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Open and laparoscopic surgical treatment of cavity infection after percutaneous treatment for liver hydatid disease

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ABSTRACT

Introduction: Percutaneous treatment is an effective alternative to surgery in suitable cases for liver hydatid disease. This study aimed to review the clinical findings and treatment methods of patients who developed cavity infections after percutaneous intervention and to evaluate the morbidity and mortality rates.

Materials and Methods: Between January 2010 and December 2020, 560 (45%) of 1240 patients diagnosed with liver hydatid cysts were treated percutaneously by the interventional radiology clinic of our hospital. In 32 (5.71%) patients, the operation was planned as a result of the development of a cavitary infection. Demographic data, clinical and laboratory findings, diagnostic methods, surgical treatment methods, morbidity, mortality, and long-term results of the patients were evaluated retrospectively.

Results: The main complaints of patients with infected liver cysts were pain and fever. Emergency surgery was planned for 3 patients. One patient died without being operated on due to rapidly developing cholangitis and septic shock. Two patients underwent emergency surgery, and 29 underwent elective surgery. Open surgery was performed in 28 patients, and laparoscopic surgery was performed in 3 patients. All patients underwent conservative surgery.

Conclusion: Cholangitis and sepsis appear as serious clinical entities in patients who develop cavity infections after the percutaneous intervention. This rate is significantly higher than in patients operated on electively. These patients should be hospitalized, and pre-operative broad-spectrum antibiotics should be started and monitored closely. Emergency or elective surgery should be planned according to the clinical and laboratory findings of the patients.

Keywords: Complicated liver hydatid cyst, Infected hydatidosis, Liver hydatid disease, Percutaneous treatment, Surgical treatment

Introduction

Hydatid cyst disease caused by Echinococcus granulosus is endemic in some countries (Mediterranean countries, Middle East, South America, New Zealand, and Australia), including Turkey. The incidence of the disease is increasing worldwide due to mass migrations. Although hydatid disease (HD) is seen in approximately 75% in the liver, 25% in the lungs, and 15% in the spleen, it can affect

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all organs to a lesser extent. After the parasite settles in the liver, it reaches a diameter of about 1 cm in the first 6 months, then grows about 2–3 cm per year and may remain silent for years.[1] The disease has no specific symptoms, and the clinical course is insidious. The diagnosis is sometimes made incidentally by imaging methods performed for examination purposes. However, in untreated patients, the cyst may enlarge and rupture to the surrounding organs (diaphragm, pleura, bronchus, and peritoneum) and bile ducts and may present serious life-threatening complications.

Medication, percutaneous treatment, and surgical treatment methods are used in the management of hydatid cyst disease. The number, location, diameter, type of cysts, and any complications related to the cyst play a role in the treatment choice.

The results of medical treatment with benzimidazole compounds (albendazole or mebendazole) for HD are unsatisfactory.[2-4] Medical treatment should be used prophylactically in all patients before and after the surgical and percutaneous procedure to prevent the spread of the parasite to the surrounding tissues.

Percutaneous therapy, which has been increasingly used in the last 20–30 years, is an effective treatment option. In the therapy of liver hydatid cyst, percutaneous methods are preferred to surgical treatment in suitable patients because it is less invasive, the hospital stay is shorter, returning to normal life is faster, morbidity and mortality rates are low, the treatment can be performed with local anesthesia, and it can be applied more easily in cases of recurrence.[5-9]

Depending on the size, type, and whether it is a cystobiliary fistula (CBF), one of three techniques is selected for percutaneous treatment. Percutaneous treatment is mostly preferred in CE 1 and 3A cysts and some CE 3B (fluid collection with daughter cyst with drainable matrices) cysts with fluid content according to the World Health Organization (WHO) classification. The puncture, aspiration, injection, and reaspiration (PAIR) technique is used for cysts smaller than 6 cm in diameter not associated with the bile ducts. For cysts larger than 6 cm with CBF, the percutaneous treatment and external catheterization technique are applied to the cyst cavity.[6,10,11] In addition, in the treatment of type CE 2 and CE 3B liver hydatid cysts, a modified catheterization technique is used.[12,13]

