Advances in Liver Echinococcosis: Diagnosis and Treatment

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Echinococcosis or hydatid cyst disease is a zoonosis caused by the larval cestode Echinococcus granulosus. It consists of a parasitic tapeworm disease affecting mainly liver. Nevertheless, the disease might well spread to more unusual sites such as lungs and brain. The definitive diagnosis of liver echinococcosis requires a combination of imaging, serologic, and immunologic studies. Despite the fact that a number of scolecoidal agents have been developed against liver hydatid disease, the cornerstone of the definitive treatment remains surgery. Both the classic surgical techniques and the recently developed minimally invasive and laparoscopic methods target the eradication of the disease by simultaneously avoiding perioperative spillage and dissemination or recurrence of echinococcosis. The present article constitutes a review of the biology of the parasite as well as the epidemiology, diagnosis, and therapeutic options of the liver hydatid disease.

Echinococcosis or hydatid cyst disease is a parasitic zoonosis caused by the tapeworm Echinococcus granulosus or E. alveolaris, which is harbored in carnivore intestines. Echinococcus infects human beings in cases of accidental ingestion of tapeworm eggs via terminal host feces. Most common locations of echinococcus infection are liver and lungs (60% and 30%, respectively); nevertheless, hydatid cysts might rarely affect kidney, bones, brain, pericardium, etc.

Uncomplicated liver cysts might stay asymptomatic for a long time. Most common symptom of liver echinococcosis is right upper quadrant pain. Other symptoms include right upper quadrant swelling and discomfort, right scapula pain, jaundice, symptoms of cholangitis, or acute abdomen in cases of intrahepatic or extrahepatic cyst rupture.

The aim of the present review was to focus on the diagnostic and therapeutic algorithm of hydatid disease from the view of surgeons specializing in hepatobiliary and pancreatic surgery and provide a background for further questioning.

Epidemiology

Echinococcosis is an endemic disease, with varying prevalence and distribution influenced by agricultural, educational, economic, medical, and cultural factors. It is highly endemic in Mediterranean countries (southern part of Spain, France, and Italy, Greece, Bulgaria, Romania, Turkey, Israel, Lebanon, Syria, Jordan, Tunisia, Morocco), Iran, India, China, Chile, and Argentina.1-7 In the rest of Europe (except central Europe and Scandinavian countries), Asia (except Indonesia), Africa, America (except United States and some regions of Central America), and Oceania (except New Zealand), echinococcosis is considered simply endemic. On the other hand, New Zealand is considered provisionally free of the disease, and in Greenland and Iceland not a single case has ever been reported.8 The disease prevalence varies considerably even within highly endemic regions. In Mediterranean countries, despite the decline observed in the incidence of echinococcosis during the last decades, it still remains a common disease. The amelioration of the situation was attributed to the adoption of safer procedures, which in turn were supported by the economic flourishing of these countries. In most Asian countries, the prevalence of hydatid disease was increased because farming practices failed to follow the economic, educational, and public health progression.9

Classification of Echinococcal Liver Cysts

Although many classifications of hydatid liver cysts have been proposed during the past years, the U.S. classification described by Gharbi et al10 seems to be the most widely accepted. The pathognomonic characteristics and signs of hydatid liver disease are the presence of a detached laminated membrane from the pericyst, the presence of daughter cysts, and the presence of calcifications in the cyst wall. The criteria and classification of Gharbi et al are shown in Table 1.

Biology of Echinococcus granulosus

Hydatid cyst is a parasitic disease caused by the larval stage of the tapeworm E. granulosus. The adult form measures about 5 mm in length and lives for 5–20 months in the jejunum of dogs (Canis familiaris) and other carnivores (wolves, foxes, jackals, dingos, hyenas, coyotes). This form is called definitive host. It consists of a scolex, neck and strobila.11

The scolex has 4 sucking cups and a double circle of hooklets. The strobila is composed of 3 proglottids: the immature, the mature, which contains the reproductive system, and the gravid third proglottid measuring 2–3 mm, which bears the eggs. The eggs (embryophores), containing a hexacanth embryo, measure 25–35 μm and are eliminated with the feces of dogs or other definitive hosts.12

Echinococcosis infestation occurs in humans through the fecal-oral route. After ingestion of the eggs by humans or an

