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Surgical Techniques and Treatment for Hepatic Hydatid Cysts

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Abstract

Purpose. Hepatic hydatid cysts (HHCs) are a parasitic infestation caused by several species of *Echinococcus*. We examined the clinical features of HHCs and evaluated the results of various surgical procedures.

Methods. One hundred and sixty-nine patients aged between 17 and 84 years underwent surgery for HHCs within a 12-year period. We recorded the demographic data, location of the cysts, surgical procedures used, morbidity, recurrences, and hospital stay.

Results. Most (90.5%) of the patients presented with symptoms, but 16 (9.5%) patients reported no symptoms. The most common symptom was abdominal pain. The overall number of cysts was 216 HHCs and 9 concomitant hydatid cysts in other abdominal organs. The surgical treatments consisted of hepatic resection in 8 (4.7%) patients, cystostomy with drainage in 43 (25.5%), cystostomy with capitonnage in 22 (13%), cystostomy with omentoplasty in 72 (42.6%), and cystectomy in 24 (14.2%). Splenectomy or nephrectomy was also performed in nine patients. Postoperative complications developed in 36 (21.3%) patients, and three suffered recurrences. The postoperative mortality rate was 1.2%. Postoperative complications were more frequent after cystostomy with capitonnage than after cystostomy with omentoplasty ($P < 0.001$) or cystectomy ($P = 0.0037$). The additional procedures prolonged the hospital stay.

Conclusions. Current surgical techniques combined with antiscolicidal therapy using albendazole are effective and safe treatments for HHCs, associated with low morbidity, mortality, and recurrence rates.

Key words *Echinococcus granulosus* · Hepatic hydatid cyst · Surgical procedure · Albendazole

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Introduction

Human cystic echinococcosis, or hydatid cyst disease, is a zoonosis caused mainly by the larval cestode *Echinococcus granulosus*. *Echinococcus multilocularis* is responsible for fewer than 5% of all cases of hydatid disease. Hippocrates recognized hydatid disease over 2000 years ago, and it remains endemic today in sheep- and cattle-raising areas of the world, including Africa, the Mediterranean region of Europe, the Middle East, Asia, South America, Australia, and New Zealand. In Western industrial nations the incidence is relatively low.[1–3]

The liver is infected in about 60% of patients, the lung in about 20%, and other organs such as the kidney, brain, bone, and muscles in about 20%.[4,5] A solitary cyst develops in one organ in about 80% of patients. The host organism cuts itself off from the parasite by the formation of a so-called pericyst, which is a capsule of connective tissue.[6] This fact is important for surgical strategies in which the pericyst is left in situ and the contents inside the pericyst, being the true parasite, are removed.[6] The cysts displace healthy tissue and organs but do not grow infiltratively or destructively.

Echinococcosis may be asymptomatic for many years, and its presence is often detected only after liver is found to be enlarged or a cystic lesion is noted when imaging scans of the liver are done for different reasons.[7,8] On the other hand, it may cause pain or lead to complications. Hepatic hydatid cysts (HHCs) can rupture into the peritoneum, resulting in anaphylaxis or peritoneal dissemination, or both; into the biliary tract, causing cholangitis or cholestasis, or both; and into the pleura or lung, causing pleural hydatidosis or bronchial fistula. Cysts may become infected and form liver abscesses. Pressure or mass effects on the bile duct, portal vein, and hepatic veins and inferior vena cava can cause cholestasis, portal hypertension, and Budd–Chiari syndrome, respectively.[9,10]

The management of HHCs typically involves an open surgical approach with meticulous operative site packing, which can be achieved by a variety of operative techniques.[10–12] The medical treatment of hydatid cysts with mebendazole or albendazole alone is controversial.[13–15] It is usually reserved for disseminated systemic disease, inoperable disease, or for prophylaxis during surgery or percutaneous treatment.[16] Percutaneous treatment has been proposed as an alternative to surgery, especially for patients who cannot, or do not want, to undergo surgery.[16,17] We evaluated the clinical features, operative procedures, and outcomes of patients treated surgically for HHCs.

