Percutaneous Treatment of Biliary Stones: Sphincteroplasty and Occlusion Balloon for the Clearance of Bile Duct Calculi

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OBJECTIVE. Our study describes the percutaneous expulsion of bile duct calculi into the duodenum by dilating the papilla with a balloon catheter.

SUBJECTS AND METHODS. Patients (n = 212; 101 men and 111 women; mean age, 73 years; range, 31–95 years) had their calculi (single, 131; multiple, 81) percutaneously expelled into the duodenum in 73 patients via an indwelling T tube, and in 139 via transhepatic or transcystic duct route. Stone expulsion was facilitated with an occlusion balloon after balloon sphincteroplasty and with prior mechanical fragmentation in only 37 patients. After the expulsion of the calculi into the duodenum, drainage of the main bile duct to the exterior was maintained for 2–8 days.

RESULTS. Technical success was initially 90.4%, increasing to 93% at the second attempt. There were 13 failures due to the large size of the calculi in nine patients, excessive tortuosity of the T tube (Kher tube) in one, and breaches of the established protocol in two. Residual lithiasis was resolved in 98.6% of cases, decreasing to 92% in the group of native, or nonresidual, lithiasis. There were 10 major complications (hemobilia) with three cases of poor clinical outcome: hepatic necrosis, multiorgan failure, or death.

CONCLUSION. Percutaneous anterograde evacuation of bile duct stones with dilatation of the papilla using an angioplasty catheter and assisted with an occlusion balloon to expel the calculi is a cost-effective, nontraumatic, and safe procedure that retains the anatomic and functional integrity of the sphincter. It is a viable alternative procedure in the treatment of bile duct lithiasis.

Lithiasis in the biliary tree is a common problem. Choledocholithiasis occurs in 15–20% of patients with cholelithiasis [1] and, after biliary tract surgery, 2–5% of patients present with residual biliary stones in the bile ducts. Endoscopic sphincterotomy for stone removal is the method of choice. This procedure is not feasible, however, when the bile duct cannot be accessed because of a duodenal diverticulum or previous gastrointestinal surgery, or the stone is greater than 15 mm in diameter, impacted, or difficult to locate (intrahepatic or associated with stenosis). In these cases, percutaneous therapy is the preferred option before resorting to surgery [2]. Fluoroscopically guided extraction of resident calculi through a sinus tract T tube (Kher tube) is a well-established procedure. If no T tube is in place, a transhepatic approach may be attempted [3, 4]; that is, when removal by endoscopy fails or when a T-tube transcystic duct catheter or a transhepatic catheter is in place in the biliary tree, the percutaneous option is a viable alternative [5, 6].

After the biliary tract has been accessed, various techniques can be used in the percutaneous treatment of residual, and nonresidual, biliary stones: local chemolitholysis, removal through the hepatic tract by means of baskets, or mechanical expulsion procedures that can be combined with sphincteroplasty [7, 8]. The percutaneous treatment of bile duct stones was first performed by Mondet in 1962 [9] and Mazzariello [10] in 1970. Burhenne [11] extended this technique with the addition of baskets for stone removal through the T-tube tract. Endoscopic clearance of bile duct stones (sphincterotomy) was first described by Kawai et al. [12]. Since then, many newer and complementary endoscopy techniques, and percutaneous approaches, have been described. Papillary balloon dilatation has been a technique widely used among interventional radiol-

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ogists but has not received much attention from endoscopists. Papillary endoscopic balloon dilatation was introduced by Staritz et al. [13] in 1983 as an alternative method for gaining access to the common bile duct for the removal of stones. However, other endoscopists have been critical of the procedure because of the perceived risk of inducing pancreatitis [14, 15]. Recently, papillary endoscopic balloon dilatation has been rediscovered by a number of endoscopy groups, who have described it as offering an effective and safe alternative to endoscopic sphincterotomy. Obvious advantages of endoscopic balloon dilatation over endoscopic sphincterotomy are the avoidance of sphincterotomy-induced bleeding and preservation of biliary sphincter function, as shown by manometric studies [16, 17].

We present here our experience derived from a prospective study containing a large series of consecutive patients in whom clearance of bile duct stones was achieved by percutaneous pushing of the stones into the small bowel after balloon dilatation of the papilla.

Subjects and Methods

Over a period of 9 years (January 1994–January 2003), 212 consecutive patients underwent percutaneous removal of bile duct stones in our interventional radiology unit. This was achieved by pushing the stones into the small bowel after dilatation of the papilla with an angioplasty balloon catheter with a Fogarty-type occlusion balloon.

