

## MISE AU POINT/IN-DEPTH REVIEW

### NEW TRENDS IN THE MANAGEMENT OF HEPATIC *ECHINOCOCCUS GRANULOSUS*

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**ABSTRACT :** The liver is the most commonly involved organ in the body by cystic echinococcosis (CE) secondary to infection with *Echinococcus granulosus*. In this article, the authors discuss the classification, recent advances in magnetic resonance (MR) imaging for the diagnosis of hepatic CE, and approaches for management of hepatic CE using five therapeutic options that include : antihelminthic chemotherapy, surgery, percutaneous treatment, endoscopic approach, and the “watch and wait” approach.

**RÉSUMÉ :** Le foie est l'organe le plus fréquemment atteint par la maladie kystique hydatique (KH), secondaire à l'infestation par *Ecchinococcus granulosus*. Les auteurs de cet article discutent les progrès récents en matière de classification, de diagnostic par l'imagerie par résonance magnétique (IRM), ainsi que leur approche dans la prise en charge thérapeutique utilisant les options suivantes : le traitement antiparasitaire, la chirurgie, le traitement percutané, l'approche endoscopique, et l'approche de surveillance.

#### INTRODUCTION

There are three species of the genus *Echinococcus* which can cause hepatic echinococcosis in humans: *E. granulosus* responsible for unilocular or cystic echinococcosis (CE) prevalent in the Mediterranean basin and Middle Eastern countries, *E. multilocularis* responsible for alveolar echinococcosis (AE) prevalent in Central Europe and North America, *E. vogeli* responsible for polycystic echinococcosis (PE) prevalent in South America.

Human CE remains highly endemic in pastoral communities with an annual incidence in Lebanon estimated at 1.38 per 100.000 inhabitants [1]. The mortality rate from CE is estimated at 2-4%, but it may increase considerably if medical care is inadequate [2].

#### CLASSIFICATION

An international classification of CE has been established by the World Health Organization – Informal Working Group on Echinococcosis (WHO-IWGE) in 2003 [3], based on imaging patterns, namely ultrasound images that correlate with the natural evolution and viability of the cyst (Fig. 1). Cyst viability depends on the presence of fluid content within the cyst. The presence of cyst wall calcifications is not an indicator of cyst viability, as it may

be observed in viable, active or fertile CE 1 & 2, transitional degenerating but still viable CE 3, and degenerated inactive or infertile CE 4 & 5. Cyst wall calcifications are present in the pericyst formed by the host liver tissue, they are an indicator of chronicity or old age of the cyst. Cysts were also categorized into small (< 5 cm), medium-sized (5-10 cm), and large (> 10 cm). Cysts may also be characterized into noncomplicated or complicated cysts by rupture into the biliary tree, peritoneum, transdiaphragmatic rupture into the pleura, and by superinfection.

#### SYMPTOMATOLOGY

The symptomatology of patients with hepatic CE is non-specific, but clinical symptoms depend on the cyst size and occur when the cyst compresses or ruptures into neighboring structures [2]. Usually cysts smaller than 5 cm may be observed in asymptomatic carriers, while cysts larger than 5 cm produce symptoms by mass effect or pressure on adjacent structures.