The rate of CBF in liver hydatid cysts is reported to be 10–37%. This rate increases, especially in cysts larger than 10 cm located in the liver center. Bile drainage is monitored in patients who have had a catheter inserted due to CBF, and in some of these patients, the CBF is closed without the need for any intervention. However, endoscopic retrograde cholangiography (ERCP) with sphincterotomy or transduodenal catheter application is recommended for patients whose biliary drainage does not decrease in their follow-up and who have biliary drainage <100 mL at the end of the 10th day.[14]

However, the prolongation of the catheterization period in catheterized patients, transduodenal catheter application with ERCP, and sphincterotomy increase the susceptibility to cavity infections.[15]

Surgical treatment of liver HD is a method that can be applied in all spectrums of the disease. The aim of surgical treatment is to inactivate the parasites, empty the cavity, remove germinative membranes, and obliterate the residual cavity. Surgical treatment is done in two ways: Radical and conservative approaches. In radical surgery (cystectomy, total peri-cystectomy, hepatic resections), the cyst is completely removed along with 1–2 cm of the surrounding tissue without opening the cysts.

The conservative approach is provided by opening the cyst, completely emptying the cavity, and managing the cavity with omentoplasty, capitonnage, introflexion, and internal drainage. In patients who underwent hepatectomy, recurrence and biliary fistula are less common after surgery, but undesirable bleeding may occur during the operation. Therefore, radical surgery should not be preferred in large or centrally located cysts, as well as cysts on the hepatic vein or inferior vena cava.

Laparoscopic surgery is possible in selected patients for the surgical treatment of liver hydatid cysts. In the planning of laparoscopic treatment, the general condition of the patient, the number and localization of the cysts, the presence of complications, the experience of the surgeon, and the adequacy of the technical possibilities should be considered.

Cavity infection should be suspected if clinical symptoms, such as pain, fever, malaise, anorexia, or jaundice, occur in patients following percutaneous therapy. Diagnosis in cavity infection is confirmed by the presence of air-fluid level or small air bubbles in the cyst on the computerized tomography, increased cyst density, peri-cystic inflammatory halo in the liver tissue adjacent to the cyst, and no

shrinkage in the cysts compared to the pre-percutaneous procedure in the computer tomography, magnetic resonance imaging, or ultrasonography (USG).[16] Secondary bacterial infection is most commonly caused by Gram-positive cocci and bacilli. Escherichia coli is the most commonly detected bacteria in microbiological culture.[17]

The treatment of patients who develop cavity infections after percutaneous treatment is not yet standardized, and there is no guideline. The aim of this study is to retrospectively evaluate the demographic data, clinical findings, morbidity and mortality rates, and surgical treatment results of patients who developed cavity infection after percutaneous intervention in the treatment of liver hydatid cyst who applied to the general surgery clinic of our health center.

Materials and Methods

The approval for the study, in accordance with the Declaration of Helsinki, was obtained from the Ethics Committee of Erzurum Atatürk University Faculty of Medicine (September 30, 2021, No:6-27).

Between 2010 and 2020, files of 1240 patients over the age of 18 years diagnosed with liver hydatid cysts were reviewed retrospectively. There were 560 (45%) patients who underwent percutaneous interventions (Table 1). According to the WHO classification, type CE 1 and type CE 3A cysts were treated percutaneously, and patients with type CE 2 and CE 3B liver cysts were offered surgical treatment. Thirty-two patients who developed cavity infection during the follow-up after percutaneous treatment and were recommended to be operated on were included in the study. Patient data were from the hospital information system and by scanning the hospital's archive files.

