Bulgarian Journal of Veterinary Medicine (2007), **10**, No 1, 45–51

IMAGING (ULTRASONOGRAPHY, COMPUTED TOMOGRAPHY) OF PATIENTS WITH HYDATID LIVER DISEASE

K. KALINOVA

Department of General and Pediatric Surgery, University Hospital,
Stara Zagora, Bulgaria

Summary

Kalinova, K., 2007. Imaging (ultrasonography, computed tomography) of patients with hydatid liver disease. *Bulg. J. Vet. Med.*, **10**, No 1, 45–51.

A survey was performed with the assumption that the algorithm of used approaches is very important throughout the continuous diagnostics of asymptomatic liver echinococcosis. In the course of the 20-year experience (1986–2006) of the Department of General and Operative Surgery of the Medical University of Stara Zagora in diagnosing the disease, ultrasonography, radiography and computed tomography (CT) were performed in 127 patients. The different methods of diagnostics of the commonest symptoms of the diseases as well as the findings in complicatios, revealed during the operative treatment, are discussed. The hydatid cyst size was compared with the parasite's evaluative stages. The cyst's segmentary topography and the related risk of cystic echinococcosis were evaluated. The ultrasonography and CT scan findings were studied before and after therapy.

Key words: diagnosis, echinococcosis, liver, computed tomography, ultrasound

INTRODUCTION

Hydatid disease is a parasitic infection caused by *Echinococcus granulosus*, characterized by cystic lesions in the liver, lungs, and rarely, in other parts of the body. The liver is reported to be the most commonly involved organ (in 52–77% of cases) (Babba *et al.* 1994). The non-complicated hydatid cysts of the liver are asymptomatic. The symptoms may be related to a toxic reaction due to the presence of the parasite and the local and mechanical effects depending on the location and nature of the cysts and the presence of complications (El-Tahir *et al.*, 1992). Hepatic echinococcal cysts may be classified into five types according to the widely accepted imaging classification of Gharbi *et al.* (1981), based on sonographic patterns. Type I consists of a pure fluid collection, i.e. a non-complicated unilocular or monovesicular cyst. Type II is a fluid collection with a split wall (floating detached endocyst membrane). Type III is a cyst containing daughter cysts and septations with a predominantly fluid component on ultrasonography (US) (honeycomb image). Type IV is a cyst with a predominantly heterogeneous solid echo pattern consisting of thick membranes with few daughter cysts. Type V is a calcified non-viable degenerated cyst with thick reflecting walls, representing an involute.

Uncomplicated hepatic cysts are common lesions, lined by a single layer of epithelium. They could be solitary or mul-

tiple. The computed tomography (CT) appearance of a simple hepatic cyst consists of a well-circumscribed, homogeneous mass with no discernible wall. It has a near water attenuation value, and shows no enhancement after intravenous contrast material administration (Sayek & Onat, 2001; Suwan, 1995). On sonography it appears anechoic because of the clear fluid content with posterior acoustic enhancement, and has smooth regular wall.

The aim of this study was to analyze the imaging findings on US and CT and to determine the effective diagnostic imaging of hepatic echinococcal cyst (HEC), in order to reduce diagnostic errors.

MATERIALS AND METHODS

This is a single-center study in which all patients that had surgery by the author for hydatid liver disease between January 1986 and September 2006 were included for analysis. Sixty-five female and sixty-two male patients between 3 and 69 (mean 36.5) years were analyzed in this study. The diagnosis depended on clinical suspicion. Standard chest radiographs were performed in all cases for inspection of the associated forms of hydatid cysts.

Haematology (eosinophilia) and serological tests were employed. In all patients, indirect haemagglutination tests (IHT) and enzyme-linked immunosorbent assay (ELISA) were performed. ITH was considered positive if the titre exceeded a value of 1:32 and ELISA – of 1:200. All 127 cases were evaluated by US, using ultrasound units with a convex 3.5 MHz transducer SSD-2000 (Aloka, Japan). Also, CT imaging of the liver was performed in 65 patients by means of a conventional whole body CT system (Philips) with a data acquisition time of 2.8 s (129 Kv, 110 mA) and contiguous 10 mm sections through the region of interest. The 65 patients had both US and CT examinations.

