Percutaneous Treatment of Hepatic Hydatid Cysts: An Alternative to Surgery

OBJECTIVE. Percutaneous treatment of hydatid cysts is relatively new, and the data related to it are limited. The purpose of this study was to provide additional data to strengthen the proof of its effectiveness.

SUBJECTS AND METHODS. One hundred sixty-eight hepatic cysts in 111 patients were treated using a percutaneous approach under sonographic and fluoroscopic guidance. Cysts smaller than 5 cm in diameter were treated with a one-stage procedure that consisted of puncture of the cyst, aspiration of fluid, and injection and reaspiration of hypertonic saline solution. Larger cysts were treated with a two-stage procedure that consisted of the one-stage procedure followed by catheterization and sclerotherapy with alcohol.

RESULTS. The mean observation time was 19 months (range, 1–48 months). Follow-up examinations showed progressive shrinkage and solidification of the cysts. Early complications occurred in 32 (28.8%) of the 111 patients, including fatal anaphylaxis in one patient, biliary fistula in seven, infection of the cyst in four, persistent serous drainage from the cyst in two, intraperitoneal leakage of cyst fluid in two, urticaria in seven, fever without evidence of infection in seven, and pleural effusion in two. Late complications occurred in four (3.8%) of the 104 patients who underwent follow-up examinations, including local recurrence in three patients and intrabiliary rupture of a cyst in one patient.

CONCLUSION. Our experience indicates that percutaneous treatment is efficient in the management of hepatic hydatid cysts and that this technique should be considered an alternative to surgery.

Echinococcus granulosus causes cystic echinococcosis, which manifests as cystic lesions (hydatid cysts) in the host tissues. Cystic echinococcosis frequently involves the liver and the lungs; however, the tapeworm larvae form cysts that may be found in any organ, including the brain, heart, or bones. The disease has worldwide distribution and poses a health problem in areas where it is endemic, such as the sheep-raising regions of Europe, Asia, the Mediterranean, South America, Australia, and New Zealand [1].

The traditional treatment of cystic echinococcosis is surgery. The role of surgery and its considerable morbidity, mortality, and recurrence rates have been well documented in the literature [2–8]. Recently, benznidazole derivatives have been used in the treatment of hydatid cysts. However, the efficacy of drug therapy is limited [9].

Since the rapid growth of interventional radiology, percutaneous treatment of hydatid cysts has been performed without any mortality [10–21]. Recently, encouraging long-term results of percutaneous treatment of hepatic hydatid cysts and the successful results of a controlled trial comparing the safety and efficacy of percutaneous treatment with those of surgical cystectomy have been reported [17–19]. However, the percutaneous technique is new and has not been studied and reported as extensively as the surgical approach has. Therefore, this paper presents additional data to strengthen the proof of the effectiveness of percutaneous treatment. Here we present the results for 168 hepatic hydatid cysts in 111 consecutive patients treated using a percutaneous approach.

Subjects and Methods

Between September 1993 and November 1997, 168 hepatic hydatid cysts in 111 patients were treated with percutaneous drainage. Patients were monitored until December 1997. The study included 33 males and 78 females with a mean age
of 40 years (range, 5–80 years). Informed consent was obtained from each patient.

All patients were examined with sonography or CT or both before undergoing percutaneous treatment. The cysts were classified using the criteria defined by Gharbi et al. [22] (Table 1); type I and type II cysts were included in the study. Type III cysts were included only if daughter cysts occupied a small portion of the primary cyst. Type III cysts harboring numerous daughter cysts were not included because of the difficulty in traversing multiple septations and because of the need to puncture each vesicle, which would increase the risk of spillage of the cyst fluid. Type IV cysts that contained nondrainable soft tissue (degenerated membranes and debris) and inactive type V cysts were excluded from the study. Cysts with suspected or frank biliary communication were not treated percutaneously (i.e., were excluded from the study). Five nonhepatic (two renal, three peritonsil) hydatid cysts that were treated with a percutaneous approach were not included in the study. Seventeen cysts with an initial diagnosis of hydatid disease were drained but proved to be nonparasitic in origin; these were also excluded from the study. The data related to these 17 nonparasitic cysts in 14 patients and five nonhepatic hydatid cysts in four patients are not presented. Estimated volume of the included cysts ranged from 2 to 1456 cm³ (mean, 192 cm³).

