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Percutaneous Cholangioscopy in the Management of Biliary Disease: Experience in 25 Patients

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Abstract

Purpose: To present our experience performing percutaneous cholangioscopy in the management of 25 patients with biliary disease.
Methods: During the last 3 years, 26 percutaneous cholangioscopies were performed in 25 patients with common bile duct disease ($n = 16$), intrahepatic ducts disease ($n = 6$), and gallbladder disease ($n = 4$). Our patient population group included seven with common bile duct stones, three with intrahepatic lithiasis, and eight with benign strictures (six iatrogenic and two postinflammatory). In four patients malignancy was to be excluded, in two the tumor extent was to be evaluated, whereas in one case the correct placement of a metallic stent needed to be controlled. A 9.9 Fr flexible endoscope URF-P (Olympus, 1.2 mm working channel, 70-cm length) was used.
Results: In total, percutaneous cholangioscopy answered 30 diagnostic questions, was technically helpful in 19 cases (performing lithotripsy or biopsy or guiding a wire), and of therapeutic help in 12 (performing stone retrieval). In 24 of 26 cases the therapeutic decision and the patient management changed because of the findings or because of the help of the method. In two cases biliary intervention failed to treat the cause of the disease. No major complication due to the use of the endoscopy was noted.
Conclusions: Percutaneous cholangioscopy is a very useful tool in the management of patients with biliary disease. The method can help in diagnosis, in performing complex interventional procedures, and in making or changing therapeutic decisions.

Key words: Percutaneous biliary intervention—Cholangioscopy—Lithotripsy

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Percutaneous endoscopy was first reported in 1974 for biliary tract inspection [1] and since then has found important applications in various biliary diseases [2–11]. Some indications for transhepatic cholangioscopy are difficult cases of intrahepatic lithiasis or of common bile duct calculi not approachable with retrograde endoscopy, and cases with differential diagnostic problems where direct vision and biopsy are essential. Today cholangioscopy combined with percutaneous intracorporal lithotripsy equipment remains a very important tool for every biliary-active interventional radiologist. In this article we will present our experience in the management of 25 patients with biliary disease. We will compare this experience with those of other larger series regarding the indications, the techniques, the outcome, and the complications. Finally we will try to stress the present role of the method regarding making and changing critical therapeutic decisions.

Materials and Methods

During the past 3 years we have performed 26 percutaneous cholangioscopies in 25 patients (15 male, 10 female; aged 44–80 years, mean 61 years). Percutaneous access was achieved in 21 cases through a transhepatic tract (19 right biliary duct, 2 left), in four cases through a transcholecystic route, and in one case through a formed T-tube tract.

In our patient group, disease of the common bile duct (CBD; $n = 16$), of the intrahepatic ducts ($n = 6$), or of the gallbladder ($n = 4$) was present (Table 1). Cholangitis was present in 11 patients. Two patients had secondary sclerosing cholangitis (one patient with Crohn's disease and one postoperatively, secondary to bilioenteric anastomosis (BDA) stenosis). Nine patients had acute cholangitis: five in the early postoperative period after cholecystectomy, two several years after BDA, and two without previous history of biliary disease.

Jaundice was present in 14 patients. In four of these patients it was of unknown origin or caused by cholangitis and in three was a

