

Evaluating Cirrhosis on High-Resolution 3D MRA of the Liver

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Purpose: Liver cirrhosis often is an indolent disease with non-specific clinical and laboratory abnormalities. The purpose of this study is to determine if vascular imaging features on high-resolution MRA of the liver can predict presence and severity of cirrhosis.

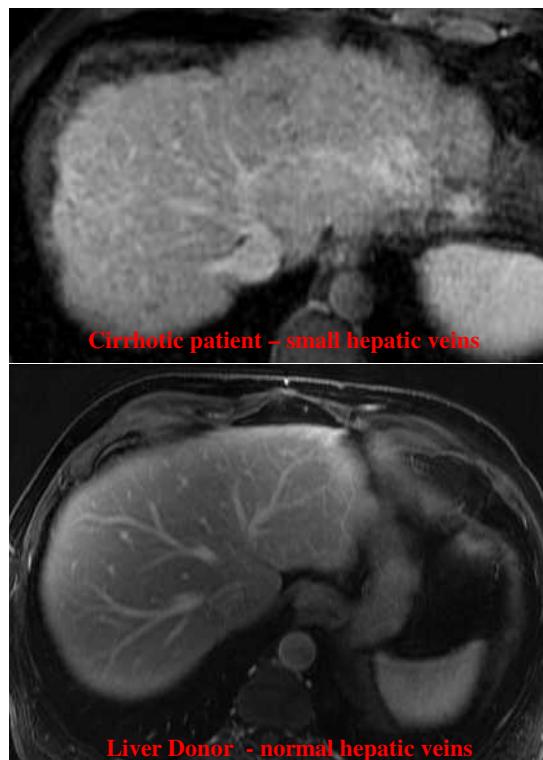
Methods: Patients with biopsy-confirmed cirrhosis (n=100) and healthy candidates for liver donation (n=89) underwent dynamic Gd-enhanced 3D MR on a 1.5 T GE scanner using an 8-channel phased array coil and LAVA (3D spoiled gradient echo imaging with fat suppression and 2-fold acceleration by parallel imaging). Imaging parameters: 512 x 256 matrix and 4.4 mm slice thickness reconstructed with 50% overlap. Images were obtained pre, during the arterial phase of a 30ml bolus injection at 2.5ml/s and post Gd. Diameters of portal veins, hepatic veins, IVC, renal veins, SMV and splenic vein as well as caudate lobe dimensions/volume, right lobe width, right and left lobe volume, spleen volume, gallbladder wall and colon wall thickness, presence of splenorenal shunt and recanalized umbilical veins were determined by two radiologists. Clinical and laboratory data including the model for end-stage liver disease (MELD) score were collected by reviewing hospital medical records and correlated with the MR imaging features. Statistical analyses included Student t test and Pearson correlation coefficient using SPSS 11.0 software

Results: Gd-enhanced 3D LAVA of the abdomen showed the morphological features of liver cirrhosis including narrowing of hepatic veins (see figures), enlargement of spleen, nodular liver surface, ascites, regenerative nodules, atrophy of right lobe, porto systemic collaterals, and expanded gallbladder fossa. Hepatic veins were significantly smaller in patients with cirrhosis measuring 4.9, 4.6 and 4.5 mm for right, middle and left hepatic veins compared to 10.9, 9.0 and 8.5 mm in liver donors (Table 1, p<<0.001). Hepatic vein diameters had the strongest negative correlations with cirrhosis ($r = -0.7, -0.7$ and -0.6 for right, left and middle hepatic veins respectively, $p < 0.05$). Spleen volume was positively correlated with liver cirrhosis with a correlation coefficient of $r = 0.6$. These correlations were nearly as high as the MELD score ($r = 0.7$).

Right portal veins were smaller in cirrhotic patients measuring 4.8 mm (anterior) and 4.7 (posterior) mm, compared to 5.9 and 5.7 mm ($p << 0.001$) in liver donors. The diameter of main and left portal veins were not significantly different except when there was a recanalized umbilical vein causing dilation of the left portal vein to 11.8 mm compared to 9.5 mm without recanalization of the umbilical vein ($p < 0.05$). Renal veins were slightly smaller in cirrhotic patients except in the presence of splenorenal shunt when the left renal vein was larger, 12.3 mm compared to 8.8 mm without splenorenal shunt.

Table 1. MRI features of cirrhosis compared to normal liver

Parameter	R	p	cirrhotic	normal	ratio
Spleen Volume	0.62	<.001	668	254	2.63
Right hepatic vein	0.68	<.001	4.9	10.9	0.45
Left hepatic vein	0.66	<.001	4.6	9.0	0.51
Middle hepatic vein	0.60	<.001	4.5	8.5	0.53
Main portal vein	0.27	0.2	12.4	11.6	1.07
Splenic vein	0.24	0.001	10.0	8.8	1.14
Gall bladder wall	0.47	<.001	2.9	2.1	1.38
Colon wall thickness	0.38	<.001	3.3	2.4	1.37
Right hepatic lobe	0.37	<.001	780	1025	0.76
Left hepatic lobe	0.23	0.001	596	496	1.20
Liver volume	0.17	0.02	1362	1515	0.90
Caudate lobe AP	0.34	<.001	3.9	3.3	1.18
Caudate lobe LR	0.30	<.001	4.4	3.8	1.16
Caudate lobe SI	0.13	0.07	5.0	4.8	1.04



Conclusion: Liver cirrhosis and its complications constitute an important clinical challenge. The diagnosis of cirrhosis is traditionally established with the invasive method of liver biopsy. The reported sensitivity and specificity of MRI in diagnosing liver cirrhosis are in the range of~80%. These data from 100 cirrhotic patients and 89 healthy liver donors show the hepatic vein diameter reduction correlates with cirrhosis nearly as strongly as the MELD score. This may help diagnose cirrhosis without liver biopsy when other imaging features, e.g. nodularity, small size, heterogeneity, ascites, splenomegaly and varices are ambiguous. A large left renal vein suggests the presence of spleno-renal shunt and an enlarged left portal vein is associated with recanalized umbilical vein.

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