Table 1. The rate of cystobiliary fistula and cavity infection seen in patients treated percutaneously (n=560)

	n (560) (%)
Patients with biliary fistula	78 (13.9)
Patient with a catheter	72 (12.8)
Biliary fistula patients treated without catater application	6 (1.1)
Patient with biliary fistula improving	43 (7.6)
Patient with cavity infection	35 (6.2)
Patient with cavity infection improving	3 (0.5)
Patient scheduled for surgery	32 (5.7)

Complete blood count (hemogram), liver function tests, coagulation tests, kidney functions, electrocardiogram, and chest X-ray were ordered in all patients. Computed tomography (CT) was used as the main imaging method to determine the cyst number, size, location, and content. In addition, magnetic resonance cholangiography was performed in patients with biochemical and radiological suspicion of CBF, cholangitis, or cholestasis, and ERCP was performed before surgery.

All patients received albendazole (Andazol; Biofarma/Turkey) prophylactically as a double dose of 15 mg/kg/day before surgery. Post-operative treatment was continued for 6 weeks. The type of surgery and incision type were determined according to the patient's number of cysts, cyst size, cyst location, cyst perforation, and the presence of cysts in other organs. In all patients, 0.04% chlorhexidine gluconate was used during surgery to inactivate the cyst contents and to prevent seeding into the surrounding tissue. Post-operative complications were classified according to Clavien et al.[18] After the operation, before drain removal and patient discharge, control abdominal USG was performed to determine whether there was a collection. Abdominal CT was taken if necessary.

The patients were followed up regarding post-operative complications, morbidity, mortality, residual cavity, reoperation, and long-term recurrence.

Results

In total, 32 patients developed cavity infections after percutaneous treatment. Eighteen patients were male, and 14 were female. The age range was 18–82, with a mean age of 38.2 years. Clinically, abdominal pain, fever, malaise, and dyspepsia were the most common symptoms (Table 2). Of the patients, 3 presented with clinical sepsis. One of these patients died in the emergency room due to septic shock before he could be operated on. Another patient underwent emergency surgery due to acute abdomen as a result of cyst perforation. The last patient with clinical sepsis was taken to emergency surgery after performing ERCP. Elective surgery was planned for the other 29 hospitalized patients.

Radiology images of the patients were compared with the previous images. The increase in density, heterogeneity, and air particles in the cyst cavity on CT and the absence of shrinkage in the cavity compared to pre-percutaneous

Table 2. Patients characteristics

	n: 32 (%)
Gender	
Male	18 (56.2)
Female	14 (43.75)
Symptoms/Signs	
Pain	28 (87.5)
Fever	20 (62.5)
Nausea, vomiting	25 (78.1)
Jaundice	8 (25)
Acute abdomen	2 (6.3)
Sepsis	3 (9.3)
Respiratory distress	3 (9.3)
Abdominal distention	3 (9.3)
Cyst Location	
R lobe	22 (68.7)
L lobe	4 (12.5)
Bi-lobar	6 (18.7)
Radiologic/Endoscopic interventions	
Catheter applied	29 (90.6)
PAIR applied	3 (9.3)
ERCP applied	18 (56.2)
Complication (%)	
CD III-IV	13 (41.9)
CD V	
Pre-operative 1 (3.1)	5 (15.6)
Post-operative 4 (12.5)	
Surgical Technique (%)	
Cystotomy unroofing drainage	
Open 25 (78.1)	28 (87.5)
Laparoscopic	3 (9.3)
Cystotomy omentoplasty	
Open 3 (9.3)	3 (9.3)
Laparoscopic	-

treatment suggested a heterogeneity cavity infection in the liver tissue adjacent to the cyst.

Localization: The total number of cysts was 63, and the mean cyst size was 8.8 cm (15–5 cm). The cysts of 22 patients were located in the right lobe, the cysts of 4 patients were located in the left lobe, and the cysts of 6 patients were bi-lobar. Twenty-two patients had a single cyst, 4 patients had 2 cysts, and 6 patients had 3 or more cysts (Table 2).

All percutaneously treated cysts were CE1 and CE3A, according to the WHO classification. The percutaneous procedure was not performed in patients who had laboratory-proven cholestasis before the procedure and those suspected of cyst rupture into the bile ducts in the USG evaluation. Surgery was planned for CE2 and CE3B cysts ruptured into the bile ducts.

