecystolithiasis [2] and increasing significantly in the elderly [8]. Although some CBD stones are asymptomatic and may be detected incidentally, their potential risk of obstructing the biliary tree and causing severe complications necessitates their elimination. Until the last three decades, the treatment was exclusively surgical: cholecystectomy or CBD exploration. Surgical solution is not ideal, even today, because of the resultant morbidity and mortality and the residual CBD stones that might remain even after utilizing intraoperative cholangiography or cholecochoscopy techniques, estimated in up to 11% of patients treated surgically [8,17].

The technical improvements using minimally invasive solutions have shifted the strategy towards endoscopic therapy by sphincterotomy and stone extraction if possible, and to sporadic use of interventional radiology from a PTC tract with Dormia basket, balloon, chemical dissolution, mechanical or laser lithotripsy and shockwave lithotripsy [3,8,9,18-20]. Endoscopic sphincterotomy has been recognized as the primary modality to remove extrahepatic duct stones [3]. However, it is not suitable for all patients for several reasons: a) the varied anatomic and surgical histories, b) a complication rate of 2–13%, and c) mortality rate of up to 1.7% due to bleeding, pancreatitis or perforation [8]. Furthermore, about 10–20% of CBD stones are not eliminated by endoscopic sphincterotomy, especially the smaller ones [21].

It has already been shown that sphincterotomy causes irreversible damage to the sphincter. The damage, which includes papillary stenosis and cholangitis due to reflux, estimated to occur in up to 24% of patients, has led to the search for a solution that causes less permanent damage to the sphincter [8]. Balloon sphincteroplasty (endoscopic or percutaneous) preserves its function and is thus a better option to dilate the sphincter and enable passage of the stones [22]. In their series of 100 patients, Garcia-Villa and co-authors [8] had no cases of cholangitis, and in only one case of mild pancreatitis was balloon sphincteroplasty performed, the balloon diameter measuring up to 12 mm.

Percutaneous access to the biliary tree is routinely performed by interventional radiologists. This access enables treatment for bile stones as well. Gil and colleagues [9] described trans-hepatic CBD stone elimination through the papilla in 17 patients, the stones measuring 3 to 16 mm in diameter. They used two types of balloons: a regular angioplasty balloon for the dilatation of the papilla that was dilated two to three times for 30–60 seconds, and a low pressure biliary occlusion balloon to push the stones into the duodenum. Gil et al. also described the same procedure from an existing T-drain or trans-cystic tract left after surgical CBD exploration in 21 patients. Their success rate was 94.7%, achieved in one to three sessions, and there were two major complications without mortalities. The same technique was reported by Park et al. [10], who used it in 15 patients, with success in 13. The failures occurred in patients with severely dilated CBD.

Garcia-Villa et al. [8] presented their 10 year experience in 100 patients with bile duct stones measuring up to 22 mm from various accesses including PTC (48 patients), T-drain (36 patients), trans-cystic (in 10 patients), and percutaneous cystostomy (in 6 patients), with a success rate of 95%.

Based on their technique, we modified the procedure by using a single balloon for both sphincteroplasty and stone push. This enabled us to work faster between the two steps to shorten the inflation time, thus reducing the possible sphincter damage, and to push the stones quickly after the dilatation. The stiffer balloon 'forced' the stone to be pushed, usually after the first attempt and without the need for sphincter relaxants. Our one failure was due to a choledochal diverticulum. An internal biliary drainage was inserted in this patient until elective surgery was successfully performed.

Our report has several limitations, mainly the small number of patients. Nonetheless, the same technique was successfully performed by our team using the trans-cystic access, T-drain, or PTC drain – without technical failures or major complications. Trans-cholecystic intervention is a relatively simple and safe option to eliminate CBD stones. The increasing use of gallbladder drains for acute cholecystitis, and the fact that up to a fifth of these patients have additional CBD stones may favor the use of the existing gallbladder access as a port to eliminate the CBD stones, thus sparing additional trans-hepatic access, endoscopy or surgical intervention.

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In everyone's life, at some time, our inner fire goes out. It is then burst into flame by an encounter with another human being. We should all be thankful for those people who rekindle the inner spirit

Albert Schweitzer (1875-1965), German theologian, organist, philosopher, physician, and medical missionary. He received the 1952 Nobel Peace Prize for his philosophy of "Reverence for Life," expressed in the founding and sustaining of the Albert Schweitzer Hospital in Lambaréné, in Gabon

Capsule

Cell attachment protein VP8* of a human rotavirus specifically interacts with A-type histo-blood group antigen

As with many other viruses, the initial cell attachment of rotaviruses, which are the major causative agent of infantile gastroenteritis, is mediated by interactions with specific cellular glycans. The distally located VP8* domain of the rotavirus spike protein VP4 mediates such interactions. The existing paradigm is that 'sialidase-sensitive' animal rotavirus strains bind to glycans with terminal sialic acid (Sia), whereas 'sialidase-insensitive' human rotavirus strains bind to glycans with internal Sia such as GM1. Although the involvement of Sia in the animal strains is firmly supported by crystallographic studies, it is not yet known how VP8* of human rotaviruses interacts with Sia and whether their cell attachment necessarily involves sialoglycans. Hu et al. show that VP8* of a human rotavirus strain specifically recognizes A-type histo-blood group antigen (HBGA) using a glycan array screen comprised of 511 glycans, and that virus infectivity in HT-29 cells is abrogated by anti-A-type antibodies as well as significantly enhanced in Chinese hamster ovary cells genetically modified to express the A-type HBGA, providing a novel paradigm for initial cell attachment of human rotavirus. HBGAs are genetically determined glycoconjugates present in mucosal secretions, epithelia and on red blood cells, and are recognized as susceptibility and cell attachment factors for gastric pathogens like *Helicobacter pylori* and noroviruses. These crystallographic studies show that the A-type HBGA binds to the human rotavirus VP8* at the same location as the Sia in the VP8* of animal rotavirus, and suggest how subtle changes within the same structural framework allow for such receptor switching. These results raise the possibility that host susceptibility to specific human rotavirus strains and pathogenesis are influenced by genetically controlled expression of different HBGAs among the world's population.

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Eitan Israeli

The greatest of faults, I should say, is to be conscious of none

Thomas Carlyle (1795-1881), Scottish satirical writer, essayist, historian and teacher