Imaging findings in complicated hydatid disease

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Learning objectives

The aim of this paper is to review the imaging findings in hydatid disease focusing on the complications of it; using cases seen in our hospital with hydatidosis complicated.
Background

The hydatidic disease is a zoonosis produced by the larval stage of the tapeworm Echinococcus granulosus. There are other types of hydatid disease caused by E multilocularis, E. vogeli and E. Oligarthus but these are much less frequent.

It is a worldwide disease. It’s considered an endemic disease in regions such as the Mediterranean countries, Africa, South America, Australia and New Zealand. Mainly affects rural areas.

Spain is one of the countries where the disease is endemic, although the incidence of hydatid disease has decreased in recent years is still of the highest in the EU, which means that the disease is far from being eradicated.

The life cycle of E granulosus requires two hosts to complete. The definitive host is usually the dog but can be any other carnivore. The adult tapeworm lives in them without causing damage. The most common intermediate host is usually the sheep. It eats grass contaminated with feces of parasitized dogs. When the definitive host eats the viscera of the intermediate host is complete cycle.

Humans become intermediate hosts by contact with the definitive host usually the domestic dog or indirectly by ingestion of water or vegetables contaminated with feces from said host, parasitized dogs or wild canids.

Once Liver acts as the first line of defense once the parasite passes through the intestinal wall into the portal circulation or lymphatic system. This is the reason explains the liver is the organ most frequently affected.

The growth of hydatid cysts is usually slow and asymptomatic, and clinical manifestations are caused by compression of the involved organs. The disease may mimic benign or malignant primary tumors, single or multiple metastases, cysts, abscesses, empyema, infarcts and other lesions (3). Once in the human liver, cysts grow to 1cm during the first 6 months and 2-3cm annually thereafter, depending on host tissue resistance(1).

The hydatid cyst has three layers:

1. The outer: Pericyst, composed of modified host cells (fibroblasts, giant cells, eosinophils, ...) which form a dense protective layer, is the host response to parasite.
2. - Middle layer: Membrane laminated (ectocyst) is a thin acellular layer of about 2 mm. thickness and permits the passage of nutrients.

3. - The inner layer: Germinal layer, producing the scolices (the larval stage of the parasite) and the laminated membrane.

The middle and inner layers form true cyst wall, called endocyst. The cyst is filled with a clear liquid, which contains sodium chloride, protein, glucose, ions, lipids and polysaccharides. It may also contain scolices or parts of them (hooklets). This fluid is antigenic and if the cyst ruptures into circulation this can cause anaphylactic reactions. When the vesicles rupture within the cyst, scolices pass the cyst fluid forming hydatid sand. The thickness of each layer depends on the tissue cyst which rests for example in the liver tends to be thicker than in muscle.

The diagnosis of hydatid disease is usually based on identification of a cystic image by imaging and detection of specific antibodies against the parasite by immunological tests. But the negativity of serological not rule out the presence of a hydatid cyst.

Imaging tests used for diagnosis are: Chest radiography, ultrasonography (US), computed tomography (CT), magnetic resonance imaging (MR), and even urography. The imaging method used will depend on the organ affected and the cyst stage.

Radiology and serology can usually establish the diagnosis but an unusual location or some atypical imaging findings may complicate the differential diagnosis. Familiarity with atypical manifestations of hydatid disease can help make an early and accurate diagnosis.
Imaging findings OR Procedure details

In human, hydatid disease involves the liver in approximately 75% of cases, the lung in 15% and other anatomic locations in 10% (1). The right lobe in the most frequently involved part of the liver. Imaging findings in hepatic hydatid disease depend on the stage of the cyst growth:

1. - **PLAIN RADIOGRAPHY**:

Calcification is seen at radiography in 20-30% (Fig. 2a) of hydatid cysts and usually manifests with a curvilinear or ringlike (Fig. 3a) pattern representing calcification of the pericyst (1). During the natural evolution toward healing, calcification of all components of cyst occurs (calcification much more coarse and dense)(Fig. 4a). Therefore, calcification of pericyst does not indicate necessarily parasite death. Only when the calcification occurs completely, tapeworm is death.

2. - **ULTRASOUND**

The appearance of hydatid cysts in ultrasound may vary. Several classifications have been proposed based on the appearance of cysts, some of the most used are: Classification of hydatid cyst Gharbi in 1981 or WHO classification hydatid cyst lesions, 2003 (World Health Classification Onganization Informal Working Group, WHO/ IWG).

