

Not-to-tap cystic lesions: spectrum of hydatid disease

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Abstract Hydatid disease (HD) may occur almost anywhere in the body. Despite their characteristic radiologic manifestations at times, they may enlarge and produce bizarre imaging features which make diagnosis challenging, particularly for those radiologists working in areas of low incidence. Plain radiography, ultrasonography, computed tomography, and magnetic resonance imaging may demonstrate some of the typical imaging manifestations of HD as well as its exact extension. On the other hand, particular caution is required before any kind of interventions to be done in that biopsy or aspiration of such lesions may cause devastating consequences, in particular anaphylactic shock. Hence, being familiar with various radiologic features of HD is essential in improving diagnostic accuracy and also preventing adverse reactions in these patients. The purpose of this pictorial review is to illustrate the different radiological features of HD in various organs.

Keywords Hydatid disease · Radiography · Ultrasonography · Computed tomography · Magnetic resonance imaging

Introduction

Hydatid disease (HD) caused by *Echinococcus granulosus* is endemic in some parts of the world including the Middle East,

South America, the Mediterranean region, Africa, and Australia [1]. In addition, given the reality of the modern world, with people freely moving about globally, this disease is much more prevalent everywhere. Furthermore, some diagnostic interventions, e.g., percutaneous needle biopsy, may result in catastrophic complications like anaphylactic shock in HD [2]. As a result, knowledge of various imaging manifestations of HD is imperative to all radiologists and clinical physicians.

Images in this pictorial essay were gathered from patients with proved HD referred to the department of radiology in four university hospitals from February 2008 to December 2012. We reviewed all kinds of available radiological images including plain radiographs, ultrasonographic, computed tomography (CT), and magnetic resonance imaging (MRI) files and omitted those illustrating repeated sites or types of involvement. Images with proper quality were selected to exhibit not only the different types of hydatid cyst in the liver but also the many faces of HD in other usual and unusual sites.

General radiologic features

The wall of the hydatid cyst is composed of three layers. The outermost layer is called the pericyst, the middle layer is the laminated ectocyst, and the innermost layer (endocyst) consists of the germinal epithelium [3, 4]. Various imaging manifestations of HD depend on their host reaction and include fluid-filled cyst, cystic lesion with undulating free-floating membrane resulting from detachment of the endocyst, cystic mass containing daughter cysts, and purely calcified lesion. Floating membrane and daughter cysts, when present, are pathognomonic for HD. However, complications of the HD as well as involvement of rare locations may produce a wide range of imaging features [5].

Moreover, numerous infective, congenital, and neoplastic lesions with different corresponding treatments are included in the differential diagnoses of HD.

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Fig. 1 A 15-year-old boy with epigastric pain. Contrast-enhanced CT shows two unenhanced hypoattenuating lesions in the liver; one of them appears as a simple cyst (*solid arrow*) without internal septa (type I HD), and the other one contains a serpentine free-floating membrane (*open arrow*), representing the detached germinal layer (type II HD)

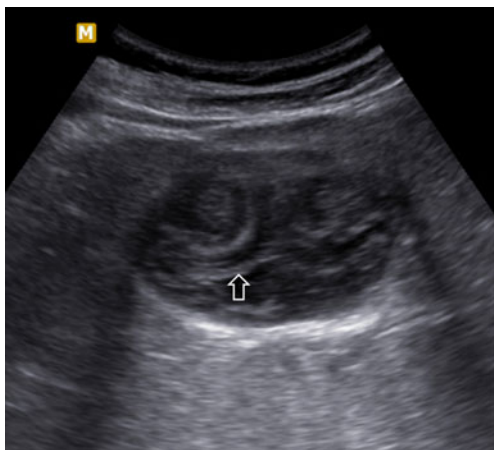


Fig. 2 A 42-year-old man with history of liver HD. Transverse ultrasound image of the liver demonstrates serpentine, closely folded membranes (*arrow*) within a mixed echogenic oval lesion, representing liver hydatid cyst with congealed water lily sign (type II HD)



