ABSTRACT

Focal, segmental, and diffuse liver pathologies have been described in the literature. This article describes a pattern in which liver pathology is confined to a lobe. This lobar pattern has not been described previously to our knowledge. Herein, we illustrate computed tomography (CT) and magnetic resonance imaging (MRI) findings of diffuse lobar involvement patterns in various liver conditions. Diffuse lobar involvement can be observed in benign (steatosis, hepatic iron overload, cholestasis, perfusion alterations, infarction, alveolar hydatid cysts, trauma, and hemangiomas) and primary malignant (hepatocellular carcinoma) pathologies. Diffuse lobar involvement in metastatic disease appears to be rare. Due in part to their potentially unusual appearances, the diagnosis of lobar pathologies using imaging can be challenging, and entities with lobar patterns can cause diagnostic confusion. Liver MRI can be used as a problem-solving tool for diffuse lobar pathologies detected on ultrasonography and CT. In- and out-of-phase MRI can help in the assessment of lobar fat accumulation.

Key words: • liver • computed tomography • magnetic resonance imaging

CT and MRI of diffuse lobar involvement pattern in liver pathology

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Infarction

Infarction of the liver is usually due to trauma (Fig. 6) and usually occurs as a result of the laceration of blood vessels that supply the right or left lobes; however, this condition has also been shown to occur as a result of other causes (toxic or viral hepatitis, non-traumatic occlusion of both the hepatic artery and portal vein branch that supplies the affected lobe, idiopathic sources, etc.) (Fig. 7) (7–9).

that is limited to the right or left lobes. The diagnosis of a hydatid cyst can be suggested by a lack of enhancement of a solid-cystic mass and the presence of calcification. Biopsy may be required for diagnosis.

Figure 1. a–f. A 50 year-old woman with a liver mass that was diagnosed by ultrasonography. Axial T2-weighted image depicts hyperintense lesion localized in the right lobe (a). Post-contrast images (b–d) demonstrate peripheral nodular enhancement and centripetal contrast filling, which confirms the diagnosis of hemangioma. Note the central presence of the scar-like hyperintense cystic component. The diffusion-weighted image (e) and apparent diffusion coefficient map (f) show high diffusivity in the cystic component.
Perfusion changes

The left or right portal veins can be occluded, leading to a transient hepatic attenuation difference that is only detectable on arterial phase images (Fig. 8) (10, 11). In hypereosinophilic syndrome, a lobar involvement pattern is usually most likely caused by periporal eosinophil infiltration and the resultant portal vein stenosis (12).

Fat accumulation

Fat accumulation in the liver is usually diffuse but can also be focal or heterogeneous (13–15). Lobar fat accumulation is rare but can occur in patients with right or left portal vein occlusion. Lobar portal vein occlusion can change the fat content of a lobe because the portal vein brings nutrients to the liver from the gastrointestinal tract. Lobar fat accumulation can also be idiopathic. The diagnosis may be difficult on US or CT but is usually straightforward on MRI; in- and out-of-phase images can be diagnostic for lobar fat accumulation by demonstrating signal drop on out-of-phase images preferentially or exclusively in the affected lobe (Fig. 9).

The diagnosis of lobar fat accumulation in patients with underlying iron overload is challenging even with MRI; however, careful analysis of in- and out-of-phase T1-weighted gradient-echo images may direct a correct diagnosis. On out-of-phase images, lobes that contain both fat and iron are likely to appear more hypointense in comparison to lobes that only contain iron (Fig. 10). On in-phase images, the signal intensity difference between lobes is likely to be smaller. Advanced MR imaging techniques that are designed to simultaneously assess fat and iron accumulation are now being developed (16, 17). These techniques are likely to facilitate the diagnosis of lobar fat accumulation that is superimposed over iron overload; however, these techniques are not yet commercially available.

Cholestasis

Cholestasis can be lobar in patients with lobar or segmental biliary strictures (18). Due to the intracellular accumulation of paramagnetic bile products, the affected lobe has higher signal intensity than the unaffected lobe on both in- and out-of-phase T1-weighted gradient-echo images with no signal drop on out-of-phase images (Fig. 11). Thus, cholestasis can be easily differentiated from lobar fat accumulation. If a hepatobiliary agent (e.g., gadoxetate) is administered, the affected lobe exhibits reduced signal intensity in the hepatocellular phase due to an impaired uptake of the agent (19). Lobar cholestasis is difficult to diagnose using CT or US, although the presence of dilated intrahepatic ducts in a lobar distribution may suggest the diagnosis.