Seventy-five patients presented with various symptoms such as right upper quadrant pain, right upper quadrant mass, or both; epigastric discomfort; and dyspepsia. Cysts in 36 patients were detected during sonography or CT examinations done for other reasons. One patient had thrombosis of the inferior vena cava caused by compression of the retrohepatic portion of this vein by multiple hepatic hydatid cysts.

To prevent secondary dissemination, patients received albendazole in a 10 mg/kg dose per day for 15 days before and 15 days after the procedure. Liver function tests were performed before initiation of prophylaxis and repeated on the day before the drainage procedure. All procedures were performed under sonographic and fluoroscopic guidance in the interventional radiology unit, which was provided with cardioversion and intubation equipment, oxygen, and emergency medications. An IV line was established, and patients were monitored closely for possible anaphylaxis. At the initial stage of the study, only 200 mg of hydrocortisone sodium succinate was given IV for premedication. Later, IV injection of pheniramine maleate (50 mg in adults, 0.5 mg/kg in children) was added to the premedication. Both drugs were given 20 min before the procedure, and the same dose of pheniramine maleate was repeated 12 hr later. The procedure was performed under local anesthesia in adults and under general anesthesia in pediatric patients. A person trained in intubation was present at every treatment session; in addition, the anesthesiology department was warned to prepare for possible anaphylaxis. When a pediatric patient was treated, a pediatrician and a pediatric surgeon were present in the unit.

The percutaneous puncture was performed under sonographic guidance with an 18-gauge needle for cysts with a diameter of 5 cm or more and with a 20-gauge needle for smaller cysts. Special attention was given to making the puncture through the normal liver parenchyma to avoid spillage of cyst contents into the peritoneal space. Especially in large univisceral cysts, the preferred puncture site was away from the dependent part of the cavity, which might contain a sediment rich in scolices. Cysts with a diameter of less than 5 cm were scheduled for the one-stage procedure, and larger cysts were scheduled for the two-stage procedure. The one-stage procedure [14] included puncture of the cyst, aspiration of half the cyst fluid, injection of hypertonic saline solution (in an amount equal to 70% of the evacuated fluid), and reaspiration of all fluid content of the cavity after separation of the endocyst from the cyst wall.

The two-stage procedure [20] included catheterization of the cavity at the end of the one-stage procedure and free drainage of the cavity for 24 hr. Then, after 24 hr, cystography and subsequent sclerotherapy of the cyst structures were performed. The fluid that was drained during the 24-hr period was checked for the presence and amount of bile staining. During cystography, 50% of the previously estimated volume of the cavity was filled with nonionic contrast medium. If no communication to sclerotherapy was present, the cavity was evacuated and half the volume of the aspirated material was infused as the sclerosant (95% alcohol). Alcohol was kept in the cavity for 20 min. Meanwhile, the patient was turned on the fluoroscopy table for 5 min in each position (supine, prone, right and left lateral decubitus positions). Before the needle or catheter was removed, the cavity was irrigated with normal (0.9%) saline solution. Contraindications to sclerotherapy of a cyst included proximity to major vascular structures, leakage of contrast medium to any space on cystograms, or bile staining of the drained cyst fluid whether or not a communication with the biliary ducts was found. If a communication with the biliary tree was present, instillation of alcohol was not performed, and the catheter was kept in place until the amount of drainage was less than 10 ml per day. In cases with persistent drainage of serious (free of bile) fluid of more than 10 ml per day, alcohol instillation was performed, but the catheter was left in place until the amount of drained fluid was less than 10 ml per day. The techniques used in this study differed from those of earlier studies [12, 18] in that the hypertonic saline solution was opacified with nonionic contrast medium until its concentration was 20%, and in that fluoroscopy was used as a routine guide in all steps of both the one-stage and the two-stage procedures. The cyst fluid sampled during the initial puncture was sent for immediate cytologic examination. The sediment obtained by centrifugation was examined for fragments of laminated membrane, scolices, and hooklets. The viability of scolices was assessed by observing their motility at immediate microscopy. Cysts without any evidence of hydatid disease on cytologic or radiologic examination (visualization of detachment of the endocyst) were excluded from the study.

Follow-up examinations were scheduled to determine cyst size, morphologic changes in cyst contents and cyst wall, and local recurrence or secondary dissemination. Sonographic examinations were performed 1, 3, 6, 12, and 18 months after the procedure. CT scans of the whole abdomen and chest radiographs were obtained at annual intervals. Decrease in cyst size and progressive solidification of cyst contents or disappearance of the cyst were regarded as positive criteria for healing. Local recurrence was defined as increase in cyst size, increase in fluid content of the cyst, or appearance of daughter cysts within the primary cavity. Secondary dissemination was defined as appearance of new hydatid cysts anywhere other than the treated cavity.

