Liver abscesses: where do they come from? A review of the main types of liver abscesses and the correlation between their causes and the radiologic findings

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Learning objectives

The aim goal of this exhibit is to: describe the most frequent types of liver abscesses, to review the different causes of liver abscesses, to describe the U/S and CT appearance and to correlate liver abscesses’ origin and their imaging features.
Background

Infectious liver diseases can be assessed with ultrasound, computed tomography and magnetic resonance imaging. Sometimes we can establish the specific diagnosis based on imaging findings but in some cases these are not specific and biopsy will be required.

The more frequent liver abscesses are pyogenic, amebic, fungal and parasitic disease.

1. PYOGENIC ABSCESS

This is the most common etiology of liver abscesses (88%).

They are mostly caused by diverticulitis, ascending cholangitis and infection of necrotic tissue as in tumoral necrosis.

The most frequent involved germs in adults is E.coli while in children is S.aureus.

ETIOLOGY

Pyogenic abscesses can have different origins:

1. Biliary tract: it is the most common mechanism. The infection can be caused by ascending cholangitis (choledocolithiasis, tumoral or stone obstruction) or after surgery or ERCP due to retrograde diffusion from bowel. Fig. 1 on page 7 Fig. 2 on page 7

These abscesses tend to be multiple, smaller and located in both hepatic lobes.

2. Portal vein: pylephlebitis secondary to appendicitis, infectious, inflammatory bowel disease or pancreas disease. Abscesses are usually solitary and more common in the right hepatic lobe. Fig. 3 on page 8

3. Arterial (hepatic artery): in the clinical context of septicemia. Fig. 4 on page 9

4. Direct extension from adjacent organs: as an example, perforated ulcer or cholecystitis. Fig. 5 on page 10

5. Posttraumatic or postsurgical: due to penetrating injuries or infection after surgery. Most of these abscesses are large and solitary. Fig. 6 on page 11

6. Cryptogenetic: sometimes a clear cause can’t be found. These abscesses tend to be solitary. Fig. 7 on page 12
IMAGING FEATURES

Ultrasound

The appearance on ultrasound varies with the timing and size of the abscess.

Pyogenic microabscesses (< 2cm) can be observed as discrete hypoechoic nodules or ill-defined areas of altered parenchymal echogenicity. In macroabscesses (> 2cm) we can find a range of ultrasound appearances and these can range from hypo to hyperechoic. Initially we may see an echogenic area Fig. 7 on page 12 with irregular margins and increased vascularity of adjacent liver parenchyma. Afterwards, we can observe an anechoic area with internal hyperechoic echos, depending on the necrotic contents. In the resolution phase the liquid content and the size of the lesion decrease.

Computed tomography (CT)

This is the most sensitive technique to detect calcifications and gas.

Microabscesses at CT with intravenous contrast administration can be seen as multiple small, well-defined hypoattenuating lesions.

The liver abscesses are usually visualized as a well-defined hypodense (0-45 Hounsfield units) mass Fig. 7 on page 12, sometimes multiseptated or multiloculated Fig. 3 on page 8. They may have peripheral enhancement, although rim enhancement is uncommon, and perilesional edema Fig. 1 on page 7. Smaller abscesses can coalesce into a bigger cavity. Sometimes air-fluid (gas is only visualized in 20% of the cases) or fluid-debris levels are seen.

Magnetic resonance imaging (MRI)

Pyogenic abscesses have variable signal intensity on T1 and T2-weighted images, depending on their protein content. Perilesional edema can be visualized as a increased signal intensity on T2-weighted MR images.

2. AMEBIC ABSCESS

They account for 10% of liver abscesses and are caused by Entamoeba histolytica. It is a more common disease in immigrants. They tend to be peripheral, solitary and rounded or oval shaped.
This kind of abscess is visualized as a well defined hypoechoic or hypodense (10-20 UH), uni or multiloculated mass, with capsular enhancement. It usually has internal brown content and "anchovy paste" consistency.

Reactive right lower lobe atelectasis and homolateral pleural effusion are common.

Treated lesions may become anechoic, calcified or have cystic appearance. The radiological resolution may take up to two years.

3. FUNGAL ABSCESS

Fungal abscesses are uncommon and represent only 2% of all liver abscesses. Candida albicans is the most commonly implicated fungus.

On **ultrasound**, hepatic candidiasis may have different appearance:

- "Wheel within a wheel": a hypoechoic central area of necrosis surrounded by echogenic area of inflammatory cells.
- "Bull’s eye": a echogenic central nidus surrounded by hypoechoic ring, this is a sign that implies active infection.
- Hypoechoic nodule: most fungal abscesses show this pattern although this appearance is nonspecific.
- Echogenic foci with posterior acoustic shadowing when they are in the resolution phase.

