

Volumetric Mangafodipir-Enhanced MR Cholangiography to Define Intrahepatic Biliary Anatomy

Vivian S. LEE¹, Glenn A. KRINSKY¹, Andrew TAN¹, Neil M. ROFSKY², Glyn R. MORGAN³, Lewis W. TEPERMAN³, Michael T. LAVELLE¹, Phil BERMAN¹, Jeffrey C. WEINREB¹

¹New York University Medical Center, 530 First Avenue-MRI, New York, NY USA; ²Harvard Medical School, 330 Brookline Avenue, Boston, MA USA; ³New York University Medical Center, Department of Surgery, New York, NY USA;

Introduction

The shortage of cadaveric livers for transplantation has led to novel surgical techniques for living adult-to-adult right lobe transplantation (1). Preoperative definition of surgical anatomy can be critical to the success of this procedure for both the donor and recipient. In particular, detection of biliary variants in the donor, which are seen in up to 45% of the population, is vital since most variants involve anomalous drainage of the lateral duct of the right lobe (2).

MR cholangiography techniques typically rely on T2-weighted turbo spin-echo techniques and are highly accurate in the identification of biliary pathology. However, definition of intrahepatic anatomic anomalies, particularly in nondilated systems, is often inadequate. Mangafodipir trisodium is a safe and approved hepatobiliary MR contrast agent (3) that is excreted primarily via the biliary system. For normal non-obstructed systems, biliary enhancement on T1-weighted images can be seen within 10 min of iv injection. We describe a new method for defining intrahepatic ductal anatomy in liver transplant donor candidates, using a combination of mangafodipir and high-resolution 3D T1-weighted gradient echo imaging.

Methods

Using an IRB approved protocol, 21 healthy transplant donor candidates were imaged at 1.5T (Vision or Quantum; Siemens Medical Systems, Iselin, NJ). Our routine MR imaging protocol consisted of T2-weighted breath hold STIR imaging and unenhanced and Gd-enhanced axial 2D and 3D T1-weighted gradient echo imaging for assessment of hepatic parenchyma and vascular anatomy.

MR cholangiography included axial and coronal HASTE images (TR/effective TE/refocusing angle = ∞ /62 ms/140-160°, matrix 128-192 x 256, field of view (FOV) 300-375 mm, rectangular FOV, 4 mm slice thickness, 15-20 slices per breath hold) and oblique coronal heavily T2-weighted turbo-spin echo images (2800/1100/150-180°, matrix 240 x 256, FOV 300-375 mm, 20-60 mm section thickness). All images were obtained during suspended respiration.

Mangafodipir trisodium (Teslascan; Nycomed, Princeton, NJ) at a standard dose of 5 μ mol/kg (0.1 ml/kg, up to a maximum of 15 ml) was administered slowly over 1 to 2 minutes iv followed by 10 ml saline flush. Ten min later, 3D imaging of the biliary system was performed using two interpolated sequences with intermittent fat-suppression pulses: a coronal higher resolution sequence with limited coverage: TR/TE/flip angle = 6.8/2.3/25-40°, 128-256 x 512 matrix, 350-450 mm FOV using rectangular FOV, 24 partitions interpolated to 48 slices with \leq 1.5 mm thickness; and an axial lower resolution sequence to include the entire liver: 4.5/1.9/25-40°, 128-160 x 256 matrix, 300-375 mm FOV using rectangular FOV, and 80-112 partitions for \leq 2 mm slice thickness (4). Imaging time for all sequences was kept $<$ 25 sec for breath holding.

3D image sets were viewed (Virtuoso; Siemens, and Vitrea; Vital Images) using volume-rendering and/or maximum intensity projection displays. Two independent blinded readers assessed biliary anatomy using the 3D mangafodipir image sets and T2-weighted images separately, and then using both sets. Interpretation and degree of confidence (scale 1-5, 5 highest) were compared for the two sets. Comparison of imaging findings was made with intraoperative cholangiography in the seven patients who underwent right lobectomy.

Results

Biliary anatomy was visualized in all patients using mangafodipir (Figures 1 and 2). Degree of confidence in defining biliary anatomy was significantly higher for mangafodipir images (4.6) than T2-weighted images (3.9, $p = 0.001$, Wilcoxon signed rank test). Six patients had variants of the right lateral duct on 3D mangafodipir images, while 7 had variants by T2-weighted imaging. Of the 3 discrepant cases (1 considered abnormal by mangafodipir, 2 by T2 imaging), review of both image sets together resulted in consensus that agreed with original mangafodipir interpretation in all three cases. Normal biliary anatomy was predicted by both imaging techniques in

all 7 patients who underwent right hepatectomy, and findings were confirmed at intraoperative cholangiography in 7/7.

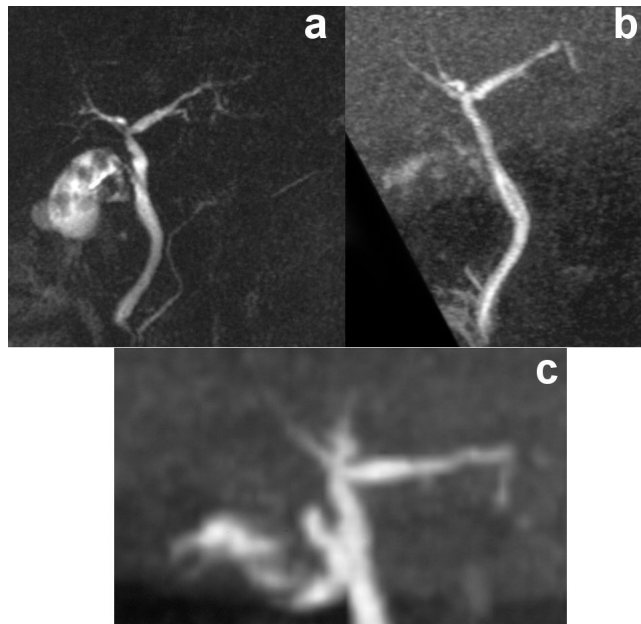


Figure 1

Fig 1.(a) Heavily T2-weighted coronal MRCP depicts possible biliary anomaly, (b) and (c) Mangafodipir-enhanced T1-weighted 3D imaging shows similar equivocal appearance in coronal view (b) which, when reconstructed obliquely in (c), confirms biliary trifurcation.

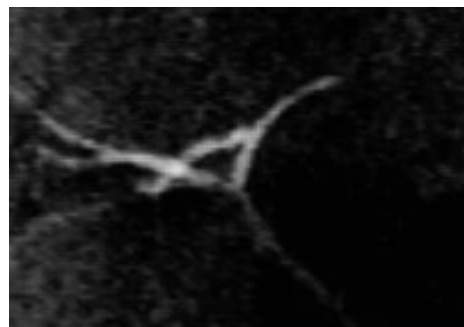


Figure 2

Fig 2. Oblique coronal projection of mangafodipir-enhanced 3D image set shows aberrant drainage of right lateral duct to left duct which excludes this patient from consideration as a right lobe donor.

Discussion

Mangafodipir-enhanced volumetric MR cholangiography provides a valuable alternative method for visualizing intrahepatic biliary duct anatomy in patients with nonobstructed systems, particularly in patients undergoing preoperative evaluation for right lobectomy.

References

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