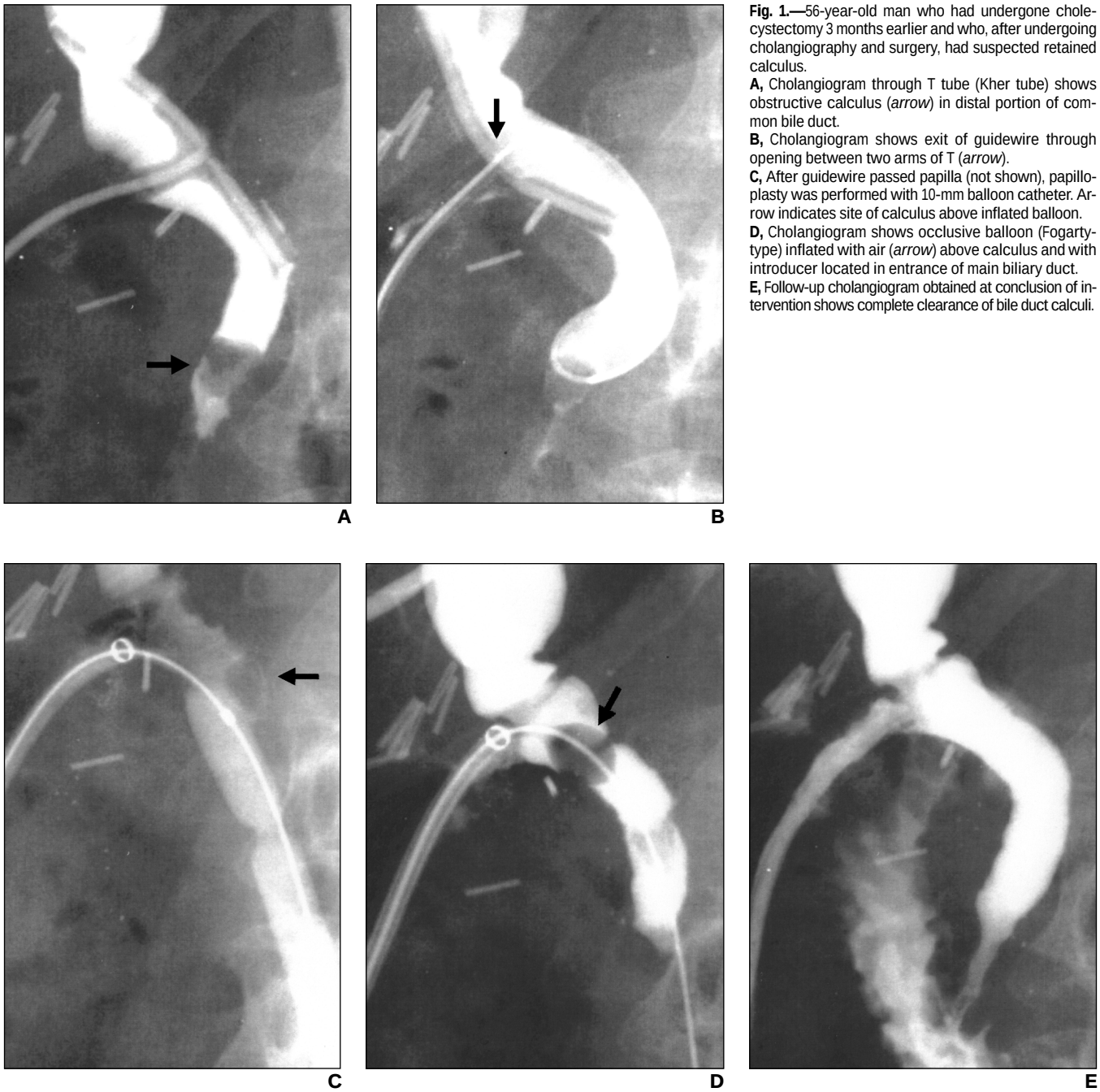


Fig. 1.—56-year-old man who had undergone cholecystectomy 3 months earlier and who, after undergoing cholangiography and surgery, had suspected retained calculus.
A, Cholangiogram through T tube (Kher tube) shows obstructive calculus (*arrow*) in distal portion of common bile duct.
B, Cholangiogram shows exit of guidewire through opening between two arms of T (*arrow*).
C, After guidewire passed papilla (not shown), papilloplasty was performed with 10-mm balloon catheter. Arrow indicates site of calculus above inflated balloon.
D, Cholangiogram shows occlusive balloon (Fogarty-type) inflated with air (*arrow*) above calculus and with introducer located in entrance of main biliary duct.
E, Follow-up cholangiogram obtained at conclusion of intervention shows complete clearance of bile duct calculi.