Fig. 3 A 42-year-old man with abdominal pain. Longitudinal ultrasound exam of the liver reveals multiple anechoic lesions with posterior acoustic enhancement in porta hepatis, indicating the daughter cysts caused by type II HD

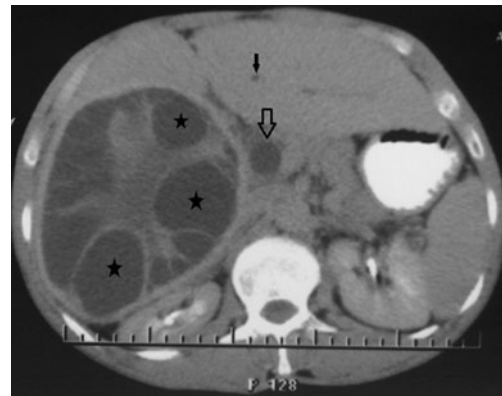


Fig. 4 A 33-year-old woman with jaundice and abdominal pain. Contrast-enhanced CT demonstrates unenhanced, well-defined hypodense lesion with peripheral daughter cysts (*stars*), producing the characteristic "spoke wheel appearance". Notice that the attenuation of daughter cysts is lower than that of the mother cyst. The intrahepatic bile ducts (*small black arrow*) and common bile duct (*large open arrow*) are dilated due to rupture of the hydatid cyst into the biliary system. The mentioned findings are consistent with progression of type II to type IV hydatid cyst

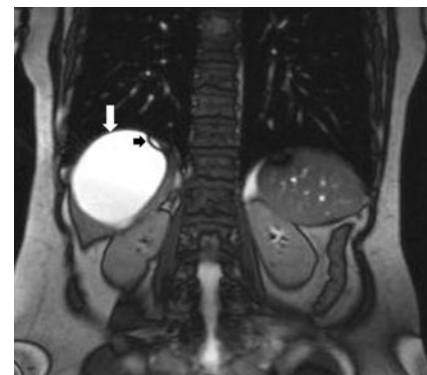


Fig. 5 A 38-year-old woman with right upper quadrant pain. Coronal gradient-echo T2-weighted image reveals a large hypersignal lesion (*large white arrow*), occupying almost the entire right lobe of the liver. Notice the detachment of the endocyst layer (*small black arrow*) in upper-medial part of the mass (type II HD)

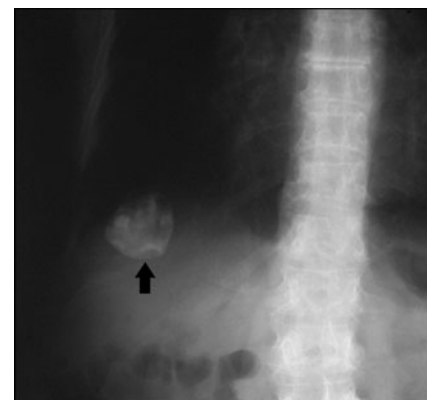


Fig. 6 A 55-year-old woman with history of liver HD. Plain radiograph shows a well-circumscribed, calcified round mass (*arrow*) in the liver, representing type III HD



Fig. 7 A 42-year-old man with history of hepatic HD and fever. Delayed phase contrast-enhanced CT demonstrates a non-enhanced, round liver lesion (*black solid arrow*) with air-fluid level (*open arrow*). Infected hydatid cyst is regarded as type IV HD

Different types of HD

Four types of HD have been described [1]; type I is the initial lesion and is made of a unilocular simple cyst (Fig. 1). On ultrasound exam, it appears as an anechoic simple cyst. CT reveals a cyst with fluid attenuation, while MRI shows a well-defined cyst with low and high signal intensity on T1- and T2-weighted images, respectively. The surrounding rim of low signal intensity on T2-weighted images may be seen accompanied by enhancement of the cyst wall on post-contrast images.