Patients and Methods

We reviewed retrospectively 169 patients who underwent surgical treatment for HHC caused by *Echinococcus granulosus* at our hospital between January 1993 and December 2004. Patient age, sex, main symptoms, preoperative radiological investigations, location of the cysts, concomitant involvement of other organs, surgical procedure performed, postoperative complications, mortality, and mean hospitalization after surgery were recorded.

Preoperative diagnosis was established by a history, followed by clinical examination and ultrasonography (US) or computed tomography (CT) of the abdomen. Ultrasonography was done routinely in all patients, except for those with acute abdominal findings caused by intraperitoneal perforation of HHC, to determine the location, number, and morphology of cysts within the liver. The liver, biliary tree, and other abdominal organs were also carefully examined for evidence of residual cysts. The main indications for CT were a need for further anatomical details, especially in patients with recurrent disease, and the presence of multiple hydatid cysts. All patients underwent chest radiography. Serological tests, enzyme-linked immunosorbent assay (ELISA), and a complement fixation (CF) test for *Echinococcus* were done in only 27 patients with equivocal disease. ELISA was positive in 26 (96%) of these patients and CF was positive in 24 (89%).

All patients diagnosed with HHC underwent laparotomy, which was performed through a right subcostal incision in all except four patients who underwent emergency laparotomy through a midline incision. The abdomen was opened and the abdominal viscera were examined, paying particular attention to potential sites of dissemination, including the pelvis. The operative field was packed with 20% hypertonic saline compresses to protect the surrounding tissues. The cyst was punctured and decompressed with a 20-gauge needle. The cystic fluid was aspirated with a large needle and the cyst was then opened with a 2–3-cm incision and the remaining contents, including the laminated membrane, were removed with sponge-holding forceps. After flushing the cystic cavity with 20% saline solution, the visible biliary openings were sutured individually with absorbable sutures and the cavity was drained with closed-tube drainage (cystostomy with drainage), obliterated with purse-string absorbable sutures starting from the bottom (cystostomy with capitonnage), or an omental flap was placed over the residual cavity (cystostomy with omentoplasty). Relatively small subcapsular cysts were managed by excising the intact cyst (cystectomy). Exploration of the biliary tract with choledochotomy, cholangiography, and placement of a T-tube was performed in patients with hydatid cholangitis, severe dilatation of the common bile duct, or persistent hydatid vesicles or debris. If the cyst was localized peripherally, hepatic resection was performed. Capitonnage procedures were done for uncomplicated cysts without unusual localization or size.

Apart from the four patients who underwent emergency surgery, all patients were operated on after preoperative prophylactic antibiotic therapy. Albendazole, 10 mg/kg daily, was given for 1 week preoperatively and continued for 28 days postoperatively, then repeated twice with an interval of 2 weeks.

Statistical Analysis

Complication rates were compared according to the χ^2 test. A value of $P < 0.05$ was considered significant.

Results

The clinical and demographic features, type, and distribution of cysts in the hepatic lobes and other abdominal organs in the 169 patients are summarized in Tables 1 and 2. Abdominal pain was the most frequent symptom, reported by 121 (71.6%) patients. Preoperative diagnosis was based primarily on abdominal US, except in the four patients with acute abdominal findings who underwent emergency surgery. Computed tomography was required to provide additional information about hepatic cysts in 52 (30.8%) patients. The diagnostic sensitivity of CT was 100%. The sensitivity of US and CT in determining the location and number of hydatid cysts was 98% and 100%, respectively.

Concomitant intra-abdominal hydatid cysts were found in the spleen in six (3.6%) patients and in the kidneys in three (1.8%) patients. Preoperative chest radiography showed a concomitant hydatid cyst in the lungs in seven (4.1%) patients. The surgical procedures performed for HHCs and the additional procedures for hydatid cysts in other abdominal organs are shown in

