Usefulness of MDCT in the diagnosis and treatment of liver abscesses. A pathology that should not be forgotten

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Learning objectives

1. Assess the clinical and radiological features that would enable the differential diagnosis between pyogenic, amoebic or fungal liver abscesses.
2. Discuss the role of MDCT in the characterization of liver abscesses and its use in interventional treatment.
Background

INTRODUCTION
Liver abscesses are considered now a severe intra-abdominal infection with incidence has declined in recent years, however, the high number of imaging studies in the emergency department in patients with alteration of liver function, justifying the need to have them present among likely differential diagnoses, because of its high morbidity, mortality and increased healthcare costs due to late diagnosis (1)

EPIDEMIOLOGY

Pyogenic abscesses are the most common form of presentation. The main pathogen in our environment is *E. coli* and other enterobacteria, although in many Asian countries, *Klebsiella pneumoniae* has been described as the most frequently isolated microorganism. The incidence of pyogenic abscesses increases with age, being more common in people over 65 years (1, 2), with a slight predominance in males (2, 3). Amoebic abscesses are caused by the spread portal trophozoites of *Entamoeba histolytica* from an intestinal amebiasis, which usually occurs in younger people with an average age of 40 years, coming from endemic regions, such as Central and South America, Africa and India, while those of fungal origin are closely related to a compromised immune system watching mainly in patients with hematologic malignancies, being *Candida albicans* germ most frequently found. Other fungi involved occasionally include *Cryptococcus, Histoplasma capsulatum, Aspergillus* and mucormycosis (4, 5).

CLINICAL PRESENTATION

Clinical presentation is variable; the classic symptoms are fever and right upper quadrant pain, associated with impaired liver biochemistry, characterized by elevated transaminases and bilirubin (2, 4). Also have been described cases of scarce or atypical symptoms, such as weight loss or mild and diffuse abdominal pain (4). Sometimes, fever is the only symptom, as may occur in elderly patients or in immunosuppressed individuals with amoebic abscesses, being latter situation a common cause of fever of unknown origin (5).
Imaging findings OR Procedure details

RADIOLOGICAL CHARACTERISTICS

In the current emergency radiology, MDCT together with ultrasound are the first imaging methods used in patients with suspected liver abscesses.

Pyogenic abscesses

Pyogenic abscesses may be single, usually cryptogenic origin or multiple, mainly related to the biliary tract infections such as cholecystitis Fig. 2 on page 7 or cholangitis Fig. 3 on page 8. Another cause is hematogenous spread, both by the arterial system in cases of bacteremia or through the portal system from gastrointestinal infections Fig. 4 on page 25. Also have been reported abscesses on preexisting injuries, such as necrotic parenchyma secondary to thrombosis Fig. 5 on page 9, trauma or metastatic involvement and have even been reports of bacterial superinfection of simple hepatic cysts Fig. 6 on page 10 or hydatid cysts Fig. 7 on page 11 (4, 6).

In relation to their size, are classified in microabscesses (< 2 cm.) Fig. 8 on page 12 or macroabscesses (> 2 cm.) Fig. 9 on page 13; may present as a unilocular cavity, homogeneous, well-defined edges Fig. 10 on page 14 or have a heterogeneous appearance, with multiple internal septa and ill defined or irregular borders Fig. 11 on page 15 (4, 6). The presence of gas inside the lesion, in the absence of instrumental manipulation or communication with a hollow viscus, is associated with gas-producing pathogens and has been related more frequently to diabetic patients Fig. 12 on page 16 (6, 7).

In the dynamic study with MDCT, the presence of peripheral enhancement in ring-shaped or double target, is a characteristic finding although not always visualized Fig. 13 on page 17 (8). After the administration of contrast, you can also look at an area of transitory parenchymal hypodensity or hyperdensity, segmental or wedge-shaped and located around the abscess, which is associated with partial or complete obstruction of the blood supply by the hepatic vein or regional portal vein Fig. 15 on page 18, probably caused by local inflammatory or ischemic changes. These temporal alterations parenchymal attenuation is important differentiate them from those associated with some malignancies, particularly those described in hepatocellular carcinoma (8, 9).