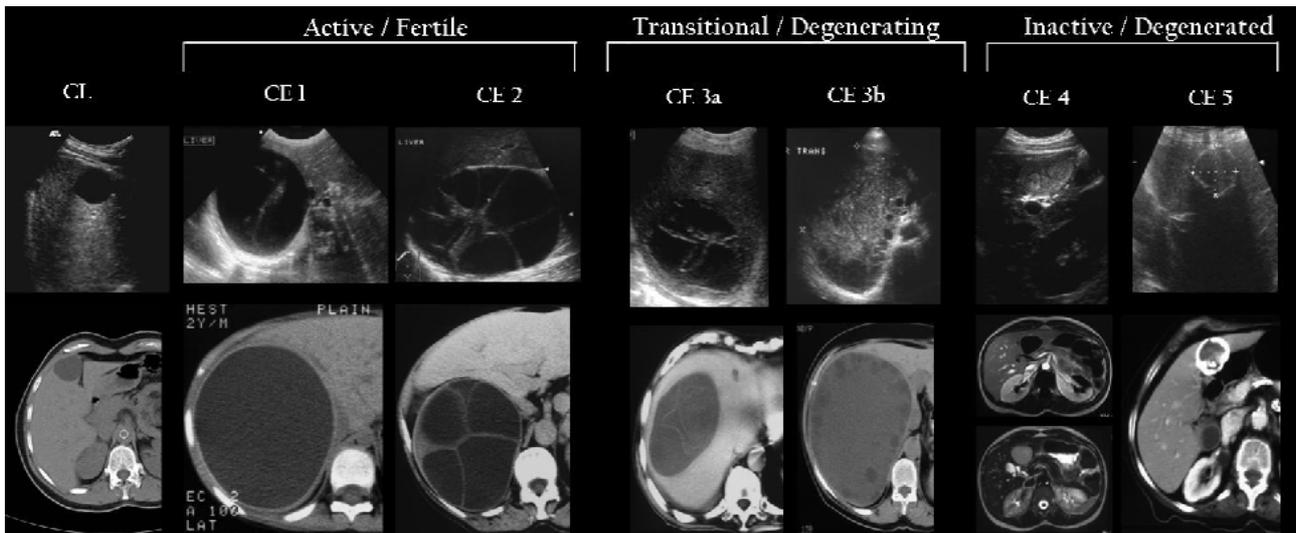
#### DIAGNOSIS

The diagnosis of CE should be suspected in a patient presenting with a cystic lesion in any organ, living in or immigrant from endemic regions. The definitive diagnosis is usually established by positive serological tests and typical cross-sectional imaging features on ultrasound, CT scan or MR imaging.

Sensitivity of serum antibody detection using indirect hemagglutination, ELISA, or latex agglutination, with hydatid cyst fluid antigens, ranges between 85% and 98% for liver hydatid cysts. Specificity of all tests is limited by

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**FIGURE 1.** Natural evolution and WHO 2003 classification of cystic echinococcosis.

- CL** Unilocular cyst. It is an indeterminate cystic lesion (CL) as it may be parasitic or a nonparasitic simple epithelial-lined biliary cyst.
- CE 1** Unilocular cyst containing fine echoes due to shifting of brood capsules which is often called hydatid sand (“snow-flake sign”).
- CE 2** Multivesicular cyst containing daughter cysts.
- CE 3a** Cyst containing a floating membrane due to detachment of the endocyst.
- CE 3b** Cyst with a predominantly solid content due to membranes and few peripheral daughter cysts.
- CE 4** Heterogeneous cyst with solid content due to membranes but no daughter cysts (pseudotumoral).
- CE 5** Cyst characterized by thick calcified wall and no fluid content.

cross-reactions due to other cestodes or helminthic infections (*Taenia solium* of cysticercosis), malignancies, liver cirrhosis and presence of anti-P1 antibodies [2].

On MR imaging, hydatid cysts are characterized by the presence of a 4 to 5 mm low signal intensity rim so-called “rim sign” seen on both T1 and T2-weighted MR images but more conspicuous or evident on T2-weighted images. The “rim sign” has been described as characteristic of hydatidosis, as opposed to nonparasitic simple epithelial cysts. This finding represents the fibrous pericyst generated by the host tissue, that is rich in collagen, with or without calcifications. However, it is a nonspecific sign or finding as it can also be seen in amebic liver abscess, hepatocellular carcinoma, and hematoma [4]. Furthermore, the newer applications of functional MR imaging using diffusion weighted (DW) MR imaging and proton MR spectroscopy (MRS) can help more specifically to differentiate parasitic from nonparasitic cysts in difficult or problematic cases with atypical imaging morphological features for hepatic CE especially in patients with indeterminate unilocular cystic lesions classified as CL cysts, obviating the need for invasive diagnostic percutaneous fine needle aspiration with its potential risks of anaphylaxis and peritoneal dissemination. In a series published by Inan et al. [5] using a 1.5T MR scanner and single-shot spin-echo echoplanar DW images (1000/81 ; echoplanar imaging factor, 77; sensitizing gradients in x, y, and z directions) and b values of 0, 500, 1000 s/mm<sup>2</sup>; most hydatid cysts were hyperintense, whereas most simple cysts were isointense with the liver at b value of 1000 s/mm<sup>2</sup>. Quantitatively, both the signal intensity and cyst-to-liver