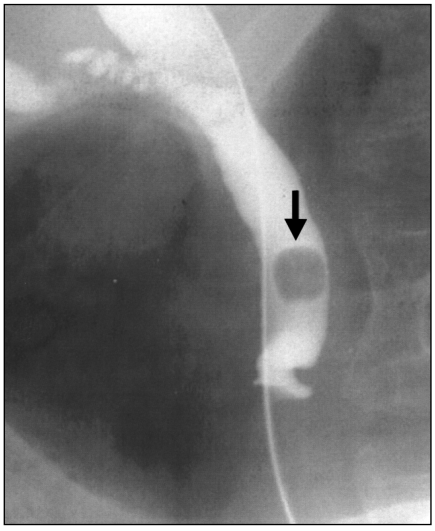
This basic technique was used in almost 99% of cases, but with some patients (n = 40) there was need for further manipulation such as mechanical fragmentation with dormia baskets (n = 37 patients), chemical litholysis (n = 1), extracorporeal shock-wave lithotripsy (n = 1), and mechanical lithotriptor (n = 1).

The prospective study involved 111 women and 101 men. The mean age was 73 years (range, 31–95 years). In 73 patients, bile duct stones were retained after cholecystectomy (61 after conventional surgery; three after laparoscopic cholecystectomy, eight after failure of endoscopy [incomplete extraction], and one after cholecystectomy that was complicated by a fistulous tract to the skin). In 61 of 73 patients, the procedure was performed through a T-tube tract (Fig. 1) placed during surgery and, in three patients, through transcystic duct catheters placed in the common bile duct at the time of the laparoscopy or surgery. In another patient, access was gained by using the fistulous tract as a percutaneous biliary access to the common bile duct. In the remaining patients, the procedure was performed through a percutaneous right transhepatic catheter (left in two patients and combined right and left in another two) put in place for external bile drainage. In 47 of these patients, percutaneous transhepatic catheterization was performed primarily as drainage for cholangitis or sepsis, and clearing the bile duct was performed as a secondary procedure approximately 1 week later (Fig. 2). The patients were hospitalized throughout the procedure. In 72 patients, the procedure was performed after diagnostic percutaneous transhepatic cholangiography, which had been performed to investigate obstructive jaundice of unknown origin. Acute pancreatitis had been suspected in three patients. Finally, in the 20 remaining patients who underwent the transhepatic approach, the percutaneous biliary access option was selected because of the impracticality of performing the endoscopy procedure due to previous gastric surgery, periampullary diverticulum, hepaticojejunostomy, or difficulty of canalizing the papilla.

In the overall series of patients studied, 94 had undergone previous cholecystectomy and 21 of them had cholecystectomy performed subsequent to the procedure of percutaneous expulsion of the calculi (seven of them via laparoscopy, the preferred technique in our opinion).

Of the patients studied, 131 had a single calculus and the remaining 81 had two or more calculi. The mean diameter of the stones was 6 mm (range, 3–18 mm). In 189 patients (89%), the site of the stones was extrahepatic, 15 patients had intrahepatic and extrahepatic biliary calculi, and 15 patients had only intrahepatic stones. In 11 pa-

Fig. 2.—66-year-old woman who had undergone percutaneous transhepatic drainage the previous week because of cholangitis. Cause was stone impacted or embedded in distal papilla resulting in obstruction of main bile duct.
A, Cholangiogram shows spontaneous dislodgement of calculus (*arrow*) and guidewire passing papilla into duodenum.
B, Next cholangiogram obtained after **A** shows papilloplasty performed with 12-mm balloon after retrograde movement of calculus (*arrow*) into intrahepatic biliary tree and precluding papilloplasty balloon from compressing calculus against biliary wall.
C, Cholangiogram shows filling defect corresponding to calculus (*arrow*) in trough of duodenal diverticulum.
D, Cholangiogram obtained 2 days after placement of external drainage catheter shows complete absence of calculus in bile duct.



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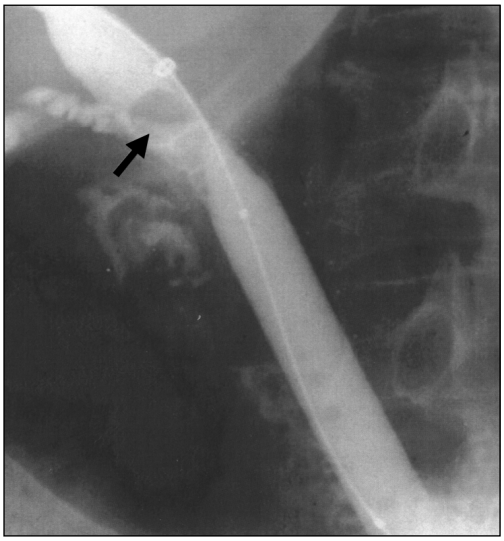

