Mangafodipir-enhanced 3D MR Cholangiography versus Conventional T2-weighted MR Cholangiography for Intrahepatic Biliary Anatomy in Living Liver Transplant Donor Candidates

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Introduction/Background

The shortage of cadaveric livers has led surgeons to develop new techniques to allow living donors to donate the right lobe of their livers for transplantation into needy adult recipients. Biliary anatomy variants are seen in 24% to 57% of the population, and these typically involve anomalous drainage of the lateral duct of the right lobe. Biliary variants are associated with an increased risk of post-operative complications in both the donor and recipient. Existing MR imaging techiques rely on conventional T2-weighted turbo spin echo methods, which may be inadequate for characterization of intrahepatic biliary anatomy in subjects with nondilated systems.

Purpose

To test a new method for defining intrahepatic ductal anatomy using mangafodipir trisodium and high-resolution 3D T1-weighted GRE in donor candidates for adult-to-adult right lobe transplantation and to compare results with conventional T2-weighted MR imaging, using combined interpretation and intraoperative cholangiography as the reference standards.

Methods and Materials

108 consecutive healthy liver transplant donor candidates were imaged at 1.5T using a phased-array coil using two MR cholangiographic methods. First, breath-hold axial and coronal half-Fourier acquisition single-shot turbo spin echo (HASTE) and oblique coronal heavily T2-weighted turbo spin echo imaging (2800/1100/150-180°) were performed. Second, ten minutes after a standard iv dose of mangfodipir trisodium (5 umol/kg, Teslascan; Nycomed), two separate breath-hold fat-suppressed 3D GRE sequences were performed--one using a coronal high-resolution acquisition through the ducts (6.8/2.3/25-40°, 128-256 x 512 matrix, ≤ 1.5 mm slices) and the second using an axial sequence through the entire liver (4.5/1.9/25-40°, 128-160 x 256 matrix, ≤ 2 mm slices).

Interpretation of biliary anatomy and degree of confidence (scale 1-5, 5 highest) were recorded by two independent blinded readers using 3D mangafodipir and T2-weighted images separately, and then using both sets together. We performed one set of analyses using the combined interpretation together. Additionally, intraoperative cholangiography served as the reference standard in the subset of 51 subjects who underwent right hepatectomy.

Results

Biliary anatomy was visualized in all patients using mangafodipir. 3D mangafodipir-enhanced imaging agreed with combined interpretations more often (106/108, 98%) than T2-weighted imaging (89/108, 82%) (See Figures 1 and 2).

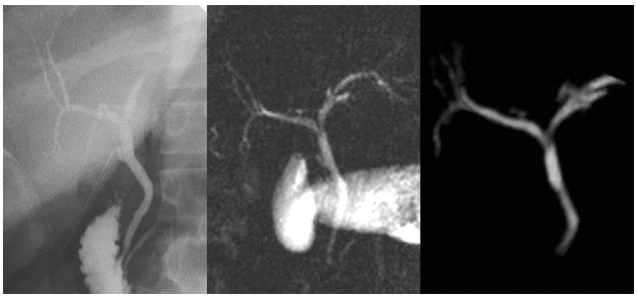

Fig 1. Intraoperative cholangiogram (left), T2 MRC, and MIP from mangafodipir MRC show normal biliary anatomy.

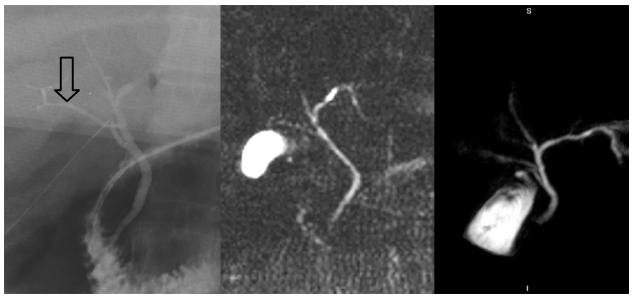

Fig 2. Example of aberrant right lateral duct draining directly common hepatic duct (arrow) which was missed on T2 imaging (middle) but easily seen on mangafodipir MRC (right).

In the subset of 51 subjects with intraoperative cholangiography, mangafodipir-enhanced imaging correctly defined anatomy in 48/51 (94%), compared with 43/51 (84%) for T2-weighted imaging. The combination of both MR techniques correctly identified anatomy in 49/51 (96%) subjects, with a sensitivity of 80% (8/10) and specificity of 100% (41/41) for detection of right duct variants.

Mangafodipir alone	Intraoperative Cholangiography	
MRI	Normal Rt Duct	Variant Rt Duct
Nl Rt Duct	41	3
Variant Rt Duct	0	7

Conventional T2 alone	Intraoperative Cholangiography	
MRI	Normal Rt Duct	Variant Rt Duct
Nl Rt Duct	38	5
Variant Rt Duct	3	5

Two subjects had variant anatomy missed by both MR imaging methods, one involving a small right lateral duct that drained into the cystic duct and a second aberrant right lateral duct that drained into the common hepatic duct. In retrospect, both missed ducts could be visualized on the mangafodipir-enhanced T1-weighted images, but not on T2-weighted imaging.

Conclusion

Mangafodipir-enhanced 3D MR cholangiography improves the definition of intrahepatic biliary anatomy, especially right duct variants, when compared with conventional breath-hold T2-weighted imaging techniques.

References

1. Federle MP, et al. JMRI 2000; 12:186-197. 2. Mitchell DG, Alam F. JMRI 1999; 9:366-368. 3. Lee VS et al. AJR 2001; 176:906-908.