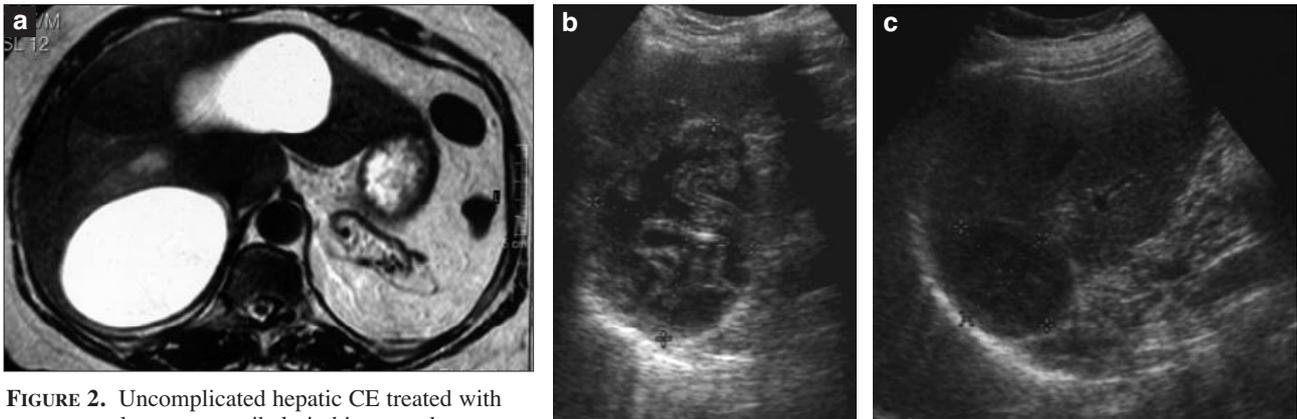
signal intensity ratio of the hydatid liver cysts were significantly higher than those for simple cysts. The apparent diffusion coefficient (ADC) map, and cyst-to-liver ADC ratio of the liver hydatid cysts were significantly lower than those of simple cysts. In vivo MRS findings of liver hydatid cysts are not yet described in the radiologic literature, this aspect constitutes an interesting subject for future research projects. Nevertheless, in vivo proton MRS of hydatid cysts in the brain and in vitro MRS studies of hydatid fluids using high-field MR scanners have shown high levels or peaks of succinate, lactate, pyruvate and acetate metabolites. These elevated metabolites may be a marker of parasitic etiology and perhaps a noninvasive metabolic assessment tool i.e. a “metabolic biopsy” of the viability of such parasitic cysts [6-9].

#### MANAGEMENT STRATEGIES

The management of CE depends largely on guidelines and experts consensus opinion (evidence-based, level 5) established by the WHO-IWGE and published in 1996, 2001, and last in 2010 [2, 10-11].

The main goals of the most appropriate treatment is to kill the *E. granulosus* or ablate the cyst while preserving normal liver tissue using minimally invasive therapy, that gives the best results with the lowest rates of morbidity and mortality.

The criteria for patient selection and choice of appropriate or optimal treatment depend not only on the WHO-IWGE guidelines, but also on local skills and expertise. There are five therapeutic options available for the man-



**FIGURE 2.** Uncomplicated hepatic CE treated with long-term antihelminthic monotherapy.

- a. T<sub>2</sub>W MR image obtained at presentation showing a medium-sized unilocular hepatic CE1.
- b. Follow-up ultrasound image obtained at one year following medical treatment showed degeneration of the echinococcal cyst with detachment of the endocyst membrane compatible with CE 3a.
- c. Follow-up ultrasound image obtained at two years showed further degeneration of the cyst with complete solidification, compatible with CE 4.

agement of CE: antihelminthic chemotherapy, surgery, percutaneous treatment, endoscopic approach, and the “watch and wait” approach. In this section, we discuss how patients with hepatic CE are managed at our institution using the above mentioned therapeutic options.