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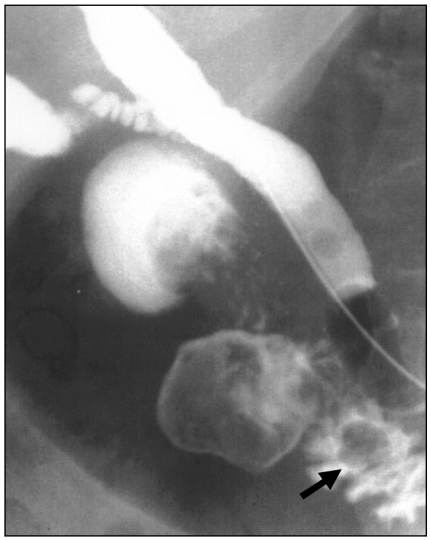

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TABLE 1 Clinical Presentation and Patient Characteristics (*n* = 212)

Patient Characteristics	No.
Retained bile duct stones; residual lithiasis	73
After conventional surgery	61
After laparoscopic surgery	3
After incomplete ERCP	8
Special case (fistulous tract to surface skin after surgery)	1
Native bile calculi with subsequent transhepatic biliary access	139
Cholangitis or biliary sepsis	47
Obstructive jaundice	72
Failure or impossibility of ERCP	20

tients, the lithiasis was associated with an accompanying neoplasm and, in an additional eight, with simple, or benign, stenosis of the biliary duct. Of these, four resulted from surgery, two were after endoscopic retrograde cholangiopancreatography, and two from idiopathic causes (Table 1).

In the patients without a T tube or transcystic duct catheter in place, the procedure began with percutaneous transhepatic biliary drainage (usually, the right side). The clearing maneuvers were performed between 2 and 45 days (mean, 6–7 days) after the initial biliary drainage (two-step technique) in all patients except three in whom the technique of expulsion was performed at the same time as the drainage. This was to preclude inconveniencing the patients because they had been referred to our hospital from a considerable distance.

Although most (≈ 80%) of the patients complained of discomfort and slight pain during the sphincteroplasty, drugs such as midazolam, atropine, and other analgesics were deemed necessary in only nine who had complained of moderate pain during the intervention. One had deep sedation performed by the anesthesiologist on the express wish of the patient. All patients who had undergone percutaneous biliary drainage, including those without a recent history of cholangitis, received prophylactic broad-spectrum antibiotics.

We started the procedure by exchanging the external catheter for a 145-cm, 0.0035-inch-diameter Bentson-type (intermediate-stiff) guidewire (CookEurope, Bjaeverskov, Denmark) with the tip located in the biliary tree. This step was followed by the insertion of an 8- to 9-French vascular introducer sheath (Brite-tip-sheath Introducer, Cordis Europe NV, Roden, The Netherlands) with a distal radiopaque section that helps to confirm the proper positioning of the distal tip in the bile duct, behind the calculus. A cholangiogram was obtained after this introducer had been placed to confirm the location, number of stones present, and status of the papilla. A hydrophilic guidewire (Terumo, Tokyo, Japan) was then advanced past the papilla and toward the duodenum. This was with the help of a standard 40-cm, 4- to 5-French angiography multipurpose catheter (Soft-vu, Berenstein Angiodynamics, Queensbury, NY) to facilitate the guidewire passage into the duodenum. On reaching this position, the hydrophilic guidewire is withdrawn and exchanged for a superstiff 145-cm guidewire (Boston Scientific, Miami, FL). This straightens the bile duct and the duodenum and facilitates working with an angle that is favorable for the subsequent, and imminent, expulsion of the stones. A standard 10- or 12-mm low-profile angioplasty balloon catheter, 6 cm in length (PTA-Pro, Cordis Europe; or XXL-Balloon PTA, Boston Scientific Natick, MA), is inserted over the guidewire and positioned symmetrically across the papilla.

The balloon is then inflated with diluted contrast medium until the waist disappears. This pressure can be up to 12–14 atm ($12–14 \times 10^5$ Pa). Inflation is maintained for 30–60 sec and, occasionally, needs to be repeated. The balloon selected needs to be one with a diameter equal to, or slightly greater than, the minimum diameter of the largest calculus. We never had to use balloons greater than 12 mm in diameter, and in patients with a calculus that was slightly more than 15 mm, we used Dormia baskets to fragment the calculi before expelling them into the duodenum. After the dilatation, the balloon is removed carefully to avoid pulling the stones proximally into the intrahepatic tree. The balloon is exchanged for a Fogarty-type 11.5-mm biliary occlusion balloon (True lumen Embolectomy Catheter, Edwards Lifesciences, Irvine, CA). This balloon is air-inflated proximal to the stones (contrast medium or saline may be used but, in our experience, air provides a better visualization against the dark background of the fluoroscopy) and advanced over the guidewire through the papilla and into the duodenum. The stones are pushed ahead of the occlusion balloon into the duodenum. This maneuver is repeated as many times as necessary. If difficulties arise, several procedures are helpful including Dormia baskets of different sizes to fragment the calculi. Alternatively, the introducer is advanced with the occlusion balloon to produce an increased mechanical force.

