Hepatic sarcoidosis: MR appearances in patients with chronic liver disease

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Sarcoidosis is a systemic granulomatous disease of unknown cause, characterized by the development and accumulation of noncaseating granulomas, which can involve almost any organ, but most commonly affects the lung. The liver can be involved in the setting of sarcoidosis. The incidence of hepatic sarcoidosis is likely underestimated, as patients are frequently asymptomatic, and other clinical manifestations tend to overshadow the clinical course. However, hepatic sarcoidosis may also manifest as granulomatous hepatitis and chronic cholestasis, and portal hypertension. Cirrhosis might develop in a small number of patients possibly due to chronic cholestasis and/or due to the coexistence of other liver-injuring diseases, requiring liver transplantation. Sarcoidosis can cause progressive liver disease with a wide array of histologic features that can mimic those of other primary liver diseases. Liver biopsy and autopsy reveals granulomatous involvement in 24-94% of cases and the classic granulomas in sarcoidosis are predominantly found in the portal triads.

There are several series of computed tomography (CT) and magnetic resonance (MR) findings of acute/subacute liver involvement in systemic sarcoidosis in the radiologic literature. In this setting, minimal hepatomegaly is a usual presentation and detection of hepatic lesions is described in up to 5% of patients. To our knowledge, however, the MR imaging appearances of chronic sarcoid liver disease has only been reported in case reports, frequently describing a macronodular appearance of the liver. Non-radiologic literature has also described in previous reports a possible relation or mimicking presentations of chronic sarcoid liver disease with autoimmune liver diseases.

Thus, the primary purpose of this study was to evaluate the MR imaging appearance of chronic liver disease in patients with pathologically proven liver sarcoidosis, and to determine whether distinctive morphologic features are present. A secondary purpose was to determine if correlation existed between MR imaging and the severity of clinical disease as measured with the Mayo endstage liver disease (MELD) score.
Methods and Materials

Study Population

Institutional review board approval was obtained for this retrospective Health Insurance Portability and Accountability Act-compliant single-center study with waived informed consent.

Our final study population included twenty patients (14 women, 6 men; mean age 45.3 ± 7.9 years; age range 33-60 years; 17 Afro-American, 3 Caucasian). Among the 20 patients, 12 (60%) were African-American women. All patients included had liver biopsy proven diagnosis.

Chronic liver disease was considered when a chronically necroinflammatory process in the liver was present for at least six months. The MELD score is calculated on the basis of the total serum bilirubin level, the creatinine level, and the international normalized ratio for prothrombin time, using the following formula: \( \text{MELD score} = 3.8 \times \log_{10} (\text{total bilirubin, mg/dL}) + 11.2 \times \log_{10}(\text{INR}) + 9.6 \times \log_{10} (\text{creatinine, mg/dL}) \) (27).

Three patients did not have all of the serologic data necessary to calculate the MELD score; thus, the MELD score was calculated for 17 patients. In our study population, 5/17 (29.4%) patients were classified into group 1; 11/17 (64.7%) were classified into group 2, and 1/17 (5.9%) was classified into group 3.

MR Technique

All MR studies were performed at 1.5T (Vision, Sonata or Avanto, Siemens Medical Systems, Malvern, PA) or 3.0T (Trio, Siemens Medical Systems, Malvern, PA) MR systems using a phased-array torso coil in all patients.

All MR imaging examinations were performed with the following protocol: transverse and coronal T1-weighted in-phase gradient-echo; transverse T1-weighted out-of-phase gradient-echo; T2-weighted sequences that included a fat-suppressed turbo spin-echo sequence and/or a fat-suppressed half-Fourier rapid acquisition with relaxation enhancement (RARE) sequence in the transverse and coronal planes. The details of the sequence parameters used at 1.5T and 3.0T MRI scanners are displayed in Table 1. Intravenous gadobenate dimeglumine (MultiHance, Bracco Diagnostics, Princeton, NJ, USA) were administered as a power-injected (Meadrad, Pittsburgh, PA) bolus of 0.05
mmol/kg at 2 mL/s in all patients followed by a bolus 20 mL of saline flush. Dynamic T1-weighted post-contrast study was performed for all patients.

