Contrast-enhanced MR Angiography of Uterine Arteries for the Prediction of Ovarian Artery Embolization in 349 Patients

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ABSTRACT

Purpose: To assess contrast-enhanced magnetic resonance (MR) angiographic findings of uterine arteries (UAs) and to evaluate the diagnostic utility of this imaging modality for the prediction of ovarian artery (OA) embolization (OAE).

Materials and Methods: The authors retrospectively evaluated 349 patients who underwent contrast-enhanced MR angiography before UA embolization (UAE) for symptomatic fibroid tumors or adenomyosis. The diameters of the UAs were compared with those of the inferior mesenteric arteries (IMAs) and classified into two groups: group I, in which the diameters of both UAs were the same as or greater than that of the IMA; and group II, in which at least one UA was smaller than the IMA or was not visible. The presence of an enlarged OA was also evaluated. Sensitivity and specificity were calculated for UA diameter, enlarged OA, and the combination of the two.

Results: Nine of 22 patients (40.9%) in group II underwent OAE, which was a significantly higher incidence ($P < .001$) than in group I (nine of 327; 2.8%). Among eight patients with enlarged OAs, six (75%) underwent OAE. Relative UA diameter had a sensitivity of 50% and specificity of 96.1%; the respective values for enlarged OAs were 33.3% and 99.3%. The combination of UA diameter and enlarged OAs showed a sensitivity and specificity of 72.2% and 95.4%, respectively.

Conclusions: In addition to the identification of enlarged OAs, contrast-enhanced MR angiography allows a comparison between UA and IMA diameters and therefore can be helpful for the prediction of OAE.

ABBREVIATIONS

DSA = digital subtraction angiography, IMA = inferior mesenteric artery, MIP = maximum-intensity projection, OA = ovarian artery, OAE = ovarian artery embolization, UA = uterine artery, UAE = uterine artery embolization

Uterine artery (UA) embolization (UAE) is effective and valuable for the treatment of symptomatic fibroid tumors and has an acceptable long-term success rate (1,2). Although technical success rates are generally reported in the range of 97%–100% (3), clinical failure rates in the range of 4%–19% are reported in most cases because of incomplete infarction of the fibroid as a result of difficulties in catheterization, incomplete embolization of the UA, or parasitized fibroid feeder vessels such as the ovarian artery (OA) (4–6). The frequency of OA collateral supply to uterine fibroids reported in the literature ranges from 5% to 8% (4,5). Knowledge regarding the presence of OA collateral supply to the fibroid before performing UAE is important for planning UAE as well as for selecting and counseling the patients, because OA embolization (OAE) itself may result in alteration of ovarian function. Recently, magnetic resonance (MR) angiography has been suggested as a useful tool for assessing OAs before UAE (6). However, OA collateral supply to the fibroid necessitating OAE is closely related to the UA status or the type of uteroovarian anastomosis (5). Pelage et al (7) reported that additional catheterization of the OA should be performed in cases of small or absent ipsilateral UA. The purpose of the present study was to assess contrast-enhanced MR angiographic findings

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of UAs in 349 patients and to evaluate the diagnostic performance of contrast-enhanced MR angiography for the prediction of OAE.

MATERIALS AND METHODS

Institutional review board approval was obtained, and acquisition of informed consent was exempted. From January 2008 to February 2011, we performed UAE in 463 patients with symptomatic fibroids or adenomyosis. Among these, 349 patients underwent contrast-enhanced MR angiography before UAE, and we retrospectively reviewed the contrast-enhanced MR angiography and digital subtraction angiography (DSA) findings of these patients. We did not include the remaining 114 patients who underwent MR imaging without MR angiography. The patients' ages ranged from 26 to 50 years (mean ± SD, 40.23 y ± 5.4).