Type II lesion contains matrix and/or daughter cysts or internal detached floating membranes. “Water lily sign”, when present, results from the detachment of the germinal layer and produces a cystic mass with internal undulating free-floating membrane. On ultrasound exam, it appears as

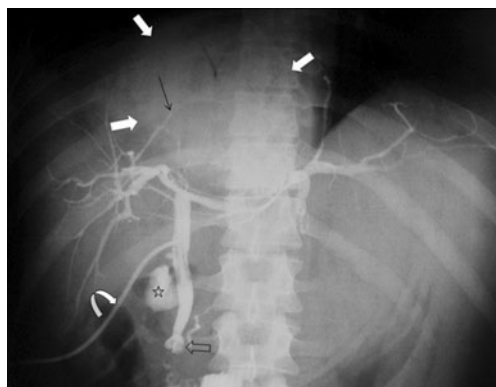


Fig. 8 A 33-year-old man with history of hepatic HD and open surgery presenting with jaundice and abdominal pain. T-tube cholangiogram shows hydatid daughter cysts as multiple filling defects (*wide open arrow*) in the most distal part of common bile duct. The large partially opaque round hepatic lesion (*white solid arrows*) with compression effect on adjacent biliary system was further found to be bile accumulation due to iatrogenic rupture of one of the right intrahepatic bile ducts (*narrow black arrow*). Also noted is the presence of biloma (*star*) near the insertion site of the T-tube (*white curve arrow*)



Fig. 9 A 70-year-old woman with history of HD and right upper quadrant pain. Post-contrast CT shows thick wall hyperattenuating gallbladder (*arrows*) adjacent to hydatid cyst (*star*) of right hepatic lobe. The initial radiologic diagnosis was cholecystitis or gallbladder carcinoma. However, fistulous communication between the gallbladder and the hydatid cyst and intraluminal hydatid cysts within the gallbladder were found in open surgery

internal echogenic linear membrane (Fig. 2). Multiple anechoic cysts with or without adjacent echogenic matrix may also be detected (Fig. 3). On CT, when the daughter cysts are arranged in the peripheral portion of the mother cyst, they produce the characteristic “spoke wheel” appearance (Fig. 4). The attenuation of the daughter cysts is lower than that of the mother cyst. Detached membranes may also be appreciated as internal serpentine densities (Fig. 1). On MRI, the daughter cysts are shown to have fluid signal intensity, whereas internal floating membrane has low signal intensity on both T1- and T2-weighted images (Fig. 5).

Type III HD appears as calcified cyst, most likely representing dead parasites. At ultrasonography, calcification is seen as an echogenic area with strong and clean posterior shadow. On CT, a well-defined high-attenuation

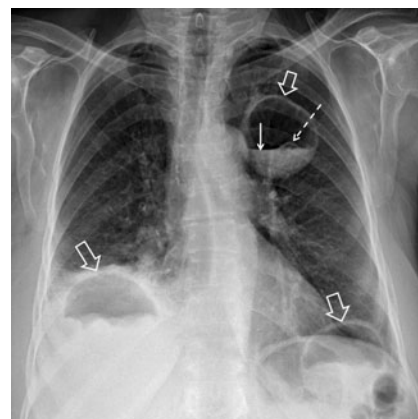


Fig. 10 A 42-year-old woman with lung HD. Chest radiograph reveals three pulmonary masses (*open arrows*) with water lily appearance, one of them containing both air-fluid level (*narrow solid arrow*) and undulating free-floating membrane (*dashed solid arrow*)

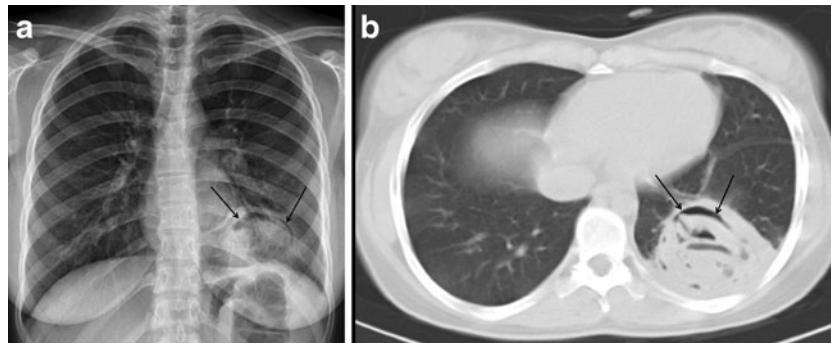


Fig. 11 A 31-year-old woman complaining of dyspnea. **a** Chest-x-ray reveals a well-defined round lesion in the inferior part of the left lung. A radiolucent band covers the lesion in its upper part, representing the