**Image Interpretation**

All MR images were retrospectively reviewed by two abdominal radiologists with 5 and 4 years of experience in MR imaging of the abdomen, respectively. These observers first evaluated all MR images independently; they then performed a consensus reading of results of all MR imaging studies.

The MRI features evaluated included: (a) the presence of imaging findings suggestive of liver cirrhosis; (b) the imaging pattern of the liver parenchyma; (c) the presence of periportal increase in signal intensity on T2-weighted images; (d) the presence and grade of intrahepatic biliary dilatation; (e) the dynamic enhancement characteristics; (f) the presence or absence of visible venous thrombosis; (g) the presence or absence of venous macroscopic collaterals; (h) the presence of splenic nodules; (i) and the presence of lymphadenopathy at the porta hepatis or celiac axis.

Imaging findings that were considered suggestive of liver cirrhosis included hypertrophy of the left lobe and/or the caudate lobe, atrophy of the right lobe, irregularity of the liver contour, a nodular or reticular pattern of the liver parenchyma, and signs of portal hypertension such as splenomegaly and the presence of portosystemic collateral vessels. The imaging pattern of the liver parenchyma was subjectively characterized as follows: pattern A, no imaging findings of cirrhosis and a normal volume liver; pattern B, no imaging findings of cirrhosis and liver with increased volume; pattern C, a large macronodular pattern of cirrhosis, with nodules 3 cm or larger; or pattern D, a diffuse pattern of cirrhosis, with nodules smaller than 3 cm or no nodules. The distribution of large (3 cm or larger) nodules was evaluated in terms of their lobar location, whether they were located exclusively in the central portion of the liver (central two-thirds) or in the central and peripheral portions of the liver. The observers assessed the number and size of the macroregenerative nodules, and qualitatively assessed their signal intensity on T1-weighted and T2-weighted MR images, and gadolinium enhancement. Signal intensity and contrast enhancement of the macroregenerative nodules and of abnormal areas of liver parenchyma were compared with those seen in surrounding liver parenchyma, and nodules and abnormal areas were rated as isointense, hyperintense, or hypointense and as isoenhancing, hyperenhancing, or hypoenhancing.

Intrahepatic ductal dilatation was considered present if intrahepatic ducts were of greater diameter than more central ducts or if they were greater than 3 mm. Intrahepatic biliary ductal dilatation was regarded as general when it involved the entire liver and
as segmental when it involved only segmental or subsegmental areas. The severity of intrahepatic ductal dilatation was subjectively graded as mild, moderate, or severe, where mild dilatation was regarded as that with a maximum diameter of less than 4 mm, moderate as that with a diameter between 4 and 6 mm, and severe as that with a diameter larger than 6 mm.

The liver was further evaluated for segmental or subsegmental areas of parenchymal atrophy. Signal intensity and contrast enhancement of the macroregenerative nodules and of abnormal areas of liver parenchyma were compared with those seen in surrounding liver parenchyma.

Splenic nodules size and signal characteristics were recorded.

Lymphadenopathy in the porta hepatis and celiac axis were considered when the short axis of the lymph nodes was greater than 1 cm.