Abbreviations used in this paper: CoES, counterimmunoelectrophoresis; DDG, double diffusion in gel; ELISA, enzyme-linked immunosorbent assay; IEP, immunoelectrophoresis test; IFA, immunofluorescence assay; IHT, indirect hemagglutination; PAIR, puncture of the cyst wall, aspiration of cyst content, injection, and re-aspiration of a scolecoidal agent; WHO, World Health Organization.
intermediate host (sheep, cattle, goats, etc), the egg develops into a larval oncosphere that enters the portal circulation after intestinal mucosal penetration. The oncosphere usually stops in the liver (60%–70% of cases). Another common site that oncosphere can reach and set up is the lung (20%–30% of cases). Only in a few cases (less than 10%) the oncosphere passes the pulmonary filter, enters the systemic circulation, and affects various organs.

Having settled in the parenchyma of the involved organ, the oncosphere (hexacanth embryo) forms a round, multinucleated mass, which gradually becomes cystic and progressively enlarged, depending on host defense, age, and especially on the structure of the involved tissue.11,13

Pathology of the Hydatid Cyst

The hydatid cyst consists of an external cuticular layer and an inner germinal membrane. The inner aspect of the germinal membrane develops brood capsules, which embrace the new larvae called protoscolices. Each capsule might contain 20–120 protoscolices. The detached brood capsules and protoscolices form the hydatid sand with potential infectious features. The hydatid cyst contains clear fluid, various concentrations of mineral salts and organic matter, has neutral pH, and possesses antigenic properties.14,15

An important biologic property of the hydatid cyst is the formation of daughter cysts. These might form from the germinal membrane or from direct transformation of the protoscolices (a mechanism producing the secondary hydatidosis) or by direct transformation of brood capsules.

These modalities of forming daughter cysts and especially the secondary hydatidosis form the small, abortive parasitic cycle, which prolongs and perpetuates the parasite life in this circumstantial parasite impasse. In the dog's intestine the tapeworm develops into an adult parasite in 6–12 weeks.16

Diagnosis

The diagnosis of hydatid disease relies on epidemiologic data, clinical manifestations, radiologic imaging, and serologic tests.17

The epidemiologic data (regarding geographical location and profession) might support diagnosis in several cases. The suspicion of echinococcosis can be set on the clinical manifestations of the disease regarding the size, number, and localization of cysts in combination with potent complications. In blood analysis, eosinophilia (4%–15%) is found in 25%–50% of cases at the beginning of infection or in case of cystic leakage, but this is not a steady and reliable finding.

Radiologic studies are more helpful in the assessment of the disease. Plain chest x-ray sets the diagnosis in 99% of patients with pulmonary cysts. Ultrasonography is helpful in describing the cystic structures (number, location, internal structure) and the presence of complications, especially in liver and lung disease. The specificity of ultrasonography is 90%. Portable ultrasonography allowed investigators to conduct surveys to determine the prevalence of echinococcosis. Computed tomography and magnetic resonance imaging seem to be the most sensitive and accurate examinations. These techniques can achieve not only the diagnosis but also the accurate staging of the disease.

In some rare cases the diagnosis can be set by anatomico-pathologic examination of sputum, vomit, and urine. The sensitivity of the above methods is limited, and many diagnostic problems present in unclear cases.

During the past years several immunologic examinations have been developed. Casoni's intradermal test had been the routine examination for several decades, although it presented low sensitivity and specificity.18

The human basophil degranulation test seems to be more sensitive and specific, especially in cases of lung disease, and might be used for postoperative follow-up.19,20

Humoral immunity can be tested with antigens obtained from fertile liver hydatid cysts of intermediate hosts. In these tests parasite antigens or soluble antigens prepared from hydatid cyst fluid are used. More recently, a recombinant myophilin of E. granulosus has been prepared.21

A procedure based on double diffusion in gel (DDG), called Ouchterlony test, consists of a simple precipitation test. The disadvantages of this method include the duration of the examinations (4–7 days to complete) and the difficulty for identification of the precipitation lines. For these reasons this test is not used routinely, although it is sensitive and accurate.

The immunoelectrophoresis test (IEP), which is completed in 3–4 days, presents 91%–94% sensitivity in liver hydatidosis and 70% in pulmonary disease. In that technique a specific precipitation line corresponding to the major antigenic fraction or antigen 5 is pathognomonic.22

Counterimmunoelectrophoresis or co-electroosmeryness (CoES) is a double diffusion test; it is very helpful in clinical practice because results are available within 3–5 hours.