On **CT** we can observe small multiple well defined hypodense nodules (under 2 cm and mostly smaller than 1 cm) in both hepatic lobes with central enhancement. They can also appear as hypodense areas without enhancement.

4. PARASITIC DISEASE

The parasites that are more frequently implicated are Echinococcus granulosus, that causes hydatid disease (the most common in Mediterranean region, Africa, South America, Australia and New Zealand), Echinococcus multilocularis or in the case of schistosomiasis the Schistosoma japonicum, S. hematobium, and S. mansoni.

HYDATID DISEASE

Humans are infected by the ingestion of eggs of E. granulosus due to contaminated food or from contact with dogs.

On **ultrasound** we can see a well-defined anechoic cyst or it can have internal "sand" (freed scolices). The cyst can be multisepitate Fig. 8 on page 12, with daughter
cysts **Fig. 9** on page 13 that can be floating within the mother cyst and have echogenic material between cysts (matrix). A internal waving membrane (delaminated endocyst) can be seen. We can see the hydatid cyst as a calcified mass or it can have pericyst calcification.

On **CT** we can see a large, well-defined hypodense lesion, uni or multilocular. In 75% of the cases daughter cysts can be observed, and tend to have less density than mother cyst. The cyst can have coarse calcifications, when there is circumferential calcification it may reflect no active infection. After contrast administration it shows enhancement of cyst wall and septations. **Fig. 10** on page 14

On **magnetic resonance imaging** the rim (pericyst) is hypointense on T1 and T2-weighted images, the mother cyst has intermediate signal intensity (higher than daughter cysts) on T1 weighted images and it is hyperintense on T2 weighted sequences (more than daughter cysts). The floating membrane has low signal intensity on T1 and T2-weighted images. **Fig. 11** on page 15
Fig. 1: Abdominal CT with i.v. contrast administration. Liver abscess caused by biliary tract source. Hypodense polilubulated mass in segment 7 with peripheral enhancement and edema of the adjacent parenchyma.

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Fig. 2: Abdominal CT with i.v. contrast administration. Hypodense rounded mass with septations and pneumobilia, consistent with liver abscess in a patient with cholangitis.

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Fig. 3: Abdominal CT with i.v. contrast administration. Multiple hypodense multiseptated liver abscesses in a patient with diverticulitis.

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Fig. 4: Abdominal CT with i.v. contrast administration. Multiple liver abscesses with peripheral enhancement (arrows) in a patient with acute pancreatitis and septicemia.

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Fig. 5: A) Axial and B) Coronal abdominal CT after i.v. contrast administration. Liver abscess due to gallbladder perforation (arrow) as a complication of acute cholecystitis.

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**Fig. 6:** Abdominal CT with i.v. contrast administration. Postoperative hypodense fluid collection with peripheral enhancement (arrow) in the prior surgical bed.

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**Fig. 7:** A) Abdominal CT with i.v. contrast administration, shows a large well defined hypodense liver mass. B) Abdominal ultrasound show a heterogeneous hyperechoic mass with a hypoechoic area inside, consistent with liver abscess.

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Fig. 8: Abdominal ultrasound that shows a multiseptated (arrows) cystic liver lesion consistent with hydatid cyst.

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**Fig. 9:** Abdominal ultrasound. Hydatid cyst with multiple hypoechoic internal daughter cysts (arrows).

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Fig. 10: Abdominal CT with i.v. contrast administration. Hypodense cystic liver lesion with more hypoattenuating daughter cysts (black arrow) and enhancement of cyst wall and septations (white arrow).

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**Fig. 11:** Gadolinium enhanced T1-weighted image that shows a multiseptated (arrow) hypointense mass consistent with hydatid cyst.

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Findings and procedure details

Bibliographical research of the main causes of liver abscesses and their imaging findings.

We did the research of our cases in Hospital Universitario de Salamanca and correlated the imaging findings with the clinical history and the microbiological and patological results.

A 16 row-detector CT was used to perform exams.

A 1.5 Tesla MRI was used to perform the exams.

Ultrasound were performed with a convex and a multi-frequency high resolution linear transducer.
Conclusion

The major teaching points of this exhibit are:

- Imaging exams can establish the diagnosis of abscess in an appropriate clinical context, besides guiding percutaneous drainage.

- The radiologic appearance can sometimes establish the etiologic diagnosis, differentiating fungal abscesses of amebic and pyogenic.

- Assessing a liver mass with radiological semiology of liver abscess, is important to know the medical history and the clinical manifestations.
References