

HIGH SPATIAL RESOLUTION 3D CE MRA USING EXTREMELY SMALL-SIZED IRON OXIDE NANOPARTICLES(ESION) AT 3T MRI

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Purpose: Extremely small-sized iron oxide nanoparticles (ESION) [1] recently developed an iron oxide based contrast agent was made of 3 nm-sized nanoparticle. Because of small size iron oxide nanoparticles, ESION has low r_2/r_1 ratio and long blood circulation time, unlike existing superparamagnetic iron oxide nanoparticles (SPIO), and that can be utilized as T1 contrast agent like a gadolinium based one without nephrogenic system fibrosis. This study was carried out to evaluate whether ESION is clinically useful through the animal study that acquired first-pass MR image and high spatial resolution 3D MR angiograph at steady-state to compare with gadolinium based contrast agent (Gd-DOTA).

Method: 6 rabbits were examined with ESION and Gd-DOTA on 3.0T MR scanner (Trio Trim, Siemens Healthcare, Erlangen, Germany) using 8-element phase-array coil. Post-contrast imaging with ESION and Gd-DOTA of 3D Flash MRA was started immediately following bolus injection and was repeated at multiple time points for dynamic time-resolved MRA(Coronal, FOV=140x280[mm], TR/TE=2.8/1.0[ms], FA=20[deg], non-interpolated voxel size = 1.1x1.1x1.1[mm³]). It acquired 125um³ - spatial resolution 3D Flash MRA(Coronal, FOV=140x280[mm], TR/TE=3.82/1.48[ms], FA=20[deg], non-interpolated voxel size = 0.5x0.5x0.5[mm³]) about heart and 27um³ - spatial resolution 3D Flash VIBE MRA(Coronal, FOV=140x280[mm], TR/TE=3.82/1.48[ms], FA=20[deg], non-interpolated voxel size = 0.3x0.3x0.3[mm³]) about kidney to ESION-enhanced high spatial resolution blood pool MR images.

Results: Gd-DOTA-enhanced MR image was seen to rapid excretion through urine within 5 minute of bolus injection. However, ESION-enhanced MR image shown that has long circulating time until after 60minute and run away in the body within a week (Figure 1). We measured signal intensity in each solid tissues and vessels as shown in figure 2 that showed similar results between ESION and Gd-DOTA.

Long circulating time of ESION could be made the high spatial resolution MRA that took a long scan time. Figure 3(a) is 125um³ (0.5x0.5x0.5 [mm³]) spatial resolution MR image about heart and (b) is 27um³ (0.3x0.3x0.3 [mm³]) spatial resolution MRA about kidney.

Conclusion: This animal study using recently developed ESION has shown possibility as good T1 contrast agent and blood pool contrast agent through comparing between ESION and Gd-DOTA image in first-pass and steady-state 3D MRA.

References: B.H. Kim, N. Lee, H. Kim, et al. J. Am. Chem. Soc. 2011, 133, 12624-12631.

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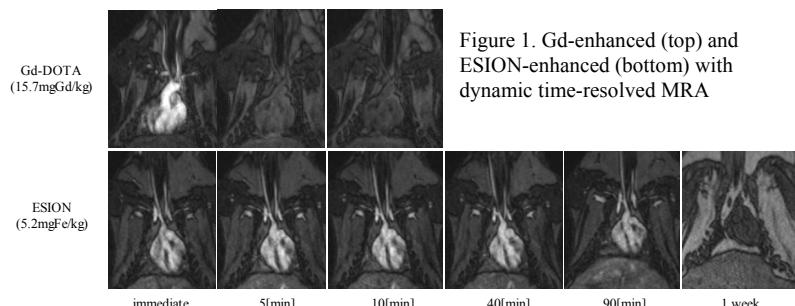


Figure 1. Gd-enhanced (top) and ESION-enhanced (bottom) with dynamic time-resolved MRA

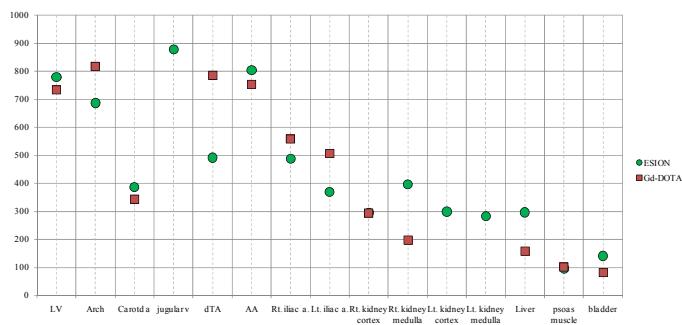


Figure 2. Signal intensity in each tissue between Gd-DOTA and ESION-enhanced MRA

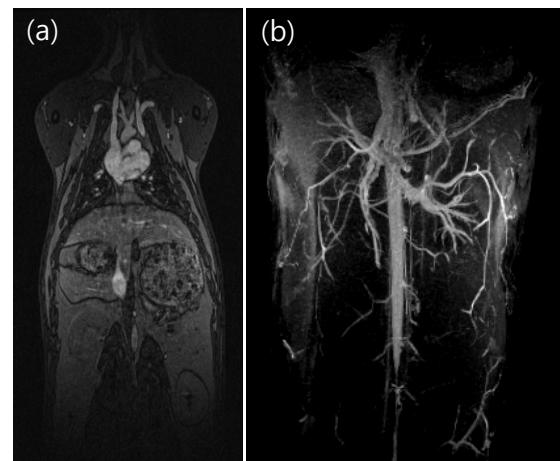


Figure 3. ESION-enhanced high resolution blood pool MRA.
(a) 125um³ 2D-flash image in heart, (b) 27um³ 3D-vibe MRA in kidney