crescent sign (*arrows*). **b** Chest CT shows introduction of air between the internal membranes of hydatid cyst, producing the so-called crescent sign in the upper portion of the lesion (*arrows*)

lesion is detected (Fig. 6), while MRI shows an area of low signal or signal void on both T1- and T2-weighted images, corresponding to the presence of calcification.

Complicated hydatid cysts, classified as type IV lesions, include superimposition of infection (Fig. 7) and rupture into the biliary tree (Figs. 4 and 8) or the gallbladder (Fig. 9), and it may occur in both type II (Fig. 4) and type III lesions [6–9].

Liver

The incidence of hepatic involvement has been reported to be 74 % [1]. Most cysts are located in the right lobe. As mentioned earlier, imaging features parallel the stage of cyst growth (Figs. 1, 2, 3, 4, 5, 6, 7, 8, and 9). It has been postulated that bile duct dilatation may result from rupture of the internal contents of a hydatid cyst into the biliary tree or compression of the adjacent biliary system. A ruptured cyst may become infected, resulting in liver abscess (Fig. 7). Presence of air or air-fluid level may indicate, albeit not certainly, superimposition of infection [10].

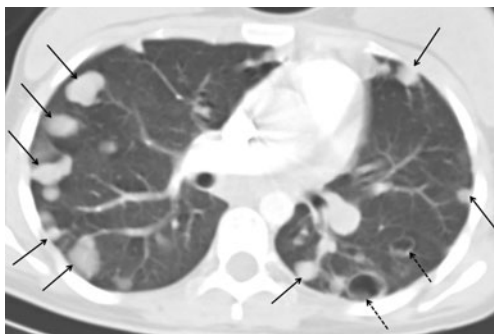


Fig. 12 A 35-year-old woman with known history of hepatic HD and dyspnea. Chest CT reveals multiple lesions in the peripheral parts of both lungs (*black arrows*), in keeping with pulmonary embolism of hydatid cysts. Notice that the most distal part of pulmonary vessels will reach some of them and two hydatid cysts are cavitated (*dashed arrows*)

Lung

Lung is the second most common site of involvement in adults (24 %) and the most common location of involvement in children [1]. Plain radiograph may show a well-defined, round opacity with or without air-fluid level (Fig. 10). A crescent sign in lung HD is indicative of separation of the membranes induced by dissection of air into the lesion (Fig. 11). After entrance of air within the cyst, the floating membrane in the dependent portion of the cyst may produce a “water lily” appearance (Fig. 10). In contrast to hepatic involvement, calcification and daughter cysts occur very rarely. Lung HD may become complicated by rupture into the pleural or pericardial spaces or into pulmonary arteries (pulmonary embolism) (Fig. 12) [11–13].

Peritoneum

Peritoneal involvement occurs in 3.8 % of the cases. It is almost always induced by intraperitoneal rupture owing to

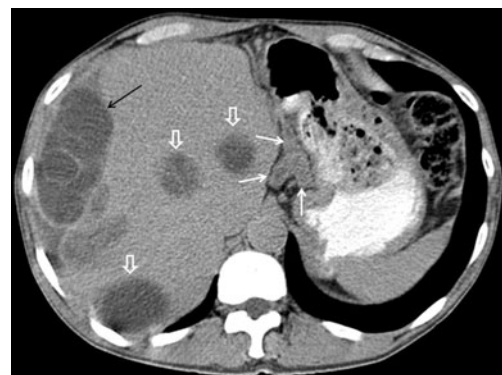


Fig. 13 A 58-year-old man with epigastric pain. Contrast-enhanced CT shows multiple intrahepatic (*white open arrows*) and intraperitoneal (*black arrow*) hydatid cysts accompanied by involvement of the lesser omentum (*white narrow arrows*)