In the early stages hydatid cyst may appear on imaging tests as a simple cyst or cystic lesion, usually unilocular anechoic content, wall uniform and clearly visible, most under 5cm(Fig. 6a, 6d). In these early stages of development this cyst is not yet fertile (contains no scolex) but its status is active. There aren't any pathognomonic data in US to distinguish it from other cystic lesions.

In later stages, the wall of the cyst is usually visible as a double echogenic layer separated by a strip hypoechoic. Simple cyst shows no internal structure, but can display multiple echogenic foci due to hydatid sand ("snow flake sign" ). It can be more evidentiif the patient is repostioned the ultrasound examination; moving most dependent area of the cyst ("snowstorm sign").

Detachment of the endocyst from the pericyst is probably related to decreased intracystic pressure, degeneration, host response, trauma or response to therapy (1).The cyst appears as a collection of well defined walls and membranes with multiple floating septa inside or multisepatate multivesicular injury(Fig. 5a, 5b).
Later when the separation of the membranes within the cyst is complete, the cyst has a content anechoic with laminar membranes that are floating within the cyst ("water lily sign"). Ultrasound is the most sensitive test for the detection of membranes, septa, and hydatid sand within the cyst.

Multivesicular cysts appears as a collection in a honeycomb pattern (Fig. 10a) with multiple septa which correspond to the walls of the daughter cyst. Daughter cysts appear as cysts within a cyst. When daughter cyst are separated from hydatid matrix (mixed echogenicity) they demonstrate a "wheel spoke" pattern (Fig. 7a). The matrix represents hydatid fluid containing membranes of broken daughter vesicles, scolices, and hydatid sand. Membranes may appear within the matrix as snaking lines, a finding that is highly specific for hydatid disease.

When the matrix completely fills the cyst has a mixed echogenicity appearance that simulates a solid mass (Fig. 8b). Since the differentiation of this lesion from other masses or liver abscesses can be difficult, it is important to find the daughter vesicles or membranes within the lesion which can help us to make a correct diagnosis.

Calcification of the cyst usually occurs in the cyst wall (Fig. 1a), although internal calcifications may also be seen. US shows a hyperechoic contour with a cone-shaped acoustic shadow. When the cyst wall is calcified (Fig. 2b), in US is visible only the anterior portion thereof, and appears as a thick arc with a posterior concavity. The partial calcification does not always indicate the death of the parasite (Fig. 4 b), but cysts with dense calcification of all components can be assumed to be inactive.

3. - COMPUTED TOMOGRAPHY

CT is indicated in cases where US fails due to patient-related difficulties (obesity, excessive intestinal gas, abdominal wall deformities, previous surgery) or complicated disease. CT has a high sensitivity and specificity for hepatic hydatid disease. The administration of intravenous contrast is not necessary unless complications are suspected.

CT may display the same findings as US (1). Cyst fluid demonstrates water attenuation (Fig. 4c). Calcification of the cyst wall or internal septa is easily detected on CT (Fig. 1b). A typical hydatid cyst wall shows a high attenuation at unenhanced CT even without calcifications. There is no clear explanation for this finding, which can also be found in patients with increased attenuation of the liver as hemochromatosis, drugs such as amiodarone or when administering intravenous contrast. Detachment of the laminated membrane from the pericyst can be viewed as linear areas of increased attenuation.
within the cyst. Daughter cysts structures are displayed as peripherally located attached to mother cyst.

4. - **MAGNETIC RESONANCE**

Hepatic hydatid cysts may have a low-signal-intensity rim on T2-weighted MR images (Fig. 10b). This finding has been proposed as a characteristic sign of hidatid disease and probably represents pericyst which is rich in collagen and is generated by the host(1). However, this finding is not specific to hydatidosis and also described in amoebic abscesses, hematomas and hepatocellular carcinoma.

When presents, daughter cysts are seen as cystic structures attached to the germinal layer that are hypointense relative to intracystic fluid on T1-weighted sequences and hyperintense on T2-weighted images(Fig 10b). Collapsed parasitic membranes appear in MR as a twisted linear structure within the cyst.

However, calcifications are detected more clearly in the CT; MR is proving superior in demonstrating irregularities of the rim, which probably represent as incipient detachment of the membranes(Fig.11b).