**Statistical Analysis**

Descriptive statistical analyses with simple contingency tables were performed to characterize the data and to determine the frequencies of the imaging findings. K scores were calculated to assess interobserver agreement (28). Fisher exact test was used for categorical data, McNemar test was used for paired data, and the Wilcoxon -Mann -Whitney U test was used for rated scores. For all tests, $p < 0.05$ was considered to indicate a statistically significant difference. All data were analyzed with the statistical package, JMP (SAS Institute, Cary, NC, USA).
### Table 1: Parameters of Sequences Used at 1.5T and 3.0T MRI Scanners

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Precontrast sequences</th>
<th>Postcontrast sequences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.0T</td>
<td>1.5T</td>
</tr>
<tr>
<td>TR (milliseconds)</td>
<td>2000</td>
<td>1500</td>
</tr>
<tr>
<td>TE (milliseconds)</td>
<td>95</td>
<td>90</td>
</tr>
<tr>
<td>Flip angle(°)</td>
<td>150</td>
<td>180</td>
</tr>
<tr>
<td>Echo train length</td>
<td>179</td>
<td>156</td>
</tr>
<tr>
<td>BW/pixel (Hz)</td>
<td>781</td>
<td>651</td>
</tr>
<tr>
<td>Matrix (phase x frequency)</td>
<td>204x256</td>
<td>192x256</td>
</tr>
<tr>
<td>FOV (mm)</td>
<td>350x350</td>
<td>400x400</td>
</tr>
<tr>
<td>Rectangular FOV</td>
<td>87.50%</td>
<td>81.30%</td>
</tr>
<tr>
<td>No. of section</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>Section thickness (mm)</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Intersectional gap (mm)</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>No. of signal acquisition</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fat suppression</td>
<td>Fat sat</td>
<td>Fat sat</td>
</tr>
<tr>
<td>Respiratory control</td>
<td>BI</td>
<td>BI</td>
</tr>
</tbody>
</table>

Note: a = T1-weighted 2D-SGE was used to acquire images in the hepatic arterial dominant phase at older 1.5T scanners. In the portal venous phase and interstitial phase a dynamic 3D-GRE sequence was used.

b = Dynamic 3D-GRE sequences were used to acquire all three postcontrast phases at 3.0T and at most recent 1.5T scanners.

TR = repetition time; TE = echo time; Hz = Hertz; FOV = field of view; RARE = rapid acquisition with relaxation enhancement; SGE = spoiled gradient echo; 3D-GRE = three-dimensional gradient echo; BI = Breathing-independent; BH = Breath-hold

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Results

Interobserver agreement at independent reading of images, as expressed by the k score, ranged between 0.74 and 1 for all parameters. MR imaging findings suggestive of liver cirrhosis were observed in 14 (70%) of 20 patients (4 men and 10 women with cirrhosis) by both readers. Six of 20 (30%) patients did not have findings suggestive of cirrhosis, 3/20 (15%) with pattern A and 3/20 (15%) with pattern B. Imaging pattern C was observed in 9/20 (45%) patients (Figs. 1 and 2). The macroregenerative nodules were located only in the central part of the liver in 8/9 (89%) patients. The number of large macroregenerative nodules per patient ranged between 1-5 in 7 patients and more than 5 in 2 patients. The mean size of the macroregenerative nodules was 6.3 ± 1.6 cm; the maximum size was 10.3 cm. The signal intensity on nonenhanced MR images and gadolinium enhancement characteristics of these nodules are described in Table 2. Imaging pattern D was observed in 5/20 (25%) patients. Peripheral wedge-shaped areas of parenchymal atrophy were observed in 10/20 (50%) patients. These 10 patients represented 71% of the 14 patients who had MR findings of cirrhosis. The combination of a macronodular pattern of liver cirrhosis and the presence of wedge-shaped areas of peripheral parenchymal atrophy was observed in 9/20 (45%) patients (Figs. 1 to 5 and 6 to 9). The signal intensity characteristics of these wedge-shaped areas on nonenhanced T1-weighted and T2-weighted MR images and gadolinium enhancement patterns are described in Table 3. Periportal increase in signal intensity on T2-weighted images was observed in 10/20 (50%) patients. Intrahepatic biliary ductal dilatation was present in 4/20 (20%) patients. Ductal dilatation was rated as mild in 3/4 (75%) and severe in 1/4 (25%) of these patients. Splenic nodules were observed in 3/20 (15%) patients and lymphadenopathy was present in 8/20 (40%) patients. The pattern of liver cirrhosis had statistically significant correlation with the presence of wedge-shaped areas of parenchymal atrophy ($p<0.005$). None of the other correlations between the imaging findings showed statistic significance. The clinical score (MELD) and the imaging findings did not have a linear relationship ($p>0.05$). The results of MELD vs parenchymal pattern are presented in Table 4. No statistically significant difference was revealed between the clinical score of patients who had imaging findings suggestive of cirrhosis and those who did not ($p>0.05$ Mann-Whitney U test).
Table 4: Liver Parenchyma Pattern