Fig. 14 A 21-year-old female with history of liver HD and blunt abdominal trauma. **a** Coronal-reformatted CT scan depicts multiple hydatid cysts with daughter cysts, scattered throughout the abdomen, involving the right kidney (*open arrow*), spleen (*solid arrow*), and intraperitoneal area (*stars*). The daughter cysts have typically lower attenuation than the mother cysts. **b** Sagittal CT image shows the extension of disseminated intraperitoneal HD. The liver, intraperitoneal, and pelvic cavities are involved

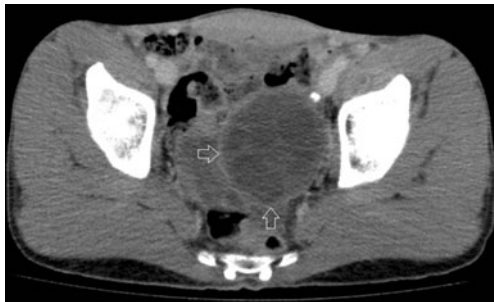
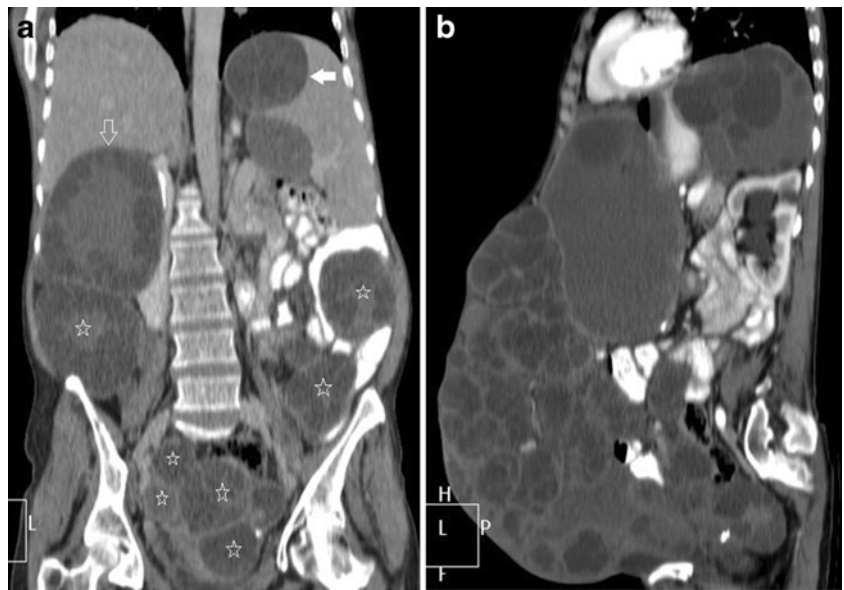


Fig. 15 A 46-year-old woman with suspicious adnexal mass and concurrent hepatic and splenic HD. Contrast-enhanced CT shows a cystic pelvic mass (*arrows*) with mild enhancement of the cyst wall and internal septa



Fig. 16 A 46-year-old man with previous history of HD and painful defecation. Ultrasound examination of the pelvis reveals a mass posterior to urinary bladder (*star*), containing multiple daughter cysts (*arrowheads*). Detached free-floating membranes (*arrows*) are also evident within the echogenic hydatid cyst

abdominal surgery, percutaneous intervention, or trauma in patients with previous hepatic HD (Figs. 13, 14, 15, and 16) [14].