#### Antihelminthic chemotherapy

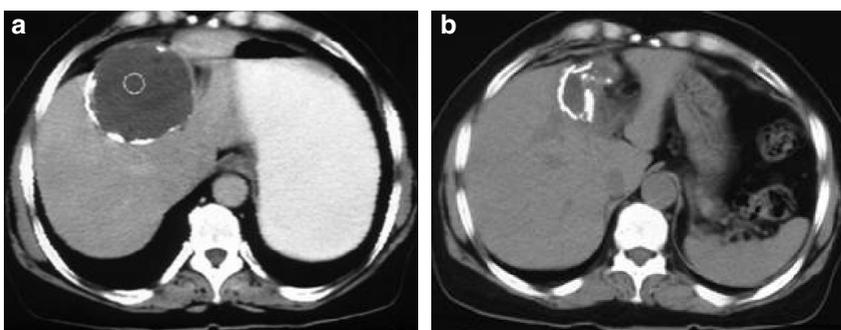
Long-term antihelminthic monotherapy using benzimidazole drugs alone has a low cure rate i.e. disappearance of the cyst estimated at 30% [10]; whilst in the remaining cases, cysts may show degenerative changes (50%) (Figure 2), or may not respond to medical treatment (20%). Albendazole is the drug of choice administered continuously for a long duration without interruptions or in interrupted courses for at least 3 to 6 months at a dose of 15-20 mg/kg/day with close monitoring of the hepatic and hematologic biological markers or tests [12]. Patients undergoing long-term antihelminthic monotherapy are predisposed to hematologic and hepatic drug toxicity at a rate of 5-10%. This toxicity can be sometimes severe and persistent and at times irreversible. Benzimidazole drugs are contraindicated in patients with cysts at risk of rupture, in early pregnancy because of teratogenic or embryotoxic effects, and in patients with chronic hepatic disease or bone marrow depression [2]. Because of its low cure rate and potential serious undesirable effects, current antihel-

minthic chemotherapy is preferably used as an adjuvant short-term therapy for a minimum of one month duration, to surgery or percutaneous treatment. Long-term antihelminthic monotherapy may be the only therapeutic option if contraindications to surgery or percutaneous treatment exist, or if patients refused invasive therapy.

#### Surgery

Surgery has been long considered as the definitive and optimal treatment for hydatidosis that has the potential to remove the endocyst and lead to a complete cure [10]. At our institution, laparoscopic surgery is the first-line treatment for symptomatic patients with noncomplicated cysts larger than 5 cm in size and in accessible locations to laparoscopic surgery (Figure 3). It is now widely preferred to open surgery, simply because of its lower morbidity and mortality rates and the advantage of a shorter hospital stay [13-14]. Open surgery is usually indicated in a small number of patients with cysts inaccessible to laparoscopic surgery, and complicated cysts by rupture into the biliary tree or peritoneum.

As for the choice of the protoscolicidal agent, cetrimide solution (cetyl-trimethyl ammonium bromide) at low concentrations 0.1%-0.5% has been traditionally adopted by our surgeons. Its efficacy and safety was documented in earlier studies [15].



**FIGURE 3.** Uncomplicated hepatic CE treated by laparoscopic surgery.

- a. Contrast enhanced CT scan image showing a medium-sized superficial and subcapsular hepatic CE 1 with pericyst calcifications.
- b. Follow-up contrast enhanced CT scan image obtained after laparoscopic surgery showed complete degeneration of the cyst and collapse of the calcified pericyst generated by the host liver tissue.

Novel thermal ablative techniques such as radio-frequency thermal ablation, high intensity focused ultrasound, and other ablative techniques may be used for ablation of nonsuperficial or deep seated intrahepatic CE in an open surgery and under intraoperative ultrasound guidance [16-17], or percutaneously under imaging guidance [18].

Liver transplantation is rarely recommended for patients with incurable or unresectable disease and severe liver dysfunction or hepatic insufficiency due to numerous cysts replacing normal liver tissue, particularly in patients with hepatic AE or PE [19-21]; however it was not necessary for our patients with hepatic CE.