If the stones are located in the intrahepatic bile ducts, a safety guidewire can be placed in the duodenum. Using angled catheter manipulation to get around the stones, we then place a second guidewire in the intrahepatic duct. The occlusion balloon is then inflated, depending on the duct diameter, beyond the calculus. When withdrawn, the balloon pulls the stone into the common bile duct and, subsequently, into the duodenum (Fig. 3). It is not always necessary to cause the intrahepatic stones to fall into the common bile duct in this manner; flushing saline or contrast medium through the catheter beyond the calculus can be sufficient to achieve this goal.

After the calculi are pushed into the duodenum (often confirmed as filling defects in the contrast-medium–filled duodenum), the balloon and the introducer are removed and an 8-French pigtail catheter (locking type) is placed in the common bile duct externally, or proximally, to the papilla. This is maintained in place for 2–8 days (mean, 2 days) to allow drainage and prevent complications. Patients are hospitalized for this procedure. Before this external drainage catheter is removed, a cholangiogram is obtained. If the biliary tree is free of calculi and easy flow of contrast medium into the duodenum is observed, the catheter is removed, and after a suitable period of observation, the patient is discharged from the hospital. The procedure is repeated if any calculi remain in place. In cases in which we encountered an accompanying malignant stenosis and expulsion of the stones to the duodenum had been accomplished, the percutaneous treatment proceeded with the placement of a metallic endoprosthesis. In the case of benign stenoses, this was accomplished with simple dilatation of the lesion with the same angioplasty balloon normally used for papilloplasty. Follow-up of patients consisted of clinical evaluation, laboratory evaluation including that of liver enzymes and bilirubin levels, and abdominal sonography every 6 months for 2 years.

Results

Initial technical success was 90.4% (*n* = 169) at the first attempt with five more patients being added at the second attempt. This takes the success rate to 93% of patients in whom we were able to clear the biliary tree completely of calculi. In 25 patients, we were unable to complete the percutaneous method of expulsion of the lithiasis via the duodenum after the transhepatic drainage. This was due to the excessive size of the calculus (> 20 mm in diameter) in nine patients. These patients were referred for surgery. In an additional three cases, this was due to the attending endoscopist in one patient and the attending surgeon in the other two patients unilaterally electing to proceed with the intervention of their choice despite the established protocol. In the other 13 cases, it was inadvisable to proceed because of the poor general status of the patients.

There were only 13 failures. In 10 of these cases, the calculus size was excessive (between 15 and 18 mm in diameter) and could not be fragmented by either the usual mechanical methods or, in one case, using external shock-wave lithotripsy. In one patient, the calculi could not be dislodged because of an excessively tortuous route of the T tube. In two cases, the expulsion was incomplete, and because for logistic reasons, we could not proceed with a second attempt, these patients were treated by ERCP in one and surgery in the other despite our preferred protocol.

In summary, the cases of residual lithiasis (n = 73) were resolved in 98.6% and the efficacy was reduced slightly to 92% in the group with native, or nonresidual, lithiasis (Table 2).

Although most (≈ 80%) of the patients complained of discomfort or slight pain during the short time of dilatation of the papilla, it ceased when the maneuver was accomplished, and in general, this period lasted no more than a few seconds. In nine patients, there was a mild to intense abdominal pain lasting up to 48 hr after the procedure, and the pain was relieved with appropriate analgesics. Three cases of fever and cholangitis were registered after the procedure but easily resolved with IV antibiotics. Clinical evidence of mild pancreatitis was observed in three patients (1.4%) several days after sphincteroplasty, although in nine there was a mild, but transient, elevation of serum amylase levels. In four of the five cases of incomplete expulsion at the first attempt, the recurrence of the lithiasis was due to the spontaneous migration of small stones from the cystic duct and, in the fifth case, due to a branch intrahepatic lithiasis occurring after the first intervention.

Ten major hemorrhagic complications occurred; six cases with slight to moderate hemorrhage of venous origin were resolved with cold saline lavage. The other four cases were of more serious, arterial origin and must be considered a poor outcome in this subset of patients. Three of these patients had embolization performed. We were unable to proceed with this option in the fourth patient

TABLE 2 Technical Success of the Procedures

Outcome	No.
Complete technical success	174
In one attempt	169
In more than one attempt	5
Incomplete procedure; first stage only[a]	25
Excessive calculi size	9
Protocol failures	3
Poor patient condition	13
Technical failures	13
Excessive calculi size	10
T-tube tortuosity	1
Worsening clinical status	2

[a]Percutaneous biliary drainage.