Indirect immunofluorescence assay (IFA) is a specific and sensitive examination, especially in hepatic hydatidosis (95% sensitivity). Results are obtained in 2.5 hours.23

Some other techniques are the immunoperoxidase assay (variation of IFA), with comparable results, and the enzyme-linked immunosorbent assay (ELISA), which shows high accuracy (both specificity and sensitivity). ELISA is very popular because of its low cost and short time of preparation (2 hours). It is useful for seroepidemiologic screening in endemic areas.2,24–26

Indirect agglutination and indirect hemagglutination (IHT) are simple and easy-to-perform tests, with high sensitivity (60%–100%) but poor specificity.23 Complement fixation test is another, rarely used technique.27 Western blotting, which allows molecular weight analysis of the antigens detected by the patient's serum, is a demanding test but with good specificity.28 Polymerase chain reaction has also been used for the diagnosis of hydatidosis.29

Serologic tests must be used and interpreted in correlation with epidemiologic data, clinical manifestations, and imaging investigations. IFA, IHT, IEP, and CoES have a sensitivity of 80%–95% in cases of liver hydatidosis and 65% in cases of pulmonary hydatidosis. Confirmation should be obtained with
IEP, Western blotting, and CoES, which are more specific. ELISA, Western blot, and polymerase chain reaction should be used for other localizations or calcified cysts. Serologic tests should also be used for the follow-up of operated, medically treated patients. Specific antibodies increase 1 month after surgery and then decrease slowly; negativity is achieved after 3–7 years. Persistence of high specific antibodies or a secondary indicates relapse.30–32

Chemotherapy

Thirty years after the first attempts toward chemotherapy, surgery still represents the cornerstone for radical treatment of hydatid disease. Chemotherapy with benzimidazole compounds (albendazole and mebendazole) is currently indicated in patients who have inoperable disease or cannot undergo major operations. Moreover, these regimens can be administered for the prevention of secondary echinococcosis during the perioperative period of a classic surgery or in combination with ultrasound-guided aspiration. Nevertheless, the efficacy of the perioperative use of benzimidazoles remains to be tested in larger clinical trials. Some authors suggest chemotherapy in recurrent hepatic disease before percutaneous drainage or operation. Chemotherapy is contraindicated for large, superficially situated, or infected cysts, which are prone to rupture.33,34

Mebendazole is a broad spectrum anthelmintic drug, with poor intestinal absorption and active against intestinal nematodes. Albendazole has better intestinal absorption, larger tissue distribution, and considerably higher cyst fluid concentrations. It is rapidly metabolized in the liver to form albendazole sulfoxide. The protoscolicide agent flubendazole, the mebendazole-fluorinated analog, does not penetrate the cyst; therefore the drug fails to provide an alternative of treatment.35–37

The benzimidazole carbamates have a direct effect on the cumulus oophorus and on the wall of the cyst. Factors that might influence the therapeutic outcome are the age of the patient, the size and the anatomic location of the cyst, and the potent presence of calcification and/or pericystic fibrosis. Younger cysts and cysts with thin walls respond better. Chemotherapy seems to be more effective in younger patients. Chemotherapy with albendazole or mebendazole might lead to liver enzymes elevation (10%–20% of patients), bone marrow suppression, pancytopenia, agranulocytosis, and alopecia. These adverse effects are reversible in cases of treatment discontinuation.38–40

In chemotherapy with albendazole, the suggested dosage is 10–15 mg · kg⁻¹ · day⁻¹ in 2 divided doses. The treatment is repeated in 3 courses lasting 4 weeks, separated by 2-week intervals. The dosage for mebendazole chemotherapy is 40–50 mg · kg⁻¹ · day⁻¹ in 3 divided doses for 3–6 months.

Albendazole, the most efficient agent used so far, might induce apparent cure, as indicated by cyst shrinkage or disappearance in 20%–30% of cases.41 In a clinical trial conducted by Franchi et al,42 which included 448 patients treated with either mebendazole or albendazole, the efficacy of albendazole has been shown to be higher than that of mebendazole (82% vs 56%). However, one fourth of patients presented signs of cyst regeneration.