Table 1. Material, disease, indications, results, and therapeutic management

Patient no./sex	Age (years)	Disease	Disease cause or main problem	Cholangioscopy indications	No. of sessions	Results	Therapeutic decision: Before endoscopy	Therapeutic decision: After endoscopy
1/F	44	Secondary sclerosing cholangitis (postoperative)	BDA stenosis; intraductal stenoses	Visualization of dilatation result	1	Sufficient BDA width	Surgery	No surgery
2/M	60	Cholangitis	BDA stenosis; intraductal stones	Stone recognition—intraductal inspection; lithotripsy—fragment removal	1	Stones recognized; stones pushed through BDA	Surgery	No surgery
3/M	80	Cholangitis	Intramural filling defect in the left main bile duct	Direct visualization for DD of filling defect and biopsy	1	Biopsy revealed a biliary adenoma	Surgery	No surgery
4/M	52	Secondary sclerosing cholangitis (Crohn disease)	Multiple impacted intrahepatic stones in the seventh liver segment	Stone recognition; lithotripsy—stone retrieval; dilatation control	3	Stones recognized; stones retrieved percutaneously	Surgery	No surgery
5/M	65	Cholangitis	BDA stenosis; impacted sludge and stones	Stone recognition; EHL—lithotripsy and stone retrieval; dilatation control	2	EHL, recognition of stone clearance; no residual stones found	Surgery	No surgery
6/M	61	CBD injury; biloma	CBD leak and angulation after laparoscopic cholecystectomy	Residual CBD stone recognition; distal CBD stone increases CBD pressure and leak; guidewire passage through angulated duct; stone removal	1	Successful guidewire passage; stone pushed into bowel	Surgery	No surgery
7/M	61	CBD injury; postdrainage stenosis	(Same patient as no. 6) Stenosed CBD after 1 month; drainage	Control of long stenting and dilatation	1	No residual lumen found	No metallic stent	Metallic stent placement
8/M	55	CBD cholangiocarcinoma	Metallic stent occlusion	Visualization of occlusion cause; DD and biopsy; bile sludge removal	1	Stent occlusion reason was unknown; biopsy revealed bile sludge encrustation; bile sludge removed	New stenting	No stenting
9/M	63	CHD/hilum cholangiocarcinoma	No clear extent of hilar carcinoma in intrahepatic ducts	Visualization of mass extent and biopsy	1	Intrahepatic duct disease; stenting; biopsy revealed a cholangiocarcinoma	Surgery	No surgery
10/F	72	Hilum cholangiocarcinoma	No clear imaging of lesion overstenting with a metallic stent	Visualization of proximal stent position and biopsy	1	Stent in tumor margins; second stent needed; biopsy revealed a cholangiocarcinoma	No second stent	Second stent placement
11/F	67	Jaundice of unknown origin	Intra- or extramural CBD obstruction cause (mass? LN?)	DD between intraductal disease and external pressure and biopsy	1	No intraductal lesion found	Surgery	Stenting due to lymph node enlargement; chemotherapy
12/M	69	Operated pancreas carcinoma relapse	BDA stenosis	DD between BDA benign stenosis and malignant infiltration and biopsy	1	Benign stenosis; biopsy revealed no malignancy	Metallic stenting	Balloon dilatation
13/F	53	Operated cholangiocarcinoma relapse	BDA stenosis	DD between BDA benign stenosis and malignant infiltration and biopsy	1	Malignant stenosis; biopsy revealed a cholangiocarcinoma	Balloon dilatation	Metallic stenting
14/M	53	Postcholecystectomy cholangitis	Choledocholithiasis; intrahepatic lithiasis	Stone recognition; stone removal; clearance control	1	Three stones found; stones pushed through duodenum	Surgery	No surgery

Table 1. Continued

15/M	51	Acute cholecystitis	Cholecystolithiasis? High surgical risk patient	Identification of stones in gallbladder sludge (through percutaneous cholecystostomy tract)	1	No stones found; gallbladder sludge removed percutaneously	Surgery	No surgery
16/F	68	Acute cholecystitis	Cholecystoliathiasis? High surgical risk patient	Identification of stones in gallbladder sludge; lithotomy—stone retrieval (through percutaneous cholecystostomy tract)	3	Multiple small stones found; stones retrieved	Surgery	No surgery
17/M	73	Acute cholecystitis	Cholecystolithiasis? High surgical risk patient	Identification of stones in gallbladder sludge: EHL–lithotripsy (through percutaneous cholecystostomy tract)	3	Multiple large stones found; partially retrieved	Conservative treatment	Conservative treatment
18/F	58	Postcholecystectomy cholangitis (retained T-tube)	Residual choledochal stones	Stone recognition; lithotripsy through T-tube tract; stone retrieval	1	One large stone recognized; stone retrieval through T-tract	New surgery	No surgery
19/M	45	Postcholecystectomy cholangitis	CBD stenosis and choledocholithiasis	Stone recognition; lithotripsy—stone retrieval; dilatation control	2	Multiple small stones found; stone retrieval; insufficient dilatation	Surgery	Long stenting
20/F	49	Jaundice of unknown origin	Hilum cholangiocarcinoma	Control of distal stent position and biopsy	1	Overstenting sufficient; biopsy revealed a cholangiocarcinoma	New stent	No new stenting
21/M	63	Postcholecystectomy cholangitis	Intrahepatic stones	Inspection of bile tract and stone recognition; stone removal	1	One stone found and retrieved; one other filling defect was a blood clot	Surgery	No surgery
22/F	52	Jaundice of unknown origin	Lower CBD mass; ERCP impossible	Mass DD and biopsy	1	Biopsy revealed a cholangiocarcinoma	Diagnostic laparotomy	No surgery
23/F	64	Postcholecystectomy cholangitis	Duodenal diverticulum; CBD stone; ERCP impossible	Stone recognition; large stone lithotripsy; stone retrieval	1	Two stones found; stones retrieved percutaneously	Surgery	No surgery
24/M	71	Jaundice of unknown origin	Lower CBD mass; ERCP refused	Mass DD and biopsy	1	Biopsy revealed a pancreas carcinoma	Diagnostic laparotomy	No surgery
25/M	78	Cholangitis	Billroth II; CBD stone; ERCP impossible	Stone recognition; stone removal	1	Three stones found; stones pushed into bowel	Surgery	No surgery
26/F	61	Acute calculous cholecystitis	Known cholecystolithiasis; high surgical risk patient	Stone recognition; lithotripsy (not completed) (through cholecystostomy tract)	3	No total lithotripsy possible	Conservative treatment	Conservative treatment

CBD = common bile duct; CHD = common hepatic duct; LN = lymph nodes; ERCP = endoscopic retrograde cholangiopancreatography; DD = differential diagnosis; EHL = EH-lithotripsy; BDA = bilioenteric anastomosis.

result of known malignancy. Two patients had had a previous tumor resection and BDA creation. In four cases acute cholecystitis was diagnosed, all in high surgical risk patients in whom percutaneous cholecystostomy was preferred. Finally one patient needed cholangioscopy for two different indications: firstly, because of iatrogenic CBD injury following laparoscopic cholecystectomy and later because of stenosis formation at the site of injury.