**COMPLICATIONS OF HYDATID DISEASE.**

A. - **LOCAL COMPLICATIONS.**

A.1. - **INTRAHEPATIC COMPLICATIONS.**

Include cyst rupture and infection(Fig. 5, 7, 8)

Although *rupture* may be related to minor trauma, the natural history of hepatic cyst implies rupture as a complication in 50-90% of cases (1). Passage of the cyst content into the host’s blood circulation can produce asaphylaxia due to the antigenic nature of the cyst fluid, although cyst rupture may be clinically asymptomatic.

Have been described in the literature three different types of cyst rupture:

- Contained: Occur when endocyst breaks but pericyst remains intact. It can be displayed as a membrane floating within the cyst. May be related to trauma, treatment response or cyst degeneration as part of the natural history of the same.
• Communicating: Implies passage of cyst contents into the biliary radicles that have been incorporated into the pericyst (Fig. 5, 7).
• Direct: Occurs when both pericyst and endocyst rupture, allowing the spill hydatid material into the peritoneal cavity, pleural cavity, viscera or abdominal wall. Direct rupture is more frequent in lesions located near the edges liver, where there is less protection due to a cyst with a layer pericystic poor or poor response of host tissues to offer support.

In communicating and direct rupture the cyst is drained and can become smaller and less spherical.

Both US and CT can demonstrate a defect in the wall of the cyst (Fig. 5d) and the contents thereof step through the defect, especially in direct rupture. In the MR images can be shown in an interrupt signal of low edge intensity of the cyst wall and an extrusion through the defect content.

**Infection** occurs only after rupture of both the pericyst and endocyst (direct and communicating rupture), which allows bacteria to pass easily into the cyst (5-8% of cases) (1). Under normal conditions laminated layer is impermeable and prevents the passage of bacteria. On clinical examination appears as a liver abscess.

US and CT findings are similar to those found in other hepatic abscesses (Fig. 7). US findings are not specific. Although the lesions usually show poorly defined margins, can also be well defined. The findings that suggest infection include a solid lesion appearance of a pattern produced by mixed solid and liquid components, echogenic foci inside and air or fluid levels within the cyst. CT is the test of choice to confirm a cyst complicated by infection. Infected cyst usually manifests on CT as a mass with poorly-defined margins, unlike the well-defined masses displayed in uncomplicated cases. If administered intravenous contrast may appear a typical hyperdense halo around the abscess. Sometimes, can be seen patchy areas in the surrounding parenchyma of injury in connection with inflammatory changes. As in the ultrasound on CT can be seen solid or mixed pattern appearance (solid and cystic components). Addition in TC can be seen more clearly the existence of air and fluid levels within the cyst (Fig. 7a, 7d).

**A.2. - EXOPHYTIC GROWTH.**

Cyst growth beyond limits the liver. Anatomical structures such as the liver capsule, ligaments or peritoneum can be used by hydatid cysts to grow beyond the boundaries of the liver. The two most common routes are to the diaphragm and chest from the bare area of the liver and into the stomach through gastrohepatic ligament.
A.3. - TRANSDIAPHRAGMATIC CHEST INVOLVEMENT:

Involvement of the diaphragm and thoracic cavity occurs in 0.6 to 16% cases of hepatid hydatid disease (2), with a mortality that varies in different cases from 5.6 to 43.7% (1).

Transdiaphragmatic migration (Fig. 9) usually occurs from cyst located in the posterior segments of the right lobe and has been linked to its proximity to the diaphragm. The bare area of the liver is the most common route of migration transthoracic, and is described as a potential pathway for the migration of hepatic abscesses, mainly because that naked areas lacking peritoneum offers little resistance exophytic cyst growth. The used of other pathways is much less common.

Transdiaphragmatic migration can vary from a simple adhesion to the diaphragm to rupture into the pleural cavity, seeding in the pulmonary parenchyma and chronic bronchial fistulae.

Chest radiograph may show pleural effusion (Fig. 9a), elevation of the hemidiaphragm, lung consolidation or laminated atelectasis at the lung base. Occasionally, an hourglass-shaped lesion or loculated pleural effusion similar to an empyema can be seen in the posterior thorax on the lateral projection (1).

US can help confirm the presence of hepatic hydatid disease and demonstrate pleural effusion (Fig. 9b, 9c) although rarely diaphragmatic defect is described with this imaging technique.