A prospective, controlled, randomized trial has demonstrated the efficiency of preoperative albendazole administration: After 1 and 3 months of preoperative administration, the majority of cysts (72% and 92%, respectively) were proved to be not viable during surgery versus 50% of cysts in the control group, which were treated with surgery alone.43

According to the World Health Organization (WHO) guidelines, preoperative administration should begin between 1 month–4 days before surgery (albendazole) and 3 months before surgery for mebendazole.44 Recurrence after medical treatment varies among studies between 3%–30%.45

Praziquantel, a synthetic isoquinoline-pyrazine derivative, has been used in combination with albendazole. Combined chemotherapy seems to be more effective than albendazole alone.32,46,47

All the available data suggest that chemotherapy has poor results, and in most of the cases the disease relapses (Table 2).

Surgical Treatment of Echinococcosis

Chemotherapy alone has been disappointing for primary liver hydatid disease treatment. WHO suggests administration of benzimidazoles only for inoperable cases and for recurrence prevention.48 The treatment of choice remains surgery, although there is much debate concerning the most appropriate surgical technique that can offer total extirpation of parasites along with minimal postoperative complications.

Numerous techniques have been proposed. Surgical procedures can be divided into 3 subcategories: the classic open surgical techniques, the laparoscopic procedures, and the minimally invasive techniques.49

Open Surgical Techniques

The classic open surgical approaches are distinguished in (1) conservative methods, which are limited to the removal of the parasitic foci alone while part or all of the pericyst remains in situ, and (2) radical methods, which propose the removal of the entire pericystic membrane and the parasitic content. The choice of the surgical technique depends on the surgeon’s experience, the size of the cysts, their location, and their type as well as the existence of complications.50

The most common conservative methods are marsupialization, partial cystopectectomy with resection of the pericyst and subtotal pericystectomy, or by peeling the pericystium.

Traditional surgical ablation of the cysts is still under use. In that procedure, the abdomen is carefully packed with pads around the cysts to reduce the risk of peritoneal soiling and contamination, the cyst fluid is aspirated with the use of a closed system, and anticoagulant agents (eg, alcohol, chlorhexidine, hypertonic saline) are infused in the voided cyst. After repetitive infusions the cyst is unroofed. The recurrence rate of this procedure ranges from 10%–30%.51,52

Marsupialization is the most commonly used conservative procedure. During marsupialization, the evacuation of the cyst from parasitic foci is followed by the external cavity drainage; the cavity remains open, and the pericyst is left intact.53 Some other authors suggest the performance of cystoenterostomy after the drainage of the cyst.

These techniques, although simple, easy, and quick, are accompanied by a high rate of postoperative complications; residual cavity, soilage in biliary tract or intraperitoneally, bile leaking, vessel injuries and hemorrhage, sepsis, cholangitis, and allergic shock are not uncommon. On that basis, several technical improvements have been proposed, including the removal
of external communications from the cyst and the obliteration of the remaining cyst with omentum or muscle flaps. Some surgeons suggest the performance of capitonnage of the remaining cystic wall to reduce bile leaking, and recently a modified capitonnage has been reported with excellent results concerning the postoperative bile leakage.51,54,55

In partial cystopericystectomy, not only the parasitic foci are eliminated, but also the surrounded pericyst is removed. Some authors suggest enucleation of the exuberant part of the cyst that protrudes from the liver, especially in small and young hydatid cysts with elastic and thin pericyst.56

Subtotal pericystectomy (fere totalis) is an alternative of partial cystopericystectomy, in which small pericystic areas close to vascular and biliary vessels are not resected because of high risk of severe complications.57 Burgeon et al58 proposed another technique that suggested removing the inner membrane and preserving the outer to protect liver parenchyma vascular and biliary vessels, minimizing postoperative complications such as biliary leaking and hemorrhage.

In radical operations the parasitic content along with the entire pericystic membrane is removed. In this subcategory the main procedures are total pericystectomy and liver resection.