**Results**

Both cytologic and radiologic evidence of hydatid disease was observed in all 168 cysts. Viability was detected in 161 cysts. One hundred eight cysts in 80 patients were treated with the two-stage procedure, and the remaining 60 cysts were treated with the one-stage procedure. Sclerotherapy with alcohol was performed for 95 cysts. For the remaining 13 catheterized cysts, alcohol injection was not performed because of biliary fistula in eight, intraperitoneal leakage of cyst fluid in two, and close proximity to the inferior vena cava in three cysts. The mean catheterization time for 108 cysts was 2 days (range, 1–53 days). The mean hospitalization time of the 110 surviving patients was 3 days (range, 1–30 days). No significant abnormality was detected on liver function tests in any patient.

One patient with a solitary cyst died of anaphylaxis, and six patients with a total of nine cysts were lost to follow-up. Overall, the mean

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Early complications occurred in 32 (28.8%) of the 111 patients. A 53-year-old woman treated for a type 1 hepatic hydatid cyst developed severe bronchospasm, cyanosis, and vascular collapse during the one-stage procedure. In spite of immediate endotracheal intubation, administration of 100% oxygen, adrenaline, antihistamines, and vasopressor medication, persistent hypotension and subsequent disseminated intravascular coagulation resulted in death on the third day.

Biliary fistula was observed in eight cysts in seven patients. The presentation of biliary fistula was intrabiliary passage of opacified hypertonic saline solution in one cyst in one patient and bile staining of the cyst fluid during free drainage in seven cysts in six patients. Although the initially aspirated fluid from all of these eight cysts was clear, the drained fluid was found to be stained with bile several hours after catheterization in all cysts. Biochemical analysis of the fluid samples from these cysts showed the presence of bilirubin in high concentrations (range, 5–25 mg/dl; mean, 7 mg/dl). The cystograms obtained 24 hr after drainage showed communication with the biliary tree in three of the eight cysts.

In the patients with biliary fistula, the bile drainage via the catheter left in the cavity ceased after a mean period of 15 days (range, 3–53 days). Meanwhile, one of the cysts with biliary communication was infected. The infection was treated by draining the cavity with a 12-French catheter and administering antibiotics. Three additional patients without a biliary fistula developed infection of the cavity a few days after hospital discharge. The fever and leukocytosis caused by infection subsided with antibiotic therapy in all three patients. All 10 patients with infections were monitored for varying periods (range, 6–48 months), and the follow-up examinations in these patients showed progressive shrinkage of the cavity and no abnormality of the biliary system.

Persistent drainage of serous fluid from four cysts in two patients was treated by keeping the drainage catheter in place until cessation of drainage (range, 2–30 days). Two patients who were treated for multiple hydatid cysts developed right pleural effusion after the two-stage

Fig. 1.—5-year-old girl with type 1 hepatic hydatid cyst.
A. CT scan shows large, purely cystic mass (asterisk) in liver.
B. Sonogram obtained during procedure (10 min after injection of hypertonic saline solution) shows complete detachment of endocyst (arrowheads).
C and D. CT scan (C) and sonogram (D) obtained 2 years after percutaneous treatment show complete collapse and solidification (pseudotumor appearance) of cyst (arrows).
procedure. The pleural effusion in both patients resolved without any therapy within 1 month. Intrapleural leakage of cyst fluid was observed during catheterization of hepatic cysts in two patients. Albendazole therapy was continued for 3 months in these patients. No secondary peritoneal cysts were detected at follow-up (range, 12–24 months).

Treatment with antihistamines was successful in seven patients who developed urticaria after the puncture. Seven patients developed fever without any evidence of infection within 24 hr of the drainage procedure. The fever subsided with symptomatic therapy in all patients.

Late complications in four (3.8%) of the 104 patients who underwent follow-up examinations included intrabiliary rupture of a cyst in one patient and local recurrence of hydatid disease in three (1.9%) of 158 cysts in three (2.9%) of 104 patients. No signs of sclerosing cholangitis were observed in any patient.