A patient admitted to the emergency department with septic shock died while pre-operative preparations were in progress. Open surgery was performed in 28 patients, and laparoscopic surgery was performed in 3 patients (Table 2). Right subcostal, median, or J incision was preferred according to the type of surgery, type of incision, the number of cysts, cyst size, cyst location, the presence of biliary fistula, cyst perforation, and the presence of cysts in other abdominal organs.

After the cyst was isolated during the surgery, 100–150 mL cyst content was drained with a thick needle, and culture was taken. 50 mL 0.04% chlorhexidine gluconate was injected into the cyst as a scolicidal agent. After waiting for 3 min, the cyst was opened, and the contents were evacuated.

All patients underwent conservative surgery. Radical surgical procedures such as liver resection and peri-cystectomy were not performed. Twenty-eight patients underwent cystotomy and unroofing to reduce the residual cavity. omentoplasty was applied to the cavity in 3 patients (Table 2).

In all patients who underwent open surgery, the cyst cavity was investigated in terms of CBF. To detect biliary fistulas, cholecystectomy was performed in 10 patients, and a tube was placed through the cystic duct. Bile leaks were checked by injecting 10 mL of 1% propofol into the tube. Bile leaks were repaired with non-absorbable sutures. The cystostomy tube was removed after the procedure (Table 3). A T-tube was applied to the common bile duct in 1 patient.

Fewer biliary fistulas were observed after the operation in patients whose CBF was checked by cholecystectomy-cystostomy. Bacterial cultures were studied in all patients.

Serious complications developed after surgery in 13 patients (41.9%) (Clavien grade III and IV) (Table 4). Four patients died due to accompanying medical problems and sepsis after the operation. A total of 5 patients (15.6%) died (Table 4). The mean hospital stay was 25 days (min: 15 and max: 58). No recurrence was observed in 27 patients at the end of the follow-up period of 8–60 months (mean 42 months). The mean age of the deceased patients was 64.2, which was higher than the other patients.

Table 3. Comparisons of groups with and without cholecystectomy- cystostomy for the detection of bile fistula

	PO-ERCP	OS	Lap	OP	BL	PS-ERCP	HS
No Cholecystectomy (n=21)	12	17	3	3	10	6	15
Cholecystectomy + cystostomy (n=10)	6	10			1		12

PO-ERCP: Pre-operative ERCP; OS: Open surgery; Lap: Laparoscopic; OP: Omentoplasty; BL: Bile leak; PS-ERCP: ERCP after surgery; HS: Hospital stay.

Table 4. Complications

	n=32 (%)
CD III-IV	
Pleural effusion	3 (9.3)
Biliary fistula into thorax	1 (3.1)
Broncho-biliary fistula	1 (3.1)
Pulmonary embolism	1 (3.1)
Bile fistula	6 (18.8 ERCP performed)
Fluid in the cavity	1 (3.1)
CD V	
Cholangitis sepsis (Pre-operative)	1 (3.1)
Cyst perforation sepsis	1 (3.1)
Liver abscess pancreatic necrosis abscess sepsis	1 (3.1)
Sepsis	1 (3.1)
V. cava bleeding into the cyst cavity	1 (3.1)

Discussion

Percutaneous treatment is today widely employed in the management of liver hydatid cysts. Costs of patients treated percutaneously are lower, and the length of stay in the hospital and returning to normal daily life is faster than the patients who undergo surgical treatment.[5-9] In a study, 1240 patients diagnosed with hydatid cyst in the general surgery outpatient clinic in the last 10 years were screened retrospectively. Percutaneous treatment was applied to 560 (45%) of the patients by the radiology clinic. Of the patients, 680 (55%) who did not receive percutaneous treatment were operated on by the general surgery clinic.

