Application of the VIBE (Volumetric Interpolated Breath-hold Examination) MR Technique to the Evaluation and Follow-up of Patients Undergoing Uterine Fibroid Embolization

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Introduction
Preoperative planning before transcatheter embolotherapy of symptomatic uterine fibroids includes evaluation of the size, number, and location of the fibroids and angiographic determination of the dominant blood supply to the uterus. VIBE is a modified 3D-FLASH MR technique that provides images of both the vascular system and soft tissues.

The purpose of this study is to describe the technique and usefulness of the dynamic VIBE sequence for the comprehensive evaluation of patients undergoing uterine fibroid embolization (UFE).

Methods
Twenty patients whose average age was 42 years (range 29-54 years) underwent VIBE imaging using a 1.5T superconducting MR unit (Magnetom Vision or Symphony, Siemens Medical System, Iselin, NJ) with a phased-array torso coil. UFE protocol sequences included coronal HASTE, axial, sagittal, and coronal high resolution T2-weighted turbo spin-echo, T1-weighted 2D-FLASH, and fat-suppressed T1-weighted 2D-FLASH. After a timing injection of 1 ml GD-DTPA, dynamic scanning was performed with the remaining 19 ml of Gd-DTPA using coronal 3D-FLASH technique (VIBE) (TR/TE/flip angle=4.5/1.9/15°). Scans were obtained pre-contrast, at arterial phase, at venous phase (50 seconds), and at parenchymal phase (100 seconds). Each acquisition took 25 seconds. Images were analyzed at dedicated workstations (Virtuoso or MagicView, Siemens) and the 3D data sets were post-processed using MPR, MIP or volume-rendering techniques. The volume of the uterus and three dominant fibroids were measured and their MR characteristics and enhancement patterns were recorded. The principal blood supply to the uterus and the arterial anatomy of the pelvis were also recorded. Scans were obtained within several weeks prior to the embolization procedure in all patients.

Three patients also had scans obtained at follow-up six months later.

Results
No patient was found to have fibroids whose blood supply was solely from the ovarian arteries. All had large, tortuous uterine arteries at both VIBE imaging and at angiography. Anatomic feature of the arteries correlated well between the two modalities. The volume of the uterus ranged from 264 to 2031 ml (mean 852 ml), and the total volume of three dominant fibroids ranged from 113 to 940 ml (mean 343 ml). Signal characteristics of fibroids were categorized as hyperintense (n=4), isointense (n=11) and hypointense (n=35) on T2-weighted images, and hyperintense (n=5), isointense (n=45) and hypointense (n=2) on T1-weighted images. Enhancement pattern of the fibroids were categorized as hypervascular (n=29), hypovascular (n=16) and avascular (n=5). Concurrent adenomyosis was discovered in three patients and no deposits of endometriosis were found in any patient.

Post-embolization MR in three patients showed decrease or disappearance of engorged uterine arteries. The volume of the uterus and dominant fibroids also decreased. Most fibroids demonstrated hemorrhagic necrosis as evidenced by increased T1-signal and decreased enhancement.

Discussion
As has been shown by other authors, MR imaging can show the size, number, and distribution of uterine fibroids, and the enhancement pattern offers an indication of the responsiveness of these tumors to embolotherapy. The VIBE sequence provides the additional benefit of demonstrating the arterial blood supply, which obviated the need for pre-embolization aortography. At the time of UFE, the potential benefits of decreased iodinated contrast and radiation dosages and shorter procedure times are obvious.

In conclusion, the comprehensive MR protocol including the dynamic VIBE sequence is useful in the evaluation of patients undergoing UFE.

References