Original Investigation

Breast MRI as a Problem-solving Study in the Evaluation of BI-RADS Categories 3 and 4 Microcalcifications: Is it Worth Performing?

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Rationale and Objectives: We aimed to investigate the utility of problem-solving breast magnetic resonance imaging (MRI) for mammographic Breast Imaging Reporting and Data System (BI-RADS) categories 3 and 4 microcalcifications.

Materials and Methods: Between January 1, 2010 and December 31, 2011, 138 women with 146 areas of categories 3 and 4 microcalcifications without sonographic correlates underwent breast MRI and had a stereotactic core biopsy using an 11-gauge needle or follow-up at least for 24 months. Positive predictive value (PPV), negative predictive value, sensitivity, and specificity were calculated on the basis of BI-RADS category, with categories 1–3 being considered benign and categories 4 and 5 being considered malignant.

Results: Twenty-four cases (16.4%) were malignant (18 ductal carcinoma in situ, 6 invasive). MRI increased PPV and specificity from 43% to 68% and from 80% to 93% ($P = .054$ and .005) compared to mammography. Within 102 category 3 microcalcifications, 5 carcinomas were assessed correctly as category 4 by MRI. Within 44 category 4 microcalcifications, a correct diagnosis was made by MRI in 77% (34 of 44) as opposed to 43% (19 of 44) by mammography, and 80% (20 of 25) of unnecessary biopsies could have been avoided. Within the 24 carcinomas, 5 were negative at MRI. MRI-negative carcinomas have a significantly higher possibility of being low grade (ductal carcinoma in situ or invasive) ($P = .0362$).

Conclusions: Breast MRI has the potential to improve the diagnosis of category 3 or 4 microcalcifications and could alter indications for biopsy. Breast MRI could help predict the presence or absence of higher-grade carcinoma for category 3 or 4 microcalcifications.

Key Words: Microcalcifications; MRI; mammography.

INTRODUCTION

Breast magnetic resonance imaging (MRI) has been widely used for patients with newly diagnosed breast carcinoma and for high-risk screening (1). However, there is no clear consensus on the use of MRI for "problem-solving" purposes in cases of inconclusive mammographic or ultrasound findings. Because positive predictive values (PPVs) of screening mammography and ultrasound have been reported to be only 18.4%–31.0% (2,3) and 6.7%–13.2% (4,5), respectively, it would be desirable to reduce the number of biopsies that yield benign results. Although the performance of problem-solving breast MRI has been reported to be excellent for noncalcified lesions (6–10), reported results of those for microcalcifications are inconsistent (11–24), and only few studies (13,20) used a large dataset including Breast Imaging Reporting and Data System (BI-RADS) categories 3 and 4 microcalcifications.

Previous studies evaluating the role of MRI in the diagnosis of microcalcifications suggested that false-negative carcinomas at MRI are low- or intermediate-grade ductal carcinoma in situ (DCIS) (12,13,22), although the characteristics of such cases were not further investigated in these studies. The results suggest that low-grade carcinomas negative at MRI might be biologically unimportant (25,26), and MRI could be used for microcalcifications at least to detect high-grade carcinomas.

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Therefore, the purpose of this study was to investigate the diagnostic utility of problem-solving breast MRI for mammographic BI-RADS categories 3 and 4 microcalcifications before performing stereotactic vacuum-assisted breast biopsy and to evaluate the characteristics of carcinomas that are negative at MRI.

MATERIALS AND METHODS

Inclusion Criteria

A retrospective search of our MRI database was performed to identify consecutive breast MRI examinations that were performed for evaluation of mammographic BI-RADS categories 3 and 4 microcalcifications between January 1, 2010 and December 31, 2011. Cases were excluded from analysis when neither histologic confirmation nor stability for longer than 24 months was obtained. In addition, sonographically visible lesions were excluded to include only cases that would be candidates for stereotactic vacuum-assisted breast biopsy.