CT is useful in demonstrating transdiaphragmatic migration of hydatid disease and evaluate intrathoracic components (Fig. 9d).

MR in coronal and sagittal planes is also very valuable to demonstrate the migration through the diaphragm. MR images allows accurate presurgical diagnosis based on various degrees of transdiaphragmatic migration and thus proved useful in surgical planning.

A.4. - PERFORATION INTO HOLLOW VISCERA:

Spontaneous rupture of the cyst into hollow viscera is an extremely rare complication with an estimated frequency of 0.5% (1). This complication may be associated with clinical symptoms such as hydatidiemesis or hydatidorrhea. Usually, communication is not discovered until the surgery, but in some cases can be found at radiology (Fig. 5, 7).
CT can demonstrate the existence of a cyst with a fluid level, finding the oral contrast administered to the patient within the cyst cavity. In some cases, the performance of the TC with the patient in the lateral position right or left can help demonstrate in filling or emptying the cyst cavity.

Barium-enhanced CT can be used to demonstrate the fistula between the cyst and the hollow viscera.

**A.5. - PERITONEAL SEEDING:**

Peritoneal hydatidosis is almost always secondary to hepatic disease, however, have been reported rare cases of primary peritoneal involvement. The overall frequency of peritoneal disease in case of echinococcosis involving the abdomen is approximately 13% (1). Most of these cases are related to previous surgery of liver disease, although spontaneous asymptomatic microruptures of hepatic cysts into the peritoneal cavity are not uncommon, 12% (1).

CT is the modality of choice because it allows imaging of the entire abdominal cavity and pelvis. Cysts may be multiple and located anywhere in the peritoneal cavity. Radiological findings are similar to those of liver disease. Peritoneal hydatid disease can grow to fill completely the peritoneal cavity, simulating a multiloculated mass. This pathological condition has been referred to as encysted peritoneal hydatidosis.

**A.6. - BILIARY COMMUNICATION:**

Communication of hydatid disease with biliary tree has been described in up to 90% of hepatic cysts (2). This can be explained by the fact that during the growth of the cyst, small biliary radicles are incorporated into the pericyst. However, frank rupture into the biliar tree occurs only 5-15% of cases (2).

Jaundice, fever and chills are symptoms that occur most often associated with biliary obstruction and cholangitis occurring secondary to this communication.

The communicating rupture of the cyst to the biliary tree can occur through small fissures or bile-cyst fistulas (55% of cases) or through a large perforation that allows access to a primary biliary branch.
It is essential that the findings in imaging tests that are suspicious for biliary communication are described to ensure adequate surgical management.

However, dilatation of the biliary tree does not always indicative cyst breakage; it can result from direct compression of the biliary branches by the cyst (Fig. 6) or a associated common bile duct stone.

The only direct sign of rupture into the biliary tree is the visualization of a defect in the cyst wall or of a communication between the cyst and the biliary radicals. In cases of a wider communication, US and CT demonstrate rupture in 46-75% and 77% (1) of the cases, respectively. In some cases, the passage of material through the defect hydatid and subsequent filling of the biliary radicals or the bile duct (common bile duct) can be displayed. In such cases, ultrasound images show anechoic, rounded or echogenic linear structures without posterior acoustic shadowing in the biliary tract.

CT may demonstrate high attenuation material passing through the defect of the cyst wall and filling of the biliary radicals or common bile duct. CT is superior to US in depicting hydatid cysts contents in the distal segment of the common bile duct.

Endoscopic retrograde cholangiopancreatography and percutaneous transhepatic cholangiography may demonstrate the communication in more detail.

Indirect signs of biliary communication include increased echogenicity at US and fluid levels and changes in signal intensity on MR images. A air-fluid level within the cyst, previously described as a sign of infection, is also considered a sign of breaking both the biliary tree or hollow viscera or bronchopleural fistula. Lipid material which forms a fat-fluid level within cyst has also been described as an indirect sign of biliary communication.

**A.7. PORTAL VEIN INVOLVEMENT**

Involvement of the portal vein compression or thrombosis, with secondary cavernomatosis, are rare and are caused by cysts located in the caudate lobe and the hepatic bifurcation (Fig. 8c). Direct portal invasion is a very rare complication.

US shows lack of flow at the portal vein and the existence of numerous vessels at the hepatic hilum associated with portal cavernomatosis.