Various diseases or problems were the reason for the cholangioscopic indications (Table 1): BDA stenosis ($n = 4$), intrahepatic stenosis ($n = 1$), intraductal stones ($n = 4$), intramural filling defect in an intrahepatic duct ($n = 1$), CBD stones ($n = 7$), CBD stenosis ($n = 2$), CBD leakage and angulation ($n = 1$), metallic stent occlusion ($n = 1$), incorrect metallic stent placement ($n = 1$), inspection of tumor extent ($n = 2$), differential diagnosis of intra- or extramural CBD tumor with subsequent biopsy ($n = 3$), and visualization of cholecystolithiasis ($n = 4$).

In all cases, endoscopic retrograde cholangioscopy was either technically not possible, or initially performed for diagnostic reasons but could not offer further therapeutic aid. Percutaneous cholangioscopy was performed for 57 different indications (Table 1): biliary stone identification ($n = 11$), local biopsy ($n = 10$), lithotripsy and stone fragment retrieval ($n = 9$), differentiation between benign, intramural malignant, or extrabiliary obstruction cause ($n = 7$), stone removal into the bowel ($n = 6$), visualization of cholangioplasty result ($n = 5$), identification of cholecystic stones in gallbladder sludge ($n = 4$), control of proximal or distal metallic stent position ($n = 2$), guidewire passage through an angulated CBD stenosis ($n = 1$), identification of the cause of metallic stent occlusion ($n = 1$), and inspection of tumor mass extent ($n = 1$).

In total, cholangioscopy was performed in 25 patients, in 26 different cases, because of 31 disease causes and 57 different indications. Thirty-six procedures were needed for completing all interventions. We used a flexible cholangioscope-ureteroscope (URF-P, Olympus, Hamburg, Germany) of 9.9 Fr outer diameter, 70-cm working length, and a working channel of 3.6 Fr (1.2 mm). After the initial percutaneous transhepatic drainage with an 8 Fr catheter, we dilated the tract up to 12 Fr during the first week and waited another 3–7 days before endoscopy. Thus there was always a period of 10–14 days for tract maturation. This was also the case for transcholecystic access, where a transhepatic access route to the gallbladder was always preferred. Only in one case was tract dilatation and endoscopy performed immediately after the initial drainage. This was in the patient with the iatrogenic CBD injury with active bile leakage, in whom the guidewire could be passed through the angulated duct, in order to proceed to an internal drainage.

The biliary approach was planned with regard to the location of the main problem. In cases of relatively inaccessible ducts, the drainage site was decided after the initial cholangiography. Patients with cholangitis were given intravenous antibiotics, and cholangioscopy was not undertaken if biliary inflammation was still active. Skin and tract were infiltrated with local anesthesia and intravenous midazolam was regularly given under continuous oxygen saturation and electrocardiographic monitoring. Only in rare cases was propofol administered, especially during dilatation of a tight stenosis. The scope was introduced through a 12 Fr Banana peel-away sheath leaving a safety guidewire between the sheath and biliocutaneous tract.

For biopsy or stone retrieval, special 3.6 Fr forceps and baskets were used. If stones were too large or very resistant, electrohydraulic lithotripsy was performed with a Lithotron EL-25 of Walz (Olympus).

Results

We performed 36 procedures completing 26 biliary interventions in 25 patients. All but one of the procedures were planned 10–14 days after initial drainage, and this period of time was in every case sufficient for tract maturation. In one case of an extremely obese patient with bile leakage from the surgical drain 1 day after laparoscopic cholecystectomy, percutaneous transhepatic cholangiography revealed nondilated intrahepatic ducts, angulation of the CBD at the level of the surgical clips, bile leakage from the distorted choledochus, and a residual stone impacted at the papilla (Fig. 1A). Percutaneous treatment was preferred by the surgeons because of the obesity of the patient and the difficulties of the initial operation. A hydrophilic angled guidewire (Terumo, Tokyo, Japan) could not be manipulated through the distal choledochus. The transhepatic tract was immediately dilated up to 12 Fr and the cholangioscope inserted through a sheath. The scope found the continuation of the angulated CBD and a wire could be guided into the lower half of the choledochus. The scope was subsequently pushed through the injured part and very easily removed the stone into the bowel (Fig. 1B). An internal drain was left in place for 1 month, until the CBD healed and the leakage ceased (Fig. 1C).