Total pericystectomy was first described in the 1930s and can be performed with the “open-cyst” or the “closed-cyst” method. In the first technique the cyst is opened, the contained material is removed, scolecidal substances are infused, and then the pericyst is removed. In the closed-cyst method, en bloc pericystectomy is performed with no other manipulations. During the removal of the pericyst, afferent blood and biliary vessels are ligated to prevent hemorrhage or bile leaking postoperatively. This procedure closes the cavity and prevents relapse of the disease and secondary inflammatory complications, although its difficulty remains a severe limitation.59,60

Many authors suggest liver resection for echinococcosis. Although this method seems to be the most radical treatment for hydatid disease, the high postoperative morbidity and mortality rate in combination with the debatable ability of the remaining liver to regenerate suggest a more skeptical use of this technique. For that reason, liver resection is indicated when other more conservative surgical therapies have failed to eliminate the disease, or when cysts destroy an entire lobe or segment, compress the healthy parenchyma, interrupt the bile ducts, or form external cyst–biliary fistula draining zones. In such cases typical left or right lobe hepatectomy or segmentectomy can be performed.61,62

Brunetti et al63 introduced radiofrequency thermal ablation for liver hydatid disease. During this technique, specific electrodes were inserted through the liver parenchyma into the echinococcal cysts, and the electrodes were stimulated. The cysts were destroyed with a pattern similar to those of hepatic metastases. Histologic examination in the material removed with suction showed no live parasites or eggs, and in their small series no recurrence was observed, and no complications were observed perioperatively. This modification might present a new alternative approach in liver hydatid cyst treatment especially in deep cysts, multiple cysts, or complicated cases, which require severe and multiple operations.

### Laparoscopic Treatment of Liver Hydatid Disease

Laparoscopic treatment of liver echinococcosis has been increasingly popular during the last decades as a result of the significant progress of laparoscopic surgery, although no randomized clinical trials comparing laparoscopic with conventional open surgical treatment of hydatid disease have been

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**Table 2. Efficacy, Complication Rates, Recurrence Rates, Indications, and Contraindications of the Available Treatment Modalities for Liver Hydatid Disease**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Indications</th>
<th>Contraindications</th>
<th>Efficacy</th>
<th>Complications</th>
<th>Recurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mebendazole</td>
<td>Nonoperable patients; combined with surgery</td>
<td>Impaired liver function</td>
<td>56%</td>
<td>10%–20% (elevation of liver enzymes, bone marrow suppression, alopecia)</td>
<td>25%–30%</td>
</tr>
<tr>
<td>Albendazole</td>
<td>Nonoperable patients, combined with surgery</td>
<td>Impaired liver function</td>
<td>82%</td>
<td>10%–20% (elevation of liver enzymes, bone marrow suppression, alopecia)</td>
<td>25%–30%</td>
</tr>
<tr>
<td>Open surgery</td>
<td>Treatment of choice</td>
<td>Severe comorbidity</td>
<td>~90%</td>
<td>~28% (biliary fistula, cyst infection, pleural effusions, wound infection, peritonitis, abscess, anaphylactic shock)</td>
<td>10%–30%</td>
</tr>
<tr>
<td>Laparoscopic</td>
<td>Deep intraparenchymal cysts, posterior cysts, &gt;3 cysts, cysts with thick and calcified wall</td>
<td>~97%</td>
<td>~1.3%</td>
<td>intra-abdominal spillage, abscess, anaphylactic shock</td>
<td>0%–9%</td>
</tr>
<tr>
<td>Percutaneous drainage</td>
<td>Infected cysts, multiple cysts, disseminated cysts, inoperable patients, pregnancy</td>
<td>Nondrainable cysts of types III and IV, ruptured cysts, inaccessible cysts, children &lt;3 y old</td>
<td>~96%</td>
<td>~10% (fistula, anaphylactic shock)</td>
<td>0%–4%</td>
</tr>
</tbody>
</table>
performed. Either pericholecystectomy or partial/whole cystectomy might be performed by laparoscopic technique.

A major disadvantage of laparoscopy is the lack of precautionary measures to prevent spillage under the high intra-abdominal pressures caused by pneumoperitoneum. Some authors argue that pneumoperitoneum is beneficial in preventing spillage, whereas others suggest a decrease in intra-abdominal pressure. The most difficult part of the laparoscopic procedure is the initial cyst puncture and aspiration of the cyst fluid. Preoperative and intraoperative use of sclerocidal factors seems to be of great importance because it ensures the inactivation and clearance of the parasites; nevertheless, some surgeons avoid them because of the potential risk of sclerosing cholangitis.75 Seven et al76 suggest that the risk of intraoperative spillage can be overcome by fixing the cyst in the abdominal wall with a special umbrella trocar and suction with a specific suction device. Bickel et al68 suggest to fill the right subdia-phragmatic suprahepatic space with antiscleocidal fluid (cet-rimide) while the patient is situated in the Trendelenburg position to decrease the risk of spillage; nevertheless, this approach cannot prevent a sudden jet of fluids escaping the cyst.