Recurrence presented as appearance of multiple daughter cysts within the collapsed and solidified cavity 18 months after percutaneous treatment (Figs. 3A and 3B). The recurrent cysts were treated by simple cystectomy. The pathologic examination of the surgical specimens showed daughter cysts interspersed between severely degenerated laminated and germinative membranes and showed necrotic material within the cavity in all three cysts in the three patients. Light microscopy of the biopsy specimen from the cyst wall showed pericyst hyalinization and inflammatory cells in the pericyst (Fig. 3C).

One patient presented with jaundice 2 years after treatment with the two-stage procedure. ERCP showed a large intrabiliary rupture with migration of cyst contents into the main bile
duct. The patient underwent endoscopic sphincterotomy, balloon extraction of the intra-ductal cyst contents, and surgical repair of the fistula. Pathologic examination of the surgical specimen showed necrosis of the cyst wall, degenerative changes in the cyst contents, and no evidence of viability within the cavity.

Discussion

Although cystic echinococcosis is a benign disease, it is progressive and may cause various complications that can result in serious morbidity and mortality. Complications of hydatid cysts include suppuration, compression of surrounding tissues, and rupture into adjacent structures [4,7]. Occasionally, anaphylactic shock may occur as a result of rupture, and death may ensue [23-25]. Therefore, timely diagnosis and treatment are important to prevent the morbidity and mortality associated with the disease.

The diagnosis of cystic echinococcosis is mainly based on radiographic grounds [22,26-28]. Serology is not fully satisfactory for diagnosis [29]. Percutaneous drainage provides a definitive diagnosis as well as treatment of cystic echinococcosis [20]. Regardless of the method used, the goals of therapy are inactivation of the parasite, elimination of the mass effect, and prevention or management of the complications. In the present study, the hydatid cysts decreased in size and lost fluid content progressively after percutaneous treatment. These observations reflect the success of percutaneous treatment in elimination of the mass effect and probably in inactivation of the parasite as well. Histopathologic evidence for the success of percutaneous treatment in inactivation of the parasite was obtained in an experimental study on sheep [20]. However, data regarding what happens histopathologically in human hydatid cysts after percutaneous treatment have been lacking. Excluding the presence of daughter cysts, the histopathologic findings encountered in the surgically removed recurrent cysts in the present study are similar to those observed in the dead cysts after percutaneous treatment in the animal study [20] and represent the regressive changes after percutaneous treatment of human hydatid cysts.

The local recurrence rate is 1.9% in the present study. Recurrence probably resulted from underexposure with the scolecidal agent. Therefore, catheterization of the cyst and turning the patient on his or her side during the procedure are important technical considerations to provide penetration of the scolecidal agent to all surfaces of the germinative membrane. Previously reported recurrence rates after percutaneous treatment range from 0% to 4% [10-19]. These recurrence rates, together with ours, compare favorably with rates after various types of hydatid cyst surgery, which range from 0% to 30% [2-8]. Moreover, past fears notwithstanding, secondary dissemination was not observed in our study or in previous studies [10-20]. Percutaneous treatment produces a much smaller exposure surface for the cyst fluid than open surgery does. Benzimidazole derivatives known to be effective in the prophylaxis of experimental peritoneal hydatidosis [30] were used in this study and other studies [11-16,19,21]. These factors may explain the much lower local recurrence rates and the absence of secondary dissemination with percutaneous treatment when compared with surgery.

One patient in the present series died as a result of irreversible anaphylaxis. The potential risk of anaphylaxis on exposure with hydatid fluid has been considered a contraindication for percutaneous puncture of hydatid cysts. Evidence for allergic reactions has, in fact, been documented in the studies of percutaneous treatment [12-14,16,18,19], but most of these complications were minor and treated successfully. Anaphylactic reactions are not unique to percutaneous treatment because cases of anaphylaxis during surgery that sometimes result in death have also been reported [2,4,5]. Although all 111 patients in the present study were possibly exposed to the hydatid cyst fluid during the treatment procedures, anaphylaxis occurred in only one (0.1%). The data from previous case reports indicate that spontaneous rupture of a hydatid cyst may cause [24,25] or may not cause [31] anaphylaxis. These data suggest that percutaneous aspiration of a hydatid cyst does not necessarily start an anaphylactic reaction. Although anaphylaxis seems to be associated with the antigenicity of the cyst contents [24], it is not clearly known which cysts cause such a reaction in which patients. Therefore, whatever the type of treatment is, precautions to treat possible anaphylaxis should be taken in every case of a hydatid cyst. Although no established premedication exists for prophylaxis of anaphylaxis, presurgical administration of histamine receptor blockers seemed effective in decreasing the adverse hemodynamic changes observed during hydatid cyst surgery in a prospective study [32]. In our study, we observed the hypersensitivity reactions at the initial stage of the study, during which only corticosteroids were used for premedication. Later, we added administration of histamine receptor blockers, and we did not encounter any hypersensitivity reactions thereafter.