Radiographic features as the pathogen are not specific, although some variants have been associated with various microorganisms, such as the presence of grouped
microabscesses or trend to confluence has been associated with coliform bacteria (mainly \textit{E. coli}) or enteric organisms Fig. 16 on page 19, whereas diffuse involvement with multiple microabscesses distributed in both lobes, is related to staphyloccocal infections with generalized septicemia Fig. 17 on page 20 (4, 6). Furthermore, visualization of a single macroabscess, solid or multilocular appearance, has been linked to \textit{K. pneumoniae} Fig. 18 on page 21 (10).

**Amoebic Abscesses**

Amoebic abscesses are usually difficult to differentiate from pyogenic, so a correlation between clinical, epidemiological and radiological information is necessary to establish the diagnosis. The common findings on MDCT are a single lesion, hypodense, near the liver capsule, round or oval and well defined margins, of smooth or nodular aspect, with a central cavity that usually has attenuation between 10 to 20 UH suggestive of content slightly heterogeneous, sometimes represented by one or more septa or liquid - detritus levels. In the dynamic study can be observed an enhancement of the wall with a variable thickness, typically less than 15 mm and an alteration of the attenuation of surrounding parenchymal in relation to edema Fig. 19 on page 22. A relatively common feature is the extension extrahepatic mainly association with ipsilateral pleural effusion, although described involvement of the chest wall, pericardium and adjacent viscera (4, 6).

**Fungal abscesses**

Fungal abscesses are characteristically opportunistic infections in immunocompromised patients. MDCT is of choice when the site of infection is unknown, being the usual findings, a diffuse af ectation parenchymal liver with multiple low density lesions, round, with a size less than 2 cm in maximum diameter. After contrast administration, there is usually a target-like enhancement, with a hyperdense center surrounded by a low density area. Also, can display a ring enhancement, although less frequently. It is common simultaneous involvement of the spleen and occasionally kidney (4, 6). In patients with a very low level of neutrophils, assessment with CT may give false negative results, requiring a biopsy to confirm the diagnosis, if clinical suspicion is high (6).

**Image-guided percutaneous drainage**

In the emergency radiology service, when we are before a liver abscess or suspicion thereof is high, should assess the possibility of a image-guided percutaneous drainage in an early stage, taking into account the immediate availability of MDCT or ultrasound. Percutaneous catheter drainage (PCD) associated with antimicrobial therapy is now widely accepted in the management of liver abscesses (mainly pyogenic origin), highlighting the fact that a satisfactory procedure would reduce the mortality rate until 2.5%, as the need for surgery (4, 11). Furthermore, this technique provides a study
sample with greater bacteriological information and more reliable than that provided by blood culture, with a lower rate of sterile results and greater sensitivity for detection of polymicrobial infections (6). Comparing the advantages of PDC on surgery, highlights the less invasive nature and lack of general anesthesia, which results in a decrease in morbidity, mortality and economic cost, with greater availability of resources for its implementation. However, it still reported a rate of 10 to 15% of failed procedures (11).

In pyogenic abscesses treated with PCD, the procedure’s success is closely related to the degree of homogeneity of the lesion, being more likely a good result in single lesions, well defined, unilocular with a fluid component characterized by a low attenuation Fig. 20 on page 23. By contrast, treatment failure has been associated in the first place with the gas present inside the lesion, which has been described as one of the main predictive factors of treatment failure, recommending not delay surgical treatment, if is not achieved a good result with the PCD in such abscesses. Another cause, is a very short distance between the abscess and the liver capsule, which reduces the amount of healthy parenchyma of support for the drainage catheter, being more feasible its detachment. Large lesions (usually greater than 8 cm in maximum diameter) tend to be more heterogeneous, with a complex content and higher probability of rupture extrahepatic, would make it difficult its drainage, as the presence of multiple internal septa (11).