<table>
<thead>
<tr>
<th>MELD Score</th>
<th>No Cirrhosis</th>
<th>Large Regenerative Nodules</th>
<th>Diffuse Cirrhosis</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>3 (18)</td>
<td>2 (12)</td>
<td>0</td>
<td>5 (30)</td>
</tr>
<tr>
<td>10-29</td>
<td>3 (18)</td>
<td>6 (35)</td>
<td>2 (12)</td>
<td>11 (65)</td>
</tr>
<tr>
<td>20-29</td>
<td>0</td>
<td>1 (5)</td>
<td>0</td>
<td>1 (5)</td>
</tr>
<tr>
<td>Total</td>
<td>6 (36)</td>
<td>9 (52)</td>
<td>2 (12)</td>
<td>17 (100)*</td>
</tr>
</tbody>
</table>

Note – Numbers are numbers of patients. Numbers in parenthesis are percentages.
* MELD score was calculated for 17 patients, because the other three did not have all of the serologic data necessary.

Table 2

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Table 3: Signal Intensity and Gadolinium enhancement of Peripheral Wedge-shaped Areas of Parenchymal Atrophy in 10 Patients

<table>
<thead>
<tr>
<th>Signal Intensity on T1-weighted MR Images</th>
<th>Signal Intensity on T2-weighted MR Images</th>
<th>Hyperintense</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypointense</td>
<td>0</td>
<td>1 (10)</td>
<td>2 (20)</td>
</tr>
<tr>
<td>Isointense</td>
<td>0</td>
<td>1 (10)</td>
<td>2 (20)</td>
</tr>
<tr>
<td>Hyperintense</td>
<td>0</td>
<td>1 (10)</td>
<td>2 (20)</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>5 (50)</td>
<td>10 (100)</td>
</tr>
</tbody>
</table>

Enhancement Immediately after Gadolinium Chelate Administration

<table>
<thead>
<tr>
<th>Signal Intensity on T1-weighted MR Images</th>
<th>Signal Intensity on T2-weighted MR Images</th>
<th>Hyperintense</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypointense</td>
<td>0</td>
<td>3 (30)</td>
<td>3 (30)</td>
</tr>
<tr>
<td>Isointense</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hyperintense</td>
<td>0</td>
<td>7 (70)</td>
<td>7 (70)</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>10 (100)</td>
<td>10 (100)</td>
</tr>
</tbody>
</table>

Note – Numbers are numbers of patients. Numbers in parenthesis are percentages.

Table 3

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<table>
<thead>
<tr>
<th>Signal Intensity on T1-weighted MR Images</th>
<th>Signal Intensity on T2-weighted MR Images</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypointense</td>
<td>0</td>
</tr>
<tr>
<td>Isointense</td>
<td>1 (11)</td>
</tr>
<tr>
<td>Hyperintense</td>
<td>1 (11)</td>
</tr>
<tr>
<td>Total</td>
<td>2 (22)</td>
</tr>
<tr>
<td>Enhancement Immediately after Gadolinium Chelate Administration</td>
<td>Enhancement 2 Minutes after Gadolinium Chelate Administration</td>
</tr>
<tr>
<td>Hypointense</td>
<td>2 (22)</td>
</tr>
<tr>
<td>Isointense</td>
<td>1 (11)</td>
</tr>
<tr>
<td>Hyperintense</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>3 (33)</td>
</tr>
</tbody>
</table>

Note – Numbers are numbers of patients. Numbers in parenthesis are percentages.