### Percutaneous treatment

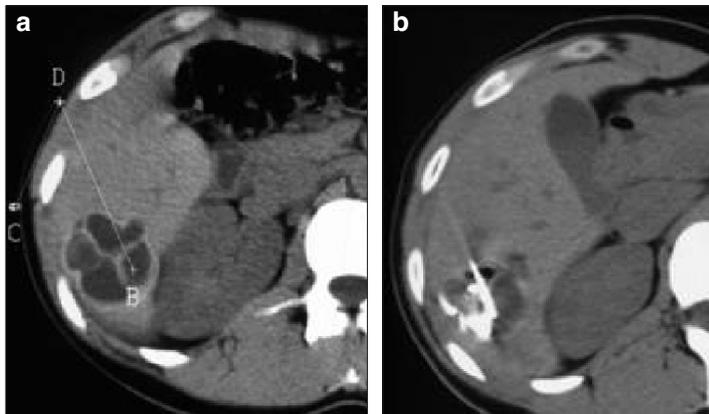
The percutaneous treatment is performed under imaging guidance by interventional radiologists assisted by anesthesiologists for patient sedation and close monitoring for potential adverse reactions. It consists of two different techniques: PAIR (puncture, aspiration, injection, reaspiration) performed as an out-patient procedure, and PEVAC (percutaneous evacuation) performed as an in-patient procedure. Albendazole at a dose of 15-20 mg/kg/day is administered 7 days prior to the procedure and continued for one month thereafter. The scolicidal agents used are either hypertonic saline 20%, 95% sterile pure alcohol, or cetrимide 0.5%.

We apply the PAIR technique using a needle puncture and injection of a sclerosing agent for symptomatic pa-

tients with noncomplicated active and viable CE 1-3 cysts smaller than 5 cm in size (Figure 4).

PEVAC is a more radical approach consisting of intracystic insertion of a large bore catheter (14F) with large side holes for evacuation of the membranes and endocyst fragments following ablation of the cyst with scolicidal agents. The indications for PEVAC technique are: 1) Patients with hepatic echinococcal cysts greater than 5 cm in size, who are not considered candidates for surgery i.e. inoperable, or refused surgery; 2) Patients with recurrent and symptomatic viable cysts after failed previous surgery. PEVAC is a technique applicable to all types of CE 1-3 with a high success rate leading to cure or solidification of the cysts in the majority of patients [22]. The percutaneous approach is also used as an adjuvant therapy in the treatment of complications following surgery for hepatic echinococcal cysts [23]. A high infection rate of approximately 22%, and a relatively long time of catheter placement remain a scourge or disadvantages of percutaneous treatment [22, 24], hence the need for prophylactic antibiotics to prevent secondary cyst cavity infection.

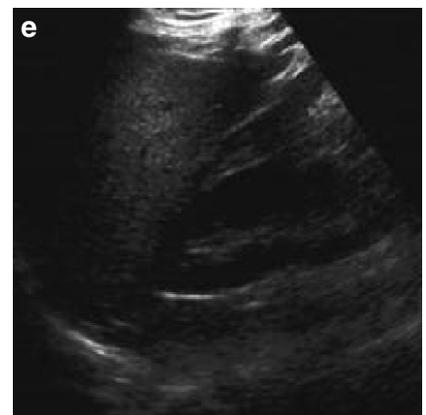
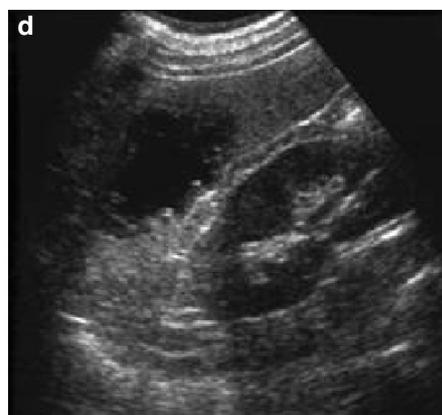
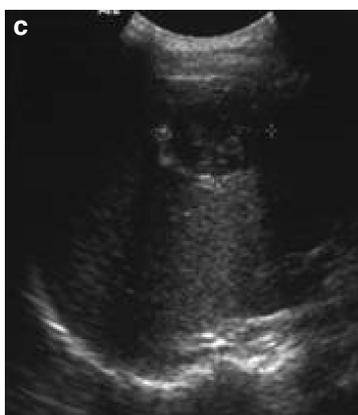
The results of percutaneous treatment are generally satisfactory and comparable to surgery in terms of effectiveness [25]. Both percutaneous techniques lead to complete cure i.e. cyst disappearance with reconstitution of liver parenchyma in approximately one-third of patients, while in the remaining cases there is significant reduction in the size of the cyst with solidification i.e. inactive degenerated