RESULTS

As we previously reported, the pain in the right upper quadrant or the epigastrium was the most common symptom, whereas hepatomegaly and a palpable mass were the most common findings. The shape, distribution and localization of hydatid cysts are summarized in Table 1. The size

Table 1. Distribution, localization and shape of HEC in 117 patients

Item	Number of patients	%
Solitary	107	84.25
Double	9	7.08
Multiple	11	8.66
Right lobe location	99	77.95
Left lobe location	20	15.75
Bilobular location	8	6.30
Subcapsular or superficial	90	70.87
Deeply situated within liver parenchyma	37	29.13
Oval	85	66.93
Round	42	33.07
Co-existent cyst in the lungs	11	8.66
Co-existent cyst in the spleen	4	3.15
Co-existent cyst in the kidney	3	2.36

of the cysts ranged from 3.5 to 18 cm in their maximum diameter (average 9.5 cm), and from 4 to 12.5 cm in their transverse diameter (average 9.1 cm).

Of the 127 patients who had US examinations, a unilocular cyst with a smooth uniform wall, with double echogenic lines separated by a hypoechogenic layer, anechoic fluid content and posterior acoustic enhancement (Fig. 1a) i.e. with no characteristic sonographic features, that could not be differentiated from a simple cyst by ultrasound criteria), was identified in 65 patients. In the remaining 62 patients, one or more ancillary findings were present. Out of these patients, in

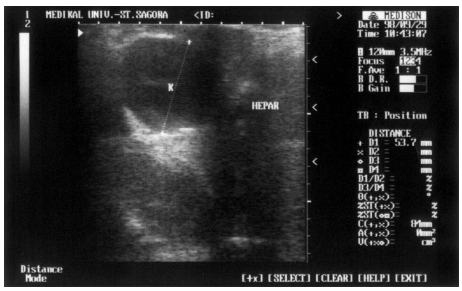

Fig.1a. Liver US – unilocular type I HEC with anechoic clear fluid content and smooth regular wall.

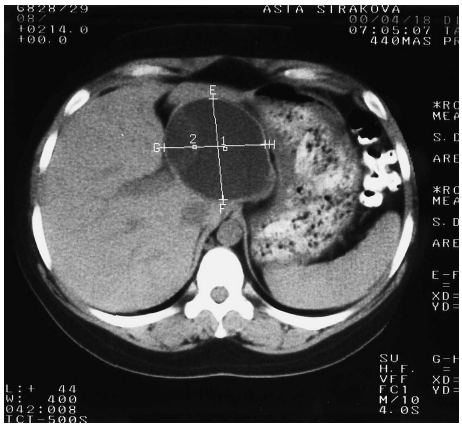

Fig. 1b. Liver CT demonstrating unilocular type I HEC in the left lobe that has a CT attenuation value of water.

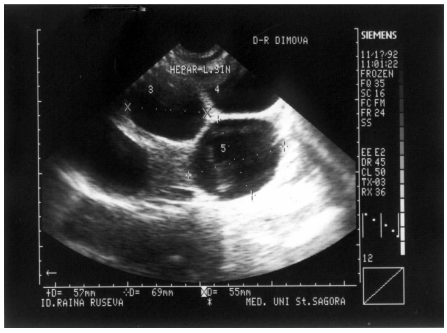

Fig. 2a. Liver US – multilocular HEC with layering and echogenic hydatid sand.

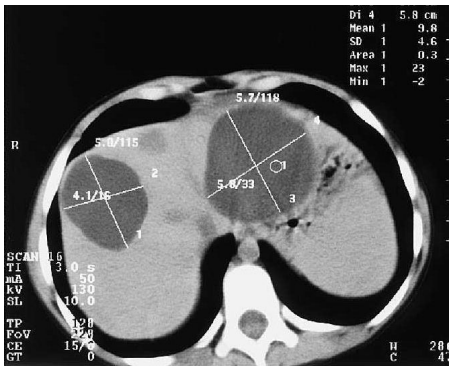

Fig. 2b. Liver CT of the same patient with non-visualized echogenic hydatid sand.

forty, layering and movable echogenic hydatid sand, visible in the deep part of the cyst that moved with patient movement of changing position were present (Fig. 2a). In ten patients – focal or segmental wall thickening (Fig. 3a), and in twelve patients – pericystic biliary radices dilatation were observed.