Table 3, and the surgical indications for each procedure, including the size and the number of HHCs, are shown in Table 4. The median HHC diameter was 14 cm (range 2–29 cm). The overall postoperative complication rate was 21.3%, occurring in 36 of the 169 patients (Table 5). Biliary fistulas closed spontaneously with long-term drainage within a median time of 33 days (range 21–76 days) after the procedure. Two patients who suffered postoperative intra-abdominal hemorrhage required a reoperation, and all of the patients with intra-abdominal abscess were treated by percutaneous drainage. There was no difference in the incidence of postoperative complications among the hepatectomy, cystostomy with drainage, or cystostomy with capitonnage treatment groups. However, the differences between the cystostomy with capitonnage and cystostomy with omentoplasty groups (with 12 complications in 22 patients and 7 complications in 72 patients, respectively) and the cystectomy group (with 2 complications in 24 patients) were significant ($P < 0.001$ and $P = 0.0037$, respectively) (Table 5). There were two (1.2%) perioperative deaths, caused by irreversible anaphylactic shock during the operation after rupture of the cyst into the peritoneal cavity during cystostomy and suction of the hydatid fluid. Three (1.8%) patients suffered local recurrence of the disease.

The median follow-up period was 18.4 months (range 12–26 months) and follow-up data were completed for 140 (82.8%) of the 169 patients. The patients were followed up for at least 1 year and abdominal US was repeated at 6-month intervals to check for any signs of recurrence of the disease.

Table 1. Clinical symptoms of the 169 patients with hepatic hydatid cysts

	No. of patients ($n = 169$)
Chronic abdominal pain	121 (71.6)
Right hypochondrial and epigastric tenderness	88 (52)
Hepatomegaly	49 (29)
Nausea and vomiting	31 (18.3)
Fever	19 (11.2)
Jaundice	19 (11.2)
Abdominal mass	17 (10)
Weight loss	12 (7.1)
Acute abdomen findings	4 (2.4)
Asymptomatic	16 (9.5)

Values in parentheses are percentages

Table 2. Patient demography, and type and distribution of cysts in the hepatic lobes and other abdominal organs

	No. of patients ($n = 169$)
Sex	
Male	74 (43.8)
Female	95 (56.2)
	No. of patients ($n = 169$)
Type of cysts	
Solitary	111 (65.7)
Multiple	58 (34.3)
	No. of cysts
Location of cysts ($n = 225$)[a]	
Right lobe	131 (58.2)
Left lobe	63 (28)
Both lobes	22 (9.8)
Spleen	6 (2.7)
Kidney	3 (1.3)

Values in parentheses are percentages
[a] 216 hepatic hydatid cysts and 9 hydatid cysts in other abdominal organs

Discussion

Although most liver hydatid cysts are asymptomatic, some patients present with vague abdominal pain. In this study, 121 (71.6%) of the 169 patients presented with abdominal pain and only 16 (9.5%) had no symptoms. Moreover, 4 (2.4%) patients underwent emergency surgery for acute abdominal symptoms. Hydatid disease affects the right lobe more commonly,[18] as found in 131 (58.2%) of our 169 patients. Moreover, the cyst

Table 3. Surgical procedures performed for the hepatic hydatid cysts

	Hepatectomy	Cystostomy with drainage	Cystostomy with capitonnage	Cystostomy with omentoplasty	Cystectomy
No. of patients ($n = 169$)	8 (4.7)	43 (25.5)	22 (13)	72 (42.6)	24 (14.2)
No. of hepatic hydatid cysts ($n = 216$)	8 (3.7)	58 (26.8)	28 (13)	90 (41.7)	32 (14.8)
Additional surgical procedures					
Cholecystectomy		16 (9.5)	11 (6.5)	10 (5.9)	10 (5.9)
Choledochotomy and T-tube drainage		8 (4.7)	6 (3.6)	4 (2.4)	3 (1.8)
Choledochoduodenostomy		6 (3.6)	4 (2.4)	5 (3)	4 (2.4)
Splenectomy		1 (0.6)	3 (1.8)		2 (1.2)
Nephrectomy		1 (0.6)		2 (1.2)	

Values in parentheses are percentages

Table 4. Surgical indications for each procedure, including the size and the number of hepatic hydatid cysts

Type of procedure	Indications	No. of HHC ($n = 216$)	Size of HHC (cm), median and range
Hepatectomy	Small subcapsular cysts with disease that had already destroyed most of the hepatic segment	8 (3.7)	3.8 (3–5)
Cystostomy with drainage	Residual cavities within the depth of the hepatic parenchyma	58 (26.8)	11.6 (7–21)
Cystostomy with capitonnage	Noninfected cysts associated with a risk of injury to the major hepatic ducts and vessels passing next to the pericyst	28 (13)	24.3 (18–29)
Cystostomy with omentoplasty	Small peripheral cysts without infection and cysts with thick walls	90 (41.7)	10.2 (8–13)
Cystectomy	Small subcapsular cysts	32 (14.8)	4.1 (2–7)