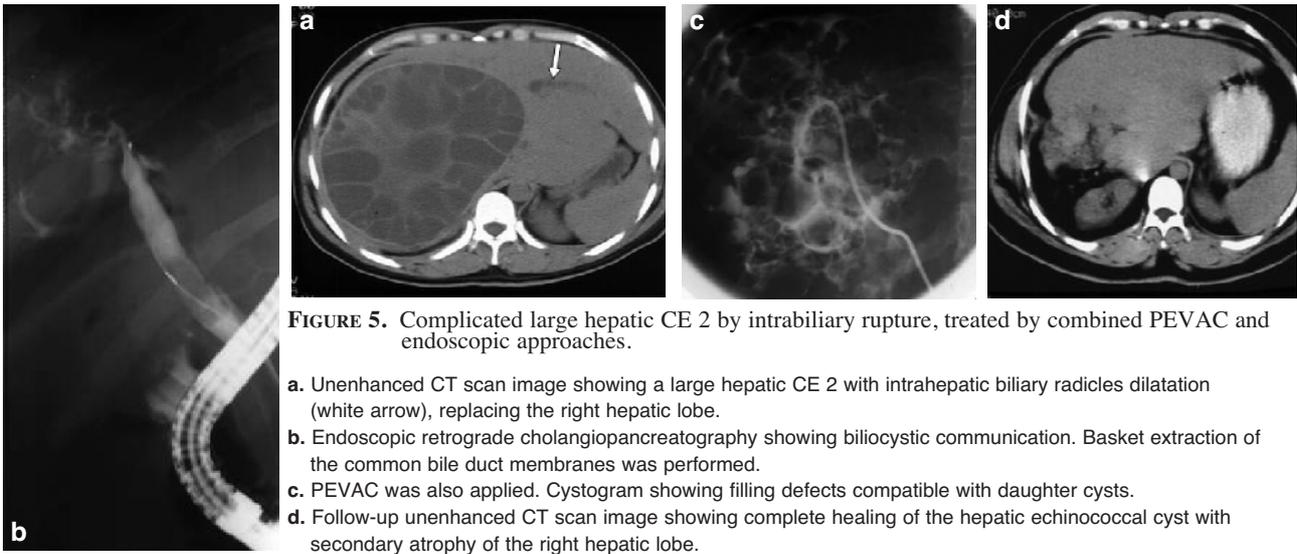


**FIGURE 4**

Uncomplicated hepatic CE treated by PAIR technique.

- a. Unenhanced CT scan image showing a small hepatic CE 2.
- b. Needle puncture under CT guidance and ablation of the echinococcal cyst with pure alcohol.
- c. Follow-up ultrasound image after PAIR technique showing complete degeneration of the echinococcal cyst.
- d. Ultrasound image of another patient with a small hepatic CE 1.
- e. Follow-up ultrasound image after PAIR technique showing complete healing and reconstitution of liver parenchymal tissue.





**FIGURE 5.** Complicated large hepatic CE 2 by intrabiliary rupture, treated by combined PEVAC and endoscopic approaches.

- a. Unenhanced CT scan image showing a large hepatic CE 2 with intrahepatic biliary radicles dilatation (white arrow), replacing the right hepatic lobe.
- b. Endoscopic retrograde cholangiopancreatography showing biliocystic communication. Basket extraction of the common bile duct membranes was performed.
- c. PEVAC was also applied. Cystogram showing filling defects compatible with daughter cysts.
- d. Follow-up unenhanced CT scan image showing complete healing of the hepatic echinococcal cyst with secondary atrophy of the right hepatic lobe.

cyst, or evidence of a residual sterile fluid-filled cavity containing no viable scolices at needle aspiration and microscopic examination of the aspirate. Hence, the percutaneous treatment is a viable, and effective alternative therapy to surgery.

**Endoscopic approach**

It is usually combined with surgery or PEVAC and reserved for patients with CE complicated by rupture into the biliary tree causing biliary obstruction with or without cholangitis. The endoscopic approach [26] primarily aims at relieving the biliary obstruction by basket or balloon extraction or nasobiliary catheter irrigation and drainage of the intrabiliary membranes or small daughter cysts obstructing the biliary tree (Fig. 5).