Table 4

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**Fig. 1:** 43-year-old male with hepatic sarcoidosis. MR images at 1.5T: Transverse T2-weighted half-Fourier RARE (TR/TE -1500/90) (1). Transverse T1-weighted fat-suppressed three-dimensional gradient-echo (3DGRE) (TR/TE/Flip angle - 4.3/1.6/10) in the precontrast phase (2), in the hepatic arterial dominant phase (HADP) (3), and in the interstitial phase (IP) of enhancement (4). Coronal T1-weighted fat-suppressed 3DGRE in the IP (5). There is a macronodular pattern of liver cirrhosis with prominent central macroregenerative nodularity. Note that the liver periphery shows heterogeneous enhancement on HADP image (3), fading to isointensity with the remaining liver parenchyma on IP image (4) suggesting, acute-on-chronic inflammatory changes.

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**Fig. 2:** 43-year-old male with hepatic sarcoidosis. MR images at 1.5T: Transverse T2-weighted half-Fourier RARE (TR/TE -1500/90) (1). Transverse T1-weighted fat-suppressed three-dimensional gradient-echo (3DGRE) (TR/TE/Flip angle - 4.3/1.6/10) in the precontrast phase (2), in the hepatic arterial dominant phase (HADP) (3), and in the interstitial phase (IP) of enhancement (4). Coronal T1-weighted fat-suppressed 3DGRE in the IP (5). There is a macronodular pattern of liver cirrhosis with prominent central macroregenerative nodularity. Note that the liver periphery shows heterogeneous enhancement on HADP image (3), fading to isointensity with the remaining liver parenchyma on IP image (4) suggesting, acute-on-chronic inflammatory changes.
Fig. 3: 43-year-old male with hepatic sarcoidosis. MR images at 1.5T: Transverse T2-weighted half-Fourier RARE (TR/TE -1500/90) (1). Transverse T1-weighted fat-suppressed three-dimensional gradient-echo (3DGRE) (TR/TE/Flip angle - 4.3/1.6/10) in the precontrast phase (2), in the hepatic arterial dominant phase (HADP) (3), and in the interstitial phase (IP) of enhancement (4). Coronal T1-weighted fat-suppressed 3DGRE in the IP (5). There is a macronodular pattern of liver cirrhosis with prominent central macroregenerative nodularity. Note that the liver periphery shows heterogeneous enhancement on HADP image (3), fading to isointensity with the remaining liver parenchyma on IP image (4) suggesting, acute-on-chronic inflammatory changes. 211x146mm (300 x 300 DPI)

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Fig. 4: 43-year-old male with hepatic sarcoidosis. MR images at 1.5T: Transverse T2-weighted half-Fourier RARE (TR/TE -1500/90) (1). Transverse T1-weighted fat-suppressed three-dimensional gradient-echo (3DGRE) (TR/TE/Flip angle - 4.3/1.6/10) in the precontrast phase (2), in the hepatic arterial dominant phase (HADP) (3), and in the interstitial phase (IP) of enhancement (4). Coronal T1-weighted fat-suppressed 3DGRE in the IP (5). There is a macronodular pattern of liver cirrhosis with prominent central macroregenerative nodularity. Note that the liver periphery shows heterogeneous enhancement on HADP image (3), fading to isointensity with the remaining liver parenchyma on IP image (4) suggesting, acute-on-chronic inflammatory changes.