No major complication was noted during the procedures. Minor intrabiliary bleeding was the result of manipulations in three cases (8%). Every time that bleeding occurred we stopped the procedure because of lack of vision and continue 3 days later. In one case, a subcapsular liver abscess was formed during the period of tract formation and was percutaneously drained by another pigtail catheter.

Patients rarely suffered from skin site infection because good care instructions were given to every patient. In the case of infection, the skin site was cleaned and the catheter changed. No special antibiotic treatment was given in such cases. Patients did not suffer very often from catheter discomfort although the catheter was in most cases intercostally placed. Interprocedural pain was acceptable with the help of intravenous injection of sedative. That means that most of the patients complained of mild or moderate discomfort. If the pain worsen, we administered larger doses of drugs. We preferred to have the patients in a relative conscious condition, so that they could communicate with us and describe their complaints. During electrohydraulic lithotripsy (EHL), pain increased, but was well tolerated.

In two high surgical risk patients with acute calculous cholecystitis, percutaneous cholecystostomy was performed followed by lithotomy through a 12 Fr tract. In the first patient lithotomy was not completed because the gallbladder decreased in volume during the first 2 weeks, leaving insufficient working space for the scope. The procedure had to be

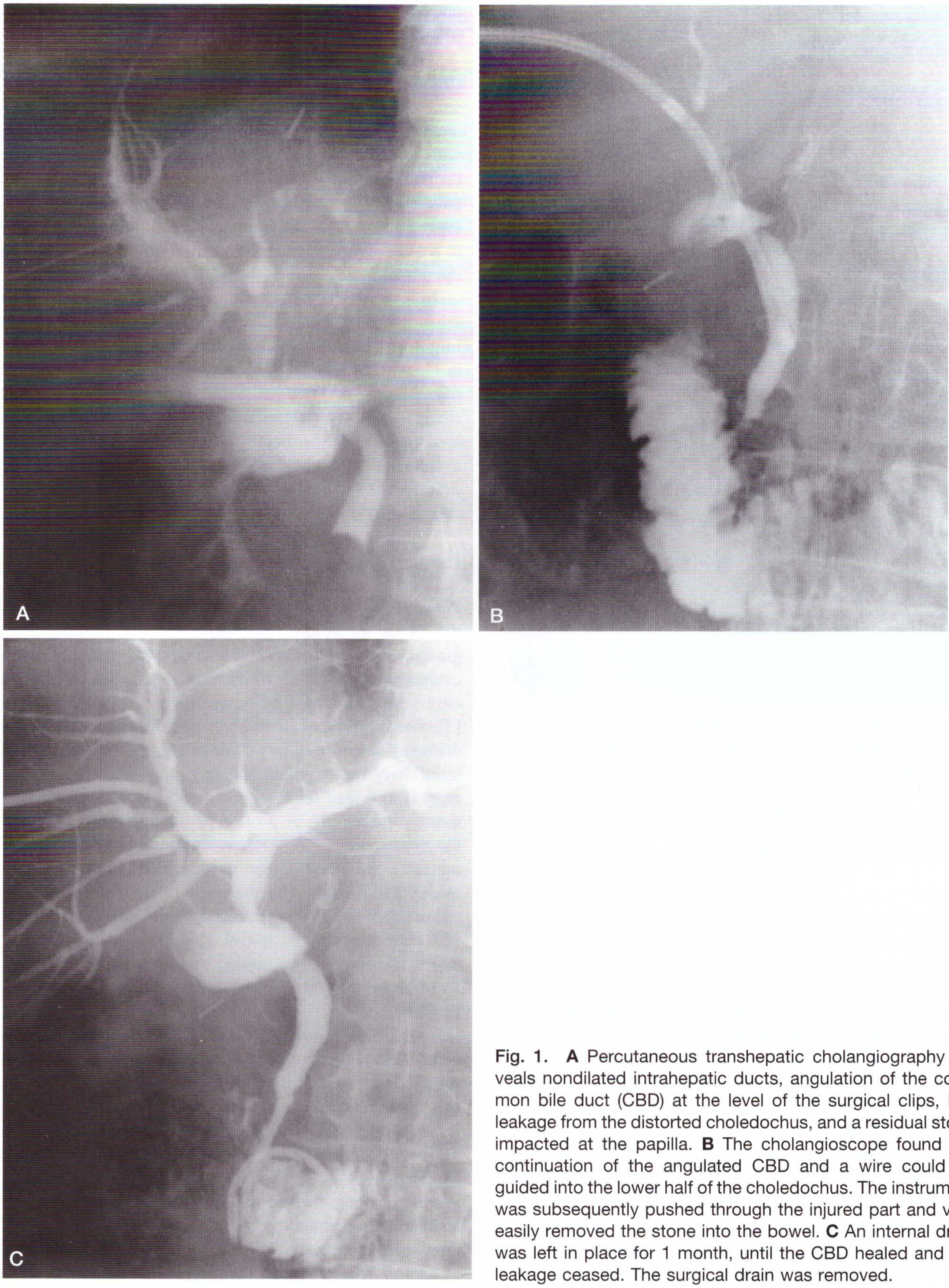

Fig. 1. **A** Percutaneous transhepatic cholangiography reveals nondilated intrahepatic ducts, angulation of the common bile duct (CBD) at the level of the surgical clips, bile leakage from the distorted choledochus, and a residual stone impacted at the papilla. **B** The cholangioscope found the continuation of the angulated CBD and a wire could be guided into the lower half of the choledochus. The instrument was subsequently pushed through the injured part and very easily removed the stone into the bowel. **C** An internal drain was left in place for 1 month, until the CBD healed and the leakage ceased. The surgical drain was removed.