Values in parentheses are percentages

Table 5. Operative procedures, complications, deaths, recurrence, and hospital stay of the 169 patients with hepatic hydatid cysts

	Hepatectomy ($n = 8$)	Cystostomy with drainage ($n = 43$)	Cystostomy with capitonnage ($n = 22$)	Cystostomy with omentoplasty ($n = 72$)	Cystectomy ($n = 24$)
Postoperative complications	1 (12.5)	14 (32.5)	12 (54.5)*	7 (9.7)	2 (8.3)
Pulmonary atelectasis		2 (1.2)	1 (0.6)	2 (1.2)	
Biliary fistula		4 (2.4)	5 (3)	2 (1.2)	
Hemorrhage	1 (0.6)	2 (1.2)	1 (0.6)		1 (0.6)
Intraperitoneal abscess		3 (1.8)	1 (0.6)	1 (0.6)	
Wound infection		2 (1.2)	3 (1.8)	2 (1.2)	1 (0.6)
Deaths		1	1		
Recurrence[a]		2	1		
Mean hospital stay (days)					
Without additional surgical procedures	21.1	16.2	14.3	9.9	12.6
With additional surgical procedures	—	29.8	23.6	22.1	22.7

Values in parentheses are percentages
* $P < 0.001$ vs cystostomy with omentoplasty and $P = 0.0037$ vs cystectomy (χ^2 test)
[a] In 140 patients with complete follow-up

is usually solitary, as found in 111 (65.7%) of our patients. The sensitive serological tests, ELISA and CF, are used routinely to aid in diagnosis. However, as tests rarely become negative, even after 10 years, they cannot be used reliably to establish cure, and we did not use them in the follow-up of our patients.

Abdominal US is considered the best diagnostic aid for providing essential information about the location, number, size, and type of cysts, the condition of the intrahepatic and extrahepatic biliary system, and the presence of concomitant hydatid cysts in other organs.[19] However, we performed CT in 52 (30.8%) patients to obtain additional information about the hepatic cysts. The sensitivity of US and CT in determining the location and number of hydatid cysts was 98% and 100%, respectively.

Since the 1970s, when benzimidazole carbamates were proven to be effective against larval *Echinococcus granulosus*, albendazole has been used for the treatment of hydatid disease.[14,20–22] This drug inhibits tubulin, induces blockage of glucose absorption, and produces glycogen depletion and degenerative alterations in the endoplasmic reticulum and mitochondria of the germinal layer, thereby increasing lysosomes and producing cellular autolysis.[23] Although it does have side effects, albendazole is generally well tolerated, but contraindicated in pregnancy, because of embryotoxicity. Preoperative and postoperative chemotherapy is given to reduce the risk of secondary hydatidosis after the operation.[24] We gave our patients albendazole, 10 mg/kg daily, for 1 week preoperatively, which was continued for 28 days postoperatively, and the treatment was repeated twice with an interval of 2 weeks. Ultimately, surgery is the treatment of choice for HHCs.[18,25] The basic principles of surgery for hydatid disease were defined several decades ago: entire elimination of the parasite, preven-

tion of any intraoperative spillage, and preservation of healthy tissue.[26] However, the technical procedure of choice is controversial because of the lack of appropriate randomized controlled studies. There are numerous terms in the literature for the surgical procedures used; with various combinations of these procedures, with or without the additional use of scolicidal agents.[27–32]