The indications for laparoscopic excision of liver echinococcosis changed throughout the years. Initially, cysts with diameter greater than 15 cm and recurrent disease were considered unsuitable for laparoscopic treatment. Currently, the only excluding criteria for laparoscopic intervention are deep intraparenchymal cysts or posteriorly situated cysts, more than 3 cysts, and cysts with thick and calcified walls, which should be followed up.69,70

Conversion to open laparotomy might be decided as a result of unsafe exposure, unsatisfactory access, intraoperative bleeding, or intrabiliary rupture of the cyst. In these patients, cholecdocho-tomy, irrigation, and placement of a T-tube drainage is indicated, although open laparotomy significantly prolongs the hospitalization period. Some authors suggest laparoscopic removal of the cysts and endoscopic sphincterotomy for intra-biliary rupture or external biliary fistulas.71,72

Postoperative morbidity in laparoscopic studies ranges from 8%–25%, whereas morbidity in open series ranges from 12%–63%. Mortality after laparoscopy in many series is null (0%), whereas mortality in open series ranges from 0%–3%. Major complications (as anaphylaxis) seem to be more common in laparoscopic interventions as a result of peritoneal spillage during debridement and removal of the cystic content. The rate of short-term recurrence ranges from 0%–9%, compared with that of open series, which ranges from 0%–30%. These favorable results of laparoscopic treatment of liver hydatid disease might not be attributed only to the advantages of minimally invasive surgery; a severe bias is considered to be the careful selection of the candidate patients.63,74

The superiority of laparoscopy is strengthened in the light of the need for a much larger upper abdominal incision for open hydatid surgery and the prolonged hospitalization. Mean hospitalization time in laparoscopy (3–12 days) than in open surgery series (9–20 days), and a significant statistical difference seems to exist.74

A major drawback characterizing the existing clinical studies regarding the selection between laparoscopy and open surgery is that the patients were not randomized, and the series of patients are relatively small. Moreover, a strong bias against open surgery is created because patients with contraindications for laparoscopic treatment, who consist of a small but considerable portion of high-risk patients, are finally handled with open surgery techniques.

**Minimally Invasive Techniques: Percutaneous Drainage of Hydatid Cysts**

Not until the last 15 years had the percutaneous treatment of hydatid liver disease been established as a therapeutic option. From 1989–1992, only a few sporadic, mainly unintentional percutaneous aspirations, followed by drainage of hydatid cysts in liver, were reported.75

Percutaneous drainage of liver hydatid cysts has been contraindicated for many years as a result of the potential risk of anaphylactic shock and spillage of the parasite, resulting in dissemination and peritoneal implantation. Both of these complications are extremely rare and should not be considered as characteristic contraindications.76 The development of fine needles and catheters in combination with the advances in imaging techniques, by which the right intercostal intrabiliary approach is selected, minimized the risk of anaphylactic shock or spillage.77

Percutaneous aspiration can be performed by ultrasonography-guided or computed tomography-guided control. The initial puncture can be performed either by free hand technique for ultrasonography guidance or by needle-guiding device mounted on a probe. After the insertion of the needle, the cystic content is aspirated, a sample is derived, contrast material is injected to opacify the cyst, and sclerocoidal drug is infused, followed by povidone-iodine infusion. The catheter remains clamped for 30 minutes, and then povidone-iodine is infused again. The catheter is preserved for drainage. Except for povidone-iodine infusion, aspiration can be followed by sclerotherapy or infusion of alcohol or a sclerocoidal such as albendazole.80–82 The above procedure is referred to as the PAIR technique (puncture of the cyst wall, aspiration of cyst content, injection, and re-aspiration of a sclerocoidal agent).