Kidney

The prevalence of renal involvement is reported to be 3.8 %. It is usually seen in the cortex of the upper or lower pole of the kidney. Like other parts of the body, renal HD may have



Fig. 17 A 29-year-old female with primary HD of the right kidney. Coronal fat-suppressed T1-weighted MRI, after intravenous administration of contrast agent, demonstrates a multilocular renal lesion (*arrows*), implying renal HD with multiple daughter cysts. Enhancement of the wall and internal septa of the renal HD is detected

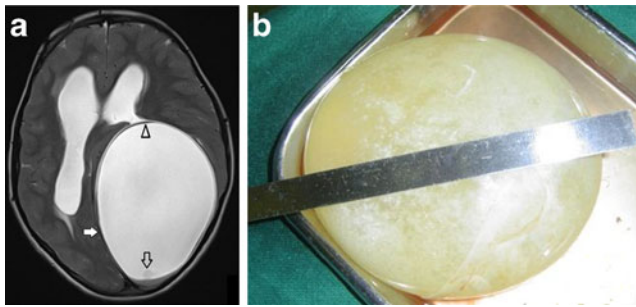


Fig. 18 A 12-year-old boy with headache. **a** Axial T2-weighted MRI reveals a large unilocular hyperintense mass (*white solid arrow*) in the left parieto-occipital lobe. A peripheral rim of hypointensity (*arrowhead*) surrounds the lesion. Also noted is tiny hydatid sand (*open arrow*) in the most dependent portion of the mass. **b** A large hydatid cyst measuring 11 cm, in its diameter, was surgically removed in toto

an appearance ranging from a simple cyst to a completely solid one. Isolated form of the renal HD is very rare (Fig. 17); thus, concurrent involvement of the kidney and liver may lead to establishing a correct diagnosis [15].

Brain

Cerebral HD occurs in 2 % of all cases of hydatid infestation, mostly located in the territory of the middle cerebral artery. The most common presentation is a homogeneous, well-demarcated unilocular (Fig. 18) or multilocular cyst (Fig. 19),

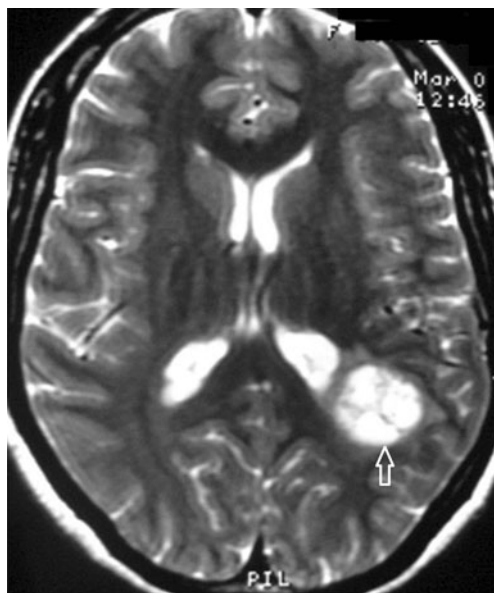


Fig. 19 A 25-year-old female with headache and seizure. Axial T2-weighted MRI shows a multilocular cystic lesion (*arrow*) adjacent to trigone of the left lateral ventricle, which is iso-signal with cerebrospinal fluid

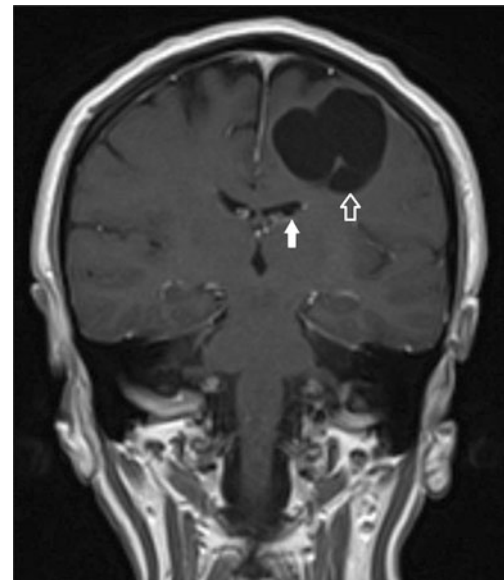


Fig. 20 A 22-year-old female with brain HD. Coronal post-contrast T1-weighted image demonstrates a non-enhanced multilocular cystic lesion (*open arrow*) in the left frontal lobe. Compression effect on the frontal horn of the ipsilateral lateral ventricle (*white solid arrow*) is observed. No peripheral edema is detected around the lesion

with a density or intensity similar to that of the cerebrospinal fluid (CSF) on CT and MRI images, respectively. Peripheral edema and ring enhancement are rare (Fig. 20), unless infection superimposes [16].