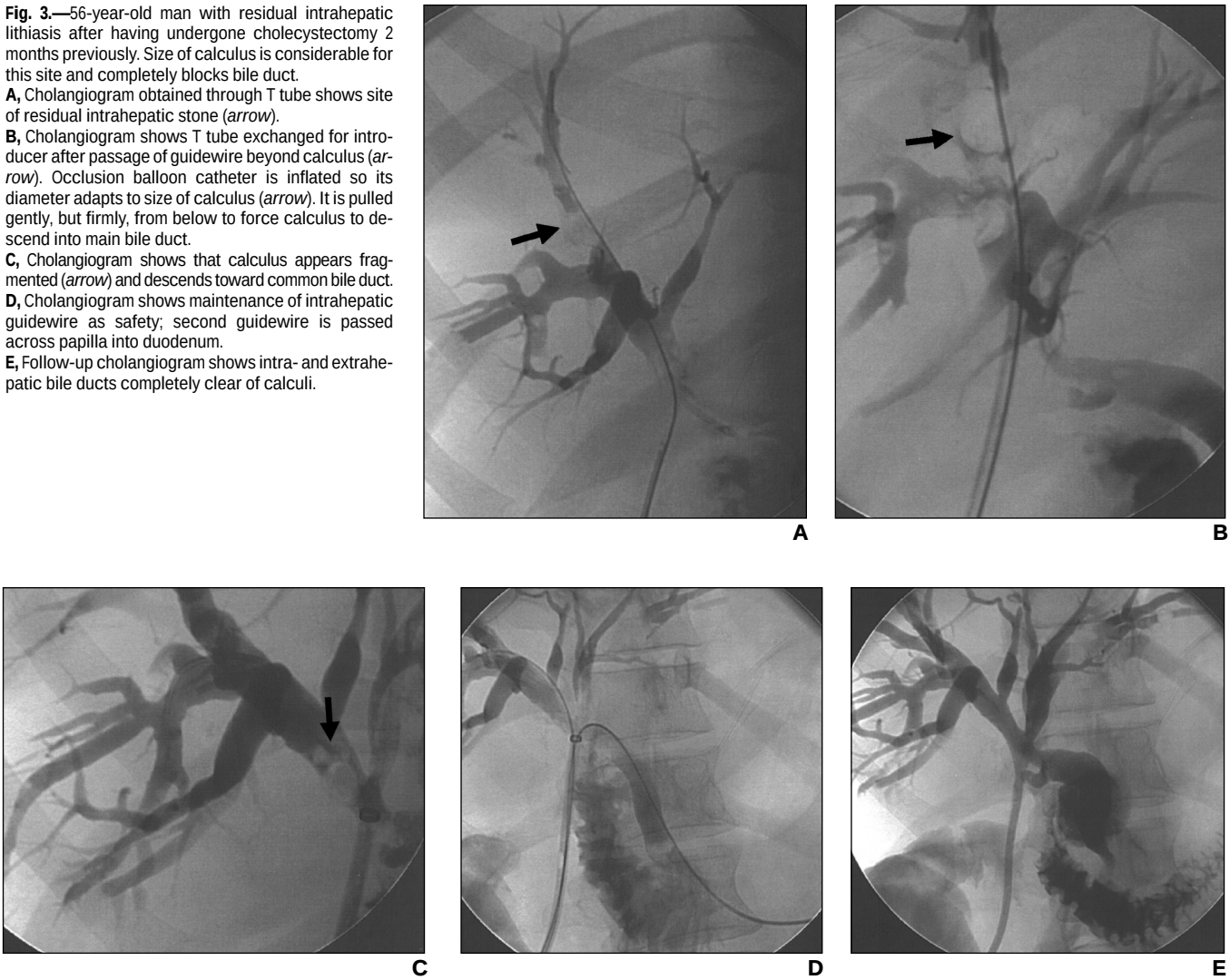

Fig. 3.—56-year-old man with residual intrahepatic lithiasis after having undergone cholecystectomy 2 months previously. Size of calculus is considerable for this site and completely blocks bile duct.
A, Cholangiogram obtained through T tube shows site of residual intrahepatic stone (*arrow*).
B, Cholangiogram shows T tube exchanged for introducer after passage of guidewire beyond calculus (*arrow*). Occlusion balloon catheter is inflated so its diameter adapts to size of calculus (*arrow*). It is pulled gently, but firmly, from below to force calculus to descend into main bile duct.
C, Cholangiogram shows that calculus appears fragmented (*arrow*) and descends toward common bile duct.
D, Cholangiogram shows maintenance of intrahepatic guidewire as safety; second guidewire is passed across papilla into duodenum.
E, Follow-up cholangiogram shows intra- and extrahepatic bile ducts completely clear of calculi.

because of severe coagulopathy. Of the three patients treated by the interventional radiologist with selective embolization at the point of the vascular injury, one patient developed a small hepatic abscess, which was resolved satisfactorily with percutaneous drainage. The other two patients, despite the initial decline in bleeding, developed massive hepatic necrosis over the next week, followed by multiorgan failure and death. In all cases of hemobilia, the occurrence was in the second part of the procedure; its source was confirmed by the withdrawal of the external catheter, before the second step, by which time the bilirubin levels had already normalized.

