Additive value of Non Contrast MRA for evaluation of Mesenteric Arterial Anatomy in Preoperative Planning for Living Donor Liver Transplants.

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TARGET AUDIENCE: Clinical radiologists and researchers interesting in non gadolinium MRA

PURPOSE: MRI is typically used for initial screening for potential liver donors because it does not use radiation and is currently the best non-invasive method to visualize variant biliary anatomy as CT biliary contrast agents are not currently available in the US. At our institution, left lobe donation is preferred if there is sufficient liver volume for the recipient but identifying left hepatic artery anatomic variants is critical for surgical planning. This study was performed to assess the additive value of non-contrast enhanced MRA (NC-MRA) using a respiratory gated 3D SSFP based sequence for evaluation of liver arterial anatomy in patients under going contrast enhanced MRA (Gd-MRA) for preoperative planning for potential liver donation.

METHODS: Retrospective review of 20 consecutive potential liver donors who underwent MRA for preoperative planning was IRB approved. MRA was performed using a 1.5T GE Magnet (HDxt, software 16.0) and 8-channel phased array coil. Patients underwent NC-MRA (Axial 3D In flow inversion recovery (IFIR), 2 mm slice thickness, matrix 256 x 256, FOV 40 cm, BW 125 Hz, TI 1400) and breath-hold Gd-MRA (Coronal 3D spoiled gradient echo, 3.0 mm ST interpolated to 1.5 mm, 384 x 224, 40 cm FOV, 62.50 BW) following administration of 10 mL of intravenous Gadofosveset Trisodium. 2 readers blinded to patient data, independently reviewed NC-MRA, Gd-MRA and combined data sets during separate read out sessions with randomization of the data sets with at least a two week interval between interpretation sessions. Readers scored the data sets based on a 5 point quality and confidence scale, noted artifacts and performed diagnostic interpretation of the liver arterial anatomy. Readers classified common hepatic, proper hepatic, right and left hepatic artery and segment 4 anatomy based on published reference anatomy and variants. 2 senior radiologists reviewed all data sets, CTA and intraoperative data sets on all patients to serve as reference standard for interpretation of arterial anatomy. The individual reader data sets were compared to the reference standard read for any disagreements and kappa scores. Qualitative assessments were averaged per reader and compared using kappa analysis.

RESULTS: For reader 1, mean diagnostic quality score on NG-MRA was 2.7 (poor-adequate), GD-MRA 3.5 (adequate-good), Combined read 3.25 (adequate-good). Confidence scores of right hepatic arterial anatomy NC-MRA 2.7 (>25-50% confident that anatomy is correct), Gd-MRA 3.5 (>50-75% confident), Combined 3.25 (>50-75% confident), Confidence scores of left hepatic arterial anatomy were similar. For reader 2 (senior resident), mean diagnostic quality score on NG-MRA was 2.9 (poor to adequate), GD-MRA 3.2 (adequate), Combined read 3.45 (adequate). Confidence scores of right hepatic arterial anatomy NC-MRA 4.6 (>75% confident), Gd-MRA 4.6 (>75% confident), Combined read 4.8 (>75% confident), Confidence scores of left hepatic arterial anatomy were not significantly different ($p > 0.5$). For both readers, NC-MRA (n=3) was able to identify segment 4 origin when GD-MRA failed to identify it due to venous contamination on the GD-MRA (n=2) or motion artifact. However, accessory left gastric arteries were missed by NC-MRA (n=3) due to motion artifact or limited field of view and 1 was missed on both NC and GD-MRA.

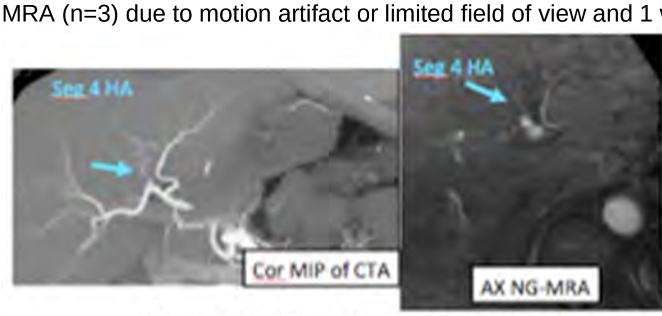

Fig 1.NC-MRA (right) was is agreement with reference standard interpretation and correlated well with CTA finding (left). GD-MRA was suboptimal due to venous contamination, image not shown

Agreement with Reference Standard and Inter-rater Variability

	Common HA	Proper HA	Michel's Classification of Right and Left HA	Segment 4 HA
NG-MRA				
Reader 1	100% (20/20), κ=1.0	95%(18/20), κ=0.82	95% (19/20), κ=0.91	85% (17/20), κ=0.64
Reader 2	100% (20/20), κ=1.0	95%(19/20), κ=0.91	80% (16/20), κ=0.67	75% (15/20), κ=0.45
Reader 1 vs. 2	κ=1.0	κ=0.91	κ=0.74	κ= 0.79
GD-MRA				
Reader 1	100% (20/20), κ=1.0	95% (19/20), κ=0.92	100% (20/20), κ=1.0	80% (16/20), κ= 0.40
Reader 2	95%(19/20), κ= 0.92	95% (19/20), κ=0.92	95% (19/20), κ=0.93	75% (15/20), κ=0.57
Reader 1 vs. 2	κ= 0.93	κ=0.84	κ=0.93	κ= 0.27
NG+GD-MRA				
Reader 1	100% (20/20), κ=1.0	95% (19/20), κ=0.94	100% (20/20), κ=1.0	80%(16/20), κ=0.40
Reader 2	95%(19/20), κ= 0.92	100% (20/20), κ=1.0	95%(19/20), κ= 0.95	85% (17/20), κ=0.68
Reader 1 vs. 2	κ=0.93	κ=0.94	κ=0.95	κ=0.28

DISCUSSION: Liver donor arterial anatomy is not significantly improved by the addition of NC-MRA but can be useful when GD-MRA is suboptimal and further improvements in sequence design would be helpful to limit contrast exposure in this population and increase efficiency of patient throughput. A major limitation of this study aside from small sample size was the 3D inflow SSFP sequence has since been further optimized by the vendor for mesenteric vessels but was not available at the time of this study.

CONCLUSION: Liver donor arterial anatomy is not significantly improved by the addition of NC-MRA but can be useful when GD-MRA is suboptimal.

REFERENCE: 1. Kalra VB, Gilbert JW, Kirshnamoorthy S et al. Value of non-contrast sequences in magnetic resonance angiography of hepatic arterial vasculature. Eur J Radiol. 2014; 83(6):905-8