Extension of Ductal Carcinoma in Situ: Histopathological Association with MR Imaging and Mammography

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The purpose of this study is to evaluate the capability of breast MRI (magnetic resonance imaging) and mammography in determining tumor extent and the detectability of ductal carcinoma in situ (DCIS) in association with histopathological features. Thirty women with breast cancer underwent 3D dynamic MRI. Twelve women had pure DCIS and 18 women had DCIS with microinvasion. We analyzed the results of preoperative MRI and mammography with histopathologic results, retrospectively. The mean lesion size was 55.1 mm from the histopathologic results. Twenty-six lesions were detected through the MRI (a sensitivity of 86.7%). MRI depicted eight lesions without mammographically detected microcalcification. In seven cases, MRI showed tumor extent accurately compared with mammography, and the combined diagnosis improved the accuracy of evaluating tumor extent. MRI can complement mammography in guiding surgical treatment of DCIS by providing better assessment of the extent of the lesion.

Keywords: breast, magnetic resonance imaging, mammography, ductal carcinoma in situ, diagnosis

Introduction

Because of its easy availability, low cost, and ability to detect microcalcifications, mammography is currently the imaging modality of first choice for breast evaluation. Ductal carcinoma in situ (DCIS) accounts for 15%–20% of all detected breast cancers and 25%–56% of clinically occult cancers detected with mammography; it is found in 16% of asymptomatic women at autopsy.1,2 Clustered microcalcification is the most common mammographic feature of DCIS and is found in 85%–90% of cases.3 However, the several limitations of mammography are well documented, including difficulties in the assessment of dense breasts and the evaluation of DCIS without microcalcification. Recently, breast conservation surgery has become an increasingly common treatment for DCIS. Accurate evaluation of the tumor extent is important for breast-conserving treatment of DCIS.4

Advanced breast MRI techniques are gaining ground as adjuncts to mammography, although questions remain about their usefulness in imaging of in situ carcinomas. We evaluate the capability of breast MRI and mammography regarding lesion detectability and the extent of DCIS association with histopathologic features.

Materials and Methods

MRI studies were reviewed in thirty histologically verified lesions (12 pure DCIS and 18 DCIS with microinvasive foci). The patients ranged in age from 34 to 70 years (average, 49.8 years). Nineteen of 30 lesions were treated with mastectomy, and 11 lesions were treated with breast-conserving surgery. Mammography and MRI were performed within four weeks of surgery.

Imaging technique

The MRI examinations were performed with two different 1.5T systems (Gyrosan, ACS-NT, Philips; VISART, Toshiba). On both systems, a breast surface coil was used with the patient in the prone position. The entire single breast was imaged with a 3D spoiled gradient echo sequence (TR: 50
ms, TE: 9 ms, excitations: 1, FA: 30, FOV: 25 cm, matrix: 256×256, slice thickness: 3–4 mm, no gap) with fat saturation. The coronal dynamic series comprised four scan times: before and 2, 6, 10 min after intravenous injection of 0.1 mmol/Kg Gd-DTPA. MPR (multiplanar reconstruction) images were obtained with parasagittal images after examination.

In the mammographic examinations, magnification and/or spot compression views were obtained in addition to the standard oblique and craniocaudal projections (Mammorex, MGS-110B Toshiba).

Pathological resection and method

In breast-conserving surgery, the received material is prepared as 5-mm thick slices throughout the nipple margin to the distal end to evaluate the tumor extent precisely. In cases where mastectomy was performed, a 5-mm sliced section was obtained in parallel to the line passing through the nipple and the tumor. The tumor diameter was estimated by pathologists through tumor extent mapping with the results of the microscopic examination.

Imaging analysis

MRI and mammography examinations were separately evaluated by two radiologists (AS, MS) with extensive experience in breast MR imaging and mammography. The reviewers were unaware of the histopathologic results. The consensus of the two radiologists as present was considered positive.

In mammography, mass lesions, asymmetric opacities, architectural distortion, and malignant microcalcifications were considered positive findings.

MRI findings were considered to be positive for tumor if a focal area of enhancement, compared with normal breast tissue, was seen after contrast administration; the findings were interpreted as negative if no enhancement was seen or if diffuse and uniform enhancement of the breast parenchyma was seen.

We analyzed the preoperative MRI and mammography for tumor detectability and tumor extent, and the greater lesion size between mammography and MRI was selected in a combined diagnosis.

The tumor size was measured as the maximal diameter in each modality, and we evaluated the accuracy of demonstrated tumor extent. For lesions detected in both modalities, we determined the difference in size between the imaging and histopathologic results as follows: within 10 mm, 11–20 mm, and more than 20 mm. We also evaluated size discrepancy as a percentage: the difference in size divided by the actual size of the specimen.

Results

Of 30 lesions, the mean lesion size was 55.1 mm from the histopathologic results. MRI depicted 26 lesions (a sensitivity of 86.7%), mammography depicted 23 lesions (a sensitivity of 76.7%), and 22 lesions were detected with both modalities. Of the 26 lesions detected by MRI, four lesions without dense breast could not be depicted with mammography. In eight cases, mammography did not detect microcalcifications. All lesions in these eight cases were identified with MRI. In one case, a lesion was identified with mammography as a clustered microcalcification, although no abnormality was detected with MRI. Three lesions (less than 10 mm in two lesions incidentally detected with microscopic examination and 20 mm in one lesion detected with ultrasound) were not detected with either modality. For lesions detected with both modalities, the mean histopathological tumor size was 40.9 mm (ranging from 10 to 90 mm).