The mean hospitalization period was 1 week (2–45 days), though this need not be universal, and the patient may be discharged from the hospital within 2–3 days if no complications or major discomfort is apparent. In the follow-up, four cases of recurrence of lithiasis were noted, two of them quite early on (< 1 year) and the other two much later in the seventh and eighth years, respectively. Because of the considerable time-lapse, these latter occurrences were considered as de novo lithiasis and not as recurrences. Over the course of the follow-up (mean, 5 years; range, 1–9 years), 43 patients died as a result of advanced age and other causes not related to the procedure. Another 10 patients have been lost to follow-up because they have chosen not to keep their outpatient clinic appointments. There was one death registered after surgical laparoscopy. This patient had not had percutaneous removal of the stones because of their excessive size.

Discussion

ERCP is the standard method for removal of bile duct stones. Although well established, the method is still associated with short- and long-term complications. Acute complications such as bleeding, duodenal perforation, pancreatitis, and cholangitis may arise in 8–12% of patients, with a fatal outcome in 0.5–1% [18, 19]. In addition, biliary sphincter function is irreversibly damaged after endoscopic sphincterotomy, leading to duodenobiliary reflux and chronic inflammation of the biliary system [20]. Recurrent biliary problems (predominantly cholangitis, sphincterotomy stenosis, and recurrent stones) were observed to occur in 13% of patients, especially in young patients, followed up for up to 11 years after endoscopic sphincterotomy [21, 22]. Endoscopic sphincterotomy is associated with bacterial colonization and the presence of cytotoxic components in bile and chronic inflammation, fibrosis, and reactive epithelial changes of the bile ducts [23]. Some reports have indicated that papillary destruction may lead to malignant transformation of the choledochal epithelium [24] and increase in the incidence of biliary tract cancer [25]. Hence, other procedures that can preserve the physiologic function of the biliary tract may be advantageous, particularly in young patients [26].

Balloon dilatation of the papilla has been described as a safe and successful technique for the transhepatic (and endoscopic) route to facilitate the passage of stones into the duodenum. However, its direct comparison with other techniques has received little attention in the radiology and endoscopy literature [8]. Endoscopic papillary dilatation was introduced by Staritz et al. [13] as an alternative method of gaining access to the common bile duct for the intended removal of stones, in a rather limited series of 11 successfully treated patients. However, despite great advances and other similar reports since then, stone extraction without sphincterotomy does not appear to have gained wide acceptance in the endoscopy community. Reluctance to use this technique, even in present times, may have arisen from the belief that sphincter dilatation is a risk for pancreatitis, a rate of 25% being quoted frequently [14]. However, this value had been derived from a study of balloon dilatation in suspected sphincter of Oddi dysfunction in which two of the eight patients developed pancreatitis. Kozarek [15] also mentioned a complication rate of 35% (more frequently cholangitis than pancreatitis) in a multicentered survey. As May et al. [27] reported in their article, interventional radiologists apparently push stones through the papilla with impunity (with or without sphincter dilatation) but always leave a temporary biliary drainage that should eliminate the risk of cholangitis.

Since the studies published by May et al. [27] and Staritz et al. [13], endoscopic balloon dilatation has been rediscovered by a number of endoscopy groups who have described it as offering an effective and safe alternative to endoscopic sphincterotomy. As has been shown in animal experiments [28], in large series of patients [29–31] including randomized studies, and by manometric studies [16, 17], the significant advantages in endoscopic balloon dilatation relative to endoscopic sphincterotomy are avoidance of sphincterotomy-induced bleeding and preservation of biliary sphincter function.

Even less attention has been paid to percutaneous papillary balloon dilatation in the radiology literature. Centola et al. [32] in 1981 described a patient in whom they performed a percutaneous papillary balloon dilatation to flush a small stone into the duodenum. Since then, investigators such as Meranze et al. [33] have described a series of patients, albeit limited, in whom elimination of the retained bile duct stones was achieved by pushing them into the duodenum using angiography occlusion balloons without dilating the papilla, except in cases of very large calculi. Subsequently, Berkman et al. [34] in 1988 reported a series of 17 patients in whom dilatation of the papilla and expulsion of the calculi was achieved with the same angioplasty balloon catheter. Since then, to our knowledge, only two recent publications, one by Muchart et al. [7] and the other by Gil et al. [8], have reported cases of expulsion of bile stones into the duodenum with a technique similar to our own (papilloplasty plus occlusion balloon). The former was a series of five patients with retained stones removed via a T-tube tract. The latter was a series of 38 patients, 21 of whom were treated for residual calculi via T-tube or transcystic duct routes, and 17 were treated via a transhepatic tract after percutaneous biliary drainage. In another study in 1996 [35], our group described the percutaneous transhepatic access in 39 patients.