Imaging Technique and Interpretation

Mammography Protocol and Interpretation

Bilateral digital full-filed mammography was performed using the Mammomat Novation DR digital full-filed mammography System (Siemens Healthcare, Erlangen, Germany), which included spot-magnification views over the area of microcalcifications. All mammographic images were interpreted by physicians who are qualified to read mammograms by the central committee for quality control of mammographic screening (27). Microcalcifications were classified according to BI-RADS descriptors including morphology (punctate, amorphous, pleomorphic, fine branching) and distribution (diffuse, clustered, regional, segmental, linear), and a mammography BI-RADS category for each area of microcalcifications was provided.

Breast MRI Protocol and Interpretation

MRI was performed using a 1.5-T system (Avanto, Siemens Healthcare) with use of a 4-channel breast coil. Dynamic MRI using a 3D fat-suppressed gradient-echo sequence was performed before and three times after injection of gadopentetate dimeglumine (0.1 mmol/kg; Magnevist, Bayer Healthcare, Leverkusen, Germany) at a rate of 2 mL/s, followed by a 20-mL saline flush, with the coronal plane on the first, second, and third phases at 0.5, 1.5, and 4.5 minutes after contrast injection (TR/TE, 5.2/2.3; flip angle, 12°; field of view, 33 cm; matrix, 448 × 318; slice thickness, 0.9 mm; acquisition time, 60 seconds). Sagittal images of the right and left breasts were acquired using a gradient-echo sequence at 2.5 and 3.5 minutes after contrast injection, between the second and third phases of the coronal images (TR/TE, 4.0/2.2; flip angle, 15°; field of view, 16 cm; matrix, 256 × 256; slice thickness, 1.2 mm; acquisition time, 60 seconds).

Breast MRI had been prospectively assessed by one radiologist specializing in breast imaging for 13 years, using the BI-RADS lexicon and assessment category, with knowledge of clinical information and mammographic findings. For 3D acquisitions, multiplaner reformatting was also available in an imaging viewer. Kinetic features were also measured during the interpretation. Categorization of MRI findings was based on an interpretation method proposed by Tozaki et al. (28–30). Considering different patients' positioning for MRI and mammography, the interpreter compared the location, size, morphology, and distribution of possible correlates.

Management

All patients with MRI category 4 findings at the sites of microcalcifications were recommended for biopsy, although some women declined and decided to have follow-up studies after discussion with physicians. Histologic sampling was performed with vacuum-assisted biopsy with stereotactic technique (GE Senographe DS, GE Healthcare, Chicago, IL), using an 11-gauge needle (Mammotome, Cincinnati, OH).

For mammographic category 3 microcalcifications that were negative at MRI, 6-month follow-up mammography was recommended; however, some women underwent biopsy upon their requests. For mammographic category 4 microcalcifications, biopsy was recommended regardless of MRI findings; however, some women declined because their MRI was interpreted as negative or probably benign. Those women were monitored with mammography (and MRI for MRI category 3 cases).

For patients whose microcalcifications were mammographically stable for longer than 24 months, the microcalcifications were considered benign.

Statistical Analysis

For histopathologic analysis, all tissue samples were examined by a certified pathologist with 27 years of experience in pathologic assessment of breast lesions.

For mammographic and MRI findings, lesions classified as BI-RADS categories 1–3 were considered negative, and lesions classified as category 4 or 5 were considered positive for statistical analysis.

Sensitivity, specificity, PPV, and negative predictive value (NPV) were calculated for mammography and mammography plus MRI. Fisher exact test was performed using IBM SPSS Statistics 22 (IBM Corp, Armonk, New York). A P value of less than .05 was considered significant. The protocol for this study was approved by our institutional review board and informed consent was waived.

RESULTS

Patient Cohort

A total of 4448 consecutive breast MRI examinations were identified from the study period in our database, and 200 studies