CT and MR images help confirm cystic filling of the portal lumen and helped assess the lack of flow within the portal venous system (1).
A.8. - ABDOMINAL WALL INVASION:

Cysts can invade the right anterolateral abdominal wall from the right hepatic lobe and the anterior abdominal wall from the left hepatic lobe. Cysts typically pass through a small hole adopting an hourglass morphology. The images reveal a cystic mass in the abdominal wall that is similar to and is in communication with the components hepatic hydatid cyst.

B. HEMATOGENOUS DISSEMINATION

B.1. - LUNGS.

The lungs are the second most commonly affected organ in hematogenous spread in adults and probably the first in children (15-25% of cases) (2). Compressible organs such as the lung or brain facilitate the growth of the cyst, and this has been proposed as the reason for the high prevalence of the disease in childhood. Many cysts are acquired in childhood and remain asymptomatic for long periods of time, and are diagnosed incidentally on a chest radiograph. Cysts are multiple in 30% of cases, bilateral in 20%, and are located in the lower lobes in 60% of cases (2). Calcification in pulmonary cysts is very rare (0.7% of cases), but can be seen in pericardial, pleural and mediastinal cyst (2).

Sudden coughing attacks, rib pain and hemoptysis are the most common symptoms.

After cyst rupture may occur expectoration of cyst fluid, scolices and membranes. Although allergic episodes can occur after this rupture, severe anaphylaxis is rare. Bacterial infection of the cyst is one of the most serious complications seen after rupture.

Uncomplicated cysts appear as a well-defined mass. Centrally located cysts are usually round, although more peripheral may have an oval morphology.

Pulmonary hydatid cysts can vary from 1 to 20cm. Cyst growth produces erosions in the bronchioles that are included in the periquiste and as a result, air is introduced between the membrane laminated and pericyst. This collection of air appears as a thin radiolucent crescent in the upper portion of the cyst and is known as the crescent sign or meniscus sign. Some authors believe that this is a sign of impending rupture and therefore an indication for emergency thoracotomy. If air continues to enter this space separating the two layers just completely and cyst shrinks and breaks, allowing the passage of air to endoquiste. A air-fluid level inside the encocyst an air between the endocyst and pericyst with an appearance in "onion peel" constitute the Cumbo sign(1).
After partial expectoration of cyst contents, the cyst was empty and collapsed membranes can be visualized within the cyst (serpent sign). When the cyst is completely collapsed, the crumpled endocyst floats freely in the cyst fluid ("water lily sign"). If the liquid is completely evacuated by expectoration, the remaining solid component will fall to the most dependent area of the cavity ("mass within the cyst") (1). Hydatid disease is a rare cause of recurrent acute pulmonary embolism. This complication may occur after the invasion of the cardiovascular system or direct invasion of the inferior vena cava.

**B.2. - KIDNEYS.**

Renal involvement occurs in 3% of cases(1)(2). Usually remains asymptomatic for many years (Fig. 10). The most common signs and symptoms are palpable masses in the flanks, pain and dysuria.

Cysts are often solitary and located in the cortex, and may reach 10 cm. before symptoms are noted.

At excretory urography, uncomplicated cyst may cause a bulge in the contour of the kidney and appear as a round mass that lengthens the infundibula and chalices. In up to 18% of cases, the cyst can rupture into the collecting systems, resulting in acute renal colic and hydatiduria. Several round filling defects can be displayed in the excretory system due to daughter cysts. The ring-shaped calcifications of the cyst walls suggest the diagnosis of hydatid cyst. US and CT images of renal hydatid cysts are similar to those of cysts in other locations (Fig. 10).

**B.3. - SPLEEN**

The reported incidence of splenic involvement of hydatid disease ranges from 0.9 to 8% (2). In some series, the spleen is the third most commonly affected organ after the liver and lung. The splenic hydatidosis is mainly produced by systemic dissemination or intraperitoneal seeding from a ruptured liver cyst. The most common signs and symptoms are abdominal pain, splenomegaly and fever. Splenic hydatid cysts are usually solitary, and radiological findings are similar to cysts in other locations. Calcification of the cyst wall may occur and is best characterized by CT than by plain radiography or US. CT may demonstrate the typical high-attenuation linear wall without calcifications as well as daughter cysts within the cyst.