We performed CT in cases when US failed due to patient-related difficulties (eg obesity, excessive intestinal gas, abdominal wall deformities, and previous surgery) or disease complications. Out of the 65 patients with unilocular cysts who had CT, some of them with ancilliary US findings, no characteristic CT imaging

Fig. 3a. Liver US – unilocular type I HEC with a focal wall thickening due to slight detachment of the endocyst membrane.

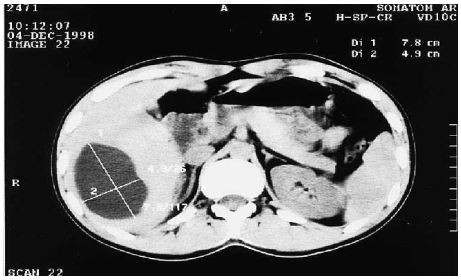

Fig. 3b. CT of the same patient as in Fig.3a.

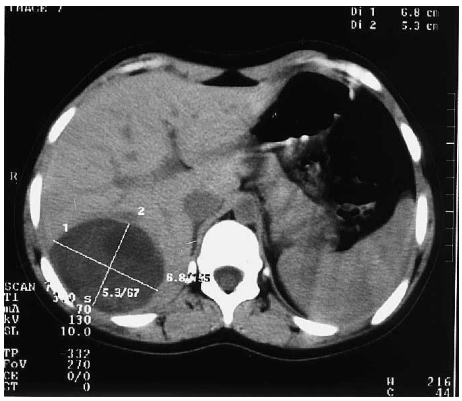

Fig. 4. Liver CT showing a type I HEC with a hypodense rim surrounding the cyst.

findings (Fig. 1b) were observed in 30 patients, while one or more helpful features were identified in 35 patients: A hypodense rim surrounding a thick cyst wall was present in nineteen patients (Fig. 4), pericystic biliary radicles‘ dilatation – in three patients (Fig. 5), faint segmental egg-shell calcification of the pericyst – in twelve patients (Fig. 6), and focal wall thickening – in one patient (Fig. 3b). These imaging findings were seen on both unattenuated and contrast-enhanced CT, but were better visualized on the contrast-enhanced images. CT had high sensitivity for hepatic hydatid disease. In 5% of cases with complications (intrabiliary rupture), we performed this method with contrast. CT scan failed to visualize echogenic hydatid sand in ten patients (Fig. 2b). In our observations, CT displayed the same findings as US, but the sensitivity was 98%.

IHT was positive in 75% of HEC cases and ELISA – in 85%.

Infected hydatid cysts occured only after both pericyst and endocyst rupture (communicating and direct rupture), which allowed bacteria to pass easily into the cyst (5–8% of cases). At clinical examination, infection was usually manifested as a hepatic abscess. US and CT findings were similar to those in other hepatic abscesses. US findings were nonspecific. Although the lesion usually demonstrated poorly defined margins, it remained well defined. Findings suggesting an infection included a solid appearance, a mixed pattern produced by solid and fluid elements, internal echogenic foci, and air or air-fluid levels within the cyst.

CT was the approach of choice for demonstrating cyst infection. Infected cysts were manifested at CT as poorly defined masses, in contrast to the more clearly defined masses seen in uncomplicated cases. Contrast-enhanced CT revealed the typical high-attenuation rim representing abscesses surrounding the lesion. Occasionally, patchy areas of contrast-enhanced liver parenchyma were

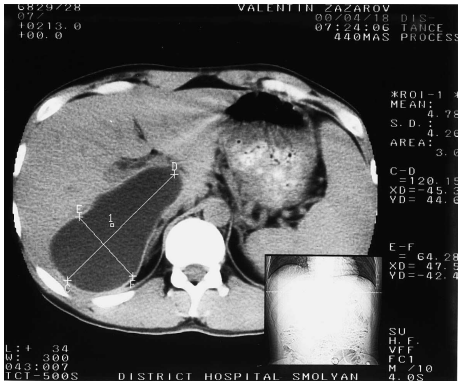

Fig. 5. Liver CT showing a type I HEC with an evidence of pericystic billiary radices dilatation.