Amoebic abscess drainage is usually done in cases of uncertain diagnosis (exclusion of pyogenic origin) or patients with an unfavorable evolution. It is further recommended in lesions with a high risk of rupture, which are defined as a cavity with a diameter greater than 5 cm Fig. 21 on page 24 or those located in the left hepatic lobe. In view of the better results obtained in recent years, the average rate of amoebic abscess treated with percutaneous drainage has increased progressively, being at present 40 - 50% (5).
**Fig. 1:** Axial CT image with intravenous contrast in the upper portion of the liver (a) with coronal reconstruction (b) and sagittal (c) in male age 48 with 5-day history of fever, abdominal pain and dyspnea. Great hypodense lesion between segments VII - VIII, thick-walled, with septa and solid-appearing areas (curved arrows) and heterogeneous content suggestive of detritus (asterisks), confirmed as abscess secondary to Streptococcus intermedius infection of unknown cause. Subhepatic collection (straight arrow) and pleural effusion (arrowhead).

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Fig. 2: Axial CT image with intravenous contrast in the middle portion of the liver (a - c) and coronal reconstruction (d) in male 43 years old with 3 day history of fever and right upper quadrant pain. Multiple hypodense lesions with peripheral enhancement in segment V - VIII (curved arrows), the largest in intimate contact with the right side of the gallbladder and in communication with its light through a solution of continuity of the wall (straight arrows), compatible with abscesses secondary to perforated acute cholecystitis. Segmental hypodensity in the right lobe suggestive of perfusion disorder (asterisk).

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Fig. 3: Axial CT image with intravenous contrast in the upper (a) and middle (b) portion liver (b) with coronal reconstruction (c) in male 78 years old with a history of 6 days of fever, abdominal pain and signs of sepsis. Predominantly cystic lesions with ill-defined walls in the left lobe (straight arrows), associated to important aerobilia and dilatation of the bile duct (curved arrows), which in the absence of previous surgical or instrumental manipulation, is compatible with cholangitis secondary to fistula enterobiliar (circle).

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Fig. 5: Axial CT image with intravenous contrast in the upper portion of the liver (a) with sagittal reconstruction (b) in male 81 years old with a history of 3 days with abdominal pain and hemodynamic instability. Triangular morphology hypodense lesion between segments VII - VI, with gas bubbles inside (arrows), suggestive of vascular origin. Axial image mesogastrium level (c) and epigastric (d) shows a marked loss of pancreatic structure with involvement of mesenteric fat (circle)and gas in the stomach draining vein (curved arrow), compatible with acute pancreatitis complicated with liver abscess due to remote ischemic phenomena.

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Fig. 6: Axial CT image with intravenous contrast in the upper (a) and middle (b) portion liver with sagittal reconstruction (c) in male aged 59 with right upper quadrant abdominal pain. Cystic lesions of appearance homogeneous, variable size and thin wall in relation known simple cysts (straight arrows), observing a higher density lesion, thick and well-defined wall (asterisk) with gas inside (curved arrow), compatible with cyst superinfection. Thickened gallbladder wall suggestive of inflammatory changes (arrowhead).

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Fig. 7: Axial CT image with intravenous contrast in the upper (a, b) and lower (c) portion of the liver with coronal reconstruction (d) in women 62 years of age with diffuse abdominal pain and vomiting of 3 days duration. Lesions with marked calcifications in segment VIII, compatible with known hydatid cysts (circles). In segment VI is observed hypodense lesion, lobed, thick-walled, gas inside (straight arrows) and small parietal calcifications (curved arrows) suggestive of hydatid cyst superinfection and confirmed in subsequent microbiological study.

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Fig. 8: Axial CT image with intravenous contrast in the upper (a, c) and middle of the liver (b, c) with minimum intensity projection (d) in women 49 years of age with fever, abdominal pain and dyspnea 48 hours evolution. Hypodense lesions in the left lobe with a diameter less than 2 cm. (greater of 18.3 mm), well-defined edges and peripheral enhancement (curved arrows), associated with marked dilatation of the bile duct (straight arrow), compatible with microabscesses secondary to cholangitis.

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Fig. 9: Axial CT image with intravenous contrast in the middle portion of the liver (a) with sagittal reconstruction (b) and coronal (c) in male 36 years old with 7 days history of fever and abdominal pain right in upper quadrant. Cyst-like lesion in the right lobe, thick-walled, well-defined, incomplete septa (straight arrows) and larger diameter of 8.2 cm, compatible with cryptogenic macroabscess secondary to Enterococcus faecium infection.