**B.4. - BRAIN.**
Hydatid disease affects the central nervous system in 1% of cases and is usually diagnosed in childhood (1) (2). Although you can find anywhere in the central nervous system more often to be located in both hemispheres, particularly in the territory of the middle cerebral artery. In young patients, radiography of the skull can show suture separation, unilateral enlargement of the vault or erosion of the posterior clinoid processes.

CT and MR showed a well-defined oval lesion or a cystic mass with an attenuation or signal intensity similar to cerebrospinal fluid. Cyst may cause a compression of the ventricular system and therefore hydrocephalus, however not associated with the displayed typical edema in cystic tumors and abscesses. The lesion does not enhance after intravenous contrast administration and calcification is extremely rare.

B.5. - BONE:

Skeletal involvement by primary hydatid disease is uncommon and represents 0.5-4% of patients. The spine and pelvis(Fig. 11 b), followed by the femur, tibia, humerus, skull and ribs are most frequently affected.

In bone involvement, pericyst formation does not occur, thereby allowing aggressive proliferation unevenly along the lines of least resistance especially the bone canals. The parasite replaces the osseous tissue between trabeculae due to the slow growth of multiple vesicles. With time, the parasite reaches and destroys the cortex producing seed of disease to surrounding tissues. Intraosseous hydatid disease rarely show the calcifications.

Spinal hydatid disease is the most common form of skeletal involvement and is usually difficult to distinguish from tuberculous spondylitis or chronic osteomyelitis. Some images have been described characteristics of spinal hydatidosis. These includes lack of osteoporosis or sclerosis in the host bone, no damage interdiscales spaces and vertebral bodies and spread of the disease by subperiosteal and subligamentous path; paraspinal extension and particularly the involvement of the adjacent rib.

Although CT allows a very accurate assessment of bone lesions and clearly shows calcifications, MRI is superior in demonstrating the involvement of neural structures.

Hydatidosis affecting other osseous locations typically manifested areas of different sizes of pure osteolysis that may become confluent and cause thinning of the cortex. The lesion growth causes breakage of the bone cortex and consequently spread into the surrounding tissues(1).
B.6. - OTHER LOCATIONS

Hydatid disease can affect almost any part of the human anatomy mainly through hematogenous spread.

The unusual locations include heart, pericardium, orbits, gastric wall, retrocrural space, mediastinum, subcutaneous space, muscles and adrenals.

Hydatid disease should be included in the differential diagnosis when a cystic lesion is identified in a patient lives or comes from an area where hydatid disease is endemic, especially if some of the images displayed characteristics that we discussed (multivesicular cyst, calcification, intracystic membranes ...).

The orbital involvement occurs in less than 1% of cases. In endemic areas, the orbital hydatid disease is the second most common injury at this level after dermoid cyst. Serologic tests and imaging findings in other locations help confirm the diagnosis.

The soft tissue hydatid (Fig. 11) disease occurs in 0.5-4.7% of patients living in endemic areas (3). The growth of cysts inside muscles is hampered by the contractility of the muscles and the presence of lactic acid. The affinity for the muscles of the neck and trunk and root ribs can be explained by the high vascularity and low activity of these muscle groups. Primary muscular hydatidosis is rare. Radiologic findings of hydatid disease in soft tissue are well defined in the literature. The multivesicular lesion is characteristics of hydatid disease and presents with multiple daughter cysts within the parent cyst, whereas complex or solid lesion is the result of inflammatory changes mimicking a tumor. In that case MR and US could be useful in the diagnosis (3). On US the multivesicular lesion is characteristic but soft tissue hydatidosis can have multiple appearances unilocular cyst, unilocular cyst with daughter cysts inside or detached membranes and calcified cysts. Multiple hydatid cysts can be seen associated with spontaneous rupture, trauma or surgery. Edema or acute inflammation caused by compression of or allergic reaction in soft tissue adjacent to the cyst is uncommon but may be seen (2). MR imaging has become the best imaging modality for the detection and characterization of soft tissue masses (Fig. 11b). The MR imaging provides excellent definition of muscle, facial boundaries and tumor mass by its multiplanar imaging capability (4). A low-signal intensity rim is evident on T2-weighted MR images (Fig. 11b).
Fig. 1: Calcified hydatid cyst in a 76 year old patient. (a) US shows two lesions localized one in segment VII-VIII (2cm in diameter), intensely calcified, and another located in segment IV-V (4-4.5cm in diameter) and having a heterogeneous appearance with peripheral calcification. (b) CT examination (without intravenous or oral contrast) shows the lesion in segment VII-VIII well defined and partially calcified.