Heart and pericardium

Heart and pericardial HD are very rare (0.02–2 %) (Figs. 21 and 22), and these may cause deformation of the lung borders in case of pericardial involvement [17].

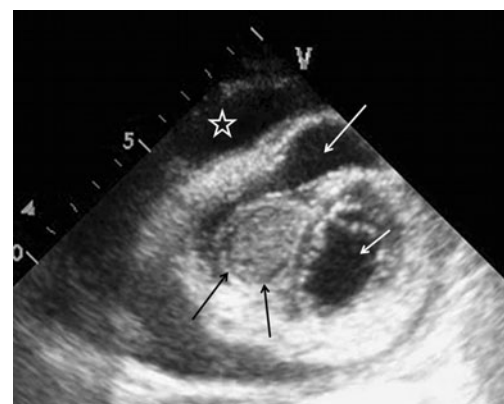


Fig. 21 A 7-year-old girl with history of hepatic HD. Short-axis echocardiography reveals an oval hyperechoic lesion (*black arrows*) in the right ventricle (*long white arrow*) adherent to the interventricular septum. Also depicted are the left ventricle (*short white arrow*) and pericardial effusion (*star*)

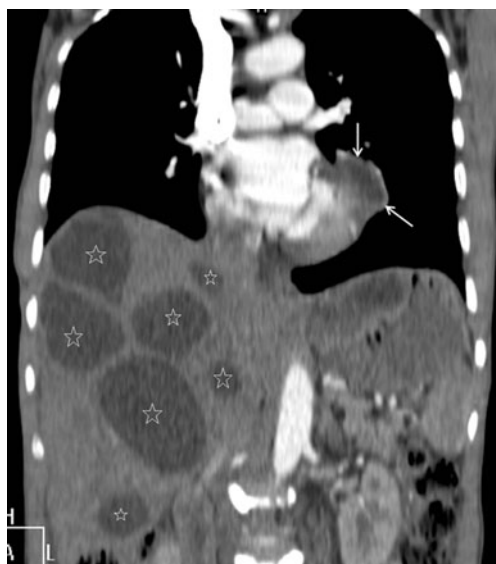


Fig. 22 A 31-year-old man with history of HD. Post-contrast coronal-reformatted CT demonstrates a pericardial hydatid cyst (arrows) accompanied by multiple hepatic cysts (stars). Multiple pulmonary hydatid cysts were also present (not shown)

Spleen

Splenic HD is relatively rare (0.9–8 %). It usually occurs due to intraperitoneal spread from rupture of hepatic HD or systemic dissemination, and its radiologic manifestation is nonspecific (Figs. 14a, 23, and 24) [18].

Pancreas

Primary involvement of the pancreas is extremely rare, accounting for 0.25 % of all HD cases. It usually appears as a

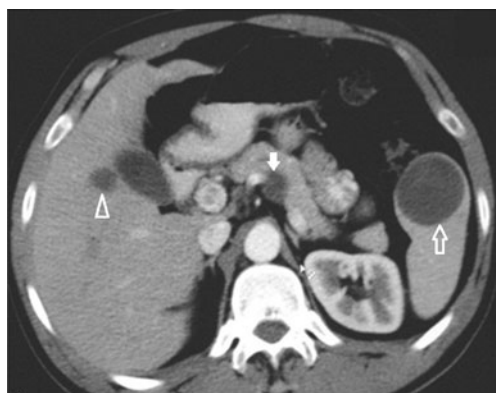


Fig. 23 A 60-year-old woman with abdominal pain and history of HD. Contrast-enhanced CT shows hydatid cysts within the anterior part of the spleen (open arrow) and the liver (arrowhead). Retroperitoneal involvement is also detected at the posterior aspect of the pancreas (white solid arrow)



Fig. 24 A 40-year-old woman with epigastric pain following laparotomy. Contrast-enhanced CT reveals a unilocular mass with fluid attenuation in the pancreatic tail (open arrow). Hydatid cyst is also vaguely detected within the spleen (white solid arrow). Mesenteric infiltration is present throughout the abdomen

solitary cyst in the head of the pancreas [19]; thus, it might be easily misdiagnosed as pancreatic pseudocyst (Fig. 24).