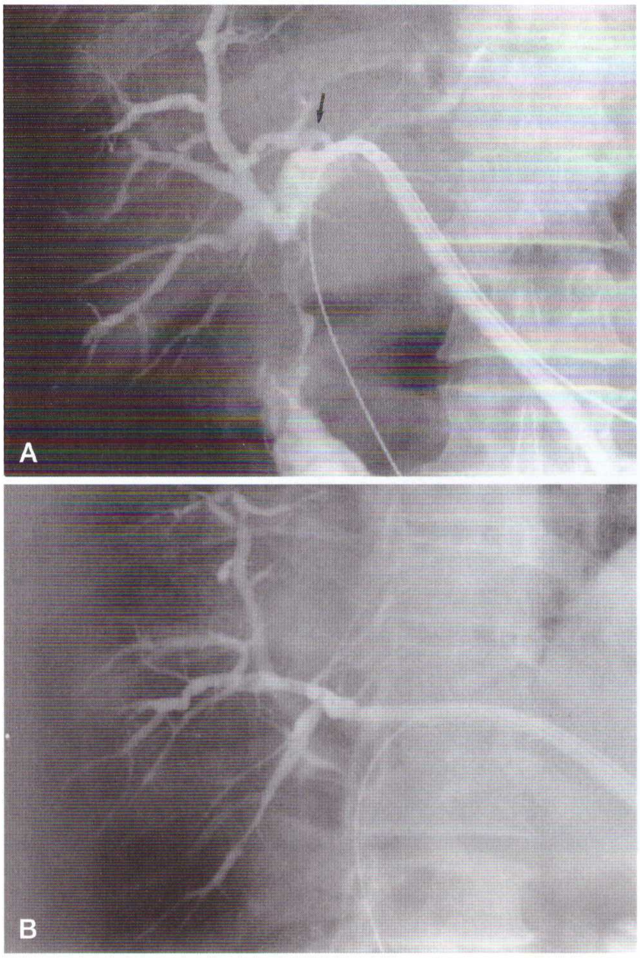

Fig. 2. **A** Percutaneous cholangioscopy through the left bile ducts in a patient with a stenosed biliodigestive anastomosis and intrahepatic lithiasis. The instrument pushed a stone from the left bile ducts into the bowel. A second small stone (arrow) was suspected. **B** The endoscope was advanced in the duct with the suspected stone and confirmed the diagnosis. The stone was subsequently retrieved.

interrupted and the catheter was retrieved with the stone fragments in the gallbladder lumen. The patient experienced no further symptoms and died 1 month later because of her critical underlying disease. The second patient had a large number of gallstones of various size. He cooperated well in three lithotripsy sessions during which half the calculi were retrieved, but then refused any further treatment. He died of a heart problem 3 months later when the draining catheter had already been removed.

In 13 cases without lithiasis, 13 procedures were enough to complete the intervention. In the other 13 cases, lithotripsy was completed in 23 sessions. Of these, in four cases the stones could be pushed by the scope into the bowel during the initial session (Fig. 2), while in the other nine, 19 sessions were needed for mechanical and EH-lithotripsy with subsequent stone retrieval (2.1 sessions per patient). Nine intraductal biopsies revealed a cholangiocarcinoma in five cases, a pancreas carcinoma in one, a biliary adenoma in one (Fig. 3), presence of bile sludge in one, and were negative in two cases (Table 1).

The shortest time needed for our procedures was 2 weeks (for inspection and biopsy) and the longest 3 months (for stone removal). Between the initial drainage and the subsequent sessions, the patients were able to leave the hospital with the draining catheter in place. If, for example, three different sessions were taking place during one week, the patient stayed in the hospital for that time. The total hospital stay and cost have not been calculated but we presume that it was in every case lower than if the patients had been operated on.

In total, percutaneous cholangioscopy answered 30 diagnostic questions, was technically helpful in 19 (performing lithotripsy, biopsy, or guiding a wire) and of therapeutic help in 12 (performing stone retrieval) (Table 1). In 24 of 26 cases the therapeutic decision and the patient management changed because of the findings or with the help of the technique (Table 1). In two cases biliary intervention failed to treat the cause of the disease (calculous cholecystitis), but despite that fact the patients did well after catheter removal and died from unrelated causes.