The mortality rate in our series (0.1%) compares favorably with the reported mortality rates associated with various methods of surgery, which range from 0% to 7.8% [2-8]. The reported morbidity rates for surgery are even higher than the mortality rates, ranging from 14% to 60.8% in large series [2,3,5,6,8] and reaching 62.8% in complicated cases [7]. The common causes are infective complications, biliary fistula, pulmonary complications, intra-abdominal hemorrhage, and sclerosing cholangitis [3-8]. Early complications associated with percutaneous treatment occur in 0% to 71.4% of patients [10-19]. The most common complications include fever without infection, minor hypersensitivity reactions, and biliary fistula [12-19]. The first two complications probably represent a reaction to the antigenic stimulus by the parasite and can be managed with symptomatic therapy [12-19]. The persistent drainage of bile or serous fluid from the cavity was treated in the present study by simply keeping the drainage catheter in place. Infection of the cavity was treated with antimicrobial therapy with or without percutaneous drainage of the cavity. Right pleural effusion in two patients resolved without any therapy, which suggests that the pleural effusion developed as a reaction to multiple catheters placed using an intercostal approach. Leakage of hydatid cyst fluid, another complication in our study, carries the potential risk of peritoneal dissemination of the disease [33]. No peritoneal cysts developed during the follow-up period in the two patients with intraperitoneal leakage of the cyst fluid in our study. The leakage in these patients occurred after administration of hypertonic saline solution. Therefore, the leaked fluid was expected to contain dead scolices, if any. Albendazole therapy was continued for 3 months in these patients. These two factors seem to have been effective in prevention of peritoneal dissemination. One late complication we encountered was the rupture of a treated cyst into the biliary ducts 24 months after percutaneous treatment. Because no evidence of a biliary fistula had been found at the time of percutaneous treatment and the follow-up had been eventful, the complication was attributed to necrosis of the cyst wall, which was confirmed histopathologically.

The early and late complication rates (28.8% and 3.8%, respectively) in this study compare favorably with those of hydatid cyst surgery [2-8]. This comparison may seem unfair because almost all types of hepatic hydatid cysts were included in the surgical studies. However, the type of hydatid cyst would not seem to affect the success rate of surgery because all surgical
methods aim at removal of cyst contents regardless of cyst type [2-8, 29]. Furthermore, the results of a prospective study comparing the efficiency of surgery with percutaneous treatment for identical types of hydatid cysts showed that the mean hospital stay was significantly shorter and the morbidity rate significantly lower in the percutaneous treatment group [19]. The methods used in percutaneous treatment are much less invasive than those used in surgery. Thus, it is not surprising that the hospital stay for percutaneous treatment (range, 3-4 days) [10-19] is much shorter than for various methods of surgery (ranging from 15 to 40 days in two large series) [5, 6].

Because the intracavitary instillation of a scleroidal agent is an important part of percutaneous treatment, the success and safety of the treatment are affected by the potency and safety of the agent used. The scleroidal effect of hypertonic saline solution [20] and the scleroidal and sclerosing effects of absolute ethanol are known [34], and our study offers more evidence of their effectiveness.

However, no scleroidal agent is completely safe. In a recent review, the association of secondary sclerosing cholangitis with the use of scleroidal agents (formalin, hypertonic saline solution, ethanol, silver nitrate, or iodine solution) during surgery was emphasized [35]. However, percutaneous treatment uses a different method for scleroidal agents than surgery does.