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Fig. 10: Coronal (a) and sagittal (b) CT image with intravenous contrast in man 60 years old with 3 day history of fever, abdominal pain and epistaxis. Multiple cyst-like lesions, unilocular and defined margins in the left lobe, most with mild perilesional edema, compatible with microabscesses secondary to Streptococcus intermedius infection confirmed by microbiological study.

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Fig. 11: Axial CT image with intravenous contrast in the upper portion of the liver (a, b) coronal reconstruction (c) in male age 81 with diabetes mellitus and history of 3 days of fever, abdominal pain, vomiting, cough and dyspnea. Lesion in the left lobe, multiloculated (straight arrows), irregular margins with slight peripheral enhancement and solid component in its anterior portion (curved arrows) compatible with abscess secondary to infection K. pneumoniae. Pleural effusion (arrowhead) and perihepatic free fluid and perisplenic (asterisks). Pleural effusion (arrowhead) and perihepatic free fluid and perisplenic (asterisks).

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Fig. 12: Axial CT image with intravenous contrast in the middle portion of the liver (a) with coronal reconstruction (b) and sagittal (c) in women 74 years of age with diabetes mellitus and history of 5 days of fever, vomiting and abdominal pain intensified in the 24 hours prior to admission. Left lobe lesion with a large amount of gas in its interior, air - fluid level and lobulated margins (asterisk) with perilesional hypodensity suggestive of flow disorder. Presence of aéreobilia (straight arrow), pneumoperitoneum (curved arrows), intraabdominal free fluid (arrowheads) and thickening of the gastric wall, especially in the area of antral contact the liver surface (circle). Presence of aerobilia (straight
arrow), pneumoperitoneum (curved arrows), intraabdominal free fluid (arrowheads) and thickening of the gastric wall, especially in the antral area in contact with the liver surface (circle).

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**Fig. 13:** Axial CT image with intravenous contrast in the lower portion of the liver (a, b) in 66-year old woman with a history of diffuse abdominal pain and fever of 48 hours’ duration. Cyst-like lesion located in segment VI, thick-walled, with peripheral enhancement and perilesional hypodense halo [dual target image] (curved arrow) with septa lower most portion (straight arrow), compatible with liver abscess secondary to Fusobacterium infection, confirmed by microbiological study.

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Fig. 14: Axial CT image with intravenous contrast in the upper portion of the liver (a, b) in 59-year old male with a history of eight days with diffuse abdominal pain, fever and hypotension on admission. Multiloculated lesion with cystic component areas and poorly defined margins, located in segment VIII (straight arrows), compatible with abscess secondary to infection by E. coli, complicated with right hepatic vein thrombosis (curved arrows). Segmental hyperdensity in the right lobe (asterisk) suggestive of impaired perfusion.

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Fig. 15: Axial CT image with intravenous contrast in the lower (a) and middle liver portion (b) with sagittal reconstruction (c) in male 39 years old, born in China and history of 5 days with abdominal pain in right iliac fossa fever and vomiting. Hypodense lesion in segment VI, gas bubbles inside and triangular morphology, compatible with abscess of vascular origin (straight arrows) for thrombosis posterior branch of the right portal vein (curved arrow). Decreased enhancement of the entire right lobe (asterisk) suggestive of impaired perfusion. Sagittal image abdominal ultrasound in right iliac fossa with high resolution probe (d) visualizing cecal appendix increased caliber (arrowhead), surrounded by mesenteric fat striation, compatible with complicated appendicitis with pylephlebitis.

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**Fig. 16:** Axial CT image with intravenous contrast in the upper portion of the liver (a) in women 68 years of age with a history of three days with fever and abdominal pain in abdomen. Hypodense lesion located in the left lobe with clustered small cystic areas in the periphery and well-defined margins, surrounded by a halo hypodense (curved arrow), compatible with abscess secondary to infection by E. coli. Axial CT image with intravenous contrast in the upper portion of the liver (b) 45 years old male with a history of 5 days with fever and right upper quadrant abdominal pain. Hypodense lesion located in segment VII - VIII of similar characteristics to the previous patient (straight arrow), consistent with abscess secondary to infection by Enterococcus faecalis. Pleural effusion in the left hemithorax (asterisk).