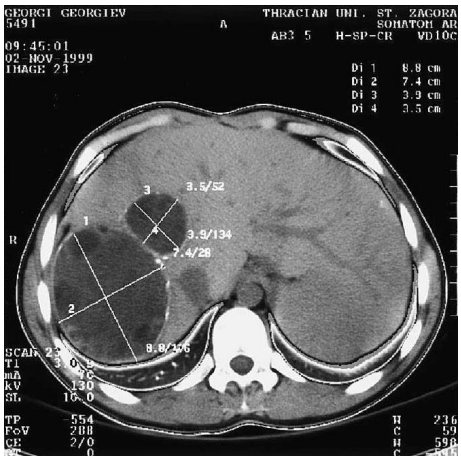

Fig. 6. Liver CT demonstrating faint segmental egg-shell calcification of the pericyst.

seen in the vicinity of the lesion representing inflammatory changes. Also, CT depicted gas or air-fluid levels within the cyst the most clearly.

About 5% of the patients with liver cysts also exhibited a hydatid cyst on chest radiography.

Eosinophilia was present in 40% of patients. The determination of specific antigens and immune complex of the cyst yielded a positive result in more than 90% of the patients. US was the most sensitive (in 90%) modality for the detection of membranes, septa, and hydatid sand within the cyst. Multivesicular cysts as well defined fluid collection in a honeycomb pattern with multiple septa representing the walls of the daughter cysts were observed in 11 patients. When daughter cysts were separated by the hydatid matrix, they demonstrated a"wheel spoke" pattern. The matrix represented hydatid fluid containing membranes of broken daughter vesicles, scolices, and hydatid sand.

DISCUSSION

Unilocular type I HEC is the most common (25–46%) of all types of HEC (Suwan, 1995). US and CT, the most important diagnostic tools, are helpful for determining the complications and planning treatment. Liver scanning was an important diagnostic tool in the 1970s. Since then, US and CT have replaced scanning and are considered the first choice in diagnostics. US is a noninvasive, readily available, sensitive, cost-effective imaging technique, helpful for defining the internal structure, number and location of cysts and the presence of complications. Ultrasonographic features and patterns of hydatid cysts of the liver have been defined by various authors (El-Tahir *et al.*, 1992, Sayek & Onat, 2001).The classification proposed by Gharbi *et al.* (1981) gives a morphologic description. Lewall and McCorkell proposed a classification of the cysts that reflects the pathology and natural history of the disease (Lewall & McCorkell, 1985). A proper description of the ultrasonographic findings is helpful during treatment as well. Cyst calcification usually occurs in the cyst wall. US demonstrates it as a hyperechoic contour with a cone-shaped acoustic shadow. In-

ternal calcification in the matrix may also be seen. Partial calcification of the cyst does not always indicated the death of the parasite; nevertheless, densely calcified cysts may be assumed to be inactive (Pedrosa *et al.*, 2000; Gulubova, 1998)

CT yields information equivalent with that derived by US for diagnosis of hydatid cyst of the liver. It gives better information about the location and the depth of the cyst in the liver. The presence of daughter and exogenous cysts can also be seen clearly on CT. The volume of the cyst can be estimated as well. CT is essential when planning surgical treatment, especially when the laparoscopic approach is to be used.

Detection of HEC represents no challenge for cross-sectional imaging, where the detection rate approaches (Sayek & Onat, 2001). These imaging techniques are highly sensitive but not specific for the diagnosis of type I unilocular HEC without awaiting the results of serological tests. Echogenic and movable intracystic hydatid sand was visualized by US and not by CT, while a thick cyst wall and pericyst calcification were demonstrated by CT and occasionally by US. Therefore the two techniques appear to be complementary. The hydatid sand is formed by brood capsules and free scolices – a sign, observed in the deep part of the cyst. However, this sign is believed to be of limited diagnostic significance since debris within an abscess or necrotic tumour could also produce a similar US appearance (Niron & Ozer, 1981). A simple hepatic cyst complicated by haemorrhage or infection can also contain internal echoes that may be indistinguishable from hydatid sand. Focal or segmental wall thickening is attributed to a localized detachment or separation of the endocyst membrane formed by the parasite from the pericyst constituted by fibrous liver tissue of the host, so-called „split wall sign" (Erdem *et al.,* 2004). Pericystic biliary radicles dilatation was secondary to the mass effect produced by large echinococcal cysts measuring greater than 12 cm in size. Similarly, large simple hepatic cysts may produce mass effect with pericystic biliary dilatation. It may also be due to rupture of HEC into the biliary tree which occurs in approximately 10% of cases, but this is more commonly seen with the hypermature type II-IV HEC and can lead to biliary obstruction caused by membranes and daughter cysts with resulting jaundice. The cyst size, shape, location and CT attenuation values appear to be non-specific signs for the diagnosis of HEC and are of no diagnostic value, since non-parasitic simple hepatic cysts may have similar CT features (Lewall & McCorkell, 1985; Gulubova, 1998). The immunodiagnostics with IHT, being less sensitive but more specific than the radiological diagnosis, was positive in 85–95% of patients with proven HEC. That corresponded to the literature data (Gharbi *et al.* (1981). Enzyme-linked immunoelectrotransfer blot and ELISA had a higher sensitivity and specificity than IHT, exceeding 95% (El-Tahir *et al.*, 1992; Babba *et al.*, 1994).