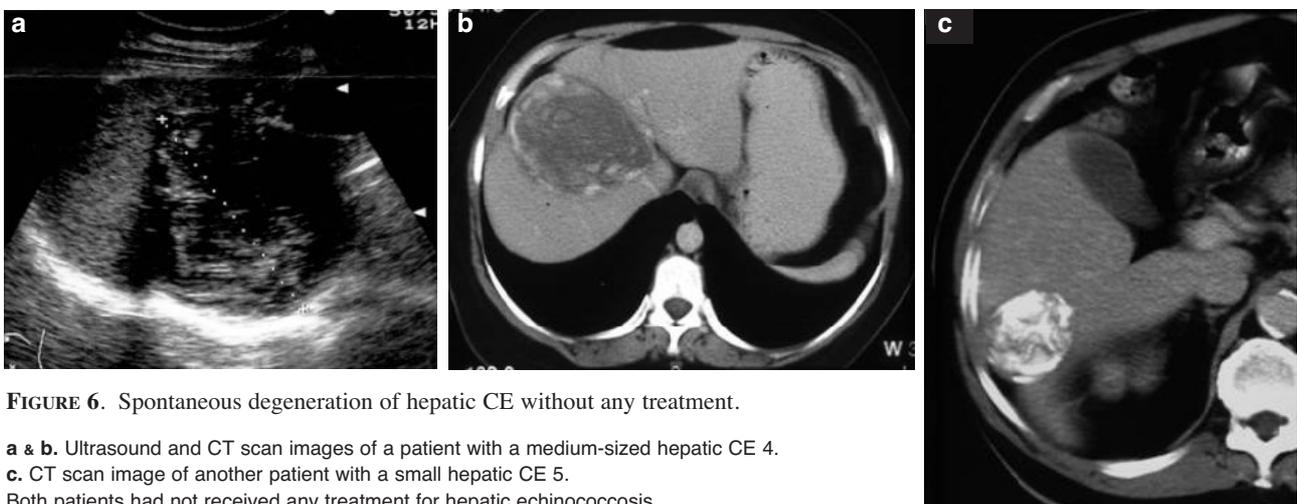
**“Watch and Wait” approach**

Hepatic echinococcal cysts may undergo spontaneous degeneration without any treatment, the so-called “burned-out” or dead cysts (Fig. 6); such cysts are usually discov-

ered incidentally on imaging examinations performed for other reasons. Inactive degenerated CE 4 & 5 cysts are “leave me alone” lesions that do not require any intervention or treatment.

An important alert to radiologists is that CE 4 cysts might have a pseudotumoral appearance on imaging (Fig. 6 a & b) and may be occasionally confused with a hepatic tumor.

The approach to asymptomatic carriers of active CE 1-3 remains debatable. Larrieu & Frider [27-28] have reported that 67% to 75% of asymptomatic carriers remain so throughout their lifetime. They recommend observation and monitoring of small unilocular cysts, and treatment with antiparasitic chemotherapy followed by PAIR technique if the antihelminthic chemotherapy fails for larger or more complex cysts. On the other hand, Saidi [29] recommends a watchful waiting approach for asymptomatic carriers especially in endemic regions, but if cysts grow or become symptomatic then treatment is justifiable.



**FIGURE 6.** Spontaneous degeneration of hepatic CE without any treatment.

- a & b. Ultrasound and CT scan images of a patient with a medium-sized hepatic CE 4.
  - c. CT scan image of another patient with a small hepatic CE 5.
- Both patients had not received any treatment for hepatic echinococcosis.

## CONCLUSION

The ideal strategy for management of hepatic CE is a multidisciplinary approach. It requires adequate patient selection and the careful choice of the most appropriate treatment, not dissimilar to the management approach of tumors.

In general, there is a universal acceptance and worldwide tendency towards the applications of noninvasive diagnostic techniques using advanced cross-sectional anatomical and functional imaging with serological tests and minimally invasive therapeutic options such as laparoscopic surgery or percutaneous treatment coupled with adjuvant short-term antihelminthic chemotherapy, replacing the traditional open surgery and/or the long-term antihelminthic monotherapy.

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