Biliary fistula is the most common complication of percutaneous hydatid cyst treatment. Bile leakage into the cyst cavity may develop within 1–2 days after the procedure and may not be noticed during the procedure. The occult biliary fistula rate is 10–37%, and the frank biliary fistula rate is 3–17% in liver HD.[19-22] Although there was no evidence of biliary fistula in the baseline clinical, laboratory, and USG investigations of the 560 patients who underwent percutaneous procedures, post-procedure biliary fistulas were observed in 78 (13.9%) patients.

Out of 78 patients with biliary fistula, 72 received catheter applications and were followed up daily. The biliary fistula regressed in 43 patients (55%). Cavity infection developed in 35 patients (45%) and regressed in 3 patients with frequent follow-up and cavity irrigation. In 32 patients, the cavity infection did not regress, and surgery was planned. The rate of cavity infection in patients with biliary fistula is significantly higher than in the literature (n=35/78, 44.8%). Furthermore, in patients with cavity infection, the recovery rate of cavity infection is significantly lower (n=3/35, 8.5%).

Cavity infection was observed more frequently in catheterized patients. However, in our patients, the reason for this may be the transition from the PAIR to catheter technique in the case of biliary fistula in patients who underwent percutaneous intervention. In a randomized controlled study conducted by Akhan et al., it was reported that in the percutaneous treatment of liver HD, cavity infection was observed in 2.8% of patients who underwent PAIR and 12.8% in patients who had a catheter.[13]

In another prospective randomized controlled study by Akhan et al., PAIR and catheterization techniques were compared. Patients with CE1 and CE3A cyst larger than 4 cm were included, and the patients were compared concerning major complications, including abscess, CBF, and recurrence. The complication rate was reported 2.9% in patients who underwent PAIR and 36.8% in patients with catheters.[15] In the study conducted by Akhan et al., PAIR is recommended to patients first. Catheterization is suggested for patients with CBF, in whom the PAIR procedure was unsuccessful. In our patients, the PAIR technique

was applied first and changed to the catheter technique in the case of biliary fistula.

The treatment of patients who develop cavity infections after percutaneous treatment is not yet standard. There are publications suggesting elective surgery in patients who develop a liver abscess, first performing percutaneous drainage and after the patient's clinical improvement. In a study conducted by Lopez-Marcano et al., 3 patients were started on antibiotics according to the pre-operative culture results, a catheter was inserted, and the patients were taken into surgery after their general condition improved.[23] Considering the patient's clinic, we follow the same approach.

The rate of cavity infections in our patients with biliary fistula was similar to the literature. However, the recovery rate of cavitary infections was low during the follow-up, and most patients were referred to surgery (n=32/35, 91.4%).

In our patient series, emergency surgery was planned for 3 patients due to sepsis. Two patients had cholangitis and sepsis, and one patient had infected cyst perforation and acute septic abdomen. One patient died in the emergency department due to septic shock before an emergency operation could be initiated. The other 2 patients underwent emergency surgery. However, they died on the 1st and 15th days after the operation. Mortality in these patients occurred due to sepsis and age-related concomitant medical problems. The mean age of these patients was comparatively higher.

Patients with cavity infections after percutaneous treatment should be differentiated from CBFs without cavitary infection. If the catheter does not provide adequate drainage, rapidly developing sepsis occurs in patients with significant CBF with increased cystic pressure. The patient should be followed closely, especially in cysts larger than 10 cm and located close to the main bile ducts in the liver center. As the cyst approaches the liver center, the diameter of the bile duct where the cyst is fistulated increases. In these patients, cholangitis and sepsis may progress more rapidly in case of a fistula into the bile ducts. Cavitary infection developed after the PAIR treatment in a patient with a 12 cm cyst located centrally in the 4–5th segments of the liver. The patient did not accept hospitalization and died after 1 day in the emergency department due to sudden-onset septic shock. We recommend that these patients should not be treated as outpatients, be hospitalized, and be followed closely regarding cholangitis and sepsis.

In our patients, cystotomy and unroofing were performed on all patients. No recurrence was observed in any patient. Total peri-cystectomy, a radical method, was not preferred in hydatid cyst, a benign disease. We think that the conservative approach is sufficient as a surgical technique.