The following observations are derived from previous and present data concerning biliary fistulas complicating percutaneous treatment (Table 2). First, the fistula rates (ranging from 1.7% to 6.2%) in the typical percutaneous treatment studies, in which the solid components of the cyst are left in the cavity [13-16, 18, 19], are significantly less than those encountered after surgery (ranging from 14.1% to 22.3% with conservative methods and from 0% to 7.7% with radical methods) [5, 6]. Second, in the study by Saremi and McNamara [17], although a percutaneous approach was used, the solid components of the cysts were evacuated with the aid of a large-bore cannula. In that study, the biliary fistula rate (34.3%) was even higher than rates observed after surgery. These two observations suggest that leaving the solid components in the collapsed cavity decreases the fistula rate, probably by obliterating the cavity and occluding the fistula orifices. Third, the cumulative data in Table 2 show that intrabiliary passage of a scleroidal agent during percutaneous treatment was observed in only three (12%) of the 25 patients with a fistula, and the fistulas in the remaining patients gained patency several hours or even months after the initial procedure. These findings suggest that most biliary fistulas gain patency after complete decompression of the cavity and complete collapse of the endocyst and that the probability of passage of the scleroidal agent into the bile ducts during the procedure is low. Fourth, although indirect evidence (bile staining of the cyst fluid) existed for biliary fistulas, a fistula was shown by cystography in only 13 (54%) of the 24 patients in whom cystography or ERCP was performed. This suggests that almost half of the fistulas are minute, fissurelike communications between the cyst and the biliary system, and that such fistulas do not allow passage of injected material into the biliary tree even after collapse of the endocyst.

Fifth, no case of sclerosing cholangitis after percutaneous treatment has been reported. In fact, the first four observations explain the absence and the low probability of sclerosing cholangitis after percutaneous treatment. Although its probability is low, such a complication cannot be ignored; therefore, in the future, a safer scleroidal agent should replace the ones currently used. We advocate the routine use of fluoroscopy during the percutaneous treatment procedures to detect any leakage and to ensure immediate and complete reaparation of the scleroidal agent. We also recommend leaving a catheter in large cysts for free drainage for 24 hr because most of the biliary connections gain patency during the free drainage

### Table 2: Biliary Fistulas Complicating Percutaneous Treatment in Several Studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Methoda</th>
<th>Imaging Technique</th>
<th>F/C (%)b</th>
<th>Characteristics of Fistulas</th>
<th>Detected on Cystography or ERCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Khuuro et al. [13]</td>
<td>One-stage procedure</td>
<td>Sonography</td>
<td>1/21 (4.8)</td>
<td>Scolecidal Agentc</td>
<td>1 (4 weeks after procedure)</td>
</tr>
<tr>
<td>Giorgio et al. [15]</td>
<td>One-stage procedure repeated with intervening 3-day period</td>
<td>Sonography</td>
<td>1/16 (6.3)</td>
<td>Bile Staining of Cyst Fluid</td>
<td>1 (3 days after procedure)</td>
</tr>
<tr>
<td>Khuuro et al. [16]</td>
<td>One-stage procedure</td>
<td>Sonography</td>
<td>1/22 (4.5)</td>
<td>Biliary Obstructiond</td>
<td>1 (1 week after procedure)</td>
</tr>
<tr>
<td>Saremi and McNamara [17]</td>
<td>Evacuation of all cyst contents with percutaneous approach</td>
<td>Fluoroscopy</td>
<td>11/32 (34.4)</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Akhan et al. [18]</td>
<td>One-stage procedure for small cysts; two-stage procedure for large cysts</td>
<td>Sonography, fluoroscopy, or both</td>
<td>1/57 (1.8)</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Khuuro et al. [19]</td>
<td>One-stage procedure</td>
<td>Sonography</td>
<td>1/25 (4)</td>
<td></td>
<td>1 (3 months after procedure)</td>
</tr>
<tr>
<td>Present study</td>
<td>One-stage procedure for small cysts; two-stage procedure for large cysts</td>
<td>Sonography and fluoroscopy</td>
<td>9/158 (5.7)</td>
<td></td>
<td>1 (24 months after procedure)</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td></td>
<td>25/331 (7.6)</td>
<td></td>
<td>13</td>
</tr>
</tbody>
</table>

Note — Dash (-) indicates not performed.
aOne- and two-stage procedures were similar for each study.
bF = no. of cysts with fistula, C = no. of treated cysts, numbers in parentheses are percentage of cysts with fistula.
cScolecidal agent used.
dPassage into biliary ducts during procedure.
eCaused by intrabiliary passage of cyst contents, detected after procedure.
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period. Our study found that leaving the catheter in the patient allows for better detection and treatment of fistulas.

This study presents the results of what is, to our knowledge, the largest series of hepatic hydatid cysts treated using a percutaneous approach, and the mean observation time is longer than that of many previous studies [10–16, 19]. The cumulative data from the literature and the experience of this study indicate that percutaneous treatment should be an alternative to surgery for treatment of selected hydatid cysts. However, we recommend that the procedure be performed in specialized centers where medical teams are prepared to manage potential complications.

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References