In the present series, we drained small residual cavities within the depth of the hepatic parenchyma with closed-tube drainage to permit spontaneous obliteration of the cavities. The drain was removed on the 6th postoperative day after a cavogram confirmed that there was no biliary communication. Cystostomy with drainage was performed for 58 (26.8%) cysts in 43 patients. Small subcapsular cysts were managed by resecting the cysts with a rim of healthy hepatic tissue. Cystectomy was performed for 32 (14.8%) cysts in 24 patients; however, hepatic resection was necessary for 8 (4.7%) cysts because the disease had destroyed most of the hepatic segment. The outcome of both these resections, when technically feasible, is excellent because no dead space is left behind. Hepatic resection and cystectomy may be preferred for small cysts located peripherally, pedunculated cysts, and extrahepatic intra-abdominal cysts since they carry an operative risk.[33,34] We performed cystostomy with omentoplasty for 90 (41.7%) cysts in 72 patients, who had either small, peripheral cysts without infection, or cysts with thick walls. Finally, we performed capitonnage for cysts without infection, but which were located where there was a high risk of injury to the major hepatic ducts and vessels passing next to the pericyst. This technique approximates the cystic walls by sutures to obliterate the cavity.[14] In this series, cystostomy with capitonnage was performed for 28 (13%) cysts in 22 patients.

Exploration of the biliary tract with choledochotomy and placement of a T-tube is mandatory for HHCs complicated by rupture into the biliary tract. The rupture of an HHC into the biliary tree commonly manifests as biliary obstruction and cholangitis. This complication can be diagnosed best by endoscopic retrograde cholangiopancreatography (ERCP), percutaneous transhepatic cholangiography, or intraoperative cholangiography. In patients complicated by jaundice or acute cholangitis, routine preoperative ERCP with sphincterotomy is an alternative approach with diagnostic and therapeutic value.[35,36] We performed choledochotomy or choledochoduodenostomy for patients with cholangitis secondary to hydatid disease, severe dilatation of common bile duct, and persistent hydatic vesicles or debris (Table 3).

The incidence of postoperative complications after surgery for HHCs has been reported to range from 6% to 47%.[37,38] The overall postoperative complication rate in this series was 21.3% (36 of 169 patients). The most common postoperative complication was biliary fistula, which developed in 11 patients. The morbidity rates were 12.5%, 32.5%, 54.5%, 9.7%, and 8.3% in the hepatectomy, cystostomy with drainage, cystostomy with capitonnage, cystostomy with omentoplasty, and cystectomy groups, respectively. There was a significant difference in the complication rates between the cystostomy with capitonnage and cystostomy with omentoplasty groups, and between the cystostomy with capitonnage and cystectomy groups; however, there were no significant differences among the other treatment groups. We attribute the high rate of complications in the cystostomy with capitonnage treatment group to the fact that capitonnage was performed for patients with a larger diameter of HHC and higher risk of injury to the major hepatic ducts and vessels than those in the other groups. Moreover, this procedure was performed in three patients who required synchronous splenectomy for concomitant hydatid cysts. Two patients died of irreversible anaphylactic shock during the operation; one in the cystostomy and drainage group and one in the cystostomy and capitonnage group. Hydatid disease may recur either from spillage of hydatid fluid during the operation or from reinfestation of the patient.

The rate of recurrence after HHC surgery has been reported to range from 1.1% to 9.6%.[17] In this study, follow-up data were completed for 82.6% of patients. The mean follow-up period was 18.4 months (range 12–26 months), but all patients were followed up for at least 1 year and abdominal US was repeated at 6-month intervals to check for recurrence, as most recurrences are detected within this time.[39] Local recurrence was found in three patients after a mean period of 17 months (range 13–21 months). All of these patients were treated medically with anthelmintic therapy for 3–6 months. We think that patients of advanced age, those with a small local recurrence, those with serious comorbid diseases, and those with asymptomatic disease should be managed medically because repeat surgery for recurrent disease is associated with high morbidity and mortality rates, and the effects of chemotherapy are acceptable. However, albendazole alone is minimally effective against HHC and in-adequate for preserving recurrences. All of our patients were routinely given albendazole and this treatment protocol helped to reduce the local recurrence rate after surgery. In fact, the recurrence rate of 1.8% in patients treated with the combination of chemotherapy and surgery was significantly lower than that reported for patients managed with medical treatment only.[40]

The recurrence rate in this series was also lower than that reported in other studies in which patients were managed by the same combined treatment.[41,42] Four patients who suffered free rupture of the hepatic cysts and spillage of the hydatid fluid into the peritoneal cavity were treated with two courses of albendazole; however,

this treatment protocol was effective in controlling postoperative local recurrence in only one patient, followed up for 13 months. Finally, patients who required additional surgical procedures as well as cystostomy with drainage, cystostomy with omentoplasty, or cystostomy with capitonnage and cystectomy, had a longer hospital stay than those who did not undergo additional surgical procedures.