Discussion

Percutaneous cholangioscopy was first performed in Japan in the 1970s for biliary tract inspection [1]. Initially cholangioscopy was used mainly for diagnostic purposes, such as evaluation of the nature of obstructive jaundice [2], uncertain cholangiographic diagnosis, cytologic sampling and biopsy [3], visualization of small ducts and differentiation between different causes of biliary stenosis [3], and the calculation of intrabiliary tumor extent [4]. In benign disease cholangioscopy is indicated for the control of balloon-dilatated anastomotic stenoses [7], inspection of inflammatory strictures of the hepatic hilus [7], differentiation between calculous and noncalculous filling defects such as blood clots, air bubbles, mucus and tumors [12], the study of the color and composition of stones [3], as well as for intracorporeal lithotripsy and stone removal [2, 3, 4, 9, 12–16]. Metallic stent occlusion is not necessarily caused by tumor in- or overgrowth. Bile sludge or granulation tissue can be the obstructing problem. This differentiation can easily be achieved by direct visualization and biopsy [17]. The same technique provides differentiation of biliary papillomatosis from other tumors and can also identify more intrahepatic lesions than can endoscopic retrograde cholangiography (ERC) [18]. Differentiation between benign fibrous stenosis and malignant infiltration of a BDA is another indication for percutaneous cholangioscopy [19]. Lesions which are found without tumor vessels on their surface could represent granulomas, while lesions with irregularly dilated and tortuous vessels usually represent malignancy [20]. Despite that fact, discrimination of benign from malignant stenosis can remain difficult [21], so that direct biopsy is mandatory. Manipulation of guidewires through stenotic ducts or strictures to the CBD or the

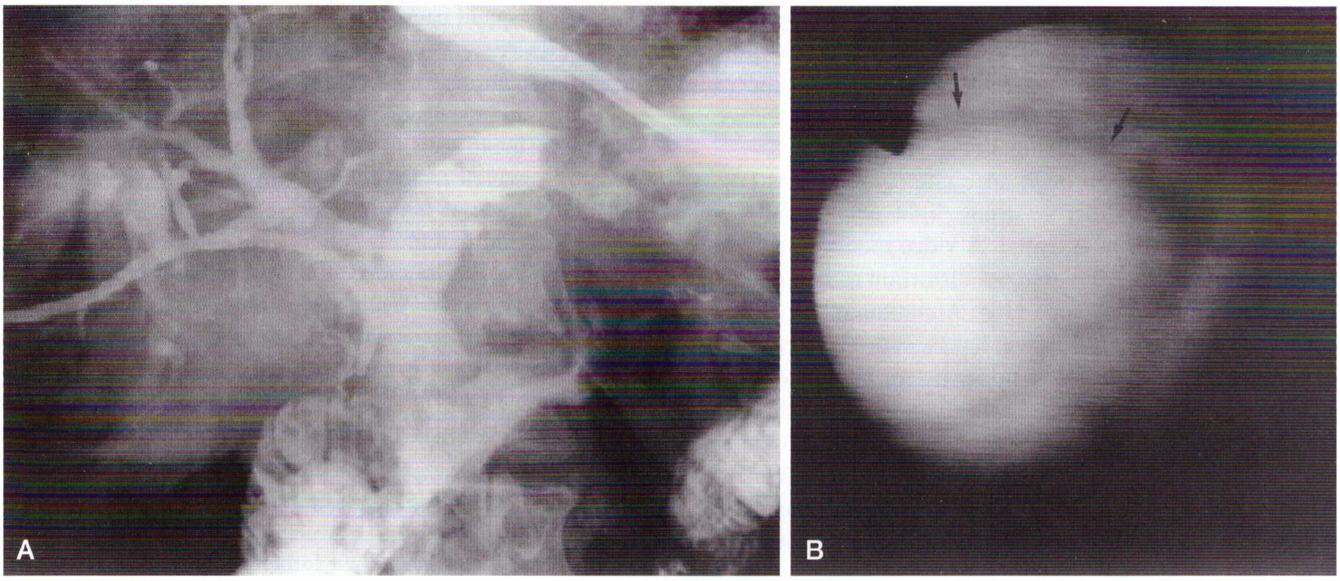

Fig. 3. **A** Cholangiography shows a stone-like filling defect in a left bile duct. **B** Cholangioscopy reveals a round tumor protruding into the duct (arrows). Biopsy found a biliary adenoma.

contralateral lobe can be carried out very successfully under cholangioscopic guidance [22]. Satisfactory dilatation of a post-traumatic stricture can be confirmed with endoscopy [23].

The mother-baby peroral cholangioscopy technique provides a less invasive method for biliary tract visualization [24]. When peroral endoscopy fails, is not available, or is not possible, due to a nonaccessible papilla or surgical hepaticojejunostomy, percutaneous cholangioscopy is indicated [5].