During surgery, CBFs should be carefully explored and sutured. The post-operative biliary fistula rate in patients who underwent CBF repair by cholecystectomy is considerably lower than in patients who did not. For example, in the group in which the cystic duct was cannulated by cholecystectomy, post-operative biliary fistula was observed in 1 out of 10 patients, whereas biliary fistula was observed in 10 out of 20 patients whose biliary control was not done.

Choledochotomy and choledochoscopy are recommended in patients with dilated common bile ducts who had no ERCP before surgery. In our patient group, choledochotomy and external drainage of the common bile ducts were mostly not performed because ERCP was performed before the operation. External drainage with a T-tube was used in 1 patient.

Publications report that omentoplasty reduces biliary fistula and infection rate in occult bile duct fistulas. We preferred administering propofol through the cystic duct and suturing the bile leaks in the cavity to detect cavity leaks during surgery. We made the cavity as small as possible by unroofing and providing good drainage to prevent infection. Omentoplasty was performed only in 3 patients with intraparenchymal cysts.

Laparoscopic surgery can be preferred in suitable patients depending on the location, size, and stage of the liver cysts. In our patients, laparoscopic surgery was selected in 3 patients with type 1 and type 2 cysts according to the Gharbi classification with peripherally located cysts. In type 3 cysts with dense cavity contents, technical facilities should be good for completely emptying the cyst cavity with laparoscopy. For this purpose, we use an aspirator with a diameter of 1.2 cm designed for hydatid cyst surgeries with a wide lumen for the aspiration of the cyst cavity.

Fistula occurred in 2 patients whose cyst was adjacent to the diaphragm, and severe pleural effusion occurred in 3

patients. In 1 patient whose cyst was adherent to the diaphragm and had an abscess in the cyst cavity, bile came from the drains on the 1st day of the cystotomy – unroofing procedure. Due to diaphragm inflammation and negative pressure in the thorax, a broncho-biliary fistula developed in the patient on the 6th day. Thorax bile fistula occurred in another patient. In patients whose cyst is adjacent to the diaphragm, lung complications due to cavity infection are more common and clinically more severe.

In the literature, mortality after hydatid cyst surgery varies from 0% to 7.5%,[24,25] and this rate is significantly higher in the group of patients we operated on due to a cavity infection. Between 2010 and 2020, 650 patients were treated surgically in the general surgery clinic, and 6 (1.07%) patients died. This rate is similar to the literature, but 5 of these patients had a previous percutaneous intervention and cavity infections. Mortality, morbidity, and hospital stay of patients who developed cavity infection after percutaneous intervention in our center are higher than patients with hydatid cysts who were not suitable for percutaneous treatment and were operated on electively. Delayed surgery in patients who develop cavity infections after percutaneous treatment increases morbidity and mortality proportions.

In our patients, the rate of cavity infections in patients with biliary fistula was similar to the literature. However, the recovery rate of cavity infections in the follow-ups was low. Most of these patients had been operated on, but the morbidity and mortality of the electively operated hydatid cyst patients were lower.

Conclusion

The percutaneous treatment achieves good results in selected patients with liver hydatid cysts. However, the development of cavity infections after percutaneous treatment can be life-threatening. These patients should be hospitalized, broad-spectrum antibiotics should be started, and should be followed up closely. We recommend the selection of emergency or elective surgery according to the clinical conditions of the patients. The development of sepsis and the patient's advanced age increases the morbidity and mortality rate in patients who develop cavity infections after percutaneous treatment. Therefore, the morbidity and mortality of these patients are higher, and the length of hospital stay is longer than hydatid cyst cases not suitable for percutaneous treatment operated on directly.

Disclosures

Ethichs Committee Approval: The approval for the study, in accordance with the Declaration of Helsinki, was obtained from the Ethics Committee of Erzurum Atatürk University Faculty of Medicine (September 30, 2021, No:6-27).

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