In conclusion, our experience suggests that albendazole combined with variant surgical techniques is an effective treatment for hepatic hydatidosis, with low morbidity, mortality, and recurrence rates. Surgery remains the optimum treatment for HHCs, but the most appropriate technique must be selected according to the size, number, and location of the cysts.

References

1. Buttenschoen K, Buttenschoen DC. *Echinococcus granulosus* infection: the challenge of surgical treatment. Langenbecks Arch Surg 2003;388:218–30.
2. Agaoglu N, Turkyilmaz S, Arslan MK. Surgical treatment of hydatid cysts of the liver. Br J Surg 2003;90:1536–41.
3. Khuroo MS, Wani NA, Javid G, Khan BA, Yattoo GN, Shah AH, et al. Percutaneous drainage compared with surgery for hepatic hydatid cysts. N Engl J Med 1997;337:881–7.
4. Ammann R, Eckert, J. Clinical diagnosis and treatment of echinococcosis in humans. In: Thompson RCA, Lymbery AJ, editors. Echinococcus and hydatid disease. Wallingford: CAB International; 1995. p. 411–63.
5. Wilson JF, Diddams AC, Rausch RL. Cystic hydatid disease in Alaska. A review of 101 autochthonous cases of *Echinococcus granulosus* infection. Am Rev Respir Dis 1968;68:1–15.
6. Milicevic M. Hydatid disease. In: Blumgart LH, Fong Y, editors. Surgery of the liver and biliary tract. Philadelphia: Saunders; 2000. p. 1167–204.
7. Frider B, Larrieu E, Odriozola M. Long-term outcome of asymptomatic liver hydatidosis. J Hepatol 1999;30:228–31.
8. Taylor BR, Lange B. Current surgical management of hepatic cyst disease. Adv Surg 1998;31:127–48.
9. Ammann RW, Eckert J. Cestodes; Echinococcus. Gastroenterol Clin North Am 1996;25:655–89.
10. WHO. Informal Working Group on Echinococcosis. Guidelines for treatment of cystic and alveolar echinococcosis in humans. Bull World Health Organ 1996;74:231–42.
11. Gollackner B, Langle F, Auer H, Maier A, Mittlbock M, Agstner I, et al. Radical surgical therapy of abdominal cystic hydatid disease: factors of recurrence. World J Surg 2000;24:717–21.
12. Casado OA, Gonzalez EM, Segurola CL, Calvo AG, Pinto IG, Saborido BP, et al. Results of 22 years of experience in radical surgical treatment of hepatic hydatid cysts. Hepatogastroenterology 2001;49:235–43.
13. Morris DL. The use of albendazole in human hydatid disease. Ann Trop Med Parasitol 1984;78:204–6.
14. Todorov T, Vutova K, Mechkov G, Petkov D, Nedelkov G, Tonchev Z. Evaluation of response to chemotherapy of human cystic echinococcosis. Br J Radiol 1990;63:523–31.
15. Vutova K, Mechkov G, Vachkov P, Petkov R, Georgiev P, Handjiev S, et al. Effect of mebendazole on human cystic echinococcosis: the role of dosage and treatment duration. Ann Trop Med Parasitol 1999;93:357–65.
16. Deger E, Hokelek M, Deger BA, Tutar E, Asil M, Pakdermirli E. A new therapeutic approach for the treatment of cystic echinococcosis: percutaneous albendazole sulphoxide injection without reaspiration. Am J Gastroenterol 2000;95:248–54.
17. Akhan O, Ozmen MN. Percutaneous treatment of liver hydatid cysts. Eur J Radiol 1999;32:76–85.
18. Magistrelli P, Masseti R, Copolla R, Messia A, Nuzzo G, Picciocchi A. Surgical treatment of hydatid disease of the liver: a 20-year experience. Arch Surg 1991;126:518–23.
19. el-Tahir MI, Omojola MF, Malatani T, al Saigh AH, Ogunbiyi OA. Hydatid disease of the liver: evaluation of ultrasound and computed tomography. Br J Radiol 1992;65:390–2.