Percutaneous access to the bile ducts is important for the success of cholangioscopic procedures. Analyzing the ductal anatomy in relation to the problem, for example stone distribution, and then targeting the most convenient duct for percutaneous drainage, can offer a higher success rate and decreases the number of treatment sessions and the total intervention time [25, 26]. The catheter angle to the biliary duct is a very important factor which determines technical success and complete stone clearance [20, 26]. Even if angle and duct are appropriate, manipulation of the instrument can be difficult if angulation or strictures are present [12]. Simultaneous intervention under endoscopic guidance can also be compromised by the low steerability of the accessories used [21], ie., lithotriptor wires or biopsy forceps.

Endoscopic access can be achieved transhepatically, through pre-existing T-tube tract, through a percutaneous cholecystostomy tract, or transjejunally through a Roux-en-Y loop fixed to the anterior abdominal wall [8, 19, 27].

Dilatation of the biliocutaneous fistula is an important issue in percutaneous cholangioscopy. The tract can be dilated in consecutive sessions at 3-day intervals, up to the required final width [14], a further week being allowed for the tract to mature. For a desired biliocutaneous fistula of 11 Fr to a maximum of 24 Fr, 2–4 weeks of preparation are needed [14, 15, 17]. The instrument can then be safely inserted with or without a sheath [14]. Similar preparation is also required for a transcholecystic approach, where a 2–3-week period is needed, depending on the transhepatic or transperitoneal approach [28]. When a T-tube fistula is used the time needed is much shorter because of the pre-existing mature tract.

The endoscopes used are usually of two main sizes: the relatively large 15 Fr scope and the smaller cholangio- or ureteroscope of 10–12 Fr. Larger scopes provide better optical resolution and optimal vision, because of the higher number of optical fibers [20, 29]. Their use is not very easy in smaller ducts or through tight strictures. A larger working channel permits use of stronger baskets, biopsy forceps, or other instruments. Of course, the tract has to be dilated up to 16 Fr or even more in order to achieve easy insertion. Smaller scopes have fewer light fibers, so that the visibility is not as good, but they are more flexible and can explore almost the whole biliary tree [29]. With this kind of scope, we were able to explore even the smallest intrahepatic ducts without any difficulty or complication (Fig. 2B). They also require a smaller percutaneous tract and the time needed for final maturation is shorter. We used a 9.9 Fr flexible cholangio-ureteroscope (URF-P), with a 70-cm working length and 3.6 Fr (1.2 mm) working channel. We dilated the tract from 8 up to 12 Fr during the first week and left the tract to mature for another 3–7 days. Thus after a maximum of 2 weeks the tract was ready for endoscopy and jaundice, inflammation, or hemobilia had disappeared. Antibiotic prophylaxis, deep sedation under continuous monitoring, and sterile conditions are routine in such procedures [20, 30]. For clear visibility, irrigation with saline through the scope's working channel is important, while bleeding can decrease or totally inhibit visualization [14].

In difficult interventional procedures fluoroscopy time is an important factor. It was also our experience that cholangioscopy requires less fluoroscopy for performing interventions such as stone removal and differentiation between calculi and disease mimicking stones [15].

Technical support through adequate equipment is essential. For better visibility a strong light source and good quality monitoring are essential. A video monitoring system which magnifies the view without distortion can increase the vision capacity of the scope [10]. A combination of endoscopy with intraductal ultrasound has been proposed to obtain more detailed information on tumor extent [31]. The baskets and forceps we use are of 1.2 mm diameter. This can cause problems when calcified or irregular-shaped stone fragments have to be entrapped or broken. Lithotripsy can decrease the size of stones before removal. EL generators, such as the one we use (EL-25 of Walz), are connected with a special wire which can be inserted through the working channel of the scope and can be guided in front of the calculi. Direct contact between wire and stone is needed for optimal effect [26, 29]. Dye-laser lithotripsy through 11–12 Fr scopes has also been used with equal success [9, 13]. A 13 Fr sheath is utilized and laser fiber is activated under direct visualization of the stone [31].

Contraindications for cholangioscopy are the same as those for biliary drainage. Prolonged bleeding parameters or septic conditions are inhibitors of the procedure and one should correct the patient's blood status before further intervention.

Possible procedure-related complications are hemorrhage and ductal or tract perforation [14]. In both circumstances the procedure has to be stopped for several days [29]. Subdiaphragmatic hematoma, bile collection or abscess, as well as vasovagal reaction, have also been reported [2, 16]. Lithotripsy-related complications are transient cholangitis, pancreatitis, or septic shock. Bile duct injury and intraductal hematoma have been reported, due to inadvertent contact of the activated laser fiber or lithotriptor wire with the duct wall [14, 16, 32]. Minor or major bleeding and pain intolerance can limit the use of cholangioscopy in 22% of cases [6]. Severe nausea or bleeding can occur during tract dilation [9, 15]. In our series we had very few problems with procedure-related complications. The use of a small scope and the slow increase in tract diameter may be the main reasons for our low complication rate (8%). We also followed precautions for prevention of adverse effects. Antiemetics and analgesics increased patient cooperation. Morbidity decreased from 54% to 5% with progressive tract dilation [30]. Antibiotics and postprocedural overnight external drainage through a biliary catheter can minimize the possibility of sepsis [15].

