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Breast magnetic resonance imaging for preoperative locoregional staging

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Abstract

BACKGROUND: Breast magnetic resonance imaging (MRI) has been recommended increasingly in the preoperative setting for patients newly diagnosed with malignancy to evaluate tumor extent, multicentricity, and contralateral disease.

METHODS: Results of conventional imaging, breast MRI, and pathology were analyzed from 603 consecutive breast cancer patients who underwent MRI preoperatively. The focus of this retrospective study was imaging-histologic correlation.

RESULTS: Reoperation for positive margins after lumpectomy occurred in 8.8% of patients. Multicentricity was identified by MRI alone in 7.7% of patients, whereas 3.7% were found to have contralateral cancer by MRI. The sensitivity of MRI was 93% in detecting multicentric disease and 88% for contralateral disease, whereas sensitivity for conventional imaging was 46% and 19%, respectively. Unsuspected disease was identified by MRI equally for invasive ductal and ductal carcinoma in situ histology, whereas multicentricity was found more frequently with invasive lobular carcinoma.

CONCLUSIONS: Breast MRI is recommended for preoperative evaluation of the newly diagnosed breast cancer patient.

Breast magnetic resonance imaging (MRI) is being used in the preoperative setting for newly diagnosed breast cancer patients, both to define tumor extent and to search for other foci of malignancy. During the development of this modality, preoperative patients were often selected for MRI because conventional imaging was believed inadequate. As a result, the probability of discovering occult multicentricity or bilaterality was possibly magnified, and such results were difficult to extrapolate to the general population of newly diagnosed breast cancer patients.

To assess the impact of breast MRI in the overall population of preoperative patients, we began performing breast MRI on all women newly diagnosed with breast cancer in March 2003, reporting our initial series of 334 sequential patients in which MRI-discovered multicentric disease occurred in 7.7%, whereas contralateral cancers were discovered in 3.6%.[1] The 11.3% total for occult disease discovery by MRI, when coupled with findings at the primary tumor site, impacted surgical therapy in 20% of patients overall.

These findings were comparable with other series reported, such as in a multi-institutional study of 426 patients[2] wherein 10% of women were found to have tumor foci more than 2.0 cm from the index lesion, and an analysis of 103 women in the same collaborative group[3] that revealed a 4% chance of contralateral cancer.

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Recently, the American College of Radiology Imaging Network (ACRIN) Trial 6667 announced multi-institutional results of preoperative staging with MRI in 969 women, reporting a 3.1% probability of discovering occult contralateral cancer missed by mammography and examination.[4] The sensitivity of MRI for detecting contralateral cancer was 91% and the specificity was 88%. Notably, the detection of these cancers was not influenced by breast density, menopausal status, or the histologic features of the primary tumor.

Because the ACRIN study provided further evidence for the routine use of preoperative MRI, the question is raised as to whether or not comparable results can be achieved when breast MRI is used in the community setting. This current series of 603 sequentially diagnosed patients is an update of our earlier review, representing what we believe to be the largest single-site study to date, with the primary intent being that of imaging-histologic correlations.

Methods

Patient selection

From March 2003 through December 2006, consecutive patients newly diagnosed with breast cancer underwent breast MRI and were included for study according to an institutional review board–approved protocol. Record review included conventional imaging, MRI, and pathology reports. Histologic confirmation of diagnosis was available before the MRI through image-guided biopsy or surgical biopsy. Because our focus was on imaging-histologic correlations, those patients who received neoadjuvant chemotherapy were excluded from the study because partial and complete pathologic responses would automatically impart discordance to the MRI performed at the time of diagnosis. Other reasons for exclusion were as follows: patients who refused surgical intervention after the MRI or were lost to follow-up evaluation, and patients in whom no residual was found on MRI after definitive surgical excision led directly to radiation therapy rather than more surgery. Thus, all patients included in this study underwent additional surgery shortly after the MRI, providing the basis for correlating histology and MRI findings. In addition, for the purposes of this review, lobular carcinoma in situ was not scored as malignant.

MRI technique

For the first 249 patients in the series, axial and sagittal gradient echo T1 acquisitions were performed for both breasts preceding and after manual infusion of .2 mmol/kg gadolinium followed by a 20-mL saline flush, using an Aurora (North Andover, MA, USA) breast-dedicated .5-Tesla MRI with bilateral breast coil. Subtractions and T2-weighted pulsing sequences also were performed.

For the next 354 patients, high-resolution rotating delivery of excitation off-resonance (RODEO®) axial acquisitions were obtained of both breasts using an Aurora 1.5-Tesla breast-dedicated MRI. Sequences were performed preceding and after the infusion of .2 mmol/kg gadolinium administered as a bolus dose with a power injector followed by a 20-mL saline flush. Subtraction images also were performed.

Physician participation and source of data

Radiology interpretations for conventional breast imaging were performed primarily by 5 radiologists at Mercy Health Center, and 10 surgeons and 3 pathologists completed the treatment and histologic evaluations, respectively, in the majority of cases. A minority of patients had some portion of their diagnosis, treatment, or pathology performed at outlying facilities, and written reports were relied on in these cases. Tissue processing on all breast specimens was routine, under no special protocol for additional histologic sections. Re-excision rates were compiled through follow-up phone calls to surgeons' offices and hospital medical records departments at delayed intervals, up to 6 months after initial surgery when re-excisions were anticipated by close or positive margins.

MRI results form the crux of this retrospective review, and all MRIs were performed at Mercy Women's Center. MRI interpretations all were performed by 3 of the 5 radiologists who manage conventional breast imaging at this same facility. Written reports for MRI as well as actual images were used in data acquisition, usually presented along with conventional images and pathology slides at a weekly interdisciplinary breast conference.

Results

From a total of 4,569 patients who underwent breast MRI during the study period, 650 were performed for preoperative locoregional staging. Of these 650 patients, 37 were excluded because of neoadjuvant chemotherapy, 6 patients were excluded when they moved directly to radiation therapy after surgical biopsy, and 4 patients were excluded when they declined any further treatment after the initial biopsy or were lost to follow-up evaluation, leaving 603 patients for inclusion in the study group in which direct histologic correlations to the MRI findings could be made.

Histologic types included 388 invasive ductal carcinomas (and subtypes), 149 patients with ductal carcinoma in situ (DCIS), 65 with invasive lobular carcinoma, and 1 patient with a malignant phyllodes tumor. Diagnosis was made by image-guided biopsy in 547 patients, whereas the remaining 56 patients underwent a surgical biopsy. The term *image-guided biopsy* includes all forms of lesion sampling (core, vacuum-assisted, and so forth) under radiologic guidance, be it radiograph, ultrasound, or MRI. Wire-local-