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**Fig. 17:** Axial CT images with intravenous contrast of the liver at different levels arranged in craniocaudal direction (a - f), at 36 years old male with symptoms of septic shock and bacteremia by S. aureus confirmed at the time of admission. Multiple cystic lesions localized predominantly in the right lobe, some with thin septa inside (straight arrow), most with a size close to 2 cm, compatible with abscesses.

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Fig. 18: Axial CT image with intravenous contrast in the upper (a) and middle portion liver (b) with coronal reconstruction (c) in male 40 years of age with diabetes mellitus and history of 4 days of fever, abdominal pain and hemodynamic instability. Large hypodense lesion of 15 cm between segment VII - VIII, ill-defined wall, with areas of solid component isodense with the surrounding parenchyma (asterisks) and multiple internal septa (arrows), confirmed as abscess secondary to infection by K. pneumoniae. Perisplenic and perihepatic free fluid (arrowheads).

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Fig. 19: Axial CT image with intravenous contrast in the middle portion of the liver (a) with coronal reconstruction (b) and sagittal (c) in male 36 years old, born in Nicaragua, who has fever of 10 days weeks duration, no other symptomatology. Cyst-like lesion, subcapsular, unilocular with hyperdense slightly content suggestive of detritus (asterisk) and thick wall with mild perilesional hypodense (curved arrow), compatible with liver abscess secondary to infection by E. histolytica.

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**Fig. 20:** Axial CT images in middle portion of the liver to assess evolution of pyogenic liver abscess after antibiotic treatment and percutaneous catheter drainage guided by image. (a) CT performed on the patient's admission. Abscess located in the right lobe subcapsular level, with air-fluid level and thin septum inside [straight arrow]. (b, c) CT percutaneous drainage. Protocol to define the puncture site [circle]. Radiopaque guide placement on the skin surface and marking the theoretical path to cover on the needle from the skin (point A) to the abscess cavity (point B), determining the distance between two points. (c) Puncture needle of the abscess cavity [arrowhead] and subsequent placement of the drainage catheter. (d) Small residual lesion after the 3rd day of the puncture [curved arrow], achieving a satisfactory result.

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**Fig. 21:** Axial CT images in middle portion of the liver to assess evolution of amebic liver abscess after drug treatment and percutaneous catheter drainage guided by image. (a) CT performed on the patient's admission. Abscess located in the right lobe subcapsular level, with homogeneous content and thick wall [straight arrow]. (b, c) CT percutaneous drainage. Protocol to define the puncture site [circle]. Radiopaque guide placement on the skin surface and marking the theoretical path to walk by the needle from the skin (B) until the abscess cavity (point A), determining the distance between two points. (c) Puncture needle injury [arrowhead] and subsequent placement of the drainage catheter. (d) Small residual cavity after the 5th day of the puncture [curved arrow], achieving a satisfactory result.

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**Fig. 4:** Axial CT image with intravenous contrast in the upper portion of the liver (a) and coronal reconstruction (b) in male age 65 with 5-day history of fever, abdominal pain predominantly in hypogastrium and left iliac fossa with altered liver profile. Hypodense lesion with internal septa, located in the left lobe (straight arrows). Axial image at the level of the pelvis (c) and coronal reconstruction (d) showing wall thickening of the sigmoid colon with multiple diverticula (circle) and collection on the wall that extends above the bladder dome (curved arrow) compatible with acute diverticulitis complicated by liver abscess.

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Conclusion

Use of MDCT in emergency radiology service is a fundamental tool in the diagnosis of liver abscesses, because has greater sensitivity and specificity than ultrasound, especially in cases of atypical presentation or in patients with no known infectious origin. It is necessary highlight that in most of these lesions, radiologic findings are not specific to establish an accurate diagnosis, however, several features presentations have been described, and that in an adequate clinical context increases the likelihood of a correct diagnosis. The immediate availability of MDCT in the emergency room is a useful guide for conducting early interventional treatment, which associated with simultaneous administration of antibiotics, has been related to decrease extrahepatic complications and mortality. Moreover, this procedure provides an optimal sample for the microbiological study that will allow confirmation or discard of pathology and thereby assess the maintenance or change of the conduct therapy.
References