Cholangioscopic-related mortality is reported to be very low, with a rate of about 0–0.3% [2, 4, 12, 25]. Bonnel et al. [14] found a high rate of severe complications of 22% and a mortality of 8% early in their study of 50 cases with quick tract dilation up to 20 Fr during the first 3 days. Bleeding was the most frequent cause. Improvements in technique brought about a decrease in these numbers [14].

The indications for percutaneous cholangioscopy are well defined. We had in our patient group almost every kind of indication mentioned in the literature, except biliary papillomatosis, which is not as common in Greece as elsewhere [18]. Our material is quite representative of what an interventional team practicing biliary procedures can encounter. In most of the patients more than one indication was present (Table 1). Thus, one session of cholangioscopy can help in multiple diagnostic questions. More than one session is usually indicated for lithotripsy; we needed one to three sessions (mean 2.1). In two cases of cholecystolithotomy, we stopped the treatment because of the large number and size of the stones. In one of these patients, the gallbladder shrank in the first postcholecystostomy week, due to impacted cystic duct stones and continuous drainage. The scope could not be manipulated in the shrunken lumen and lithotomy was impossible. Gallbladder lithotripsy usually requires a larger tract (15–20 Fr), so that the rate of successful clearance through a 12 Fr fistula, such as we used, is lower. The method remains a good alternative for patients unsuitable for surgery or general anesthesia [33]. If stones have passed the cystic duct, transcystic cholangioscopy and stone removal into the bowel are possible without a second transhepatic puncture [8].

Normally, CBD or intrahepatic stone retrieval can be performed through a 10–12 Fr tract and the clearance rate is higher than for cholecystolithotomy [33, 34]. Rates of 75%–97% have been reported [9, 14, 26, 27, 30, 35], with higher rates for CBD stones alone [12]. The rates in the literature vary, perhaps depending on the number of cases, their difficulty, and operator experience. Large intrahepatic impacted stones can decrease the success rate and often additional procedures such as second-site drainage, antegrade papillotomy, and retrograde endoscopy are necessary [9]. Most of the referred patients had previous attempts at ERC and lithotomy, which failed in 10%–15% [27]. In such patients, an existing sphincterotomy can be very useful for percutaneous stone removal. If not, antegrade papillotomy is an alternative [32].

Lithotripsy in patients with coexisting stenoses was no different from that in patients without [25]. Prior to extraction of calculi, any existing stricture should be dilated to aid clearance [27]. Calculi proximal to such stenotic areas are usually pigmented stones which are easily fragmented by baskets [27].

Calculous disease recurrence remains the most frequently reported problem after percutaneous clearance. Yeh et al. [35] observed a 33% recurrence rate in a 5-year follow-up. Other authors report lower rates of 18% in 32 months [30], or 28% in 5 years [36]. A 40% rate was found after gallbladder lithotripsy in a 3-year period [33]. Not all these patients are necessarily symptomatic and need reintervention. Maetani et al. [25] think that the appropriate choice of access route offers a higher success rate and leads to a lower recurrence of biliary stones. Lithiasis is usually an incidental finding during follow-up screening [33, 36]. Courtois et al. [33] reported that only 12% of patients returned with new symptoms from retained or newly formed gallbladder stones in a 33-month period, and none had evidence of gallbladder carcinoma development. The two patients in whom we stopped cholecystolithotomy had no symptom recurrence, but died a few months later from unrelated causes. Although stone recurrence remains high, initial treatment is justified, firstly because endoscopic or surgical attempts failed or were impossible and secondly because recurrent stones can stay asymptomatic [13, 27, 35, 36].

All percutaneous radiologic procedures aim to replace an open surgical treatment with a less invasive one. This fact is well appreciated by clinicians. Our results emphasize this point of view. Percutaneous biliary interventions play an important role in the cases presented here, but without the help of cholangioscopy they would not have had the same positive outcome. In 24 of 26 cases (92%) we were able to change the initial treatment and in 11 of these surgery was avoided. Given the patients' general situation—most had a malignancy, were a high surgical risk or had already undergone endoscopic or surgical treatment—a percutaneous, minimally invasive treatment was a great relief for them.

We believe that percutaneous cholangioscopy is a very useful tool which complements biliary intervention and should not be absent from any interventional radiology unit. Of course the majority of percutaneous interventional procedures, with the exception perhaps of intraductal inspection, biopsy, and EHL-lithotripsy, can be performed and completed without the help of cholangioscopy, but the use of this direct optical method gives radiologists a greater feeling of safety, teaches them to compare fluoroscopic with real endoscopic images, and improves their skills and experience in every way. The method can aid in diagnostic problems, can help in simple and complex biliary procedures and offers the interventional radiologist the opportunity to make a new therapeutic decision with greater safety or to replace the proposed treatment with a less invasive one.

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