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**Fig. 5:** 43-year-old male with hepatic sarcoidosis. MR images at 1.5T: Transverse T2-weighted half-Fourier RARE (TR/TE -1500/90) (1). Transverse T1-weighted fat-suppressed three-dimensional gradient-echo (3DGRE) (TR/TE/Flip angle - 4.3/1.6/10) in the precontrast phase (2), in the hepatic arterial dominant phase (HADP) (3), and in the interstitial phase (IP) of enhancement (4). Coronal T1-weighted fat-suppressed 3DGRE in the IP (5). There is a macronodular pattern of liver cirrhosis with prominent central macroregenerative nodularity. Note that the liver periphery shows heterogeneous enhancement on HADP image (3), fading to isointensity with the remaining liver parenchyma on IP image (4) suggesting, acute-on-chronic inflammatory changes.

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Fig. 6: 54-year-old female with hepatic sarcoidosis. MR images at 1.5T: Transverse T2-weighted fatsuppressed half-Fourier RARE (TR/TE -1500/90) (6). Transverse T1-weighted fat-suppressed twodimensional gradient-echo (2D-GRE) (TR/TE/Flip angle - 142/4.4/70) in the precontrast phase (7) and in the hepatic arterial dominant phase (HADP) (8). Transverse T1-weighted fat-suppressed three-dimensional gradient-echo (3D-GRE) (TR/TE/Flip angle - 4.3/1.6/10) in the interstitial phase (IP) of enhancement (9). Note central regeneration of the liver with presence of macroregenerative nodules, which result in peripheral atrophy and ductal dilatation due to obstruction. This pattern of liver cirrhosis is most characteristically found in patients with primary sclerosing cholangitis (PSC). Patients with sarcoidosis presenting with MR imaging findings suspicious for PSC, the diagnosis of sarcoidosis should be strongly considered. 209x158mm (300 x 300 DPI)
Fig. 7: 54-year-old female with hepatic sarcoidosis. MR images at 1.5T: Transverse T2-weighted fatsuppressed half-Fourier RARE (TR/TE -1500/90) (6). Transverse T1-weighted fat-suppressed twodimensional gradient-echo (2D-GRE) (TR/TE/Flip angle - 142/4.4/70) in the precontrast phase (7) and in the hepatic arterial dominant phase (HADP) (8). Transverse T1-weighted fat-suppressed three-dimensional gradient-echo (3D-GRE) (TR/TE/Flip angle - 4.3/1.6/10) in the interstitial phase (IP) of enhancement (9). Note central regeneration of the liver with presence of macroregenerative nodules, which result in peripheral atrophy and ductal dilatation due to obstruction. This pattern of liver cirrhosis is most characteristically found in patients with primary sclerosing cholangitis (PSC). Patients with sarcoidosis presenting with MR imaging findings suspicious for PSC, the diagnosis of sarcoidosis should be strongly considered. 209x158mm (300 x 300 DPI)

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Fig. 8: 54-year-old female with hepatic sarcoidosis. MR images at 1.5T: Transverse T2-weighted fatsuppressed half-Fourier RARE (TR/TE -1500/90) (6). Transverse T1-weighted fat-suppressed twodimensional gradient-echo (2D-GRE) (TR/TE/Flip angle - 142/4.4/70) in the precontrast phase (7) and in the hepatic arterial dominant phase (HADP) (8). Transverse T1-weighted fat-suppressed three-dimensional gradient-echo (3D-GRE) (TR/TE/Flip angle - 4.3/1.6/10) in the interstitial phase (IP) of enhancement (9). Note central regeneration of the liver with presence of macreregenerative nodules, which result in peripheral atrophy and ductal dilatation due to obstruction. This pattern of liver cirrhosis is most characteristically found in patients with primary sclerosing cholangitis (PSC). Patients with sarcoidosis presenting with MR imaging findings suspicious for PSC, the diagnosis of sarcoidosis should be strongly considered. 209x158mm (300 x 300 DPI)
**Fig. 9:** 54-year-old female with hepatic sarcoidosis. MR images at 1.5T: Transverse T2-weighted fatsuppressed half-Fourier RARE (TR/TE -1500/90) (6). Transverse T1-weighted fat-suppressed twodimensional gradient-echo (2D-GRE) (TR/TE/Flip angle - 142/4.4/70) in the precontrast phase (7) and in the hepatic arterial dominant phase (HADP) (8). Transverse T1-weighted fat-suppressed three-dimensional gradient-echo (3D-GRE) (TR/TE/Flip angle - 4.3/1.6/10) in the interstitial phase (IP) of enhancement (9). Note central regeneration of the liver with presence of macroregenerative nodules, which result in peripheral atrophy and ductal dilatation due to obstruction. This pattern of liver cirrhosis is most characteristically found in patients with primary sclerosing cholangitis (PSC). Patients with sarcoidosis presenting with MR imaging findings suspicious for PSC, the diagnosis of sarcoidosis should be strongly considered. 209x158mm (300 x 300 DPI)