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**Fig. 2:** 53 years old patient with calcified hydatid cysts. (a) Supine abdominal radiograph display a dense calcification of a cyst in the liver. (b) US shows two heterogeneous calcified images (3.5 and 5.6 cm in diameter) in relation to calcified hydatid cysts.

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Fig. 3: 77 year old female patient with calcified hydatid cysts. (a) Plain abdominal radiograph in supine position, shows a dense arclike calcification in right hypochondrium. (b) US: Displays a calcified lesion in segment VII of approximately 4.6 cm., in relation to calcified hydatid cyst.

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**Fig. 4:** 61 years old women with calcified hydatid cysts. (a) Plain abdominal radiograph shows a round image on hepatic silhouette with calcified wall seems to correspond with calcified hydatid cyst. (b) US image displayed injury about 6cm in diameter located in segment VI, isoechoica relative to liver parenchyma and calcified periphery, in relation to calcified hydatid cyst. (c) CT scan shows a lesion with peripheral partial calcification in liver (segment VI).

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Fig. 5: 77 years old male patient with hepatic hydatid disease complicated. The patient presented with fever and acute abdominal pain in the right upper quadrant (Fig.a,b). The patient was initially treated conservatively with good outcome (Fig.c) but a few months later after additional tests, which shows a clear communication between the cyst and the gallbladder, decides surgery (Fig.d), confirming that communication and performs resection of the cysts and cholecystectomy (Fig.e). (a) US image shows a multilocular cystic lesion of 8.8x8.9cm (TXCC), in the right lobe of the liver, and a daughter cyst is identified within the lesion, suggestive of hydatid cyst. Also in the posterior segments seen other injury about 13.3cm in diameter, with a thick wall and echogenic heterogeneous content. (b) Contrast material-enhanced CT scan shows two cystic liver lesions, well-defined wall, located in segments IV and V (9.7x9.3cm) and in the segments VI and VII (12x12.7cm). The latest injury described therein shows membranes (serpentine structures) within the matrix representing collapsed membranes. (c) US after medical treatment (one month after the previous one) shows two cystic lesions. The localized on segment IV presents multiple daughter vesicles and the cyst located in the segment VI shows multiple membranes inside. (d) CT scan shows that the cyst of the later segments has not changed. But the cyst of the segments IV-V decreased of size appreciating a clear communication with the biliary bladder.

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**Fig. 10:** 85 years-old male patient with a history of surgery for hepatic hydatid disease (1996). Imaging tests showed a right renal mass, compatible with a hydatid cyst with minimal breakage. He was treated conservatively with good outcome at follow-up. (a) US shows in right renal cell a well defined mass (15 cm) with heterogenous content, including solid parts and cyst adjacent to the wall, suggestive of cystic hypernephroma although other possibilities are polycystic kidney disease and hydatid cyst. (b) MR image scan shows multicystic mass suggestive of right renal hydatid cyst (11x11x9 cm). Well-defined margins, with a hypointense capsule on all pulse sequences and cystic structures attached to the wall that are hypointense relative to intracystic fluid on T1-weighted sequences and hyperintense on T2-weighted images. This injury depends on the anterior lip of the right kidney and no enhancement in the paramagnetic intravenous contrast study except at the inner portion of the capsule where there is also an increase in the around the kidney fat signal. It is very suggestive to correspond to a renal hydatid cyst probablemtne with minimal break in its inner side.

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Fig. 9: 83 year-old female patient with hepatic hydatid disease admitted to our hospital with right pleural effusion. Imaging tests confirm finally that it is a transdiaphragmatic migration of a hydatid cyst and was decided surgery (cyst resection, diaphragm port closure) (a) Posteroanterior chest radiograph shows right pleural effusion. (b) US shows heterogeneous hepatic lesion suggestive of multicystic with content areas (7.4x11.5x17cm) which seems to correspond to a hydatid cyst in the right hepatic lobe. Right pleural effusion. (c) Chest ultrasound shows membranes and daughter cysts in the right pleural cavity, which target a thoracic invasion of hepatic hydatid cyst. (d) CT scan shows a large hydatid cyst in the right hepatic lobe, having in its upper contour ill-defined areas, and adjacent cystic images subdiaphragmatic, which may be secondary to cyst rupture. It also shows right pleural effusion loculated with a discreet enhancement pleural line, and the right diaphragma is not identified completely. All these findings are suggestive of a cyst transdiaphragmatic migration.

