MR evaluation of biliary anatomy: Comparison of conventional T2-weighted MR cholangiography, 3D T2-weighted MR cholangiography, and mangafodipir trisodium-enhanced MR cholangiography

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Purpose

Living-related liver transplantation is a complicated surgical procedure which poses significant risks to both donor and recipient. A major objective of pre-surgical imaging is to define the biliary anatomy, as the incidence of complications increases with the number of biliary anastamoses required. Numerous biliary variants have been described (1) with a 35% incidence of variants requiring multiple biliary anastamoses (2). Magnetic Resonance Cholangiopancreatography (MRCP) has been shown to be highly accurate for defining donor biliary anatomy, but the optimal MR techniques have yet to be determined. Previous authors have described the superiority of mangafodipir trisodium-enhanced (MTE) MR cholangiography over conventional T2-weighted MRCP (3,4) and of volumetric 3D T2W MR cholangiography over conventional T2W imaging (5). To our knowledge, this is the first study that directly compares all three of these techniques.

Methods

Fifteen consecutive patients were referred for MRCP for preoperative evaluation for potential living related liver donation (n=14) or postoperative evaluation (n=1). Imaging was performed using a 1.5 T magnet (Siemens Vision or Sonata, Erlangen, Germany) and a dedicated phased array coil. MRCP protocol included the following sequences: Coronal and coronal oblique breath-hold "thick-slab" 2D T2W TSE (TR/TE 2800/966-1100, 150-180° flip angle, 250-350 mm FOV, 224-512 x 256-512 matrix and a 40-80 mm slab thickness), coronal respiratory-triggered 3D T2W TSE (TR/TE 1300-1630/622-658, 180° FA, 250-350x250-350 FOV, 241x256 matrix, 1.0-1.2 mm slice thickness), and axial and coronal breathhold fat-suppressed 3D SPGR (TR/TE 3.7/1.2, 35° FA, 350-400 FOV, 288-360 x512 matrix, 0.8-1.5 mm ST) 10 minutes following a slow IV infusion of 0.1 mL/kg (up to 15 mL) of mangafodipir trisodium. Images were evaluated at a workstation by two radiologists independently and in consensus. Sequences were randomized and evaluation was performed at two sessions one week apart to minimize recall bias. Images were scored for overall quality and confidence scores were given for diagnosis of biliary and pancreatic duct anatomy, exclusion of biliary pathology and cystic duct insertion site using a 4 point scale. The highest-order intrahepatic ducts visible were also recorded. A consensus reading using all three MRCP techniques was used as a reference standard for biliary anatomy. Signal-to-noise, contrast-to-noise, normalized SNR and normalized CNR were calculated.

Results

Mean scores for qualitative and quantitative image assessment for the 2D MRCP, 3D MRCP and MTE sequences are shown in the table. Using consensus read as a standard, 2D MRCP correctly described the biliary anatomy in 11/15 (73%), 3D MRCP in 12/15 (80%), and MTE in 14/15 (93%). 3D MRCP and MTE performed similarly in the qualitative measures, though more intrahepatic ducts were visible with MTE ($p<0.04$, Wilcoxon matched-pairs signed-ranks test). Both 3D MRCP and MTE received higher confidence scores for biliary anatomy than 2D MRCP ($p<0.02$ for 2D v. 3D; $p<0.002$ for 2D v. MTE). Normalized SNR and CNR were better for MTE than 3D MRCP ($p<0.0009$, $p<0.00007$) and 2D MRCP ($p<0.00007$, $p<0.00007$).

Technique	Overall Quality	Biliary Anatomy	Highest Order	Biliary Pathology	Pancreatic Duct	nSNR	nCNR
2D MRCP	3.3	2.5	2.9	2.8	2.9	0.74	0.71
3D MRCP	3.3	3.6	3.0	3.5	4.0	31.46	28.58
MTE	3.5	3.6	3.5	3.7	n/a	65.24	46.27
Scores based on 4 point scale 1=uninterpretable and 4=definite diagnosis							

Figure 1. From left to right, 2D MRCP, 3D MRCP and mangafodipir trisodium enhanced image depicting drainage of the posterior right hepatic duct into the left hepatic duct, a common variant

References

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Discussion: These results confirm the superiority of 3D T2 MRCP over conventional 2D MRCP and of mangafodipir trisodium-enhanced (MTE) MR cholangiography over 2D MRCP. MTE performed slightly better than 3D MRCP, more often correctly describing the biliary anatomy, allowing visualization of more intrahepatic ducts, and providing better normalized signal-to-noise and contrast-to-noise ratios.