MR Imaging

All patients underwent preoperative MR imaging (1.5-T Signa HD/HDx, GE Healthcare, Waukesha, Wisconsin), equipped with a high-performance gradient system with a maximum amplitude of 50 mT/m and a slew rate of 150 mT/m, by using a body array coil. The time resolving of contrast kinetics technique was used for contrast-enhanced MR angiography, and the exact sequence parameters were as follows: repetition time/echo time/flip angle/thickness, 2.6 s/1.0 s/20°/3 mm; field of view/matrix dimension, 300 × 300 mm/256 and 224. The MR angiography slab was oriented in an oblique coronal fashion to include the downstream abdominal aorta, from the level of the renal artery to that of the common femoral artery. The timing for MR angiography was calculated by using a bolus-track technique. A 10-mL dose of meglumine gadoterate (Dotarem; Guerbet, Villepinte, France) was administrated at a flow rate of 2.5 mL/s, followed by a 25-mL dose of saline solution with the same injection parameters.

Angiographic Procedures

All procedures were performed by one interventional radiologist (M.D.K.) with 11 years of angiographic experience. Unilateral right femoral artery access was used for all the cases. A 5.0-F RHR catheter (Cook, Bloomington, Indiana) was placed in the internal iliac artery, and a coaxial 3-F microcatheter (Microferret; Cook) was advanced distally into the UA. Embolization was performed with the catheter tip beyond the origin of the cervicovaginal branch. The primary embolic agent was nonspherical polyvinyl alcohol particles (Contour; Boston Scientific, Natick, Massachusetts). Embolization was performed until complete cessation of blood flow was achieved in the ascending and transverse segment of the UA for 10 cardiac beats. Aortography was performed with a 5.0-F pigtail catheter (Cook) after completion of the UAE to confirm the presence of OA collateral vessels. In patients with an enlarged OA, defined as equal in size or exceeding the diameter of the 5-F pigtail catheter and extending visibly into the pelvis, selective catheterization of the OA was performed. Subsequent OAE was performed by using gelatin sponge particles (Gelastypt; Braun, melsungen, Germany) or polyvinyl alcohol particles if OA collateral supply to fibroids or adenomyosis was verified.

Follow-up

Patients were followed up clinically and radiologically 3 months after UAE. Patients were classified into the clinical success group, which represented patients who showed symptomatic improvement and complete necrosis at the 3-month follow-up MR imaging study; and the clinical failure group, which represented patients who did not show symptomatic improvement or complete necrosis at the 3-month follow-up MR imaging study.

Data Collection

All contrast-enhanced MR angiography images were assessed independently by two radiologists (M.D.K. and M.S.L.), and discrepancies were resolved in consensus. On the maximum-intensity projection (MIP) images, the diameter of the distal transverse segment of the UA was compared with the maximum diameter of the inferior mesenteric artery (IMA) after crossing the left common iliac or external iliac artery. All patients were classified into two groups: group I, in which the diameters of both UAs were the same as or larger than that of the IMA; and group II, in which at least one UA was smaller than the IMA or was not visible.

Visibility of the OA on the MIP images was also recorded. The OA was considered to be enlarged if corkscrew-appearing vascular structures extended from the aorta to the pelvis (7).

Statistical Analysis

The Pearson χ^2 test or Fisher exact test was used to analyze the association between the contrast-enhanced MR angiography and DSA findings, and significance was accepted for P values of .05 or lower.

Sensitivity, specificity, and positive and negative predictive values for the UA diameter and the presence of enlarged OAs on contrast-enhanced MR angiography were calculated for patients who underwent OAE and for those who did not undergo OAE. We also assessed the sensitivity and specificity of the UA diameter combined with enlarged OAs on contrast-enhanced MR angiography. All data analyses were performed by using SPSS version 12 statistical software (SPSS, Chicago, Illinois).

RESULTS

Of the 349 patients, 220 (63%) were diagnosed with uterine fibroids, 92 (26.4%) were diagnosed with adenomyosis, and 37 (10.6%) were diagnosed with both. A total of 65 patients