20. Franchi C, Di Vico B, Teggi A. Long-term evaluation of patients with hydatidosis treated with benzimidazole carbamates. Clin Infect Dis 1999;29:304–9.
21. Pawlowski Z. Chemotherapy in cystic echinococcosis: optimal treatment. Archivos Internacionales de la Hidatidosis 1997;32:167–9.
22. De Rosa F. Chemotherapy in cystic echinococcosis: experience following protocols without intermittent treatment. Archivos Internacionales de la Hidatidosis 1997;32:169–70.
23. Lacey E. Mode of action of benzimidazoles. Parasitol Today 1990;6:112–5.
24. Morris DL, Dykes PW, Dickson B, Marriner SE, Bogan JA, Burrows FGO. Albendazole in hydatid disease. Br Med J 1983;286:103–4.
25. Sayek I, Yalyn R, Sanac Y. Surgical treatment of hydatid disease of the liver. Arch Surg 1980;115:847–50.
26. Saidi F. Surgery of hydatid disease. Philadelphia: Saunders; 1976.
27. Ayles HM, Corbett EL, Taylor I, Cowie AG, Bligh J, Walmsley K, et al. A combined medical and surgical approach to hydatid disease: 12 years' experience at the Hospital for Tropical Diseases, London. Ann R Coll Surg Engl 2002;84:100–5.
28. Utkan NZ, Canturk NZ, Gonullu N, Yildirir C, Dulger M. Surgical experience of hydatid disease of the liver: omentoplasty or capitonnage versus tube drainage. Hepatogastroenterology 2001;48:203–7.
29. Cirenei A, Bertoldi I. Evolution of surgery for liver hydatidosis from 1950 to today: analysis of a personal experience. World J Surg 2001;25:87–92.
30. Haddad MC, Huwaijah SH, Mourad FH, Sharara AI, AI Kutoubi AO. Adjuvant therapy in the treatment of complications following surgery for hepatic echinococcal cysts. Cardiovasc Intervent Radiol 2000;23:406–9.
31. Saglam A. Laparoscopic treatment of liver hydatid cysts. Surg Laparosc Endosc 1996;6:16–21.
32. Sayek I, Onat D. Diagnosis and treatment of uncomplicated hydatid cyst of the liver. World J Surg 2001;25:21–7.
33. Dawson JL, Stamatakis JD, Stringer MD, Williams R. Surgical treatment of hepatic hydatid disease. Br J Surg 1988;75:946–50.
34. Ulualp KM, Aydemir I, Senturk H, Eyuboglu E, Cebeci H, Unal G, et al. Management of intrabiliary rupture of hydatid cyst of the liver. World J Surg 1995;19:720–4.
35. Rodriguez AN, Sanchez del Rio AL, Alguacil LV, De Dios Vega JF, Fugarolas GM. Effectiveness of endoscopic sphincterotomy in complicated hepatic hydatid disease. Gastrointest Endosc 1998;48:593–7.
36. Dumas R, Le Gall P, Hastier P, Buckley MJ, Conio M, Delmont JP. The role of retrograde cholangiopancreatography in the management of hepatic hydatid disease. Endoscopy 1999;31:242–7.
37. Alfieri S, Doglietto GB, Pacelli F, Costamagna G, Carriero C, Mutignani M, et al. Radical surgery for liver hydatid disease: a study of 89 consecutive patients. Hepatogastroenterology 1997;44:496–500.
38. Vagianos CE, Karavias DD, Kakkos SK, Vagenas CA, Androulakis JA. Conservative surgery in the treatment of hepatic hydatidosis. Eur J Surg 1995;161:415–20.
39. Little JM, Hollands MJ, Ekberg H. Recurrence of hydatid disease. World J Surg 1988;12:700–4.

40. Saimot AG. Medical treatment of liver hydatidosis. World J Surg 2001;25:15–20.
41. Kapan M, Kapan S, Goksoy E, Perek S, Kol E. Postoperative recurrence in hepatic hydatid disease. J Gastrointest Surg 2006;5: 734–9.
42. Tsaroucha A, Polychronidis A, Lyrantzopoulos N, Pitiakoudis M, Karayiannakis A, Manolas K, et al. Hydatid disease of the abdomen and other locations. World J Surg 2005;29:1161–5.