Bone

Bone HD is also rare (0.5–2 %), mostly occurring in the spine (Fig. 25). Vertebral body involvement may occur possibly via the portovertebral venous shunts. Lack of either osteoporosis or sclerosis and absence of damage to the intervertebral disk spaces are helpful in distinguishing HD from spinal tuberculosis [16, 20, 21].

Spinal cord

The prevalence of spinal cord involvement is reported to be less than 1 %. Spinal hydatid cysts may be located in intramedullary, intradural–extramedullary, or extradural spaces. It usually appears as multiple cysts with intensity or density of CSF. Neither enhancement nor wall calcification is appreciated in spinal cord HD (Fig. 26) [16].

Other rare sites

Lesser omentum (Fig. 13), retroperitoneum (Fig. 23), and muscles (Fig. 27) [22] are among other rare sites of involvement in HD.

Conclusion

Familiarity with the many faces of HD in different parts of the body and especially with some of its characteristic features,

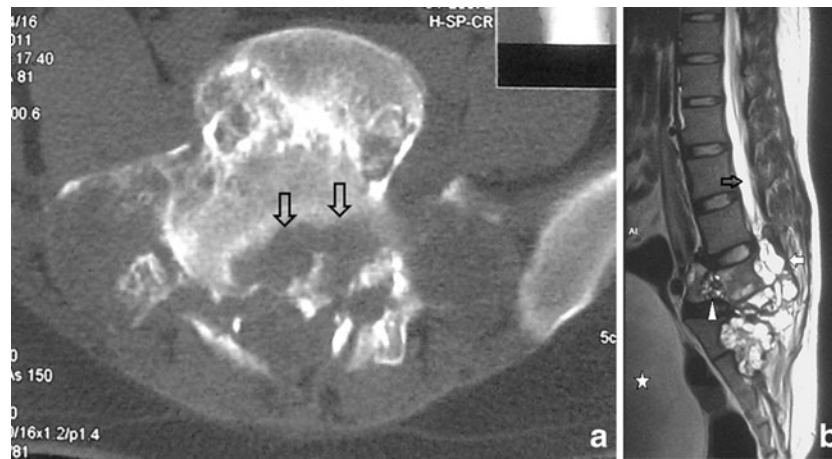


Fig. 25 A 26-year-old man with low back pain. **a** Axial CT, at the level of the sacrum, shows destructive lytic lesions (*arrows*) caused by hydatid cyst. **b** Sagittal T2-weighted MRI reveals multiple destructive cystic lesions at L-5 and sacrum, causing vertebral fracture (*arrow-head*)

head). Extension of hydatid cysts within the spinal canal (*white solid arrow*) is clearly depicted, accompanied by atonic severely distended neurogenic urinary bladder (*star*). The intensity of the mass (*white solid arrow*) is similar to that of the cerebrospinal fluid (*open arrow*)

e.g., floating membrane and daughter cysts, helps in differentiating it from other cystic lesions throughout the body and contributes to prevent or mitigate adverse reactions especially in patients affected in the regions with high prevalence of HD.



Fig. 26 A 34-year-old man with back pain. Sagittal fat-suppressed T1-weighted image after injection of intravenous contrast agent demonstrates three extradural extramedullary cystic lesions (*arrows*). No enhancement is detected within the hydatid cysts of the spinal canal



Fig. 27 A 23-year-old man with back pain and history of HD. Axial CT shows a well-circumscribed cystic lesion in longissimus thoracis muscle (*long white arrow*) as well as a round cystic lesion in the liver (*short white arrow*). The latter contains a focus of calcification in its wall (*dashed arrow*). The right kidney of the patient was also involved with HD (not shown)

Conflict of interest The authors declare that they have no conflict of interest.

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