Recently a modified PAIR technique, which introduces the concomitant evacuation of cyst contents while infusing sclerocoidal agent via a specially designed coaxial catheter system, has been described with promising results. The simultaneous aspiration/infusion process allows almost complete washout of cyst content, thus reducing the chances of any scolices surviving, and the maintenance of the intracystic pressure minimizes the risk of biliary fistula formation.82

Other modified techniques, such as percutaneous evacuation and percutaneous puncture, drainage, and curettage, are indicated for multivesicular cysts. Some authors have reported promising results regarding the performance of percutaneous ablation of the cysts via radiofrequency, although the reported series were small.

Indications of percutaneous treatment of liver hydatid cysts are type I and II cysts, type III and IV cysts with drainable material, suspected fluid collections, infected hydatid cysts, inoperable patients, pregnant women, and patients with multiple, disseminated, or symptomatic cysts. Moreover, cysts with exophytic component, surrounded by dilated bile ducts, situated in the upper surface of the liver or in other critical locations (eg, portal bifurcation), or >100 mL should be considered candidates for evacuation.82

The contraindications of the procedure include some subgroups of type III, IV (hydatid cysts with heterogeneous echo
pattern), ruptured liver cysts into the biliary system or peritoneum, cysts inaccessible to puncture, and children <3 years old.\textsuperscript{44,87} Hydatid cysts of type V are generally considered not eligible for any intervention except simple follow-up.\textsuperscript{88}

Failure of treatment is defined as recurrence in the same location or complication related with the intervention. For uncomplicated hydatid cysts of types I and II, percutaneous treatment seems to be the optimal treatment. All cases with contraindication for percutaneous treatment should be treated surgically. Recurrence rates vary between 0%–4% among several series. Recurrence can be treated with percutaneous aspiration.\textsuperscript{49,90}

The overall complication rates in percutaneous drainage range from 15%–40%. In previously treated surgical cases, the incidence of complications after percutaneous drainage is quite higher. Major complications, such as anaphylactic shock, are rare (0.1%–0.2%). Minor complications (urticaria, itching, hypotension, fever, infection, fistula, rupture in biliary system) range from 10%–30%.\textsuperscript{91} Cyst-biliary communications (biliary rupture and fistula formation), developing after PAIR and caused by cyst decompression, can usually be handled endoscopically\textsuperscript{92} or, in case of inability or recurrence, by cyanoacrylate infusion.\textsuperscript{93} Cholangiography or endoscopic retrograde cholangiopancreatography is recommended before any attempt for percutaneous drainage to inject contrast material to make any communication visible.\textsuperscript{92}

The overall mortality ranges from 0.9%–2.5% among several studies of the past, a rate that has been lowered to 0.1% in a recent meta-analysis.\textsuperscript{92} Mortality factors are associated with perioperative complications, patient’s age, and infection of the remaining cyst cavity. Hospitalization period is approximately 1 day, whereas in complicated cases it might range from 17–20 days.\textsuperscript{94}

Percutaneous drainage seems to be the ideal therapy for liver hydatid disease because it combines cure with low morbidity.\textsuperscript{45–97} In a recently published meta-analysis comparing surgery with PAIR in 1721 patients, the latter has been shown to have fewer major (25.1% vs 7.9%) and minor (33.0% vs 13.1%) complications and fewer recurrence rates (6.3% vs 1.6%).\textsuperscript{95,96} The efficacy of percutaneous treatment has also been documented in pediatric cases, because it has been proved that the long-term results of the method are in accordance with the results of adults.\textsuperscript{98,99}

Where indicated, percutaneous drainage is the most effective and reliable minimally invasive interventional procedure, which is associated with low mortality, morbidity, and recurrence and short hospitalization.\textsuperscript{99}

**Early Diagnosis and Prevention of Echinococcosis**

Echinococcosis is a crucial health problem in many rural and remote areas of Europe, Africa, Asia, and South America. Although the disease is of rather surgical interest, the role of general practitioners in early recognition and prevention should be emphasized. There is an urgent need for public health programs to screen patients and to inform the populations of highly endemic regions for echinococcosis. Despite the considerable cost of preventive medicine measures, which might be unaffordable especially for developing countries, the cost of therapy with benzimidazoles is even higher. Benzimidazole costs range from US $5,500– 17,800 per single patient per year, whereas total treatment costs are estimated to be some US $300,000 per single patient.\textsuperscript{100} Therefore, the cost-effectiveness of preventive medicine is considered to further support it through rural practitioners.

**References**


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