In our current series, residual lithiasis was resolved in 98.6% of cases (73 succeeded from a total number of 74 attempted). Efficacy was slightly reduced to 92% in the group with native, or nonresidual, lithiasis (139 succeeded from a total number of 151 attempted) who were treated via the percutaneous transhepatic approach. These results are encouraging despite the complications encountered in the second group of patients in whom, apart from the three cases of severe hemobilia that led to death of the patients despite embolization treatment (mortality rate, 1.4%), no major complications were noted. The rate of pancreatitis related to the procedure was 1.6% in our study. This mortality rate is appreciably lower than that associated with pancreatitis treated using endoscopic sphincterotomy, which has been estimated at between 5% and 10%. The treatment failures were due, in part, to the excessive size of the stones compared with the diameter of the balloon used. Using a 12-mm-diameter balloon for papilloplasty to push calculi of up to 15 mm through the papilla is, in our opinion, acceptable. However, other authors [8, 26]

maintain that this causes overdilatation of the sphincter and can directly damage its structure and function. Because the aim of this technique is to preserve the function of the papilla, this could be considered highly counterproductive. As such, even endoscopists who use the endoscopic balloon dilatation technique normally recommend the use of an 8-mm balloon that, in our opinion, is far too small. Our recommendation for large stones (15–18 mm) is to try to fragment them with Dormia baskets and, when impossible to do so, refer the patient to surgery.

Papilloplasty with expulsion of the calculi using an occlusion balloon presents, in the hands of the interventional radiologist, several advantages over the equivalent treatment (endoscopic balloon dilatation) in the hands of the endoscopist. Because the procedure is in the direction of the bile flow (and not contrary to it, as in the case of endoscopy), favorable angles are achieved in which to better transmit the force necessary for the expulsion. The kinking of the guidewires is avoided, and better positioning of the balloon is achieved in the middle (equidistant or symmetric) of the groove of the papilla to achieve better dilatation. Further, the introducer catheter can be used to administer contrast material, prevent air bubbles, and avoid tract injury. The most important aspect is ensured access to the bile duct so that the expulsion maneuver can be repeated as many times as necessary.

Finally, having the bile duct with external drainage in position for several days reduces the risk of manipulation-induced cholangitis by precluding sphincter spasm and by providing an egress route for infected bile. The principal complication in the case of transhepatic placement is the possibility of intrahepatic vascular damage. This is known to occur very infrequently but, nevertheless, is inherent in the procedure. The best way to minimize possible arterial hemobilia is to perform biliary drainage by accessing the bile duct from the most peripheral site possible (i.e., with the least distance of hepatic parenchyma to be crossed by the transhepatic catheter). In our present series of patients, the mortality rate was slightly higher than that reported in the literature (1.4% vs 1%)—even though we applied highly selective embolization at the bleeding site and performed indirect portography before the procedure in all patients to ensure portography findings were normal. Also, the bilirubin levels had normalized in the absence of biliary dilatation. The presence of significant coagulopathy in two cases arising from immunosuppression because of chemotherapy treatment for urinary bladder cancer can, perhaps, explain these outcomes. Sphincteroplasty carries a smaller risk of serious hemorrhage (no single case in our series) than does endoscopic sphincterotomy (2.5–5%). In the case of T-tube placement, it is necessary that the surgeon leave adequate access to the biliary tree (i.e., a 14-French T tube that is short and straight). It is preferable that the extreme end of the T tube is cut horizontally to facilitate the manipulation of the guidewires and catheters. Although not always necessary, it is convenient that the T tube be left in place for between 4–6 weeks if it is to be used in the therapeutic option.

Another merit of this radiologic procedure is that it is simple and cost-effective. The mean hospitalization period of about 1 week for the entire procedure is comparable to that of other therapeutic options.

In conclusion, percutaneous anterograde elimination of stones in the bile duct with dilatation of the papilla and elimination of the calculi using an occlusion balloon is an effective, nontraumatic, and safe technique. Maintenance of the anatomic integrity and function of the sphincter is desirable and is a great advantage compared with other treatment techniques, such as endoscopic papillotomy or surgery. It can be a viable alternative therapy in the treatment of bile duct lithiasis in specific patients, especially those in whom access to the bile duct is via an indwelling T tube or transhepatic catheter.

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