With MRI, the tumor size was underestimated or overestimated within 10 mm in 13 cases. MRI overestimated tumor size by more than 20 mm in one case; in this case, proliferative fibrocystic change was found around the malignant lesion histologically. In seven cases, MRI underestimated tumor size by more than 20 mm. MRI could not show the microscopic extent of the tumor.

Mammography evaluated tumor size with a distinction range within 10 mm in 10 cases. In seven cases, mammography underestimated tumor size by more than 20 mm. In seven cases, MRI was superior to mammography, and in three cases mammography was more accurate than MRI in evaluating the tumor extent. In the diagnoses combining MRI and mammography, the distinction range was more than 20 mm in four cases if the greater size was selected. (Table 1 shows the results demonstrating tumor extent.) MRI evaluated the percentage discrepancy within 20% in 12 cases. (Table 2 shows the percentage discrepancy in size.)

Discussion

Breast MRI has recently evolved, and many studies have documented the improvements in diagnostic performance, showing a higher sensitivity to invasive carcinoma than is provided with mammography.5-7 The use of MRI as an adjunct to mammography resulted in an increase in diagnostic accuracy. An early steep increase in signal intensity followed by a decrease or plateau in signal intensity has been reported as a sign of malignancy, and a continuous increase in signal intensity is regarded
as a sign of benignity.\textsuperscript{8} Various authors reported MR findings of DCIS; however, the evaluation of DCIS with MRI is reported to be limited. The reported sensitivities of MRI for the detection of DCIS have varied widely, ranging from 40\% to 100\%\textsuperscript{9-13}; moreover, there have been reports of false-negative cases with variable-size tumors.\textsuperscript{5,14-16} DCIS demonstrates a variable enhancement pattern with MRI. Some investigators have identified relatively slowly enhancing cancers and rapidly enhancing benign lesions.\textsuperscript{17} DCIS shows clumped or linear enhancement along the ductal pattern. The ductal pattern is important in the diagnosis of DCIS. However, fibrocystic changes show clumped enhancement as well as DCIS, and the enhancement is sometimes delayed, suggesting benignity.\textsuperscript{11} Therefore, if the ductal pattern is not identified, DCIS is often indistinguishable from a benign lesion with MRI.

The cure rate of DCIS with mastectomy is approximately 100\%. Currently, demand for breast conservation treatment is increasing. Harris et al. describe lumpectomy and radiation therapy as reasonable for a DCIS within 3 cm in size.\textsuperscript{18} Rosner et al. demonstrated that patients who underwent wedge resection had equivalent outcomes to those who underwent mastectomy for DCIS.\textsuperscript{19} Therefore, accurate evaluation of the tumor extent is important when breast conservation treatment is considered. Mammography can demonstrate most DCIS lesions, but a more accurate imaging assessment of lesion extent is necessary for successful breast conservation. The extent of DCIS cannot always be accurately predicted with mammography.\textsuperscript{20,21} The tumor extent is often underestimated with mammography.\textsuperscript{22}

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<td>mammography</td>
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MRI + mammography: combined evaluation with MRI and mammography

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<th>MRI + mammography</th>
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<td>MRI + mammography</td>
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MRI, several previous reports are available.\textsuperscript{23,24} They concluded that MRI provided greater accuracy than did mammography in determining tumor size. Boetes et al. demonstrated with eight DCIS lesions that, while the size of the invasive part was correctly estimated, the DCIS component was underestimated by more than 1 cm in all patients.\textsuperscript{12} However, little data is available for DCIS.

In our study group, the detectability of DCIS was higher with MRI than with mammography. Microcalcifications and the microscopic extent of the lesions are not depicted with MRI; therefore, MRI alone may be insufficient. One false negative case with MRI was correctly diagnosed as a malignancy with mammography. Because MRI was able to depict DCIS without microcalcification (Fig. 1), a combined evaluation would increase the sensitivity compared with a single modality. One 15 mm lesion was not identified with MRI, suggesting that tumor size alone is not responsible for false-negative results. We considered that mammography is able to depict lesions if microcalcification exists, and that demonstration with MRI is related not only to lesion size, but also to the amount of tumor cells and the signal behavior of contrast enhancement.

We analyzed the histologic results and the preoperative MRI results regarding tumor extent for DCIS. MRI in addition to mammography improved the diagnostic accuracy of evaluating tumor extent and reduced the number of cases in which the tumor margin was underestimated by more than 20 mm. In our hospital, surgeons have a policy of maintaining a 20 mm surgical margin for breast-conservative surgery. Our results suggest that MRI is helpful for preoperatively evaluating tumor extent in DCIS. However, the presence of
fibrocystic changes reduces the diagnostic value. If there is only diffuse or patchy enhancement without linear fashion with MRI, histological examination is necessary in the cases where mammography depicted no malignant calcifications.

In conclusion, MRI improves lesion detectability and accuracy when evaluating tumor extent and it is able to depict DCIS without microcalcifications.

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Fig. 1. 61-year-old woman with bloody nipple discharge
Mediolateral oblique mammogram of the right (a) and left (b) breasts shows no definite mass and malignant calcifications.
Dynamic studies of coronal images (c) before and at (d) 2, (e) 6, and (f) 10 min after injection of Gd-DTPA show clumped enhancement in the upper inner quadrant of the left breast. (g) The MPR image demonstrates linear enhancements toward the nipple in a ductal pattern, corresponding to a DCIS.

References

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