HIGH RESOLUTION ESION-ENHANCED MR ANGIOGRAPHY IN EXTREMITY VESSELS OF RABBIT THIGH AT 3T

Pan-ki Kim[1], Bong-sik Jeon[2], Eun-Ah Park[3], Eung-Gyu Kim[2], Wan-Jae Myeong[2], and Whal Lee[3]
[1]Seoul National University, Seoul, Korea, [2]Hanwha Chemical, Daejeon, Korea, [3]Seoul National University Hospital, Seoul, Korea

Purpose: Recently developed extremely small-sized iron oxide nanoparticles (ESION) contrast agent[1] was made of 3 nm-sized nanoparticles. So that can be utilized as T1 contrast agent like a gadolinium based contrast material due to have a character of high r1, low r2/r1 ratio and long blood half-life, as previous study[2]. This study was carried out to evaluate whether ESION is clinically useful through the rabbit thigh vessels MR angiography that acquired first-pass and equilibrium 3D MR angiography with high spatial resolution to compare with conventional Gd-CE MR angiography and a reference standard digital subtraction angiography (DSA).

Methods: 5 rabbits (New Zealand White rabbits, nearly 3kg weight) were examined with ESION and Gd-DOTA on 3.0T MR scanner (Trio Trim, Siemens Healthcare, Erlangen, Germany). Pre/Post-contrast MRA with ESION and Gd-DOTA was measured immediately before/after bolus injection and then measured at first-pass and equilibrium phase using conventional and high-resolution 3D FLASH MRA sequence.(First pass and 1 min delay phase 3D MRA: TR/TE=3/1.15ms, FA=20°, Voxel size=0.8mm isotropic, FOV=108x205mm, TA=13sec; 0.4mm-high-resolution MRA: TR/TE=7.15/2.81ms, FA=20°, TA=5min; 0.2mm-high-resolution MRA: TR/TE =4.72/1.85ms, FA=20°, TA=10min) For administration of contrast materials, the imaging dose of Gd-DOTA was used 15.7mgGd/kg(0.1mM/kg), ESION was used 5.2mgFe/kg(0.1mM/kg). The CE 3D MRA has been done to acquire the ESION and Gd-enhanced high spatial resolution MR images for thigh vessels at intervals of about a week to make sure the completely excision of contrast media. And then DSA images obtained within 2 weeks of the MR images.

Results: In figure 1, The ESION and Gd-enhanced MRA images by MIP reconstruction and DSA were shown. The ESION, Gd-enhanced MR images (a, b) were seen to considerably resemble the DSA image(c) at first pass. But ESION-enhanced MRA was slightly more expressed the small vessels in rabbit thigh (d). In delay phase, Gd-enhanced MR image was rapidly dropped the blood signal due to excrete the Gd-contrast media through urine within 5 minutes after bolus injection, whereas ESION-enhanced MR images had shown the bright blood signal throughout the image scans. Also the high-resolution images using ESION (f, g) were comparable with DSA in manifestation of extremity vessels on thigh.

Conclusions: This rabbit thigh extremity MRA using recently developed ESION has shown a possibility as superior T1 contrast agent and blood pool contrast agent through comparing between ESION and Gd-DOTA image in first-pass and equilibrium 3D MRA and DSA.

References: 1. B.H. Kim, N. Lee, H. Kim, et al. Large-Scale Synthesis of Uniform and Extremely Small-Sized Iron Oxide Nanoparticles for High-Resolution T-1 Magnetic Resonance Imaging Contrast Agents. J. Am. Chem. Soc. 2011, 133, 12624-12631.
2. P. Kim, B. Jeon, W. Lee, et al. High spatial resolution 3D CE MRA using extremely small sized iron oxide nanoparticles(ESION) at 3T MRI. ISMRM. 2012;1206.

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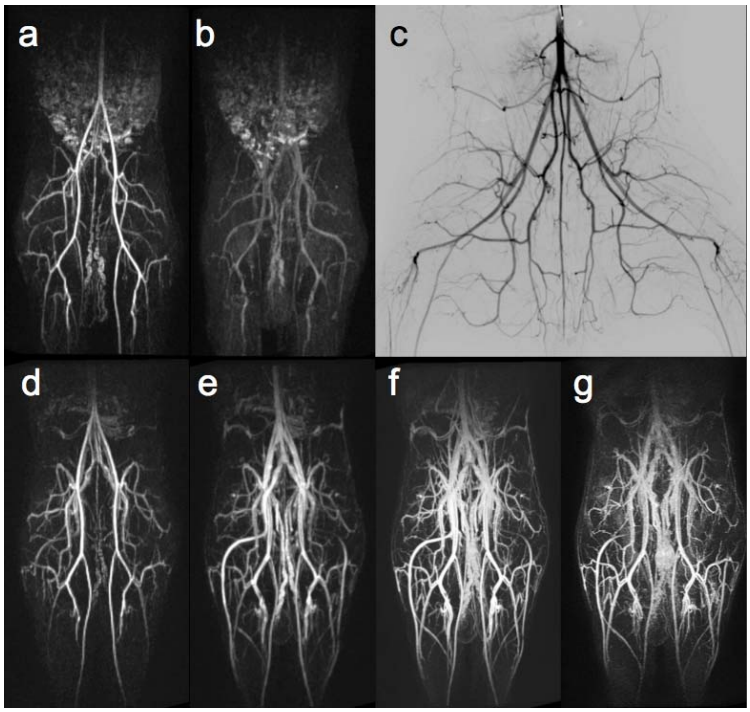

Figure 1. The ESION, Gd-enhanced MRA images by MIP reconstruction and DSA were shown. (a-b) are Gd-enhanced MRA at first-pass and 1min (0.8 isotropic voxel size) delay phase after bolus injection, respectively. (c) is DSA image as reference, (d-g) are ESION-enhanced MRA images at first-pass, 1min (0.8 isotropic voxel size), 1min (0.4 isotropic voxel size) and 5min (0.2 isotropic voxel size) delay phase after bolus injection, respectively.