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Conclusion

To our knowledge, this is the first series report of sarcoid-related chronic liver disease. The majority (70%) of all patients in our study population had imaging findings of liver cirrhosis. The MR imaging appearance of the liver parenchyma, however, was not uniform. We observed four patterns: pattern A, no imaging findings of liver cirrhosis (15% of patients); pattern B, no imaging findings of liver cirrhosis, but enlarged liver volume (15% of patients); pattern C, large macronodular pattern of liver cirrhosis (45% of patients); and pattern D, a diffuse pattern of liver cirrhosis (25% of patients).

The combination of a macronodular pattern of liver cirrhosis and the presence of wedge-shaped areas of parenchymal atrophy was observed in 9/20 (45%) patients. This combination is also common in the setting of PSC (30). Biliary ductal dilatation was observed in 20% of all the patients, representing 29% of the patients with other findings of cirrhosis.

Periportal increased tissue, best demonstrated as high signal intensity on T2-weighted images, has been described in patients with hepatic sarcoidosis (17, 18). We found 10 patients with this finding, but this is a nonspecific finding. It has been postulated that periportal increased signal on T2-weighted images may reflect the presence of sarcoid granulomas, which show predilection to develop along the portal tracts (5).

As in previous studies (12), we found that a high percentage (40%) of patients had lymphadenopathy. However, there was no correlation between other imaging findings and lymphadenopathy. Prior studies reported splenic nodules being more common than hepatic nodules. We observed only 3 patients with splenic nodules, one with scattered hypointense nodules, suspicious for splenic granulomas from sarcoidosis and two with siderotic nodules, which are nonspecific findings of chronic portal hypertension. This may be explained by that all our patients had chronic liver disease, and perhaps the imaging appearance of splenic granulomas may diminish or disappear with advancing disease. This may emulate the pattern of disease that occurs in the thorax, where lymph nodes tend to recede as interstitial lung disease progresses (2, 3).

The correlation between the MELD score and various imaging findings was not significant. This may reflect that some patients were receiving treatment, probably resulting in a complex clinical status. This suggests that morphologic changes per se may not enable an adequate characterization of the severity of liver compromise. This lack of correlation between MELD score and morphological findings has been previously reported for other autoimmune liver conditions (30, 31).
In conclusion, we have described the MR appearances of hepatic sarcoidosis in patients with chronic liver disease. Liver cirrhosis was seen in 70% of the cases. A central macronodular pattern of liver cirrhosis associated with peripheral atrophy was the most common pattern of liver cirrhosis and their presence should strongly suggest the diagnosis in patients with sarcoidosis, although this appearance is typically seen in patients with PSC. As we observed similar features for sarcoidosis as has been described for PSC, a controlled comparison between MR studies in these patient groups may be warranted. It is important to recognize that hepatic sarcoidosis may result in a pattern of chronic liver disease that is similar to description of PSC, as therapies, follow-ups and outcomes are different for these entities. No significant correlation was found between MR morphologic features of cirrhosis and the MELD score.
References