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**Fig. 8:** 73 years with a hydatid cyst mimicking a solid mass, complicated with an infection (amebiasis, schistosomiasis, ascariasis). The initial imaging showed a solid lesion, but later determined that it was a complicated hydatid cyst and surgery confirmed it (infected hydatid cyst). (a) Contrast material-enhanced CT scan shows a round lesion with a mixed echogenic pattern in segment VII of the liver possibly related to solid mass with central necrosis. (b) US shows a solid mass located in liver segment VII that measures approximately 6 cm in diameter which has areas of necrosis within probably related to tumor lesion. (c) CT scan confirms the existence of a round lesion in liver segment VII, which protrudes outside the liver surface, with smooth wall, and with a content of low density, without significant differences between the arterial phase and portal phase showing a zone inside dense, and even some poorly defined membranes. It is associated with hypodensity in right hepatic vein, which seems thrombosed to its mouth in the inferior vena cava and can be considered which might correspond to a thrombosis (which was subsequently confirmed in surgery). Given the location, homogeneous wall, hypodense content should think first possibility in hydatid cyst.

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Fig. 7: 75 years old patient with complicated hydatid cysts. Imaging tests shows possible rupture to a hollow viscera. Surgery confirmed the gallbladder perforation. (a) US (before the complication) shows complex cystic liver lesions, large (13cm) located in the right hepatic lobe, with multiple daughter vesicles with the typical peripheral location within the mother cyst; and is thought to parasitic cyst. (b) CT scan shows cystic lesion (16cm) containing air inside that could be related to infected hydatid cyst or fistula to hollow viscera. (c) Posteroanterior abdominal radiography shows multiple hipodenses images in right upper quadrant, corresponding to air bubbles inside the complicated hydatid cyst. (d) US shows us the hydatid cyst occupying almost the entire right lobe and air inside. (e) CT (after surgery, cholecystectomy and resection of the cyst) shows hypodense area on the right lobe compatible with fat, regarding epiploplasty made on the cystic cavity.

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Fig. 6: 88 years old patient with malaise and diarrhea. Ct scan incidentally shows bile duct dilatation in the left lobe of the liver(a,b,c,d) and multiple unilocular hipoattenuating lesion (a,d) in the liver that corresponde to simple cyst. In segment III shows a lesion(5cm in diameter), well defined, with a small calcification in the periphery(c,d) and heterogeneous content with multiple cystic areas(c,d); that seems to compress the bile duct.

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**Fig. 11:** 77 year old woman with a history of multiple interventions gluteal hydatid disease. The last intervention was performed in 2010. Imaging tests before surgery shows hydatid cysts at the gluteus, spread to pelvis and right leg with signs of infection. Surgery is performed with partial removal of infected cysts. (a) Oblique hip radiograph showed calcification of cyst wall, and mass effect. (b) MR images of multiple hydatid cysts in the gluteal, obturator internus, piriformis, tensor fascia lata (entire length), vastus lateralis and intermedio, quadratus femoris and adductor magnus rights, with compression of the sciatic nerve, disruption of sacrotuberous ligament and extraperitoneal extension in the ipsilateral hemipelvis. We also observed some smaller cyst in the acetabulum and ilium. Extensive musculoskeletal hydatidosis in rights hip and thigh . (c) Enhanced CT shows a multivesicular cyst in the right gluteal muscles, affecting the adjacent muscles and extending to the pelvis; with multiple low-atenuation daughter cyst, and mural calcification.

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Conclusion

Hydatidosis is a dynamic entity with very different images. Imaging findings range from purely cystic lesions to solid-appearing masses (5) and it can affect almost any part of the body.

Hydatid disease primarily affects the liver and presents some findings in imaging tests very characteristic and well known. However, there are multiple potential local complications and secondary possible involvement to other organs almost any anatomical location, by hematogenous spread.

The combination of serological tests and radiology, especially in patients living in endemic areas, may contribute to the diagnosis (5) and familiar with atypical manifestations of hydatid disease can help it to be faster and more accurate.
References