If no diagnosis has been established by cross-sectional imaging and immunological methods, a definitive diagnosis can be made before therapy with a needle aspiration of the cyst performed under imaging guidance (Pedrosa *et al.*, 2000).

In conclusion, when a unilocular hepatic cyst is identified by cross-sectional imaging, it is crucial to evaluate the cyst wall and content, and to look for extra hepatic cysts on both US and CT imaging which can help to differentiate a unilocular type I HEC from a simple hepatic cyst. The current treatment for hepatic echino-

coccal cyst depends on the experience of the surgeon and the interventional radiologist. CT may demonstrate additional small intrahepatic or unsuspected extrahepatic cysts. Hydatid disease primarily affects the liver and typically demonstrates well-known, characteristic imaging findings. However, there are many potential local complications, and secondary involvement due to haematogenous dissemination that may be seen in almost any anatomic location. Familiarity with atypical manifestations of hydatid disease may be helpful in making a prompt, accurate diagnosis.

REFERENCES

Babba, H, A. Messedi, S. Masmoudi, M. Zribi, R. Grillot, P. Ambriose-Thomas, I. Beyrouti & Y. Sahnoun, 1994. Diagnosis of human hydatidosis: Comparison between imagery and six serological techniques. *American Journal of Tropical Medicine and Hygiene*, **50**, 64–68.

El-Tahir, M. I., M. F. Omojola, T. Malatani, A. H. Al-Saigh & O. A. Ogunbiyi, 1992. Hydatid disease in liver: Evaluation of ultrasound and computed tomography. *British Journal of Radiology,* **65**, 390–392.

Erdem, L. O., C. Z. Erdem, K. Karlioguz & C. Uner, 2004. Radiological aspects of abdominal hydatidosis in children: A study of 31 cases in Turkey. *Clinical Imaging*, No 3, 196–200.

Gharbi, H. A., W. Hassine, M. W. Brauner & K. Dupuch, 1981. Ultrasound examination of the hydatic liver. *Radiology*, **139**, 459–463.

Gulubova, M., 1998. Intracellular adhesion molecule-I (ICAM-I) expression in the liver of the patients with extrahepatic cholestasis. *Acta Histochemica*, **100**, 59–74.

Lewall, D. B. & S. J. McCorkell, 1985. Hepatic echinococcal cysts: Sonographic appearance and classification. *Radiology*, **155**, 773–775.

Niron, E. A. & H. Ozer, 1981. Ultrasound appearances of liver hydatid disease. *British Journal of Radiology*, **54**, 335.

Pedrosa, I., A. Saiz, J. Arrazola, J. Ferreirós, & C. S. Pedrosa**,** 2000. Hydatid disease: Radiological and pathologic features and complications. *Radiographics*, **20**, 795–817.

Sayek, L. & D. Onat, 2001. Diagnosis and treatment of uncomplicated hydatid cyst of the liver. *World Journal of Surgery*, **1**, 21–28.

Suwan, Z., 1995. Sonographic findings in hydatid disease in the liver: Comparison with other imaging methods. *Annals of Tropical Medicine and Parasitology*, **89**, 261–269.

Paper received 21.12.2005; accepted for publication 27.02.2007

Correspondence:

Dr Kr. Kalinova
Department of General and Pediatric Surgery,
University Hospital,
Trakia University,
18 Armeiska str.
6003 Stara Zagora, Bulgaria
E-mail: krasimirakalinova@abv.bg