As a conclusion, liver pathologies may manifest with lobar distributions. Such manifestations are uncommon and may cause diagnostic confusion. The differential diagnoses of these pathologies include benign and primary malignant etiologies. Diffuse lobar involvement via metastatic disease appears to be rare, and US findings are usually nonspecific. While CT findings may be diagnostic, they are often not definitive. In such cases, MR imaging may be helpful in achieving the correct diagnosis. Awareness of specific lobar patterns in combination with a careful review of MRI features can usually lead to a correct diagnosis.
Figure 3. a–g. A 60-year-old man with elevated liver enzymes with heterogeneous echogenicity in the right lobe of the liver with suspicion of fat accumulation by ultrasound (not shown). Coronal true fast imaging with steady state precession (TRU-FISP) (a), fat saturated axial T2-weighted (b), and diffusion-weighted (e) images show diffuse high signals in right lobe. In- (c) and out-of-phase (d) gradient echo images depict low signal in the right lobe. The absence of signal loss on the out-of-phase in comparison to the in-phase image refutes the sonographic diagnosis of lobar fat accumulation. Post-contrast arterial phase images show hypervascularity of the right lobe in comparison to that of the left lobe (f). Venous phase images show heterogeneous signal with peripheral enhancement (g). Note the high signal intensity of the entire right lobe on a diffusion-weighted image (e). MRI findings suggest a malignant process. Biopsy confirmed the diagnosis of hepatocellular carcinoma.
Figure 4. a–d. A 54 year-old man with chronic hepatitis B viral infection presented with a palpable abdominal mass. Hepatic arterial phase (a) and portal venous phase (b) MR images at 1.5 T reveal a heterogeneous mass that occupied the entire left lobe. Note the abnormal vessels within the mass and the surrounding tumor capsule, which can be best seen on the portal venous phase image. Innumerable arterial-phase hyper-enhancing, ill-defined, and vaguely nodular perfusional alterations are present in the right lobe; these pseudolesions are probably due to arterioporal shunts. These pseudolesions fade to iso-intensity on the portal venous phase. Diffusion-weighted images with b-values of 0 (c) and 500 (d) s/mm² show low diffusivity within the mass. Note that the right lobe of the liver appears to be normal on the diffusion-weighted images; the pseudolesions are not visible.

Figure 5. a–d. A 21-year-old woman with a right liver lobe mass detected on ultrasonography. Axial CT images (a–d) show a hypodense mass with calcifications that are limited to the right lobe and causing biliary dilatation of the left lobe. Biopsy confirmed the diagnosis of alveolar echinococcosis. The patient underwent a right hepatectomy. Note the presence of calcifications (c, d) and a lack of enhancement.
**Figure 6.** A 50-year-old man who had sustained trauma. Axial CT image shows a lack of perfusion to the entire right lobe due to traumatic infarction.

**Figure 7.** A 41-year-old woman presented with right upper quadrant pain after cesarean section. Axial CT images (a, b) show capsular enhancement and diffuse patchy hypodense areas exclusively in the right lobe. Axial T2-weighted (c) and diffusion-weighted (d) images depict hyperintensity and restricted diffusion. Axial in- (e) and out-of-phase (f) T1-weighted images exclude the diagnosis of heterogeneous fat accumulation. Right liver lobe infarction is suggested based on imaging findings and the spontaneous resolution of pain within a week. The infarction was attributed to non-traumatic thrombosis of vessels supplying the right lobe.
Figure 8. a–c. Axial (a) and coronal (b) late arterial phase CT images depict a diffuse transient hepatic attenuation difference in the left lobe due to left portal vein occlusion (arrows). The density difference disappears on the venous phase image (arrow, c). Note the relatively small size of the left lobe, presumably due to atrophy from long-standing lack of portal venous supply.

Figure 9. a–c. A 49-year-old woman who was operated on due to the presence of a periampullary tumor. The axial CT image (a) shows hypodensity of the right lobe in comparison to left lobe, which is consistent with fat accumulation. The differential diagnosis from the findings on this CT image includes a transient hepatic attenuation difference; however, in this case, the attenuation difference persisted on other phases. Axial in- and out-of-phase (b, c) T1-weighted MR images show signal drop in left lobe of liver on out-of-phase images consistent with steatosis.
Conflict of interest disclosure
The authors declared no conflicts of interest.

References


